University College London Hospitals NHS
NHS Foundation Trust

Injectable Medicines Administration Guide

Pharmacy Department



Third Edition

WILEY-BLACKWELL

Also available online at www.uclhguide.com

Quick User Guide

Users of the UCL Hospitals Injectable Medicines Administration Guide should be familiar with the terminology used in the monographs. A full explanation of the terms is found in the User Guide and Tutorial in Section B. For quick reference, the key abbreviations are listed here.

Method of administration	Description
IV bolus	Intravenous bolus
(I) IV infusion	Intermittent intravenous infusion
(C) IV infusion	Continuous intravenous infusion
SC bolus	Subcutaneous bolus
(C) SC infusion	Continuous subcutaneous infusion
IM	Intramuscular injection

Diluent	Definition
NS	Sodium chloride 0.9%
W	Water for injections
G	Glucose 5% (dextrose monohydrate)
G10	Glucose 10%
G20	Glucose 20%
H	Compound sodium lactate (Hartmann's or lactated Ringer's)
GS	Glucose 4% and sodium chloride 0.18%

Infusion device	Description
Volumetric pump	A device which pumps fluid from a reservoir, such as an infusion bag or bottle, through an administration set at a preset rate
Syringe pump	A device which delivers fluid from a syringe into an administration set at a preset rate
Syringe driver	A portable device which delivers fluid from a syringe into an administration set at a preset rate

Term	Definition/Explanation
Reconstitute	Add fluid to a dry powder to produce a solution or suspension
Dissolve	Add fluid to a dry powder to give a solution
Diluent	The fluid used to either reconstitute a powder, or to further dilute a drug solution or suspension
Dilute *to* XmL fluid	Add fluid to the container so the final volume is X. For example, if the instruction says "dilute dopamine 200 mg/5 mL to 20 mL water", the user should take the dopamine and mix it with water so that the final volume is 20 mL. The final concentration is dopamine 200 mg/20 mL, or 10 mg/mL.
Dilute *with* XmL fluid	Add XmL to the container. For example, if the instruction says "dilute dopamine 200 mg/5 mL with 20 mL water" the user should take the dopamine and add 20 mL water, so that the final volume is 25 mL (20 mL from the water, 5 mL from the drug). The final concentration is dopamine 200 mg/25 mL, or 8 mg/mL

Understanding the NPSA risk rating: a full explanation of the risk rating scale is provided in the User Guide. The number bar indicates the complexity of the adjacent preparation and administration method. It is colour coded to give a visual indication of the risk: low risk tasks are green, moderate risk tasks are amber, and high risk tasks are red. The user should take additional time to plan and prepare medicines with a high risk rating, ensuring local protocols are adhered to, and appropriate safety measures and patient monitoring are in place.

UCL Hospitals Injectable Medicines Administration Guide

University College London Hospitals NHS
NHS Foundation Trust

UCL Hospitals Injectable Medicines Administration Guide

Third Edition

Pharmacy Department
University College London Hospitals

WILEY-BLACKWELL
A John Wiley & Sons, Ltd., Publication

UCL HOSPITALS

This edition first published 2010

Blackwell Publishing was acquired by John Wiley & Sons in February 2007. Blackwell's publishing programme has been merged with Wiley's global Scientific, Technical, and Medical business to form Wiley-Blackwell.

Registered office
John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom

Editorial offices
9600 Garsington Road, Oxford, OX4 2DQ, United Kingdom
350 Main Street, Malden, MA 02148-5020, USA

For details of our global editorial offices, for customer services and for information about how to apply for permission to reuse the copyright material in this book please see our website at www.wiley.com/wiley-blackwell.

Library of Congress Cataloging-in-Publication Data

UCL Hospitals injectable medicines administration guide / Pharmacy Department, University College London Hospitals. – 3rd ed.
p. ; cm.
Other title: Injectable medicines administration guide
ISBN 978-1-4051-9192-0 (pbk. : alk. paper)
1. Injections–Handbooks, manuals, etc. 2. Drugs–Handbooks, manuals, etc. I. University College London Hospitals Foundation NHS Trust. Pharmacy Dept. II. Title: Injectable medicines administration guide.
[DNLM: 1. Pharmaceutical Preparations–administration & dosage–Handbooks. 2. Injections, Intramuscular–methods–Handbooks. 3. Injections, Intravenous–methods–Handbooks. 4. Injections, Subcutaneous–methods–Handbooks. QV 735 U17 2010]
RM170.U26 2010
615'.6–dc22

2010003288

A catalogue record for this book is available from the British Library.

Set in 11/13.5 Cambria by Aptara Inc., New Delhi, India
Printed in Singapore

1 2010

Contents

Third edition editorial board

The *UCL Hospitals Injectable Medicine Administration Guide*, Third Edition, is produced by the UCLH Pharmacy Department on behalf of the Trust Use of Medicines Committee.

Contributors

Ms Fiona Maguire, BPharm, Dip Clin Pharm, MRPharmS

Mr Neil Tickner, MPharm, Dip Clin Pharm, MRPharmS

Mrs June Minton, BPharm, Dip Clin Pharm, MRPharmS

Ms Carolyn Gates, BPharm, MSc, MRPharmS

Mr Shahid Gani, MSc, MRPharmS

Ms Preet Panesar, BPharm, MRPharmS

Ms Emma Riches, Dip Clin Pharm, MRPharmS

Ms Kerstin von Both, MPharm, MSc, MRPharmS

Ms Hannah Wilton, MPharm, Dip Clin Pharm, MRPharmS

Mrs Shola Ajibodu, BSc, Dip Clin Pharm, MRPharmS

Ms Sheetal Sumaria, BSc, MRPharmS

Ms Evelyn Frank, MPharm, Dip Clin Pharm, MRPharmS

Mr Balram Malhotra, BSc (Hons), MSc, MRPharmS

Ms Rina Kundi, MRPharmS

Ms Aoife Sheilds, Dip Clin Pharm, MRPharmS

Mrs Ravijyot Saggu, MPharm, Dip Clin Pharm, MRPharmS

Acknowledgements

The *UCL Hospitals Injectable Medicines Guide* is the result of an extensive team effort, some members of which have changed since the book was published within UCL Hospitals. The editors would like to acknowledge the contribution of Sarla Drayan, Robert Shulman, Simon Badcott, Mark Harries and Denise Hoare for their extensive work on the first edition.

We offer our sincere thanks to the above contributors for their detailed feedback; their in-depth knowledge and attention to detail ensures the monographs are both authoritative and representative of current practice. Furthermore, the editors would like to thank the nurses of Ward T9 at University College Hospital for road testing some of the new monographs and for providing their frank and honest opinion of the content. Nursing feedback has allowed us to make this an altogether more user-friendly guide. We would also like to thank Mr Ronny Jähne for his constructive advice regarding the format of the new style monographs.

Furthermore, we acknowledge the UKCPA Critical Care Group for their Minimum Infusion Volume document (third edition). We would also like to recognise the contribution of the Pharmacy Department of Imperial College Healthcare Trust, Susan Keeling, and the pharmacists from the many different hospitals from around the UK who have contributed to the National Injectable Guide website. Information on the *IV Guide* site can be obtained from Gill Bullock (gbullock@hhnt.org) who is based in the pharmacy at Charing Cross Hospital.

Preface

The *UCL Hospitals Injectable Medicines Administration Guide*, Third Edition, is a fully revised and updated version of the previous editions published in 1997 and 2007. The general structure and format remain unchanged. The positive feedback we have received from nurses, pharmacists and doctors across the globe demonstrates that the *Guide* is a winning format. As computer-based systems are being introduced to manage all aspects of patient care, including patients' medicines, an internet version of the *Guide* has been launched. In 2009 the *UCLH Guide* online went live (www.uclhguide.com) to meet the demand for up-to-date information in the digital age.

Healthcare is a rapidly evolving field, and in recent years patient safety has become an NHS priority. There is great interest in reducing the risk associated with injectable medicines, particularly since the publication of the National Patient Safety Agency alert *Promoting Safer Use of Injectable Medicines*. The injectable practices within the UCLH have been thoroughly scrutinised; every identifiable practice has been risk assessed and risk reduction strategies introduced. At UCLH we believe we are now working in a safer environment: we have rationalised the injectable products we use, expanded the range of ready-to-use injectables on our formulary, introduced guidelines to support those who prescribe, dispense and administer high-risk injectables and improved the training package for new staff who give injectables. Many of the risk reduction strategies have resulted in amendments to the monographs that form the core of this publication. Staff in the pharmacy department of UCLH are proud in the knowledge that their hard work is protecting patients through the safer use of injectable medicines, and we are happy to share the progress we have made through the *Guide*.

The opening chapters of the *Guide* have been revised to reflect recent changes in the use of injectables. Many concepts in the introductory chapters have been expanded to give the reader a more comprehensive overview of injectable therapy. Examples from current practice have been given so that readers can relate their own experiences to the text. A tutorial and example monograph has been added to make it easier for new users to get to grips with the *Guide*. This edition features over

40 new monographs, ranging from abatacept to zoledronic acid. A large number of unlicensed medicines have been added to support those administering medicines for which there is a paucity of information. The existing monographs have been overhauled to ensure they include all methods of administration, whether licensed or unlicensed, widespread or specialist. In many cases bold decisions have been made in order to give the user the best possible advice, which may differ from the drug manufacturer's recommendations. The compatibility section now includes much more detailed information about possible compatibilities. This means that those caring for critically ill patients, who often require multiple concurrent infusions, now have a greater range of options when medicines need to be co-infused.

Finally information to support the use of injectable medicines in paediatric and neonatal patients has been included wherever possible. When these patients require special dilutions or infusion rates, this is highlighted. Advice about the preparation of low volume medicines for administration to neonates, and the use of displacement values to ensure accurate dosing in children, is embedded in the monographs.

In short, this is the safest and most comprehensive *UCLH Injectable Medicines Administration Guide* to date.

We trust that you will be satisfied with the *Guide*; however, we continuously strive to improve. Your comments, criticism and suggestions for change are gratefully received. This feedback is essential to ensure that the *Guide* continues to lead in the field of injectable medicines.

Kenny Mole

Medicines Governance Pharmacist

University College London Hospitals NHS Foundation Trust

Please send your comments to: injectable.guide@uclh.nhs.uk

Section A

1 Introduction

The use of injectable products is fundamental to modern healthcare. Almost every patient admitted to hospital will be prescribed intravenous fluids, or an intravenous medicine. It is essential that healthcare workers who prepare and administer injectables have access to concise information to ensure they use the products appropriately. This need has prompted the publication of the *UCL Hospitals Injectable Medicines Administration Guide*.

The *Guide* includes information to support the prescribing, dispensing and administration of medicines given via the intravenous, subcutaneous and intramuscular routes. It includes a wealth of background information, including descriptions of the various methods of administration, the relative merits of each method, the devices used to give injectables, and pharmaceutical issues that may influence therapy. The *Guide* incorporates both local practice advice and some nationally accepted best practice guidance, including a summary of aseptic non-touch technique.

2 Overview

2.1 Organisation of information in the *Guide*

The *Guide* comprises two sections:

Section A outlines the responsibilities of the various professionals involved in the prescribing, dispensing and administering of injectables. Full descriptions of the methods of intravenous administration are given, while the infusion devices used to deliver medicines and fluids are discussed. Practical guidance on flushing lines and cannulae, management of extravasation, and drug compatibility is provided. The use of drugs in a syringe for subcutaneous infusion and pharmaceutical aspects of intravenous therapy are also detailed.

Section B starts with a user guide which fully explains the information in the drug monographs. New users can work their way through a tutorial to aid interpretation of the monograph content. The remainder of section B contains the individual medicine monographs in tabular form. Medicines are arranged in alphabetical order and include the following information:

- Formulation.
- Injectable method of administration and recommended infusion device.
- National Patient Safety Agency (NPSA) risk rating.
- Preparatory instructions for the medicine.
- Administration details.
- Recommended flush fluid.
- A list of adverse effects that may result from administration.
- Pragmatic 'in use' advice from clinicians at UCL Hospitals.
- Compatibility data for the medicine with fluids and other drugs for both intravenous and subcutaneous use.
- Pharmaceutical particulars, including pH, tonicity, sodium content and displacement value.

Cytotoxic medicines are beyond the scope of the *Guide.*

2.2 Sources of information and disclaimer

The majority of information in the *Guide* is based on the best available published data at the time of writing. However, some of the advice given is representative of practice at UCL Hospitals and may not be consistent with licensed information found on the manufacturers' summary of product characteristics (SPC). Each monograph has been carefully constructed to give pragmatic preparatory instructions to support those administering the drug. For example, the preparatory instructions from the manufacturers of some medicines, such as abatacept, phytomenadione and ertapenem, have been simplified to reduce the number of steps required to get the medicine ready to administer to the patient. At UCL Hospitals we believe that the simplest methods are the safest. All deviations from manufacturer's advice are supported by literature.

Administration advice for certain patient groups, including children, neonates and the critically ill, has been verified by specialist pharmacists and nurses with first-hand experience of using the medicine. All the advice is given with patient safety at the fore.

Published compatibility data are ***not*** available for all the combinations and situations covered in this *Guide*. Some of the advice and information therefore reflects local practice and experience only. Readers are reminded that slight variation in the exact combination and concentrations of medicines can adversely affect compatibility. Readers are referred to their local hospital pharmacy department for more specific information and advice.

Neither the authors nor the publisher can accept any legal responsibility or liability for any errors or omissions that may be made within the *Guide*. Readers should take their own precautions to ensure that new information published after the *Guide* was written is followed wherever possible. Readers are referred to the SPCs produced by the pharmaceutical companies for further or more up-to-date information. SPCs are periodically updated and thus the recommendation(s) for administering the medicines included in this *Guide* may alter from time to time.

3 UCLH policies

3.1 Responsibilities of professional staff at UCLH

3.1.1 Nurses' and midwives' responsibilities for injectable medicines (including blood products, IV fluids and IV medicines)

Nurses are referred to the *Standards for Medicines Management* of the Nursing and Midwifery Council and the *Standards for Infusion Therapy* published by the Royal College of Nursing. These provide a comprehensive description of the responsibilities of a practitioner when administering a medicine. Other healthcare professionals will find these documents useful as these standards are universally applicable.

At UCL Hospitals, injectable medicines may be prepared and administered by a registered nurse/midwife as described in UCL Hospitals *Administration of Medicines by Nurses/Midwives Policy and Procedure* document. This document is available from UCL Hospitals.

3.1.2 Pharmacists' responsibilities for injectable medicines

- Pharmacists should provide appropriate information and advice to medical, nursing and other health professionals on pharmaceutical aspects of parenteral medicines, e.g. choice of medical therapy, compatibility, stability, dosage and administration details.
- Pharmacists should monitor prescriptions for parenteral medicines and alert medical and/or nursing staff to any potential problems. Pharmacists should annotate prescriptions for parenteral medicines where appropriate.
- Pharmacists should ensure patients are switched at the earliest opportunity to oral therapy, to minimise risk from IV therapy.
- Pharmacists should provide education and training to healthcare professionals involved in the administration of parenteral medicines.
- Pharmacists will monitor medication errors in local clinical areas, provide targeted training to those involved in the incident and formally report the error. Lessons learned from the incident should be disseminated to colleagues to ensure best practice in all areas.
- Pharmacy will prepare some medicines to be administered by the parenteral route as locally agreed. This centralised intravenous additive service (CIVAS) prepares cytotoxic medicines, intravenous nutrition, monoclonal antibody infusions and a selected group of high-risk medicines such as foscarnet and ganciclovir.

3.2 Preparation of injectable medicines on wards, clinics and departments at UCLH

Injectable medicines:

- **Must not** be prepared in advance of their immediate use
- **Must not** be prepared by anyone other than the registered nurse/midwife or doctor who is going to administer them, unless they are prepared in his or her presence.

All medicines prepared must be appropriately labelled. Additive labels should be completed and attached to the infusion container.

Exceptions:
Injectable medicines may be prepared in advance if covered by a specific protocol agreed by relevant pharmacy and nursing staff. In emergencies practitioners are not required to label medicines, but if several medicines are prepared at the same time, individuals should ensure they are able to identify each separate medicine, and any pre-prepared flushes.

4 An overview of intravenous therapy

There are multiple routes of drug administration including oral, topical, rectal, inhalation, intravenous, intramuscular, subcutaneous and intrathecal injection. A prescriber must decide which is the most appropriate route of administration for a medicine according to the clinical condition of the patient. Intravenous injection is defined as the introduction of medicine or infusion fluid into a vein.

4.1 When is intravenous therapy appropriate?

Intravenous therapy may be the most appropriate option when:

- High plasma levels of a drug are required rapidly. Unlike other routes, the drug is introduced directly into the bloodstream and is available to exert its pharmacological effect as soon as it enters the body. Medicines given by other routes need to be absorbed into the bloodstream first, which can take considerable time. Oral medicines are usually absorbed from the small intestine, while medicines administered intramuscularly must be absorbed from muscle fibres into the bloodstream. The intravenous route is usually the route of choice in emergencies because it is usually the fastest way to achieve a therapeutic effect.
- Tight control of drug levels is required, with the need for small adjustments to the rate of administration, according to the patient's response. This can be achieved by giving the drug as a continuous infusion. Examples of such infusions include insulin for blood glucose control and the infusion of anaesthetic agents during surgery to maintain unconsciousness.
- Patients are unable to take oral medication. This may be because they are vomiting or unconscious, or because they have had recent gastrointestinal surgery.
- Patients are unable to absorb medicine orally, for example those who have severe diarrhoea, active Crohn's or coeliac disease.
- Rapid correction of fluid or electrolytes is required, for example after haemorrhage.
- Other routes are not available. For example, the intramuscular route may not be appropriate in the very young or the very old as they tend to have a reduced muscle mass, which is not ideal for the administration of medicines. Those receiving anticoagulant medicines or patients with clotting diseases such as haemophilia may bleed from the IM injection site.
- Other routes are not acceptable to the patient. IM injections can be painful, and may be refused, even by healthy individuals. Many UK patients refuse suppositories.

4.2 Drug factors that influence the choice of route

Some medicines must be given by the intravenous route because of their chemical or pharmacological properties.

4.2.1 Absorption

Some drugs are broken down by gastric secretions, which prevents them from being given orally. Proteins such as insulin and infliximab are inactivated in the gut so must be injected. Other drugs do not possess the chemical properties to cross the gut wall so cannot be given orally to cause a systemic effect. However, these drugs may still be useful for treating diseases of the gastrointestinal tract, e.g. vancomycin cannot be given orally to treat a systemic infection as it is not absorbed, but can be used to treat *Clostridium difficile* infection of the intestine.

Some drugs may be given by subcutaneous, intramuscular or rectal routes, but the absorption from these sites may be erratic and unreliable. Gentamicin may be given by IM injection, but to treat serious infection the intravenous route is used in preference as therapeutic levels are more likely to be achieved.

4.2.2 The first-pass effect

Medicines given orally are usually absorbed in the small intestine. They are then transported in the blood, via the portal system, to the liver where they may be metabolised. For some medicines, metabolism in the liver occurs to such a great extent that little medicine reaches the target organ – this is called the first-pass effect (or first-pass metabolism). The intravenous route avoids the first-pass effect as the drug is introduced directly into the systemic circulation. It is precisely for this reason that some drugs, e.g. verapamil and propranolol, need to be given at much higher doses orally, than by intravenous injection, to produce a similar therapeutic effect. For some medicines, such as lidocaine, it is not possible to make an oral formulation because the metabolism is so great.

4.2.3 Impact of half-life

The elimination half-life ($t_{1/2}$) is the time taken for the concentration of medicine in the blood to fall to half its original value, e.g. if a medicine has a half-life of 4 hours, this means that it will take 4 hours for the concentration of the medicine in the blood to fall from 10 mg/L to 5 mg/L. Medicines can have half-lives that are measured in seconds, minutes, hours or days.

Medicines with very short half-lives disappear from the bloodstream very quickly and may need to be administered by a continuous infusion to maintain a

clinical effect on tissues, e.g. dopamine has a half-life of 1–2 minutes and so has to be given as a continuous infusion. When the infusion is stopped its effects will be lost within minutes.

If a medicine has a longer half-life, it means that it may be given as a bolus injection or intermittent infusion instead of a continuous infusion, and its effects on the body tissues will last for several hours before another dose is needed. Knowledge of half-life alone is not, however, sufficient in determining the method of administration because many other factors need to be taken into consideration, e.g. drug distribution into tissues.

4.3 Disadvantages of intravenous administration

- A vascular access device (VAD) such as a cannula or catheter must be placed before any intravenous medicine can be given. This requires specially trained personnel and specific equipment.
- Obtaining vascular access can be difficult. Patients who have been regularly cannulated in the past, are in shock, are dehydrated or have fragile veins may be difficult to cannulate. Insertion of a central venous catheter requires specialist training and is an invasive procedure.
- When medicines are given by the intravenous route there is an increased risk of toxicity. Side effects may occur immediately and can be severe.
- Preparation of some intravenous medicines is complicated and can be time consuming. It may require complex calculations, multiple steps in reconstitution and dilution, competence in the aseptic non-touch technique and the use of infusion devices.
- Contamination of medicines and infusion fluids during preparation, or contamination of the VAD during administration, may result in infection as microbes are introduced directly into the bloodstream.
- There is a risk of embolism each time an intravenous medicine is given, from blood clots from the VAD or from inadvertent injection of air or particulate matter.
- There is a risk of fluid overload from the administration of multiple medicines diluted in large volume infusion bags, or through the overzealous use of intravenous infusion fluids.
- There is a risk of pain, irritation and extravasation at the injection site.
- Some patients are afraid of needles and injections and will object to their use.

4.4 Routes of intravenous administration

Intravenous administration can be divided into peripheral and central administration. Catheters and cannulae are described as 'vasular access devices' or 'venous access devices' (VADs), although in everyday language they are called 'lines'.

4.4.1 Peripheral administration

Peripheral administration is introduction of fluid into a peripheral vein. Veins are accessed via a cannula, which is most often placed in the veins of the lower portion of the arm because they are located just below the skin. Veins used for cannulation include the cephalic, basilic and metacarpal veins. Antecubital and dorsal veins may also be used. Each site has its advantages and disadvantages, which are beyond the scope of the *Guide*.

4.4.2 Central administration

Central administration is introduction of fluid into a large central vein, through a central venous catheter (CVC). The tip of a CVC terminates in the superior vena cava, right atrium or inferior vena cava. Infused fluids are rapidly diluted in the fast flow of blood in the vessel. There are a variety of CVCs – the choice of device will depend on the intended use and multiple patient factors. Refer to local CVC guidelines for a description of the devices available and their relative merits. UCLH has a central venous catheter care guideline which may be accessed via the hospital intranet.

4.4.3 Peripheral versus central vein administration

Peripheral vein administration

Advantages

- Simple to insert a cannula.
- Less traumatic compared with central line.
- Cheap.
- Cannula easy to manage for clinical staff.

Disadvantages

- Limited time period of use.
- Blocks more easily.
- Risk of infection.

- Greater risk of extravasation/phlebitis compared to a central line.
- Single lumen.
- Not suitable for certain medicines.

Central vein administration

Advantages

- Allows the administration of irritant solutions, e.g. concentrated potassium solutions or vasoactive medicines.
- Allows rapid administration of large volumes of fluid, e.g. in shock.
- Provides long-term venous access, which is useful for patients requiring intravenous therapy over extended periods, such as those having chemotherapy in cycles or intravenous nutrition (TPN) at home.
- To enable administration of concentrated solutions of medicines, which would normally need further dilution as a result of their irritancy. This is particularly useful in fluid-/sodium-restricted patients.
- Allows the co-administration of multiple medicines without the risk of incompatibility. Most CVCs have more than one lumen, which terminate at slightly different points so that medicines do not mix on infusion.

Disadvantages

- Catheters require a short procedure to be inserted, which takes more skill and time than inserting a cannula.
- Healthcare staff must be specially trained to care for the catheter.
- Insertion can be painful/traumatic.
- There is a risk of serious infection. The exit site (where the catheter comes out of the skin), the outer surface of the catheter and the inside lumen may all be colonised by microbes. This can lead to septicaemia and removal of the catheter.
- Overall more expensive to insert and manage than a cannula.

Section B of the *Guide* advises which medicines should be administered by a central line.

5 Factors affecting patency of intravenous sites

Peripheral cannulae are generally used for around 72 hours before they need to be removed and resited. The vein can become irritated and flow through the cannulae is reduced or stops. CVCs may be used for days, weeks or months depending on the type of catheter inserted. Some factors that influence how long a VAD will remain patent are common to both types of device and are described below.

5.1 Factors increasing failure of intravenous sites

- Infection.
- Irritation:
  - Movement, particularly of cannulae in areas of flexion.
  - Cannula material (steel is more irritant than Teflon).
  - Infusion of particulate matter, which physically blocks cannulae.
  - Infusion of irritant medicines.

5.2 Factors decreasing failure of intravenous sites

- In-line filters help reduce the number of particles infused. Administration sets with 15 micron filters are standard at UCLH. Smaller pore filters may be provided with some medicines that have a tendency to precipitate.
- Good practice/aseptic technique when the VAD is first inserted and each time it is accessed.
- Infusion of dilute solutions of medicines or electrolytes, which tend to be less irritant.

5.3 Occlusion of central venous catheters

Central venous catheters may be occluded by clotted blood, a fibrin sheath, precipitated medicines or the components of intravenous nutrition. Local catheter care guidelines should give advice on how to manage such events. Catheters occluded with a fibrin sheath may be unblocked using urokinase 5000 unit/mL instilled into the catheter lumen using a ‘rocking technique’ between two syringes attached to the lumen with a three-way tap.

6 Methods of intravenous administration

Medicines are given using a variety of methods which are outlined below. The choice of method may depend on the pharmaceutical properties of the drug, the clinical condition of the patient, the desired therapeutic outcome, and the type of venous access the patient has. It should be noted that there is no consensus regarding the definitions of bolus injection and intermittent and continuous infusion. Definitions in the literature and manufacturers' SPCs may differ slightly from those given here. However, the descriptions below are consistent with the administration methods given in Section B of the *Guide*.

6.1 Intravenous bolus

Introduction of a small volume of medicine solution into a vascular access device is referred to as a bolus injection. A bolus injection is usually administered over 3–5 minutes to minimise vein irritation and the risk of extravasation. Drugs typically given by bolus injection include penicillin antibiotics, such as amoxicillin, and antiemetics, such as cyclizine.

During cardiac resuscitation and other emergencies a bolus may be given over a few seconds as the risk of rapid administration is outweighed by the clinical need for immediate therapeutic effect. Adenosine, used for cardiac arrhythmias, is administered as quickly as possible as it is rapidly inactivated in the blood and would not reach the heart otherwise.

At UCLH a bolus is defined as any injection given in 5 minutes or less, and is less than 50 mL in volume. It is considered impractical to administer a bolus over longer than 5 minutes. The *Guide* recommends that medicines that need to be given over a time period of greater than 5 minutes or that are greater than 50 mL are prepared as an intermittent infusion.

Advantages

- Achieves immediate and high medicine levels.
- Easy and more convenient for the practitioner. There are much fewer steps required to prepare and give a bolus compared to an infusion. Bolus injections do not require dilution to large volumes of infusion fluid, priming of an administration set or programming of an infusion device.
- After giving the dose the practitioner can be sure the patient has received the dose and does not need to monitor an infusion bag/device (c.f. intermittent and continuous infusions).

Disadvantages

- Increased potential for adverse effects, particularly if the dose is given too rapidly, e.g. cyclizine.
- Damage to the veins, e.g. phlebitis or extravasation, especially with potentially irritant medicines.

6.2 Intermittent intravenous infusion

Administration of an infusion over a set time period, either as a one-off dose or repeated at specific time intervals, is referred to as an intermittent infusion. An intermittent infusion of medicine is often a compromise between a bolus injection and continuous infusion. It achieves high plasma concentrations rapidly to ensure clinical efficacy yet reduces the risks of adverse reactions associated with rapid administration.

Many medicines are given as intermittent infusions, including gentamicin, metronidazole and Pabrinex.

At UCLH intermittent infusions are defined as any infusion given over longer than 5 minutes but less than 24 hours. Most infusions are given over an hour, although large-volume fluids, e.g. 1 L compound sodium lactate, are usually given over 8 hours.

6.3 Continuous intravenous infusion

Intravenous administration of a fluid or medicines over 24 hours is referred to as a continuous infusion. The infusion may be repeated over a period of days. Large volumes (i.e. 250–1000 mL) or small-volume infusions (e.g. 50 mL) may be delivered continuously.

Advantages

- May be used to maintain a constant therapeutic concentration of a medicine. For example, some centres may use constant infusions of antibiotics to maintain high blood levels.
- Allows the infusion rate of a medicine to be accurately titrated according to patient response. Morphine infusions for pain control may be adjusted according to the patient's pain and also their level of sedation and respiratory rate. Insulin infusions are titrated according to blood glucose.
- Allows administration of medicines with a short elimination half-life to be given, e.g. adrenaline infusions are used to improve the strength of cardiac contraction in critical care.
- If the solutions are dilute they may be less irritating than bolus administration.

Disadvantages

- May be complicated to prepare. May require complex calculations and multiple transfers of medicine/fluids to produce a solution with the correct concentration.
- Requires the practitioner to be competent in the use of infusion equipment including syringe and volumetric pumps and administration sets.
- During administration the practitioner will need to monitor the infusion to ensure it is running into the patient. This can be very time consuming if an infusion regularly stops.
- Greater risk of microbial and particulate contamination (compared to bolus administration) because of the complexity of preparation.
- Greater risk of infection (compared to bolus administration) as the solutions are used for up to 24 hours, in which time microbes may grow in infusion fluids (particularly those containing glucose or fats, e.g. intravenous nutrition).
- The infusion occupies the VAD continuously. If the patient requires multiple medicines or fluids, more than one infusion may need to be given down the same lumen of a VAD leading to compatibility issues: before two infusions are given via the same lumen it must be confirmed they are compatible.
- Large volumes of fluid may cause fluid overload in some patients.
- Greater risk of pharmaceutical problems, such as drug degradation in solution and drug interaction with the infusion equipment.

6.4 Preparation and administration of intravenous medicines

The following checklist describes the process for preparation and administration of an intravenous medicine. The National Patient Safety Agency (www.npsa.nhs.uk) has produced an excellent and comprehensive standard operating procedure for the prescribing, preparing and administering of injectable medicines. Each item in the checklist below may be comprised of multiple processes itself. Practitioners should refer to the NPSA's document for a breakdown of the full process. Note the Nursing and Midwifery Council now advises that the preparation and administration of all injectable medicines should be second checked by another practitioner in order to minimise error.

- Check the prescription – check that the dose, time and route are correct.
- Understand what the medicine is for and how it works.

- Be aware of any local protocols for preparing and administering the medicine.
- Plan drawing up doses.
- Know how to administer each medicine, including:
  - Calculation of concentration and rate.
  - Reconstitution.
  - Addition of medicines to recommended diluents.
- Use aseptic non-touch technique to prepare the medicine.
- Thoroughly mix any additions, checking for precipitation or particles.
- Complete yellow infusion additive label and attach to infusion.
- Go to patient and check patient identification.
- Explain what you are doing to the patient, when appropriate.
- Check vascular access device.
- Check that any equipment required is working.
- Administer.
- Monitor patient for response and adverse effects.
- Monitor any infusion equipment to ensure it is functional throughout the administration. Monitor the drug solution for signs of precipitation.

6.5 Aseptic non-touch technique (ANTT)

ANTT is fundamental to the safe administration of injectables. Infection, as a result of poor aseptic technique when preparing injectables, or when handling a vascular access device, places a huge burden on healthcare systems. Infection from this route can be severe as microbes are introduced directly into the patient's bloodstream, quickly leading to systemic infection, significant morbidity and high rates of mortality. All practitioners must use ANTT every time an injectable is administered to a patient.

ANTT is an evidence-based method for standardising the aseptic technique of healthcare workers. It is a simple, efficient and logical approach which is the same for peripheral and central line access and for all patients. In IV therapy the focus is on avoiding microbial contamination of the 'key parts' at all the preparation and administration stages.

Key parts are those parts of the equipment that come into direct or indirect contact with the liquid infusion.

Healthcare workers should identify all key parts and then protect them at all times using a non-touch technique. On top of this fundamental principle, the ANTT guideline, importantly, standardises all the equipment to be used and the order in which the procedure is performed. Standardisation is paramount.

ANTT guidelines and resources can be found at www.antt.co.uk.

Here is a simple written overview of the ANTT guideline for IV therapy:

1. Clean hands with soap and water or alcohol gel.
2. Clean a plastic tray with an alcohol-based surface cleaner. Whilst drying …
3. Gather equipment, including medication, diluents, syringes, needles, etc.
4. Clean hands with alcohol gel or soap and water.
5. Put on non-sterile gloves (sterile gloves should be used if key parts must be touched).
6. Assemble equipment and prepare medicines, protecting key parts at all times by a non-touch technique. Prime the pump and expose the patient's IV port. If this is already done move on to step 7. Otherwise:
   - **6.1** Prime the pump
   - **6.2** Expose the IV port
   - **6.3** Dispose of gloves
   - **6.4** Clean hands with alcohol gel or soap and water
   - **6.5** Put on new non-sterile gloves.
7. Clean the key parts with a chlorhexidine gluconate 2% and alcohol 70% wipe. Scrub the port tip with different parts of the wipe, then allow to dry for 30 seconds.
8. Administer drugs using a non-touch technique.
9. Dispose of sharps and equipment, then dispose of gloves.
10. Clean tray with alcoholic wipes.
11. Clean hands with alcohol gel or soap and water.

For a pictoral flow chart of the above steps refer to the ANTT website.

7 Extravasation of injectables: overview and management advice

Extravasation is the infiltration of irritant fluids into the subcutaneous tissue. It may lead to an inflammatory response in the affected tissue, which may be immediate or delayed. *The potential for a delayed reaction should be remembered when the initial assessment of a suspected extravasation site is made*. The incidence of infiltration varies widely within the literature but is estimated to occur in 25% of peripheral vascular access devices (VADs, e.g. cannulae) but less than 5% of central lines.

It has been shown that a patient's risk of extravasation depends on several factors.

7.1 Patient factors affecting extravasation

Certain groups of patients are more likely to develop problems after extravasation and should therefore be monitored closely.

7.1.1 Neonates

Neonates, particularly pre-term neonates, possess less subcutaneous tissue than adults, and their veins are smaller and in some cases more fragile. In addition, any extravasated material is more concentrated in the affected area. They are also much less able to vocalise their pain (see below).

7.1.2 Patients unable to vocalise/communicate their pain

Comatose or anaesthetised patients, or those being resuscitated, are not able to provide clear vocalisation of the pain caused by extravasation of a substance. They (and the neonates mentioned above) form perhaps the group of patients at greatest risk from extravasation.

7.1.3 Patients unable to sense pain

Special care should also be taken when administering injectables to patients who have an impaired ability to detect pain. Patients who suffer from peripheral neuropathy (e.g. people with diabetes) are one such group.

7.2 Medicine factors affecting extravasation

The pharmacological properties of a drug influence its ability to induce tissue damage.

7.2.1 Cytotoxic medicines

Several cytotoxic agents will cause extensive tissue damage if extravasated because they are directly toxic to the cells that they come into contact with. Centres that administer cytotoxic agents must have local extravasation guidelines, which should stipulate how to manage the incident according to the type of agent extravasated.

7.2.2 Vasoactive medicines

When vasoconstrictor medicines are administered peripherally, extravasation can produce local vasoconstriction, leading to severe tissue hypoxia and ischaemia. Vasoconstrictors include adrenaline (epinephrine), noradrenaline (norepinephrine), dopamine and vasopressin.

7.2.3 Irritant medicines

The chemical properties of the drug may influence its propensity to cause tissue damage.

i pH

Drug solutions with a pH less than 5.5 or greater than 8.5 may cause tissue damage if they infiltrate subcutaneous tissue as they disturb the normal cellular environment. Blood and tissue fluid have a pH of 7.4 and deviation from this pH will cause damage to cellular structures, particularly by disturbing the function of proteins. The table below shows examples of medicines that have particularly high or low pHs. The reader should note pH values may vary slightly between different preparations of medicine, according to the manufacturer's formulation.

ii Tonicity

All solutions exert an osmotic pressure, dependent on the amount of substance dissolved in the solution. The tonicity of a solution is measured relative to water, which has an osmolarity of 0 mOsmol/L. Solutions with an osmolarity more or less than that of plasma (~290 mOsmol/L) may cause tissue damage. The presence of these solutions can lead to an osmotic imbalance across the cell membrane, leading to the movement of water into or out of the cell, a breakdown of cellular transport mechanisms and cell death. Most injectables are formulated to have the same osmotic pressure as plasma so that the solution to be injected into the patient is unlikely to cause vein irritation. The table below lists a selection of medicines that have high osmolarity and may potentially cause a problem if extravasated. Extra care should be taken when administering these medicines.

Medicines with high or low pH values

Intravenous medicine	pH
Acetazolamide	9.1
Aciclovir	11.3
Adrenaline (epinephrine)	2.8–3.6
Aminophylline	8.8–10
Amiodarone	3–5
Argipressin	3–5
Atracurium	3.5
Atropine	2.8–4.5
Azathioprine	10–12
Buprenorphine	3.5–5.5
Clonazepam	3.5–4.5
Co-trimoxazole	9–10.5
Cyclizine	3.3–3.7
Dantrolene	9.5
Dobutamine	2.5–5.5
Dopamine	2.5–5.5
Doxapram	3–5
Ergometrine	2.7–3.5
Fentanyl	4–7.5
Folic acid	8–11
Furosemide	8–9.5
Ganciclovir	10–11
Gentamicin	3–5
Glucagon	2.5–3.5
Glucose (pH dependent on concentration of solution)	3.5–6.5
Glyceryl trinitrate	3.5–6.5
Glycopyrronium	2.3–4.3
Haloperidol	3–3.8
Hydralazine	3.5–4.2
Hyoscine butylbromide	3.7–5.5
Ketamine	3.5–5.5

Intravenous medicine	pH
Labetalol	3.5–4.2
Lidocaine	3.5–6
Liothyronine	9.8–11.2
Methyldopa	3–4.2
Metoclopramide	3–7
Midazolam	3
Morphine	3–6
Naloxone	3–4.5
Noradrenaline (norepinephrine) acid tartrate	3–4.5
Octreotide	3.9–4.5
Omeprazole	9–10
Ondansetron	3.3–4
Oxytocin	3.7–4.3
Pancuronium	3.8–4.2
Papaveretum	2.5–4
Phenobarbital (phenobarbitone)	9–10.5
Phenoxybenzamine	2.5–3.1
Phenytoin sodium	12
Potassium canrenoate	10.7–11.2
Prochlorperazine	5.5–6.6
Propranolol	3
Protamine sulphate	2.5–3.5
Quinine dihydrochloride	1.5–3
Salbutamol	3.5
Secretin	2.5–5
Sodium nitroprusside	3.5–6
Terbutaline	3–5
Tetracosactide	3.8–4.5
Thiopental	10.5
Tobramycin	3.5–6
Vancomycin	2.8–4.5

Few medicines have an osmotic pressure less than plasma; however, if a medicine is made up with greater than the recommended volume of water for injections, the medicine is likely to be hypotonic and may cause tissue irritation. In practice, this tends to be much less of an issue than injection of hypertonic solutions. Where available, the monographs in Section B list the tonicity of a medicine.

Osmolarity or osmolality? What is the difference?

Tonicity is stated using two different conventions: osmolarity is the theoretical tonicity and is derived through calculation. Osmolality is the measured tonicity and is derived through laboratory testing, such as freezing point depression. Both values are usually similar, with some notable exceptions, such as calcium gluconate. This has an osmolarity of 670 mOsmol/L and an osmolality of 276 mOsmol/kg. It is beyond the scope of the *Guide* to discuss the complex chemistry behind this difference, but it is important to understand that some medicines may be less irritating to tissues than expected, based on their osmolarity. Where possible the osmolality of a solution is stated in the *Guide*, as this is a better indicator of whether a medicine will cause tissue damage. If a medicine has an osmolality of greater than 500 mOsmol/kg (or an osmolarity of greater than 500 mOsmol/L) it is more likely to cause problems if it infiltrates a tissue.

Medicines with a high tonicity may be diluted to a larger volume of infusion fluid in order to reduce the tonicity and thus reduce the irritancy of the medicine. The monographs in Section B give advice on recommended dilutions of medicines.

Medicines with high osmolarity

Intravenous medicine	Osmolarity (mOsmol/L)
Glucose 10%	535
Glucose 20%	1110
Glucose 50%	2775
Calcium gluconate 10%	670
Calcium chloride 5 mmol/10 mL	1500
Intravenous nutrition (TPN)	(variable with bag contents)

Intravenous medicine	Osmolarity (mOsmol/L)
Mannitol 10%	550
Mannitol 20%	1100
Magnesium sulphate 50%	4060
Potassium chloride 20 mmol/10 mL	4000
Sodium bicarbonate 4.2%	1004
Sodium bicarbonate 8.4%	2008

iii Presence of excipients

Some drugs are formulated with substances such as polyethylene glycol and ethanol (alcohol) to improve their solubility, e.g. nimodipine. Such medicines are known

to be more irritating than those formulated in aqueous solutions. If a medicine is known to contain irritating excipients, this is stated in the monograph in Section B of the *Guide.*

7.3 Administration factors affecting extravasation

7.3.1 Site of administration

The selection of the site is a very important factor when placing a VAD. Areas that have small amounts of subcutaneous tissue are the most likely to be problematic should the medicine extravasate. The antecubital fossa and the dorsum of the hand and foot are most often implicated in extravasation injury and should be avoided when administering irritant or vasoactive medicines.

7.3.2 Method of venepuncture

This method of venepuncture is probably as important as the site of injection. The repeated use of any single vein for venepuncture increases the risk of the medicine extravasating into the surrounding tissues. *Venepuncture is a skill that should not be attempted by anybody who has not completed an approved training course*. Inexperience increases the risk of problems arising from venepuncture.

7.4 Overall risk for extravasation

The multiple patient and pharmaceutical risk factors interact to influence whether an extravasated medicine causes tissue damage. A medicine with a normal pH and tonicity may cause tissue damage in a particularly sensitive individual. Before administering medicine or infusion fluid a practitioner should be aware of the possible risks of the product and take into consideration the patient factors that may influence the risk.

7.5 Treatment of extravasation

Extravasation should be suspected if:

- The patient complains of burning, stinging or discomfort at the injection site.
- Swelling or leakage is observed around the VAD.
- Blanching or erythema of the skin occurs at the site.
- Resistance is felt on the plunger of the syringe if the medicine is being given as a bolus.

- The infusion rate slows or stops (regardless of the position of the patient) when administering fluid from a bag.

Extravasation from a central VAD is more difficult to detect. Local guidelines for the management of central venous catheter problems should be consulted.

7.5.1 Immediate action

- **STOP** the administration of the medicine, **leaving the cannula in place.**
- Aspirate the residual medicine through the cannula.
- Elevate the limb.
- Inform the medical staff immediately.

At UCLH the medical/surgical team refers all cases to the plastic surgery team for assessment and advice on treatment at the *earliest opportunity*. The plastic surgery team has several techniques available to limit the likelihood of extensive tissue damage after extravasation. The sooner these measures are started, the more successful they are likely to be.

In areas where irritant injectables are routinely administered, such as haematology and oncology wards, extravasation kits are held. Such kits contain the essential equiment necessary for the immediate treatment of an extravasation, including syringes, needles, a hot and cold pack, gauze, hyaluronidase and dimethysulfoxide.

7.5.2 Subsequent action

Careful recording of the following in the medical notes is recommended:

- Medicine(s) involved.
- Appearance of site.
- Date and time of the incident.
- Administration technique.
- Needle size, type and insertion site.
- Patient's symptoms and statements.
- Approximate amount of medicine extravasated.
- Name and signature of nurse/doctor administering the medicine.
- Doctor notified.

- Time and date of referral to plastic surgery team.
- Follow-up procedure.

The doctor/nurse administering the medicine should complete an incident form. Further information about risk factors and management advice for extravasation, including a database of incident reports, can be found at www.extravasation.org.

8 Flushing cannulae, catheters and administration sets

8.1 Flushing between medicines

Flushing is simply the introduction of a small amount of fluid into a cannula, catheter or administration set to deliver the contents of the lumen into the patient. Flushing ensures the full dose of a medicine is given to the patient and prevents incompatible substances mixing in the devices. It is standard practice to flush *before* and *after* the administration of a medicine. If giving multiple medicines one after the other, a flush must be given between the individual medicines to avoid interaction between potentially incompatible drugs. Flushes are administered using ANTT, as described above.

Cannulae are usually flushed with 5–10 mL of sodium chloride 0.9% or glucose 5%. Check the individual monograph in Section B to ascertain which fluid is suitable as a flush for a particular medicine. The majority of medicines are compatible with sodium chloride, but there are a few notable exceptions, including amiodarone and phytomenadione, which should be flushed with glucose 5%. Cannulae in neonates and young children require less than 1 mL of flush fluid.

Adult ***central venous catheters*** should be flushed with 10 mL sodium chloride 0.9% as the volume of the lumen is much larger than in a cannula. Paediatric catheters generally require a smaller volume, while a neonatal catheter may require just 2 mL to be flushed.

Administration sets are flushed by connecting a bag of infusion fluid to the set. The fluid must be compatible with the medicine inside the set, and should be administered at the rate recommended for administration of the original medicine. The volume of an administration set is printed on the package it is supplied in and is usually around 20 mL. Once the set has been flushed the bag can be disconnected and discarded: there is no need to administer the whole bag. Neonatal administration sets usually require 1–2 mL to flush. It is very important to flush an adminstration set after giving a medicine as the set may contain a considerable proportion of a dose: if the orginal medicine was in a 100 mL bag, then approximately 10% of the dose will be contained in the administration set prior to flushing.

8.2 When not to flush

When an infusion has been stopped and a medicine's effect is no longer required it may not be appropriate to flush an administration set or catheter. Such medicines tend to be administered via a syringe pump and are used for short-term control of a clinical parameter, for example blood glucose control with insulin. Flushing the medicine through the administration set will deliver a large dose of the drug to the patient, as the drugs are often used in a concentrated form. This would result in a

large and undesirable therapeutic effect – hypoglycaemia may result from flushing an adminstration set containing insulin, for example.

A small number of medicines are incompatible with all infusion fluids, e.g. some brands of immunoglobulin. These medicines should not be flushed as the flush fluid may cause precipitation of the medicine in the administration set/catheter.

Before taking down an infusion the practitioner should establish whether it is appropriate to flush the medicine. Section B of the *Guide* gives flush advice for each medicine. If it is not appropriate to flush, at the end of an infusion the administration set should be disconnected and discarded and the catheter aspirated so that any medicine in the lumen is removed. The catheter should then be flushed with 10 mL sodium chloride 0.9%.

NB if the medicine is administered via a peripheral cannula the volume of drug inside the cannula prior to flushing is miniscule. Peripheral cannulae do not usually need to be aspirated at the end of an infusion; they may be flushed with 10 mL sodium chloride 0.9%.

8.3 Flushing catheters and cannulae not in use

Peripheral cannulae that are not being used for the administration of fluids or medicines should be flushed with 5 mL sodium chloride 0.9% at 8-hourly intervals to maintain their patency. Neonates require between 0.5 and 1 mL.

Central venous catheters (CVCs) – flush volumes of CVCs will depend on the type of catheter used. If a lumen is not in use, most catheters should be flushed with 10 mL sodium chloride 0.9% at least once or twice weekly. Implantable ports (Portacaths) should be flushed every 4 weeks with 10 mL sodium chloride 0.9%. Paediatric and neonatal catheters generally require a smaller volume to be flushed. Refer to local CVC care guidelines for full advice.

8.4 Flushing with heparin

Until recently flushing with heparin 10 unit/mL or heparin 100 unit/mL was relatively common practice. However, heparin flushes are no longer used at UCLH in response to the National Patient Safety Agency rapid response report *Risks with Intravenous Heparin Solutions*. The report outlined several incidents in which concentrated heparin solutions or drugs other than heparin were inadvertently used to flush venous access devices, resulting in patient harm. There is little evidence that heparin flushes are advantageous over sodium chloride flushes – it is the movement of fluid that maintains the patency of the device, rather than any property of the fluid itself.

In all instances, heparin solutions should not be used to flush venous access devices. However, heparin 100 unit/mL may be used to *lock* an implantable port.

9 Infusion pumps

Fatal errors have been reported after the incorrect administration of medicines via infusion pumps. It is the responsibility of the person administering an injectable to ensure that an appropriate pump is being used, that it is in good working order and that he or she knows how to operate it correctly. Alterations to the pump settings must be made by a person authorised to administer intravenous medicines. The volume of fluid administered should be recorded on the fluid chart. All pumps should be checked at least hourly during the infusion.

9.1 Pumps used at UCLH

In addition to the generic pumps described below, there is a number of special purpose pumps in use in specific clinical areas (e.g. the Cane ApoGo pump used for the administration of apomorphine in Parkinson's disease). These specialised pumps must be used **only** for their intended application; they must **not** be used as general purpose devices.

9.2 Volumetric pumps

These are the preferred pumps for medium- and large-volume infusions, although some are designed specifically to operate at low flow rates for neonatal use. The rate is selected in millilitres per hour (usual range 1–999 mL/hour). Typically, most volumetric pumps are accurate to ±5% at rates down to 5 mL/hour. A syringe pump should be used for rates lower than 5 mL/hour. Volumetric pumps require the use of an administration set matched to the pump.

Volumetric pumps are used to administer a wide range of fluids and medicines, including standard hydration fluids such as sodium chloride 0.9%, medicines that need administration at a controlled rate, such as iron sucrose complex (Venofer), and intravenous nutrition.

9.3 Syringe pumps

These are low-volume, high-accuracy devices designed to infuse at low flow rates and are typically calibrated for delivery in millilitres per hour (usual range 0.1–99 mL/hour). Many pumps will accept different sizes and different brands of syringe, but the pumps must be set up for the particular type and size of syringe in use, unless the pump detects the syringe size and type automatically. The Medicines and Healthcare Products Regulatory Agency (MHRA) recommends that rates less than 0.5 mL/hour should not be used unless the pump is specially designed for

this purpose, because an increase in the occlusion response time occurs. Where the response time to occlusion or the size of the post-occlusion bolus is important (e.g. in neonatal applications), syringe pumps allowing finer control over occlusion pressure should be used. These will generally require the use of a dedicated administration set incorporating a pressure cell.

In general clinical areas at UCLH syringe pumps are used to deliver heparin and insulin infusions, but in critical care they are used to give a large range of medicines, often in a concentrated form. This has the advantage of delivering a medicine in a small volume of fluid, thus minimising the risk of fluid overload. It also allows fine control of the rate of administration so that therapy can be rapidly adjusted according to patient response. Refer to the monographs in Section B for further details. Examples include adrenaline, dobutamine and epoprostenol.

9.4 Pumps for ambulatory use

9.4.1 Miniature syringe pumps (syringe drivers)

These pumps typically accept syringes between 2 and 10 mL and are able to achieve very low flow rates. They may require the rate to be set in **millimetres** per **hour** or **millimetres** per **day**, i.e. linear travel of syringe plunger against time. Calculations that depend on the syringe size used are required to convert from flow rate to linear travel per unit time.

These pumps are commonly used to deliver analgesics, antiemetics and medicines to reduce respiratory secretions in palliative care. One or more compatible medicines may be mixed in the same syringe, depending on patient need. These syringes are most commonly set to 48 mm and run at 2 mm/hour. The drugs in the syringe must therefore be diluted in a volume of fluid that corresponds to the syringe barrel being drawn up to 48 mm. Refer to Section A15 for further details.

9.4.2 Miniature volumetric pumps

These pumps use reservoirs that contain the solution within the pump. Some offer a variety of programming options. These are used to deliver a range of medicines including analgesia, insulin or iron chelating agents. The reservoirs may contain concentrated solutions of drugs which are changed relatively infrequently, e.g. weekly.

9.5 Patient-controlled analgesia (PCA) pumps

These are typically syringe pumps, but they have the facility to enable patients to administer a bolus dose themselves. A PCA pump has several programming options, which may be set by specified clinical staff; access to the programming

controls is usually restricted, typically by a key that disables the programming buttons. The syringe is generally contained inside a lockable cover, to prevent unauthorised access. With PCA pumps, protection against free flow is important because the patient may be unsupervised for some of the time.

A different type of PCA device involves the use of an elastomeric reservoir (Baxter PCA) or syringe reservoir (Vygon PCA). Unlike electronic PCA pumps they have no programming features.

Where there is a clinical need, PCA pumps may be operated by a nurse, in which case the pump is referred to as a nurse-controlled analgesia (NCA) pump. This may be required in children or patients unable to operate the device to give themselves a bolus. PCA pumps give patients the freedom to control their own pain when required. The pumps may be set to deliver boluses only, or may be used to infuse a continuous background dose, supplemented by bolus doses as required by the patient. PCAs are generally used to deliver strong opioids such as morphine, fentanyl, oxycodone or pethidine. Typical drug concentrations, bolus doses and background infusion rates are listed in the individual drug monographs in Section B.

9.6 Target-controlled anaesthesia (TCI or TIVA) pumps

These are syringe pumps incorporating specialised software to control the delivery of specific anaesthetic agents, such as propofol (Diprivan). The pumps share most properties with syringe pumps, but, instead of specifying a fixed infusion rate and volume directly, the user either sets an induction rate and volume, and a maintenance rate, or enters patient information such as gender and weight, from which the pump computes the required rates. The calculation is based on a pharmacokinetic model of the medicine's behaviour in the patient, and is intended to deliver the correct concentration in the patient. Note that some TCI/TIVA pumps require the medicine to be contained in a special, pre-filled syringe.

10 Administration of injectables in primary care

Increasingly, patients are discharged on IV therapy for use at home. Often the task of administration falls to a community (or district) nurse. Although community nurses may have access to their own IV administration policies and training, they often work in isolation and may not be familiar with the injectables they are asked to administer.

Community nurses may therefore require information and advice on the IV medicine(s) before visiting the patient at home. Some may wish to visit the patient on the ward before discharge to familiarise themselves with the medicine, the type of equipment and/or the skills required for care. The information required by the community nurse will include:

- Name of medication.
- Indication for use.
- Dose.
- Patient weight/body surface area/clinical status (as appropriate).
- Method of administration.
- For IV infusions – diluent and volume/concentrations/rate/duration of infusion.
- Method of rate control.
- Frequency of administration (community nurse schedules and patient convenience may need consideration).
- Storage requirements.
- Arrangements for ongoing prescription and supply of medicines.
- Arrangements for disposal of clinical waste.
- Side effects.
- Clinically significant interactions.
- Monitoring.

Reconstitution in the patient's home may pose additional training needs, and COSHH (Control of Substances Hazardous to Health) implications must be considered.

For licensed products the above information will usually be available from the British National Formulary (BNF), SPCs and package inserts. Where medicines are prescribed outside the recommendations of the product licence, community

nurses require access to sufficient information to satisfy themselves that the prescription is appropriate in the context of the condition of the patient. The necessary information should be made available at the time of discharge from the ward. Prescribing guidelines, shared care guidelines and pharmacy discharge plans are useful sources of information.

10.1 Self-caring patients

Some patients may be sufficiently independent to manage their own injectable therapy. There is a growing body of patients requiring long-term intravenous nutrition (IVN) and fluids. During hospital admission these patients are taught how to manage their CVC, including ANTT, how to use adminstration equipment and devices and to administer nutrition to themselves. The IVN may be compounded in batches and delivered to the patient weekly, or every 2 weeks, depending on the stability of the formulation and the patient's capacity to store the bags. These individuals are taught to recognise administration problems, as well as CVC-related problems, and may be given supplies of drugs or fluids used in such situations, e.g. a small supply of antibiotics for patients who are prone to catheter-related infection, or an additional supply of fluids for those who may become dehydrated.

There are great advantages to self administration: patients take control and responsibility for their own care, which gives them freedom and independence. It also takes some burden away from the healthcare system as daily nursing visits are unnecessary. However, setting up such a system requires patients to be motivated and capable of intensive training to ensure they will be safe at home, as well as a great deal of organisation within a hospital multidisciplinary team to co-ordinate training and install a homecare package. At UCLH this team is formed by specialist nutrition nurses, doctors and pharmacists.

11 Formulation and presentation of injectables

Injectables are available in a range of presentations, as described here.

11.1 Medicines that require reconstitution

These include medicines, e.g. amoxicillin, that are presented as a dry powder and therefore need to be reconstituted before use. Further dilution may be necessary. The advantage of this type of formulation is that it enables prolonged storage of products that are unstable in solution.

There are a number of disadvantages, including the following:

- They need to be reconstituted, which is time consuming, particularly if the preparation is difficult to dissolve.
- All manipulations pose the risk of environmental and microbial contamination of the solution.
- They may be complex to prepare, particularly if they require special diluents or multiple transfers of fluid. The greater the complexity, the greater the chance of an error being made during preparation.
- Some medicines are susceptible to 'foaming', e.g. teicoplanin and asparaginase. If doses are drawn up from foam, part of the dose may be left in the vial. Foaming of protein drugs sometimes inactivates them.
- If the product is presented as glass ampoules that require snapping, there is a danger of glass particles getting into the preparation, staff injuries and the risk of medicine droplets polluting the environment.
- Pressure differentials in vials with a rubber septum may be difficult to manage (see below).

11.1.1 Equalising pressure in the vial

Some vials are manufactured with a vacuum inside, and it is important that the effects of this are corrected during reconstitution. If the vial has a vacuum inside it will be obvious when trying to add diluent because the diluent will be 'sucked' into the vial.

If no vacuum is present in the vial, air needs to be removed. The amount of air drawn back into the syringe should be equal to the volume of diluent added. Before withdrawing the reconstituted medicine from the vial, again pressure differences have to be accounted for. Air needs to be added to the vial equal to the amount of medicine to be withdrawn.

11.2 Preparations in solution requiring further dilution before use

Examples of such preparations are amiodarone and aminophylline.

Advantage

- They are already in a liquid form, so reconstitution is unnecessary.

Disadvantages

- They may need to be further diluted before administration, so the drug may still require multiple complex manipulations before it is ready to administer to the patient.
- Vials may have a pressure differential (as above).
- Glass ampoules are easily broken if stored incorrectly, leading to environmental contamination.

11.3 Preparations available 'ready to use' without further dilution

These preparations may come in bags or small-volume ampoules that can be administered without further dilution, but still require the solution to be drawn up into a syringe for administration, e.g. ondansetron and ranitidine. These are convenient to use but still have disadvantages.

Disadvantages

- Hazards associated with microbial contamination.
- Prone to vacuum/pressure problems (if vials).
- Can cause glass breakage problems (if ampoules).

11.4 Preparations available 'ready to administer'

These preparations include infusion bags, e.g. 500 mL sodium chloride 0.9%, pre-filled syringes, e.g. adrenaline, and pre-filled bags/bottles of medicines, e.g. ciprofloxacin and metronidazole.

Advantages

- Easy to use and prepare so there is minimal risk that dosing errors may occur.
- Minimal risk of microbial contamination during preparation – usually the practitioner just needs to attach an administration set or, in the case of a pre-filled syringe, simply remove the sheath from the needle.
- Lower risk of environmental contamination.

Disadvantages

- They are bulky to store and transport. This may be a significant problem if many doses are used in a clinical area. If all drugs were presented as ready to use preparations most healthcare providers would need to find additional storage space for medicines.
- The packaging and containers must be disposed of after use. The drugs tend to come with large amounts of cardboard and are often presented in large glass bottles, for which disposal facilities must be provided. The carbon footprint of such preparations is likely to be much greater than small-volume, minimally packaged presentations.
- The drugs tend to be presented in a limited range of doses. In certain patient groups, e.g. children and neonates, it may be difficult to give the correct dose of a medicine without withdrawing fluid from the preparation, or using an infusion device to accurately measure the amount of fluid delivered, then stopping the infusion part of the way through in order to give a part bottle or bag.
- The drug may be diluted in a large volume of fluid, which may be unsuitable for some patients, e.g. fluid-restricted patients and neonates.

12 Pharmaceutical aspects of injectable administration

The preparation and administration of some drugs is influenced by the physicochemical properties of the formulation.

12.1 Displacement values

When a solid is dissolved in a fluid, the volume of the fluid increases. The volume of this increase is called the displacement value. It is important to consider this when preparing medicines, since many medicines are presented as dry powders, to which diluent must be added. For example: amoxicillin 250 mg vial has a displacement value of 0.2 mL. Usually amoxicillin is reconstituted with 5 mL water for injections. After reconstitution the total volume of the solution is 5 mL + 0.2 mL = 5.2 mL. If the prescribed dose is 250 mg, then the practitioner should administer the full 5.2 mL to the patient. The concentration of amoxicillin in the solution is 48 mg/mL.

Perhaps a practitioner is working on a paediatric ward and the dose prescribed is 50 mg. To reconstitute the vial the practitioner should take into account the displacement value. The practitioner should add 4.8 mL water for injections to the vial, so that the concentration is 50 mg/mL. The volume of the dose is 1 mL.

The monographs in Medicine monographs (in alphabetical order) advise how to take into account the displacement value for all drugs in which it is significant.

12.2 Sodium content

Some medicines can have a high sodium content which should be taken into consideration when patients are sodium restricted. Sodium may be included in the medicine because:

- It is part of the drug itself, e.g. benzylpenicillin sodium.
- It is in the excipients, e.g. sodium citrate, which is used to control the pH of a medicine.
- It is part of the diluent – many ready diluted medicines are actually formulated in sodium chloride 0.9%, e.g. ciprofloxacin and metronidazole.

If patients are sodium restricted it may be beneficial to dilute their medicines in glucose if possible. The amount of sodium from medicines is rarely greater than the amount that would be delivered in 500 mL or 1 L sodium chloride 0.9%. The sodium content of medicines, and of sodium chloride solutions, is listed in the monographs in Section B.

12.3 Drop size

The presence of solvents in some medicines may affect the drop size of the infusion. A drop in a standard adult administration set is 0.05 mL but may be reduced to 0.03 mL by the excipients that amiodarone is formulated with. This can result in inaccuracies if relying on drop-counting methods to control the administration rate. Therefore, amiodarone should be given only by devices that control the rate of administration by volume, i.e. a volumetric pump or syringe pump.

12.4 Layering

This phenomenon can occur if there is insufficient mixing of solutions with different densities. An example of this is the addition of potassium chloride to IV infusion bags. If potassium chloride injection is added to glucose 5%, it remains in the bottom of the IV bag because it is denser than the glucose solution. Thus, if the bag is not mixed thoroughly, a high concentration of potassium will remain in the lower part of the bag. Infusion of the solution may result in cardiac arrest due to the high concentration of potassium delivered in a short space of time.

When adding to an infusion bag, care must be taken to ensure that all additives are thoroughly mixed within an infusion fluid.

12.5 Fluid restriction

Medicines that require dilution in large volumes for administration may cause problems in patients who are fluid restricted. Drugs that are irritating to veins, because of high osmolarity or non-physiological pH in their concentrated form, are usually recommended for dilution in large volumes of fluid. This reduces their irritancy. However, fluid overload may also arise when patients are administered numerous intravenous medicines that may require dilution. Therefore, the amount of fluid intake from intravenous medicine administration must be considered when prescribing maintenance fluid requirements. In the monographs, advice has been given to indicate the smallest volume with which a medicine can be given. Much of this information is based on anecdotal experience compiled in the UKCPA document *Critical Care Group Minimum Infusion Volume*, 3rd edition, 2006.

High fluid intake often accompanies the following medicines:

- Co-trimoxazole.
- Sodium fusidate.
- Erythromycin.
- Intravenous nutrition.
- Liposomal amphotericin (AmBisome).
- Aciclovir.

13 Factors influencing medicine stability and compatibility of injectable medicines

An important aspect of parenteral therapy is to ensure that the patient receives the intended dose of each medicine. A proportion of the medicine will be lost between the time of preparation of the injection and entry into the bloodstream, e.g. if the medicine undergoes degradation, precipitates with the diluent or interacts with the delivery system. It is important to understand the reasons for such loss of potency in order to assess the likely clinical implications.

The following section briefly discusses some of these problems.

13.1 Degradation

13.1.1 In aqueous solution

On reconstitution, dry powder medicines are relatively unstable in aqueous vehicles and normally degrade by hydrolysis (decomposition of a substance by a chemical reaction with water). This reaction may be accelerated by a change in pH, resulting either from the diluent or from a second medicine. Such degradation may be minimised and prevented by using the recommended diluent, e.g. erythromycin must be reconstituted with water for injections because it will not dissolve in sodium chloride 0.9% or glucose 5%. After it has been dissolved it should be diluted in sodium chloride 0.9% and not glucose 5% because it degrades at an acidic pH. Alternatively sodium bicarbonate may be added to a glucose 5% bag to ensure the pH is in the range at which erythromycin is stable. See the monograph for erythromycin in Section B for further details.

13.1.2 Photodegradation

Photodegradation is the breakdown of a substance by light. It occurs to a significant degree in a small number of medicines, e.g. sodium nitroprusside. Degradation is usually the result of ultraviolet (UV) light, which is found in daylight but not artificial fluorescent light, although sodium nitroprusside is rapidly degraded by both fluorescent and UV light.

Photodegradation of some other light-sensitive medicines (e.g. ciprofloxacin or furosemide) is not clinically important provided that direct exposure to strong daylight or sunlight is avoided. Intravenous nutrition should be light protected as some vitamins are light sensitive.

13.2 Precipitation

Precipitated medicines are pharmacologically inactive but hazardous to the patient. Precipitates can block catheters and damage capillaries and may lead to coronary and pulmonary emboli. The injection of medicine precipitates must therefore be avoided.

13.2.1 Causes of precipitation

i pH

The most likely reason for precipitation is the mixing in the infusion container or the infusion line of two medicines with very different pH values, especially if one is acidic and the other alkaline.

ii Medicine–medicine co-precipitation

This occurs most commonly from the mixing of organic anions (ions with a negative charge) and cations (ions with a positive charge), which join together to form ion pairs. Gentamicin and other aminoglycosides are incompatible with heparin, penicillins and cephalosporins because of this. It is essential to avoid these interactions. Medicines that could form an ion pair should never be allowed to mix in an infusion container, syringe or administration line. Flushing between the administration of different medicines helps avoid such interactions (see Section A8 for further details).

iii Temperature

Most medicines are more soluble as the temperature increases. Generally, if a refrigerated injection does not precipitate, warming to 37°C (as occurs when an injection passes slowly through the cannula) will not cause precipitation. One exception to this is calcium phosphate, which is less soluble at 37°C than at room temperature.

Mannitol, at concentrations of 15% or more, crystallises out when exposed to low temperatures. A mannitol solution containing crystals should not be used.

13.3 Binding of medicines to plastics

Administration of IV medicines relies almost entirely on equipment made from plastic. Some medicines bind to certain plastics. The extent of binding is difficult to predict because it depends on: medicine concentration, vehicle, flow rate, available surface area of plastic, type of plastic, temperature, pH and time. The main plastic with which drugs interact is polyvinyl chloride (PVC). Syringes are generally PVC-free, and there is a movement towards the use of PVC-free infusion bags too: Baxter

Viaflo bags do not contain PVC. At the time of writing, most administration sets still contain PVC. If medicines incompatible with PVC need to be given, a PVC-free set should be obtained. These are commonly stocked in haematology areas, where they are most likely to be used. The packaging of administration equipment should state the material from which the device is made.

The table below shows some clinically relevant examples of drug–plastic interactions.

Medicine	Plastic affected	Management advice
Insulin	Any (and glass)	Do not add to infusion bags. Dilute to 1 unit/mL and give via a syringe pump. Monitor blood sugar and adjust infusion rate accordingly
Diazepam	PVC	Administer via a syringe pump and PVC-free administration set
Nimodipine	PVC	Use the polyethylene administration set provided with the drug
Nitrates (GTN, ISDN)	PVC, nylon	Administer via a syringe pump and PVC-free administration set

13.4 Destabilisation of parenteral emulsions

Care is necessary to avoid destabilising emulsions in IV lines, junctions and catheters where injections may mix during administration. Fat emulsions (e.g. Intralipid) are used widely in parenteral nutrition as an energy source. Other medicines that are prepared as a fat emulsion as a result of their poor water solubility include propofol and diazepam (Diazemuls).

Fat emulsions can be destabilised by ions with a high positive charge: calcium and magnesium may destabilise the fat emulsion in intravenous nutrition. Diazemuls may be diluted, but sodium chloride 0.9% rapidly destabilises the emulsion and should not be used.

13.5 Leaching of plasticisers

The presence of oils and surfactants can leach (leak) out toxic plasticisers, especially from PVC materials. This can happen if intravenous nutrition is made in PVC bags. Leaching from administration sets and bags during infusion can also occur. Ciclosporin solution contains polyethoxylated castor oil, which causes phthalate (a plasticiser) to leach from PVC containers and tubing. If the infusion is administered for more than 6 hours, a low sorbing PVC administration set and an infusion bag

should be used to infuse the ciclosporin. Leaching from rubber plungers of plastic syringes may occur and can affect medicine stability, e.g. ergocalciferol.

13.6 Blood and blood products

The Department of Health states that the co-administration of blood or concentrated red blood cells with any other medicine or vehicle is hazardous. Examples of incompatibility with blood include mannitol solutions (irreversible crenation of red cells), dextrans (rouleaux formation and interference with crossmatching), glucose (clumping of red cells) and oxytocin (inactivated).

In extreme circumstances medicines have been mixed with blood in the catheter, e.g. experience seems to show that furosemide can mix safely with blood. In contrast, human serum albumin has been shown to be incompatible with many intravenous infusions. Overall experience remains limited and no studies have been reported.

14 Allergic reactions to injectables

A true allergic reaction resulting in anaphylaxis will occur in a patient who has become sensitised to a medicine, via an immunologically mediated pathway, and so must have had previous exposure to the medicine. Therefore, anaphylaxis will occur on administration of the second rather than the first dose of the medicine. In a patient already sensitised to a specific medication, the risk of an allergic reaction to that medication is greatest when given intravenously and least when given orally. This is thought to be a function of the rate of medicine delivery.

Pseudoallergic or 'anaphylactoid' reactions are medicine reactions that exhibit clinical signs and symptoms of an allergic response but are not immunologically mediated. Unlike true allergic reactions, which require an induction period during which a patient becomes sensitised to an antigen, pseudoallergic reactions can occur on the first exposure to a medicine. The development of pseudoallergic reactions may be dose related and manifest only when large doses of the medicine are administered. Patients frequently exhibit anaphylactoid reactions to intravenous iron.

14.1 Latex allergy

A small number of patients are allergic to natural latex. Natural latex is made from the rubber tree. It is thought that some individuals become sensitive to the proteins present in the latex through repeated exposure. Patients with spina bifida are particularly prone to acquiring natural latex allergy, because they frequently require surgery, during which they may be exposed to latex from surgical equipment. Healthcare workers are also prone to acquiring latex allergy from the same equipment. There is a movement to eliminate the use of natural latex within healthcare precisely because of this problem.

Synthetic latex does not contain these proteins, so it does not pose a risk to those with a natural latex allergy. For most injectable medicines, if they have latex packaging, it is made with synthetic latex. Unfortunately some medicines are packaged with natural-latex-containing materials. The septum of a vial is occasionally manufactured with material containing natural latex. As a needle pierces a septum, small fragments of latex break away and enter the drug fluid. These particles may be subsequently drawn up and injected into a patient. Normally this would have no effect on a patient, but in patients with latex allergy a hypersensitivity reaction may be triggered.

Occasionally manufacturers use materials containing natural latex to make equipment used to administer injectable medicines. For example, the syringe cap or needle sheath of some pre-filled syringes may contain latex. If these come into contact with a latex-sensitive patient, it may cause an allergic reaction.

Medicines may also come into contact with latex on the production line: conveyor belts used to transport vials through a factory may contain natural

latex, so the outer surface of medicines may be contaminated with small latex particles.

The only way to definitively establish whether the packaging of medicine contains natural latex is to contact the manufacturer of the medicine. Local pharmacy medicines information departments can facilitate this.

Pharmaceutical manufacturers recognise the problem with using latex in their packaging, and will usually confirm whether it is in their product. They will not, however, guarantee whether their product has come into contact with natural latex on the production line. However, the latter is generally not thought to pose a serious risk since drug packaging and patients should not come into contact with each other.

For full details regarding the management of latex allergic patients refer to local guidelines.

15 Compatibility of drugs in a syringe driver for subcutaneous use

Continuous subcutaneous infusions are commonly used in palliative care. Analgesics, antiemetics and drugs for reducing respiratory and gastrointestinal secretions may be diluted in a small volume of fluid and administered over 24 hours. This avoids the need for administration of multiple medicines by the oral or intravenous routes and can be a much more comfortable and convenient way of giving medicines to the patient. It also ensures the medicine is delivered to the patient if there are problems with absorption from the intestine, or if the patient is unable to take oral medicines because of vomiting or gastrointestinal disease or if the patient is sedated.

It is often necessary to give more than one medicine by the SC route. However, not all medicines are suitable for administration by this method because of limited aqueous solubility or extremes of pH. The table below and Section B of this *Guide* list those medicines that are commonly given by SC infusion. Specialist texts that give advice about possible compatible combinations of medicines for SC use are available for those who routinely use syringe drivers. However, the following simple precautions will minimise the risk of problems of incompatibility and instability:

- Do not leave medicines running in a syringe pump for more than 24 hours.
- Regularly check the solution for signs of precipitation or colour changes, and respond to the pump alarm if it signals an occlusion.
- Protect the contents of a syringe from direct sunlight.
- Check with your local pharmacy department for specific stability information before using any unusual combinations.

pH is a useful predictor of the compatibility of medicine combinations. If two medicines with differing pH values are mixed, the solubility and chemical stability of combinations may be affected.

The table below shows the maximum stable concentrations of **diamorphine** (a commonly used opioid in the palliative care setting) with various agents, made up with **water for injections** (unless otherwise stated). At concentrations above those shown, there is an increased potential for the mixture to precipitate.

Additive	Maximum stable concentration of additive in syringe pump (mg/mL)	Maximum stable concentration of diamorphine in syringe pump (mg/mL)	See note
Cyclizine	10	50	1
Dexamethasone sodium phosphate	1.6	50	2
Haloperidol	1.5	50	
Hyoscine butylbromide	20	150	
Hyoscine hydrobromide	0.4	150	
Ketamine			3
Levomepromazine (methotrimeprazine)	10	50	4
Metoclopramide	5	150	5
Midazolam	5	43	
Ketorolac	12	400	6
Octreotide	0.075	25	3

Notes

1. Cyclizine is likely to precipitate in the presence of sodium chloride 0.9%. In addition, the solubility of cyclizine is reduced by the presence of other medicines in solution. Check for precipitation before administration. Certain higher concentrations of cyclizine may be compatible with lower concentrations of diamorphine. Contact pharmacy for details.
2. Check for precipitation before administration. Dexamethasone should be added last to the syringe after dilution of other medicines.
3. The maximum compatible concentrations of this combination are not known. No formal stability studies have been published. Sodium chloride 0.9% is the preferred diluent for these combinations.
4. Solutions containing levomepromazine have developed a purple discoloration in UV light: such solutions should be discarded.
5. Under some conditions metoclopramide may become discoloured: such solutions should be discarded.
6. Ketorolac and diamorphine should be mixed in sodium chloride 0.9%. The 'maximum' concentrations stated are the maximum concentrations reported in the literature. The absolute maximum compatible concentrations of ketorolac and diamorphine are not known.

Most health units have a local syringe driver policy which the reader should refer to for further information.

16 Risk assessment of injectables and risk reduction

In March 2007 the National Patient Safety Agency published the patient safety alert *Promoting Safer Use of Injectable Medicines*. This required all healthcare organisations using injectable medicines to complete a series of activities to minimise the risks associated with these products. The NPSA required risk assessment for every injectable practice in each organisation to be completed, according to set criteria relating to the preparation and administration of each injectable. On identification of high-risk activity, organisations were obliged to take steps to minimise the risk.

16.1 Risk assessment

Each injectable practice across UCLH was assessed according to the eight NPSA criteria, described in the table below. The risk assessment was conducted in all clinical areas in order to capture local variations in practice. Many injectables are used in multiple different ways, so were risk assessed multiple times according to local practice. For example, a dopamine infusion in UCLH Cardiology is prepared and administered in a different way to that in UCLH Neonatal Unit. The criteria are outlined in the following table.

All injectable practices were given a final score out of eight, according to the number of criteria that applied to that practice. The NPSA advises that practice that scores 1–2 is low risk, 3–5 is moderate risk and 6 or more is high risk. The NPSA requires risk reduction strategies to be put in place to minimise high-risk practices and mitigate the risk if possible. Our scores have been embedded into the monographs in Section B.

At UCLH it was recognised that the NPSA risk scores are very much weighted towards the preparation of the injectable rather than the clinical risk. For example, a morphine bolus would get a low score because it was relatively easy to prepare, despite being potentially very harmful to the patient. Thus a database of all practice rated as high risk according to the NPSA rating plus any practice known to be high risk for other reasons was created. The additional inclusion criteria included all opiates, anaesthetic agents, benzodiazepines, all drugs with a narrow therapeutic index which require blood monitoring, and all drugs that require acute monitoring to ensure efficacy or monitoring for serious adverse effects, e.g. beta-blockers.

The database comprises approximately 100 high-risk injectable practices across the Trust. These were further stratified according to how widespread they are and how frequently they are performed in order to identify which practices should be prioritised for risk minimisation. Some examples of high-risk and widely used injectables at UCLH are given in the table below.

Number	Risk factor	Applies when
1	Therapeutic risk	There is significant risk of patient harm if the injectable medicine is not used as intended[1]
2	Use of a concentrate	The product must be further diluted (after reconstitution) before it can be injected
3	Complex calculation	A complicated calculation must be performed in order to prepare or administer the product. This includes calculations with more than one step, or conversions between dose units, e.g. percentage to milligrammes per millilitre
4	Complex method	More than five non-touch manipulations are required to prepare the product, or when syringe-to-syringe transfer or a filter is used
5	Reconstitution of powder in a vial	Where a dry power preparation must be reconstituted
6	Use of a part vial or ampoule, or use of more than one vial or ampoule	Part or multiple vials/ampoules are required to fulfil the prescription
7	Use of a pump or syringe driver	An infusion device is required to give the injectable
8	Use of a non-standard giving set/ device required	A low sorption, air inlet or light-protected administration set needs to be used to administer the injectable

[1] As the first item, therapeutic risk, is open to interpretation; it was applied for any drug that could cause serious adverse effect if administered incorrectly, including if there was a risk of extravasation with the drug. The injectable was also given this score if patient harm was likely if the patient did not receive the correct dose of the drug or did not receive the drug at all because of an error in preparation or administration.

Drug	Administration method	Indication
Aciclovir	Intermittent IV infusion	Viral infection
Caspofungin	Intermittent IV infusion	Fungal infection
GTN	Intermittent IV infusion	Hypertension, angina
Heparin	Continuous IV infusion	Anticoagulation
Calcium gluconate	Intermittent IV infusion	Severe calcium deficiency
Morphine	Intermittent/continuous IV infusion via a PCA	Pain
Gentamicin	Intermittent IV infusion	Bacterial infection
Foscarnet	Intermittent IV infusion	Viral infection
Infliximab	Intermittent IV infusion	Immunomodulation
Iron dextran infusion (Venofer)	Intermittent IV infusion	Iron deficiency

16.2 Risk reduction

Since the risk assessment was performed, a series of risk reduction strategies have been put in place, tailored to the drug and the circumstances in which it is used. For example, nurses have traditionally made morphine 50 mg/50 mL syringes for PCA pumps on the ward. The morphine PCA pumps scored highly in the risk assessment because:

- They are complicated to make as they require multiple transfers of drug and fluid.
- They are administered using a pump.
- They are very widely and frequently used across the Trust.
- Morphine is a high-risk drug clinically because of the risk of respiratory and CNS depression if given in excess. Conversely if not enough morphine is given it may result in serious pain.

Gradually the preparation of morphine PCAs by nurses on the ward will be phased out and replaced with a ready-made product. This minimises the risk from errors in preparation, but does not influence the other factors that make it high risk. The UCLH PCA policy has been revised and an education programme for all those involved in the administration and monitoring of PCAs is underway to raise awareness of the potential risks from this intervention.

The NPSA recommends several risk reduction strategies including:

- Guideline production, to support those who prescribe, dispense, prepare and administer high-risk medicines.
- Rationalisation of products, e.g. stocking only one strength of a product to minimise risk in preparation. For example, at UCLH, heparin 1000 unit/mL is now the only product available on wards; all 5000 unit/mL preparations have been removed.
- Purchasing of ready-to-use medicines. Across London this work is being co-ordinated so that products that are not commercially available but are widely used across many hospitals, such as the morphine PCA, are available.

Risk reduction requires a co-ordinated multidisciplinary approach with inventive strategies to engage the healthcare workers who use high-risk medicines. The primary motivation for risk reduction is to improve patient safety, at the heart of healthcare.

17 Useful resources

17.1 Websites

The following websites may be of interest to readers.

www.rcn.org.uk
The Royal College of Nursing has produced *Standards for Infusion Therapy*, an excellent and comprehensive document covering nursing aspects of injectable practice.

www.nmc-uk.org
The Nursing and Midwifery Council publishes a range of standards to which registered practitioners should adhere. Their standards for medicines management are of particular relevance to this *Guide*.

www.ukcpa.org
The UK Clinical Pharmacy Association promotes expert practice in medicines management. Its critical care group publishes the document *Minimum Infusion Volumes for Fluid Restricted Critically Ill Patients*.

www.extravasation.org
A comprehensive website about extravasation, describing risk factors and outlining management advice. It also contains a database of known extravasation incidents and a reporting system.

www.bnf.org and **www.bnfc.org**
The British National Formulary and the British National Formulary for Children.

http://emc.medicines.org.uk
The Electronic Medicines Compendium contains the Summary of Product Characteristics for a large number of UK licensed medicines.

www.medicinescomplete.com (subscription required)
Provides a range of pharmaceutical publications including *Martindale, the Complete Drug Reference* edited by Sweetman and *Handbook on Injectable Drugs* by Trissel (an excellent resource for drug compatibility).

www.npsa.nhs.uk
The National Patient Safety Agency promotes patient safety. The NPSA published *Promoting Safer Use of Injectable Medicines* in 2007.

www.ukmi.nhs.uk (password required)
The UK Medicines Information website has a latex allergy information page, and also features a database that details which injectable medicines contain synthetic or natural latex within their packaging.

17.2 Further reading

Intravenous Therapy in Nursing Practice by Lisa Dougherty and Julie Lamb, 2nd edition, Blackwell Publishing, is an excellent and comprehensive text on intravenous therapy. Advanced practitioners and those involved in teaching relating to intravenous therapy may be particularly interested in this book.

Section B

User Guide

The *UCL Hospitals Injectable Medicines Administration Guide* has been designed to be concise and easy to interpret. On reading a monograph, regular users should be able to immediately understand how to prepare and administer a medicine. Those users who are new to the *Guide*, or who use it infrequently, should familiarise themselves with the layout of the monographs and the terminology used before giving a medicine.

It is assumed the user is trained and competent in administering medicines. You should be familiar with the equipment used to prepare medicines, administration sets and infusion pumps. You must also be aware of your legal and ethical obligations to your patient when administering a drug. At UCLH practitioners cannot administer injectable medicines until they have completed specific training to demonstrate both their theoretical knowledge of injectable therapy and their practical competence in the preparation and administration of a medicine.

In most cases the user of the *Guide* will be a nurse or midwife giving a medicine according to a prescription written by a hospital doctor. The monographs are written with this scenario in mind.

For detailed information about some of the features of the monographs, such as extravasation and flushing, you should refer to Section A of the *Guide*.

Core features of a monograph

While reading through these descriptions you may find it useful to look at some of the real monographs in the later pages of the *Guide*. The descriptions given may seem complicated when written, but are easy to understand when related to real monographs. Alternatively work through the tutorial for the betablocamine monograph given below.

Title

The drug name is stated at the top of the monograph. Where there are multiple recognised names for the drug, the most commonly used UK name is stated.

Formulation

This column states the preparations in which the drug is available. The form, strength, brand name and marketing authorisation holder (also known as the license holder) are given. The country in which the drug has a marketing authorisation is stated in brackets after the company name. If the drug is not branded, the term 'non-proprietary' is stated. Note that only the preparations available at UCLH at the time of writing are included in this column.

For further information about the formulations of injectables available refer to Section A11.

Method

This column describes how the drug can be injected or infused. It also states the device required to give the drug and the recommended route of administration. Many drugs are given using several different methods – each method is listed on a separate row. For some drugs the indication influences the method of administration, i.e. what the drug is being used for may determine how it is administered. Indications are stated in bold in the method box.

To understand the method column the user must be familiar with the terminology associated with intravenous administration. The tables below summarise each method of administration. Detailed information can be found in Section A6.

Abbreviation	Method of administration	Description
IV bolus	Intravenous bolus	Introduction of a small volume of medicine into a VAD[1], most often from a syringe. The fluid enters the patient rapidly, usually over 3–5 minutes
(I) IV infusion	Intermittent intravenous infusion	Introduction of a volume of fluid into a VAD over a prolonged period. Usually 50–250 mL is infused from a bag over 10 minutes to 2 hours
(C) IV infusion	Continuous intravenous infusion	Constant delivery of fluid into a VAD over 24 hours
SC bolus	Subcutaneous bolus	Injection of a small volume of fluid into the subcutaneous part of the skin
(C) SC infusion	Continuous subcutaneous infusion	Constant delivery of fluid into the subcutaneous part of the skin
IM injection	Intramuscular injection	Injection of a small volume of fluid into a muscle

[1] VAD = vascular access device, i.e. a cannula or catheter.

The user must also be familiar with the following terminology:

Term	Definition
Volumetric pump	A device that pumps fluid from a reservoir, such as an infusion bag or bottle, through an administration set at a preset rate. Pumps are usually programmed to deliver fluid in millilitres per hour
Syringe pump	A device that delivers fluid from a syringe into an administration set at a preset rate. Pumps are usually programmed to deliver fluid in millilitres per hour
Syringe driver	A device that delivers fluid from a syringe into an administration set at a preset rate. Drivers are usually smaller than syringe pumps. They are programmed to deliver fluid in millimetres per hour
Central line	A catheter that has its tip located in the superior or inferior vena cava of the right atrium of the heart

Further information about vascular access devices is given in Section A4. Further details about infusion devices are given in Section A9.

NPSA risk rating

Each method box has a coloured bar indicating the NPSA risk rating. The risk rating refers to the method of preparation and administration described along the row. The risk rating is not essential for administration; however, you should understand that the colour of the bar is indicative of the complexity of the task. Medicines that are complex to prepare and require specialist equipment or infusion devices have a high NPSA risk rating and are coloured red. You should take additional time to plan and prepare these medicines and ensure that local protocols are adhered to before giving the medicine.

Less complicated tasks are likely to have a lower NPSA risk rating and are coloured amber (moderate risk) or green (low risk).

How the risk rating is assigned

Each injectable practice has been assessed against eight criteria:

Number	Risk factor	Applies when
1	Therapeutic risk	There is significant risk of patient harm if the injectable medicine is not used as intended[1]
2	Use of a concentrate	The product must be further diluted (after reconstitution) before it can be injected
3	Complex calculation	A complicated calculation must be performed in order to prepare or administer the product. This includes calculations with more than one step, or conversions between dose units, e.g. percentage to milligrammes per millilitre
4	Complex method	More than five non-touch manipulations are required to prepare the product, or when syringe-to-syringe transfer or a filter is used
5	Reconstitution of powder in a vial	Where a dry powder preparation must be reconstituted
6	Use of a part vial or ampoule, or use of more than one vial or ampoule	Part or multiple vials/ampoules are required to fulfil the prescription
7	Use of a pump or syringe driver	An infusion device is required to give the injectable
8	Use of a non-standard giving set/ device required	A low sorption, air inlet or light-protected administration set needs to be used to administer the injectable

[1] As the first item, therapeutic risk, is open to interpretation; it was applied for any drug that could cause serious adverse effect if administered incorrectly, including if there was a risk of extravasation with the drug. The injectable was also given this score if patient harm was likely or if the patient did not receive the correct dose of the drug or did not receive the drug at all because of an error in preparation or administration.

If 0–2 of the criteria apply to a task, it is considered low risk (green), if 3–5 criteria apply, it is moderate risk (amber), and if 6 or more criteria apply, it is considered high risk (red).

The bar indicates which of the above criteria apply to the method of administration in the row. For example, if criteria 1, 5 and 6 apply, the corresponding boxes are highlighted. The colour of the boxes relates to the total score for the method, so in this example the boxes are amber as the total score is 3.

NPSA risk rating: 3

Boluses tend to be low risk as they are simple to prepare and administer. Infusions are generally higher risk.

Dilution

This column tells the user how to prepare the medicine so that it is ready to administer to the patient. To understand the instructions you should be familiar with the abbreviations and terminology outlined in the following tables.

Abbreviation	Fluid	Composition (per litre)
NS	Sodium chloride 0.9%. This fluid has previously been called normal saline or physiological saline	Sodium 154 mmol Chloride 154 mmol
W	Water for injections	
G	Glucose 5% (also called dextrose monohydrate)	Glucose 50 g
G10	Glucose 10%	Glucose 100 g
G20	Glucose 20%	Glucose 200 g
H	Compound sodium lactate (commonly called Hartmann's or lactated Ringer's)	Sodium 131 mmol Potassium 5 mmol Calcium 2 mmol Lactate 29 mmol Chloride 111 mmol
GS	Glucose 4% and sodium chloride 0.18%	Glucose 40 g Sodium 30 mmol Chloride 30 mmol

Term	Definition/explanation
Reconstitute	Add fluid to a dry powder to produce a solution or suspension
Dissolve	Add fluid to a dry powder to give a solution
Diluent	The fluid used to either reconstitute a powder or further dilute a drug solution or suspension
Dilute to X mL fluid	Add fluid to the container so the final volume is X. For example, if the instruction says 'dilute dopamine 200 mg/5 mL to 20 mL water' the user should take the dopamine and mix it with water for injections so that the final volume is 20 mL. The final concentration is dopamine 200 mg/20 mL, or 10 mg/mL
Dilute with X mL fluid	Add X mL to the container. For example, if the instruction says 'dilute dopamine 200 mg/5 mL with 20 mL water' the user should take the dopamine and add 20 mL water so that the final volume is 25 mL (20 mL from the water, 5 mL from the drug). The final concentration is dopamine 200 mg/25 mL, or 8 mg/mL

The dilution column will advise how much diluent should be added to a vial to reconstitute a dry powder formulation. It also advises which fluids the drug solution can be further diluted with, and the final volume and/or concentration the drug should be made up to, so that it is ready to be administered to the patient.

If a preparation does not need to be reconstituted or diluted this column will state 'ready diluted'.

Some dry powders displace a small volume of fluid when reconstituted. Instructions for how to take this into account are given in the dilution column. A full explanation of displacement values is given later in the betablocamine example and Section A12.

Rate

This column states the time period over which the drug should be given. Bolus injections simply state 'over *X* minutes', while intermittent infusion usually state 'over *X* minutes' or 'over *X* hours'.

When the monograph recommends to give the drug via an infusion device, the rate is stated in millilitres per hour, since most pumps are programmed using millilitres per hour.

Licensing

The term 'unlicensed' is used in some monographs. If a drug does not have a UK marketing authorisation, 'unlicensed' is stated in the monograph title.

If a drug is licensed in the UK but the monograph describes how to use the drug for an unlicensed indication, the term 'unlicensed' is used in the method box. If a method of preparation or administration is different to that suggested by the manufacturer, 'unlicensed' is stated in the dilution or rate boxes.

Users should be aware of the additional requirements and safeguards that should be in place when administering an unlicensed medicine.

Comments

The information in this column is divided into headings:

Infusion-related adverse effects: describes the side effects that patients may experience as they receive the drug. Only reactions that can be monitored at the bedside are listed. In particular, effects on blood pressure, respiration and level of consciousness, pain and gastrointestinal effects such as vomiting are included. Users should refer to this list prior to administering the drug so they can prepare themselves in the event the effect occurs.

Extravasation: if a drug is known to cause tissue damage, or theoretically may cause tissue damage because of its pharmacological properties, an extravasation warning is given. For full details about extravasation you should refer to Section A7.

ECG monitoring required: if an electrocardiogram (ECG) is required before or during infusion, an ECG statement is included. ECG monitoring may be required because the drug is given to cause a change in the rhythm or rate of the heart, or because it may cause these changes as a side effect, i.e. regardless of whether the cardiac effects are intentional or incidental, ECG monitoring may be recommended.

pH: where available, the pH of the solution injected into the patient is stated. If not available, the pH of undiluted solution is given. The pH of the drug may affect how irritating it is to veins; see Section A7 for further details. It may also influence its compatibility with other drugs.

Osmolarity or osmolality: where available, the tonicity of the solution injected into the patient is stated. The tonicity may influence how irritating the drug is to the patient's veins; see Section A7.

Flush: lists the fluids that may be used to flush the medicine through an administration set and/or catheter/cannula. If it is not appropriate to flush, a statement to this effect is given. See Section A8 for further information about flushes.

Sodium content: the amount of sodium in each preparation listed in the formulation column. The amount does not include any sodium from the diluent

or any infusion fluids to which the drug may be added. The sodium content of medicines may be important in sodium-restricted patients.

Displacement value: if a dry powder medicine has a displacement value it is stated here. See Section A12 or the betablocamine example for an explanation.

Other comments: additional information that may help the user administer the medicine is given here. You may be referred to other documents which may give further detailed information about the drug.

Compatibility

This column lists the fluids that can be used to dilute the drug in the monograph. It also lists the drugs that can be safely infused into a Y-site with the drug. A Y-site (also known as a Y-connector or three way tap) is usually used to connect two administration sets to the same lumen of a catheter or a cannula. The fluid from the two administration sets mixes before it enters the patient. Different fluids may also be infused into the same cannula by use of an extension set, e.g. the Vygon Octopus. These sets can be attached to a cannula and may have multiple lumens. Fluid given via these lumens mixes prior to entry into the patient.

It is essential that the compatibility of the substances infused into a Y-site or extension set is established before they are connected. Administration of incompatible medicines or infusion fluids may result in a chemical reaction between the two substances resulting in drug inactivation and possibly drug precipitation. Patient death has resulted from the infusion of incompatible medicines. If a combination is not listed as compatible in this section, the drug combination should not be infused without prior consultation with the user's local pharmacy department and the patient's doctor.

Before a drug is given via a Y-site it should first be established that co-administration is unavoidable. Other options should be explored, including giving the medicines one after the other, or giving one of the medicines by another route, as a subcutaneous or intramuscular injection for example.

Before compatibility can be checked in the *Guide*, you must establish two key pieces of information:

1. The concentrations of both drugs to be infused into the Y-site.
2. The fluids they are diluted in.

The majority of drugs are compatible with sodium chloride 0.9% and glucose 5%.

The compatibility section is divided into headings, which are explained below. For clarity the term 'Drug M' is used. 'Drug M' is the drug to which the monograph refers, i.e. the drug in the title strip.

Y-site statement: a standard statement is made for drugs that can be given through a Y-site with another drug – 'The following data assume ***Drug M*** is infused

into the Y-site as an *X* mg/mL solution. ***Drug M*** solutions of a lower concentration will also be compatible with these drugs and fluids'.

This statement tells you that Drug M may be infused into the Y-site at the concentration stated. It also means that Drug M can be infused into the Y-site with other compatible drugs at less than *X* mg/mL. The concentration is important as compatibility is concentration dependent.

Compatible fluids: states which of the standard fluids can be used to further dilute Drug M after reconstitution.

Y-site compatible ready-diluted medicines: this lists the drugs in a ready-to-infuse form that are compatible with Drug M.

Y-site compatible when diluted in G or NS: this lists which drugs are compatible with Drug M when either Drug M or the other drug are diluted in sodium chloride 0.9% or glucose 5%. Drug M and the other drug may both be in sodium chloride 0.9% or may both be in glucose 5%, or one drug may be in sodium chloride 0.9% and the other in glucose 5%. Any diluent combination is possible.

Y-site compatible when diluted in G: this lists the drugs that are compatible with Drug M when both drugs are diluted in glucose 5% only.

Y-site compatible when diluted in NS: this lists which drugs are compatible with Drug M when both drugs are diluted in sodium chloride only.

Incompatible: this states which drugs Drug M must not be mixed with because it is known they are not compatible.

Tutorial: betablocamine

Take a look at the monograph for the hypothetical drug betablocamine on the next page. This has been specially created to help you understand the core features of the *Guide*. The majority of real drug monographs are easier to follow than betablocamine. However, if you can understand the betablocamine example, you are well placed to use the rest of the *Guide.*

The *Guide* can be used following the same simple steps every time:

1. Select the appropriate monograph (the drugs are listed alphabetically).
2. Consult the prescription and ascertain the appropriate method of administration.
3. Read the monograph left to right, following the preparatory instructions for the selected method of administration.
4. Administer to the patient at the recommended rate.

Formulation	Method	Dilution	Rate	Comments	Compatibility
Betablocamine Dummy monograph for training purposes only					
Vial 10 mg 20mg Cardibloc Stat Pharma-co (UK)	**Arrhythmias:** IV bolus into a central line or large peripheral vein 1 2 3 4 5 6 7 8 NPSA risk rating: 3	**If using a whole vial:** add 5 mL W to the 10 mg vial, or 10 mL W to the 20 mg vial **If using a part vial:** add 4.5 mL W to the 10 mg vial, or 9 mL W to the 20 mg vial This gives a 2 mg/mL solution	Over 3–5 minutes	**Infusion-related adverse events:** hypotension, bradycardia, worsening of arrhythmias, nausea **ECG monitoring required prior to administration** **Extravasation:** may cause tissue damage; for management guidelines see Section A7 **pH:** 10 **Osmolality:** 750 mOsmol/kg (10 mg/mL in W) 290 mOsmol/kg (250 mg bag) **Flush:** NS **Sodium content:** 7.5 mmol/10 mg vial 15 mmol/20 mg vial 70 mmol/50 mg bag **Displacement value:** 10 mg vial: 0.5 mL 20 mg vial: 1 mL **Other comments:** betablocamine infusion is restricted to use in critical care and theatres where appropriate cardiac monitoring can be carried out	**The following data assume betablocamine is infused into the Y-site as a 1 mg/mL solution. Betablocamine solutions of a lower concentration will also be compatible with these drugs and fluids.** **Compatible fluids:** NS, G, GS, H, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** linezolid **Y-site compatible when diluted in G or NS:** dopamine **Y-site compatible when diluted in G:** amiodarone **Y-site compatible when diluted in NS:** furosemide **Incompatible:** adrenaline
	Hypertension in fluid restricted patients: (C) IV infusion into a central line via a syringe pump (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Reconstitute 50 mg using the 10 mg or 20 mg vials, as above. Further dilute to 50 mL with G This gives a 1 mg/mL solution	2.1 mL/hour for 24 hours		
Bag 50 mg/240 mL Cardibloc Slo Pharma-co (UK)	**Hypertension:** (C) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted	10 mL/hour for 24 hours		

The following scenarios will show how the *Guide* can be used:

Scenario A – betablocamine bolus

Patient A is suffering from an arrhythmia and is prescribed betablocamine 30 mg IV stat. How should betablocamine be administered?

The formulation column on the left shows there is both a 10 mg and 20 mg vial of the drug. The adjacent method column states the drug can be given as an IV bolus for arrhythmias. Read across the top row to see how the bolus is prepared. After reading the row you should be ready to assemble the drug vials and the equipment required to prepare the drug: you will know how many vials of the drug need to be taken, as well as the amount of water for injections. The equipment needed to prepare the drug should be assembled at this point. You should have:

1 × betablocamine 10 mg vial
1 × betablocamine 20 mg vial
1 × 5 mL water for injections ampoule
1 × 10 mL water for injections ampoule
1 × 20 mL syringe and a needle

The instructions in the dilution column for the bolus state 5 mL water for injections should be added to the 10 mg vial, and 10 mL water for injections to the 20 mg vial. As you are using the entire contents of both vials the part vial information is irrelevant here. The vials should be reconstituted using aseptic non-touch technique, then the solution should be drawn up into a single syringe, ready to be administered to the patient.

Finally, reading along the row, you can see that the dose should be injected over 3–5 minutes. From the method box you know that the drug can be injected into a peripheral vein or a central line, so the drug can be given whether the patient has a cannula or central venous catheter.

NPSA rating: criteria 1, 5 and 6 apply when preparing the bolus. This gives a total score of 3 and thus receives an amber rating.

Scenario B – betablocamine infusion

Patient B is suffering from life-threatening hypertension and is prescribed betablocamine 50 mg over 24 hours. Look at the betablocamine monograph. There are two options listed for the administration of the drug in hypertension:

- an infusion from the ready diluted bag *or*
- an infusion from a syringe, prepared from the vials.

If you were unsure which option is appropriate for your patient, you would need to clarify this with the prescriber.

Infusion using the bag

The simplest, and therefore safest, option is to use the ready prepared bag. As this is the licensed option it should be the first choice. The bag is shown at the bottom of the formulation column: the adjacent boxes in the row describe how to prepare and administer the bag.

First look at the method column, which states the drug should be given as a continuous intravenous infusion through a volumetric pump. The dilution column indicates the bag does not need any manipulation before administration, i.e. it is ready to give to the patient. Assembly of the drug and equipment is relatively straightforward. You require:

1 × betablocamine bag containing 50 mg in 240 mL
1 × administration set for use with a volumetric pump

You should prepare the bag and attach the administration set using aseptic non-touch technique. After the set has been primed and attached to an appropriately programmed volumetric pump, the patient should be given an infusion at 10 mL/hour, as stated in the rate column.

NPSA rating: criteria 1 and 7 apply for the infusion, giving it a total score of 2, which is low risk. This is lower than the bolus because it is simpler to prepare.

Infusion using a syringe

Patient B may need to be fluid restricted because of her cardiac problem. The doctor specifies the drug should be given as a concentrated infusion and amends the prescription to: betablocamine 50 mg in 50 mL glucose 5%. To prepare the syringe you should follow the instructions in the middle row of the monograph. You know that the middle row is the correct choice because the bold writing in the method box describes your scenario: **hypertension in a fluid restricted patient**. The method box tells you the drug should be given as a continuous intravenous infusion using a syringe pump.

The syringe must be prepared from the vials, hence the middle row is adjacent to the vials in the formulation column. The dilution column tells you how to prepare the vials. You should assemble the following:

2 × betablocamine 20 mg vials
1 × betablocamine 10 mg vial
1 × 20 mL syringe with a needle for reconstituting the vials
1 × 50 mL syringe
2 × 10 mL water for injections ampoules
1 × 5 mL water for injections ampoules
1 × administration set for use with a syringe pump
1 × 50 mL glucose 5% bag

The vials are reconstituted in the same manner as scenario A: using aseptic non-touch technique add 10 mL water for injections to the 20 mg vials, and 5 mL water for injections to the 10 mg vial. Draw up the drug solution into the 50 mL syringe, then draw up glucose 5% into the same syringe so that the final volume is 50 mL in total.

The administration set should be primed and attached to the patient's central line, as instructed in the method column. The rate column tells you the syringe pump should be set to deliver the fluid at 2.1 mL/hour.

NPSA rating: criteria 1, 2, 4, 5, 6 and 7 all apply when preparing and administering the syringe. This gives a total score of 6, or high risk: the boxes are coloured red. You should take additional precautions when preparing this medicine as there is a greater scope for error than with the other methods.

Understanding the other information in the monograph

The comments section lists additional information about betablocamine.

Adverse effects: betablocamine is a drug that affects the cardiovascular system so it would be expected to cause adverse effects related to this system, such as changes in blood pressure, heart rate or rhythm. If you were administering the drug you should be aware of these effects and know how to respond should they occur.

ECG monitoring: the monograph recommends an ECG prior to administration. The patient's doctor should have performed this before prescribing the drug for the patient. You should establish whether an ECG has been conducted. In an emergency a doctor may advise giving a drug without an ECG. The ECG statement is usually a recommendation rather than an absolute necessity.

Extravasation, pH and osmolality: betablocamine has an extravasation warning. You can see that the drug solution has a high osmolarity after reconstitution with water and is alkaline (pH 10). Both these factors would make it irritating to veins and, in the event of extravasation, damaging to tissues. You should be aware of the measures to be taken if extravasation of any drug occurs. In particular, you need to know how to respond if an irritant medication extravasates, as rapid remedial action may prevent serious harm. More information about extravasation can be found in Section A7.

You should note that the betablocamine bag has an osmololality of 290 mOsmol/kg, similar to blood. This would indicate the drug is less irritating when given as an infusion.

Drugs that are irritating to veins, including those with an extravasation warning, are recommended to be given via a central line. If the drug is given by a central venous catheter, the drug solution is rapidly diluted in blood and unlikely to cause such irritation. Thus betablocamine bolus for arrhythmias is recommended for central administration, but the ready diluted bag can be given via a peripheral vein if required.

Flush: this indicates betablocamine is compatible with sodium chloride 0.9%. The cannula, catheter and administration set may be flushed with this fluid.

Sodium content: this is self-explanatory. Note the sodium content of the bag may seem high. This is because ready diluted medicines are usually made up in sodium chloride 0.9% or glucose 5% and so have a tonicity similar to these fluids.

Displacement value: betablocamine has a displacement value. If a part vial is required the value needs to be taken into consideration.

Imagine you had to give a betablocamine 5 mg dose to a child. You need half a 10 mg vial. As directed in the dilution section of the monograph, you should add 4.5 mL water for injections to the vial. The final volume of the solution will be 5 mL, so the concentration in the vial is 2 mg/mL. To give a 5 mg dose you would require 2.5 mL.

Other comments: this simply gives extra background information about betablocamine.

Compatibilities of betablocamine

The statement in bold at the top of the compatibility column tells you that the Y-site compatibilities relate to a solution of betablocamine 1 mg/mL.

Compatible fluids: states betablocamine is compatible with sodium chloride 0.9%, glucose 5%, compound sodium lactate and several other fluids. This means you can dilute betablocamine in these fluids, or you could give the fluid and betablocamine via a Y-site, i.e. you could infuse betablocamine into one arm of the Y-site, and the fluid into the other arm.

Y-site compatible ready-diluted medicines: states linezolid may be given through a Y-site with betablocamine.

Y-site compatible when diluted in G or NS: states betablocamine may be infused through a Y-site with dopamine. Both drugs may be diluted in sodium chloride 0.9%, or glucose 5%, or a combination of the two, e.g. betablocamine in sodium chloride and dopamine in glucose. To check the concentration of dopamine which is appropriate to administer through a Y-site you need to check the dopamine monograph. The dopamine monograph states dopamine is Y-site compatible with other medicines when it is diluted to 3.2 mg/mL. Thus, solutions of betablocamine 1 mg/mL and dopamine 3.2 mg/mL would be compatible if infused into a Y-site. Less concentrated solutions of either drug could also be given, e.g. betablocamine 0.5 mg/mL and dopamine 1.6 mg/mL would also be compatible.

Y-site compatible with G: states betablocamine is compatible with amiodarone, but both medicines must be diluted in glucose when they are prepared. We know betablocamine can be infused into the Y-site at 1 mg/mL. Looking at the amiodarone monograph you can see amiodarone may be diluted to 0.6–2.1 mg/mL when given via the Y-site. Thus an amiodarone 1 mg/mL solution and betablocamine 1 mg/mL solution would be compatible if infused into the Y-site together.

Y-site compatible with NS: using the same principles as above, this states betablocamine 1 mg/mL (or less) is compatible for Y-site infusion with furosemide 3 mg/mL (or less).

If you intend to infuse drugs via a Y-site you MUST ALWAYS look at the monographs for both the drugs in question to ascertain the concentrations and diluents that are appropriate for co-infusion.

Incompatible: states betablocamine cannot be given via a Y-site with adrenaline. This applies for any concentration of betablocamine or adrenaline. Betablocamine and adrenaline should never be given via a Y-site. However, they could still be administered to the patient at the same time, albeit through separate lumens of a catheter.

If you have read and understood the example tutorial you should be able to use the *UCL Hospitals Injectable Medicines Administration Guide*.

Formulation	Method	Dilution	Rate	Comments	Compatibility
Abatacept					
Vial 250 mg Orencia Bristol-Meyers Squibb (UK) Each vial is provided with a silicone-free syringe for preparation of the medicine	IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Reconstitute each vial with 10 mL W using the silicon-free syringe provided Direct the W against the side of the vial during reconstitution. Rotate the vial gently to avoid foaming When dissolved vent the vial with a needle to dissipate any remaining foam Draw up the dose into the same syringe and add to a 100 mL bag NS. Invert gently to mix	Over 30 minutes Administer through a 0.2–1.2 micron filter See comment (a)	**Infusion-related adverse events:** headache, nausea, diarrhoea, hyper- and hypotension, tachy- and bradycardia, joint pain, fatigue, rash **Flush:** NS **Sodium content:** 0.4 mmol/vial **Other comments:** (a) 0.2 micron filters are available from pharmacy or may be stocked in clinical areas where they are used regularly (b) the reconstituted and diluted solution may be stored for up to 24 hours at 2–8°C	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**
Abciximab					
Vial 10 mg/5 mL (equivalent to 2000 micrograms/mL) Reopro Lilley (UK)	IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Ready diluted Draw up the required dose (usually 0.25 mg/kg)	Over 1 minute, then start the infusion Administer through a 5 micron filter (see comments)	**Infusion-related adverse events:** bleeding, particularly when cardiac catheterisation is via femoral access site; remove sheath when coagulation has returned to normal Hypersensitivity reactions may occur **pH:** 7.1–7.2 (undiluted) **Flush:** NS **Sodium content:** 0.8 mmol/vial **Other comments:** filters are supplied from pharmacy	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	(C) IV Infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Draw up the required dose then dilute to 50 mL with NS or G	Usually 7.5 micrograms/kg per hour Usual maximum 600 micrograms/hour Administer through a 5 micron filter (see comments)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Acetaminophen					
see paracetamol					
Acetazolamide					
Vial 500 mg Diamox Goldshield (UK)	IV bolus (preferred method) 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Reconstitute each vial with 5 mL W	Over 5 minutes	**Infusion-related adverse events:** paraesthesia, mood and taste disturbances. Hypersensitivity reactions may occur due to the sulphonamide component **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 9.1 **Flush:** NS **Sodium content:** 2 mmol/vial **Other comments:** IM injection is not recommended as it is very painful	**Do not infuse with any other medicines or infusion fluids**
	IM (see other comments) 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Reconstitute each vial with 5 mL W			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Acetylcysteine					
Ampoule 2 g/10 mL *Non-proprietary* Cardinal Health (UK)	**For renal protection pre-contrast:** IV bolus (unlicensed) 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted May be further diluted to a convenient volume with NS or G	Over 3–5 minutes	**Infusion-related adverse events:** 'anaphylactoid' reactions including nausea/vomiting, flushing, itching, hypotension, tachycardia and bronchospasm, usually within 15–60 minutes of starting the infusion **pH:** 6.5–7.5 (undiluted) **Flush:** NS **Sodium content:** less than 0.01 mmol/vial **Other comments:** (a) for full management guidelines for paracetamol poisoning consult Toxbase or the National Poisons Information Service (b) for fluid volumes for administration to neonates and children under 20 kg consult the BNF for Children or Toxbase (c) solutions may turn light purple, however the solution may still be used	**The following data assume acetylcysteine is infused into the Y-site as a 200 mg/mL solution. Acetylcysteine solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** esmolol **Y-site compatible when diluted in G or NS:** adrenaline, alfentanil, aminophylline, atracurium, clonidine, dobutamine, dopamine, fentanyl, heparin sodium, insulin, labetolol, midazolam, morphine, noradrenaline, remifentanil, rocuronium, tacrolimus, vecuronium **Y-site compatible when diluted in NS:** furosemide **Y-site compatible when diluted in G:** amiodarone
	For paracetamol poisoning (adults): (C) IV infusion via a volumetric infusion pump 1 **2** **3** **4** 5 **6** **7** 8 NPSA risk rating: 5	Step A. Dilute 150 mg/kg with 200 mL G	Over 15 minutes, then give step B		
		Step B. Dilute 50 mg/kg with 500 mL G	Over 4 hours, then give step C		
		Step C. Dilute 100 mg/kg with 1 L G	Over 16 hours		
	For paracetamol poisoning (children over 12 and 20 kg or over): (C) IV infusion via a volumetric infusion pump 1 **2** **3** **4** 5 **6** **7** 8 NPSA risk rating: 5	Dose as adult but dilute with only half the volume of G	As per adult		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Aciclovir					
Vial 250 mg/10 mL 500 mg/20 mL *Non-proprietary* Hospira/Mayne (UK)	(I) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 4	**Doses 250–500 mg:** add to 100 mL bag NS or G **Doses above 500 mg:** add to 250 mL bag NS or G	Minimum 1 hour	**Infusion-related adverse events:** phlebitis and injection site inflammation. Nausea, vomiting, fatigue. Rarely acute renal failure, confusion, hallucinations, agitation and convulsions **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 10.7–11.7 (undiluted) **Osmolality:** 316 mOsmol/kg (500 mg in 100 mL NS) **Flush:** NS **Sodium content:** 1.2 mmol/10 mL vial 2.3 mmol/20 mL vial **Other comments:** ensure patient is well hydrated to minimise risk of renal impairment Aciclovir is incompatible with fluids or other medicines that contain paraben preservatives	**The following data assume aciclovir is infused into the Y-site as a 5 mg/mL solution. Aciclovir solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H, potassium chloride, 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** fluconazole, linezolid, metronidazole, propofol 1% **Y-site compatible when diluted in G or NS:** amikacin, cefotaxime, ceftriaxone, chloramphenicol, clindamycin, co-trimoxazole, granisetron, hydrocortisone sodium succinate, imipenem with cilastatin, remifentanil, tobramycin, vancomycin, zidovudine **Y-site compatible when diluted in NS:** erythromycin **Incompatible:** dobutamine, dopamine, foscarnet, meropenem, morphine, phenytoin, pipericillin with tazobactam, tacrolimus
	(I) IV infusion via a volumetric infusion pump or a syringe pump (dependent on final volume) 1 2 3 4 5 6 7 8 NPSA risk rating: 5	**Doses below 250 mg including neonatal and paediatric doses:** dilute each 1 mL (25 mg) aciclovir with 4 mL of NS or G The final concentration should be no greater than 5 mg/mL	Minimum 1 hour		
	Fluid restriction: (I) IV infusion through a central line via a syringe pump (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Do not dilute	Minimum 1 hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility

Activated protein C

see drotrecogin alfa

Actrapid

see insulin

Formulation	Method	Dilution	Rate	Comments	Compatibility
Adenosine					
Vial 6 mg/2 mL Adenocor Sanofi-Aventis (UK)	Rapid IV bolus for supraventricular tachycardias (SVT) **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted	As quickly as possible followed by a rapid flush with NS	**Infusion-related adverse events:** dyspnoea, flushing, chest tightness/pain, bradyarrhythmias, hypotension **ECG monitoring required.** **Resuscitation equipment must be available** **pH:** 6.3–7.3 (both vials) 4.8–6.2 (bag) **Osmolarity:** 450 mOsmol/L (both vials) **Flush:** NS **Sodium content:** 0.6 mmol/vial (Adenocor) 3.9 mmol/vial (Adenoscan) 15 mmol/bag (Bart's) **Other comments:** when treating SVT inject as proximally as possible into a central or large peripheral vein	**Y-site compatibility:** during the cardiac stress test adenosine is administered with the radiopharmaceuticals thallium-201 and technetium-99 m **Compatible fluids:** NS, G, GS, H **Do not infuse with any other medicines or infusion fluids**
Bag (unlicensed) 130 mg/130 mL *Non-proprietary* St Bartholomew's Hospital (UK)	(I) IV infusion for the cardiac stress test with ready prepared bag (preferred method) **1** **2** **3** 4 5 6 **7** 8 NPSA risk rating: 3	Ready diluted	140 micrograms/kg per hour (equivalent to 0.14 mL/kg per hour)		
Vial 30 mg/10 mL Adenoscan Sanofi-Aventis (UK)	(I) IV infusion for the cardiac stress test with vial **1** **2** **3** **4** 5 **6** **7** 8 NPSA risk rating: 6	Withdraw 38 mL from a 100 mL bag NS. Draw up 33.3 mL of adenosine 30 mg/10 mL and add to the bag to give a final concentration of approx. 1 mg/mL	As above		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Adrenaline (epinephrine)					
Ampoule 1 mg/1 mL (1 in 1000) *Non-proprietary* Taro (UK)	**Adults:** (C) IV infusion via a syringe pump, into a central line (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute 2, 4, 8 or 16 mg to 50 mL G	0–100 micrograms/minute or greater, adjusted according to response See comments (a) and (b)	**Infusion-related adverse events:** arrhythmias, hypertension, hyperglycaemia, dyspnoea **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 2.8–3.6 (Taro 1 in 1000), 2.2–5.0 (Minijets) **Osmolality:** 270–320 mOsmol/kg (Taro 1 in 1000) **Flush:** NS, if appropriate. ⚠ **Do not flush** the administration set after an infusion: disconnect, aspirate the catheter, then flush with NS **Sodium content:** Minijets 0.2 mmol/mL Taro 1 in1000 amp 0.1 mmol **Other comments:** (a) administration of adrenaline via the IV route should be considered high risk because of the potential for patient harm. It must be performed only by those competent in life support. Use restricted to Critical Care, theatres and high dependency areas where appropriate cardiac monitoring is available (b) at other centres adrenaline is given at 0.01–0.3 microgram/kg per minute in adults (c) both methods in neonates give 100 nanogram/kg per minute. See 'Neonatal Drug Monograph – Adrenaline' at www.uclhguide.com or the UCLH intranet, or local hospital guidelines, for further details	**The following data assume adrenaline is infused into the Y-site as a 0.4 mg/mL solution. Adrenaline solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, G10, H, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** doxapram, esmolol, propofol 1%, sodium bicarbonate 8.4% **Y-site compatible when diluted in G or NS:** acetylcysteine, alfentanil, atracurium, ceftazidime, clonidine, dobutamine, dopamine, fentanyl, heparin sodium, insulin, labetolol, midazolam, morphine, noradrenaline, ranitidine, remifentanil, rocuronium, sodium nitroprusside **Y-site compatible when diluted in G:** amiodarone **Incompatible:** aminophylline, thiopental
Ampoule 1 mg/10 mL (1 in 10,000) *Non-proprietary* South Devon Healthcare (UK)	**Neonates:** (C) IV infusion via a syringe pump into a central line (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 6	**For neonates up to 2.5 kg:** dilute 1.5 mg/kg to 25 mL with G **For neonates 2.5 kg or over:** add 4 mg to 25 mL G See comments (a) and (c)	**For neonates up to 2.5 kg:** 0.1 mL/hour **For neonates 2.5 kg or over:** 100 nanograms/kg per minute Adjust rate according to response		
Pre-filled syringe 1 mg/1 mL (1 in 1000) 1 mg/10 mL (1 in 10,000)	IV bolus during resuscitation 1 2 3 4 5 6 7 8 NPSA risk rating: 1 (but see comments)	Use the ready diluted 1 mg/10 mL (1 in 10,000) syringe if available	As fast as possible, followed by a 20 mL NS flush		
Minijet International Medication Systems (UK)	IM (preferred route) or SC for anaphylaxis 1 2 3 4 5 6 7 8 NPSA risk rating: 2 (but see comments)	Use the ready diluted 1 mg/1 mL (1 in 1000) syringe if available	Usual adult dose: 0.5 mg, thus discard 0.5 mL (0.5 mg) prior to administration		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ajmaline (unlicensed)					
Ampoule 50 mg/10 mL Gilurytmal Solvay Pharmaceuticals GmbH (Germany)	IV bolus **1** 2 3 4 5 6 7 8 NPSA risk rating: 1 (but see other comments)	Ready diluted Maximum single dose: 50 mg	As determined by the electro-physiologist, according to the ECG Maximum rate 2 mL/minute (equivalent to 10 mg/minute)	**Infusion-related adverse events:** ventricular tachyarrhythmias, respiratory depression, hypotension, eye twitching, convulsions **ECG monitoring required – ajmaline is used to induce ECG changes as part of the diagnostic process** **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **Flush:** NS **Sodium content:** negligible **Other comments:** to be administered only in areas with a defibrillator, resuscitation facilities and access to advanced coronary support facilities At UCLH ajmaline is only administered by electro-physiologists for the diagnosis of cardiac conduction disorders, e.g. Wolff–Parkinson–White syndrome and Brugada syndrome. Despite a low NPSA rating this is a high-risk intervention which should only be carried out by competent individuals Contains propylene glycol	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	(I) IV infusion **1** **2** **3** 4 5 6 7 8 NPSA risk rating: 3 (but see other comments)	Add required dose to 50 mL G	As determined by the electro-physiologist, according to the ECG Maximum rate 10 mg/minute		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Alemtuzumab					
Vial 30 mg/1 mL MabCampath Bayer (UK)	SC (preferred method – unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted		**Infusion-related adverse events:** hypotension, chills/rigors, fever, dyspnoea, rash, nausea, headache, itching. Paracetamol, methylprednisolone and chlorphenamine are given 30 minutes prior to alemtuzumab to minimise adverse effects **pH:** 6.8–7.4 (undiluted), 6.8–6.9 (diluted with 100 mL G or NS) **Osmolality:** 270–310 mOsmol/kg **Flush:** NS or G **Sodium content:** 0.2 mmol/vial **Other comments:** may be given over longer periods (up to 8 hours if infusion-related adverse effects are problematic). In this case the infusion must be given immediately after reconstitution Alemtuzumab is used in T-Deplete BM/PBSC transplantation; bags are incubated with alemtuzumab 30 minutes before reinfusion of cells	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	(I) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 3 (4 if part vial is used)	Add the required dose to 100 mL bag NS or G	Over 2 hours (see comments)		
	(I) IV infusion for low intensity BM/ PBSC transplantation (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 3 (4 if part vial is used)	Add the required dose to 500 mL bag NS	Over 8 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Alfacalcidol					
Ampoule 1 microgram/0.5 mL 2 micrograms/1 mL One-Alpha Injection Leo (UK)	IV bolus **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted	Over 30 seconds	**Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 7–8 **Flush:** NS (but see other comments) **Sodium content:** negligible **Other comments:** contains propylene glycol and ethanol Alfacalcidol is formulated in micelles which may be disrupted by aqueous fluids, including the flush fluid. Suggest switch to oral alfacalcidol at the earliest opportunity	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Alfentanil					
Ampoule 1 mg/2 mL 5 mg/10 mL Rapifen Janssen-Cilag (UK)	**Analgesia before and during anaesthesia:** IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted May be further diluted to a convenient volume with NS or G	Over 30 seconds. Initial dose may be followed by supplemental doses to prolong therapeutic effect	**Infusion-related adverse events:** respiratory depression, muscle rigidity, hypotension, bradycardia, involuntary movements **pH:** 4.3–6 (undiluted) **Flush:** NS **Sodium content:** less than 0.2 mmol per 1 mg vial; less than 1 mmol per 5 mg vial **Other comments:** the use of alfentanil during surgery and in critical care is highly specialised. Doses and infusion rates are very variable, dependent on the patient, procedure and other agents used. Infusion rates stated here are taken from literature and the manufacturer's information, and are intended only as a guide. Individual anaesthetists and critical care physicians are best placed to decide how alfentanil is administered to their patients	**The following data assume alfentanil is infused into the Y-site as a 0.5 mg/mL solution. Alfentanil solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H **Y-site compatible ready-diluted medicines:** linezolid, esmolol, propofol 1% **Y-site compatible when diluted in G or NS:** acetylcysteine, atracurium, etomidate, fentanyl, heparin sodium, insulin, labetolol, mivacurium, morphine, remifentanil, rocuronium, vecuronium **Y-site compatible when diluted in G:** adrenaline, aminophylline, amiodarone, clonidine, dobutamine, dopamine, midazolam, noradrenaline, sodium nitroprusside **Incompatible:** thiopental
	Analgesia before and during anaesthesia of ventilated patients: (I) IV infusion via a syringe pump or volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	As above	Usually 0.5–1 microgram/kg per minute (after a 50–100 microgram/kg bolus)		
Ampoule 5 mg/1 mL Rapifen Intensive Care Janssen-Cilag (UK)	**Analgesia and respiratory suppression in mechanically ventilated patients:** (C) IV infusion via a syringe pump or volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Dilute to a convenient volume with NS or G	Initially 2 mg/hour adjusted according to response. Usual range 0.5–10 mg/hour		

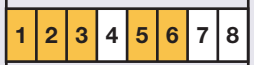
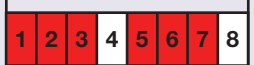
- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Alprostadil					
Ampoule 500 micrograms/mL (500,000 nanograms/mL) Prostin VR Pharmacia (UK)	**For maintenance of patency of ductus arteriosus in neonates:** (C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute dose (30 micrograms/kg) to 10 mL with G	Initially 0.1 mL/hour (equivalent to 5 nanograms/kg per minute) Usual maintenance 0.1–0.4 mL/hour Maximum rate: 2 mL/hour (equivalent to 100 nanograms/kg per minute)	**Infusion-related adverse events:** apnoea, pyrexia, bradycardia, flushing, seizures, hypotension, tachycardia, diarrhoea **Flush:** do not flush administration set. Replace set every 24 hours. Flush cannula/catheter with G **Sodium content:** nil **Other comments:** if undiluted alprostadil comes into contact with a plastic container it leaches plasticisers. If the solution or container turns hazy during use, the solution should be discarded and replaced When preparing alprostadil add the drug solution to the G to minimise contact with the container May be administered via the umbilical venous catheter, but intravenous administration is the preferred method at UCLH Contains ethanol	**Compatible fluids:** G **Do not administer with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Alteplase (tPa) for pulmonary embolism					
Vial 10 mg 20 mg 50 mg Actilyse Boehringer Ingelheim (UK) Each drug vial is supplied with a vial of 10 mL, 20 mL and 50 mL W respectively The 20 mg and 50 mg vials are also supplied with a transfer cannula (not required if making a solution with a final concentration of 2 mg/mL)	**For PE, patient weight 65 kg or more:** IV bolus, followed by IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Reconstitute two 50 mg vials, each with 25 mL W, to produce a 2 mg/mL solution Withdraw 5 mL and give as a bolus, then administer the remainder as an infusion	Bolus: over 1–2 minutes Infusion: 22.5 mL/hour for 2 hours (i.e. 90 mg over 2 hours)	**Infusion-related adverse events:** haemorrhage, particularly at injection site, but also cerebral, GI and other organs, hypersensitivity reactions, hypotension, pyrexia **pH:** 7.3 **Osmolality:** 215 mOsmol/kg **Flush:** NS **Sodium content:** nil **Other comments:** for full PE management guidelines consult the 'UCLH Pulmonary embolism in adults' guidelines available via the UCLH intranet (Inform) If the transfer cannula is used to produce a 1 mg/mL solution, bolus and infusion volumes must be adjusted accordingly	**Compatible fluids:** NS **Incompatible:** G **Do not infuse with any other medicines or infusion fluids**
	For PE, patient weight less than 65 kg: IV bolus, followed by IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Reconstitute dose (1.5 mg/kg) with W to produce a 2 mg/mL solution Withdraw 5 mL and give as a bolus, then administer the remainder as an infusion	Bolus: over 1–2 minutes Infusion: over 2 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Alteplase (tPA) for stroke					
Vial 10 mg 20 mg 50 mg Actilyse Boehringer Ingelheim (UK) Each drug vial is supplied with a vial of W. The 20 mg and 50 mg vials are also supplied with a transfer cannula	**Stroke:** IV bolus  NPSA risk rating: 5	Reconstitute dose (0.9 mg/kg, maximum 90 mg) with W to produce a 1 mg/mL solution. Withdraw 0.09 mL/kg (maximum 9 mL) and give as a bolus, then give the remaining solution as an infusion, as below	Over 2 minutes	**Infusion-related adverse events:** haemorrhage, particularly at injection site, but also cerebral, GI and other organs hypersensitivity reactions, hypotension, pyrexia **pH:** 7.3 **Osmolality:** 215 mOsmol/kg **Flush:** after dose, flush with 30 mL NS **Sodium content:** nil **Other comments:** if the final solution is divided into two syringes, ensure the second syringe is clearly labelled with the drug name and concentration and the patient's details. This should be stored in a safe area until used but does not need to be refrigerated For doses above 80 mg use 2×50 mg vials. For doses 80 mg or less use 1×10 mg, 1×20 mg + 1×50 mg vial as appropriate For full stroke management guidelines consult 'A+E Stroke Assessment Tool & Thrombolysis Tool' available via UCLH intranet	**Compatible fluids:** NS **Incompatible:** G **Do not infuse with any other medicines or infusion fluids**
	Stroke: IV infusion via a syringe driver, after the bolus  NPSA risk rating: 6	Draw up the remainder into one or two 50 mL syringes, depending on the final volume of the solution. Administer as an infusion	Over 1 hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Amikacin					
Vial 500 mg/2 mL *Non-proprietary* Hospira (UK) Vial 100 mg/2 mL Amikin Bristol-Myers Squibb (UK)	IV bolus (preferred method) **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted. May be further diluted to a convenient volume with NS or G	Over 2–3 minutes	**Infusion-related adverse events:** tinnitus, deafness, vertigo, paraesthesia, nausea, vomiting **pH**: 4.2–4.8 (undiluted – 100 mg vial), 3.5–5.5 (undiluted – 500 mg vial) **Osmolality:** 349 mOsmol/kg (500 mg in 100 mL NS) **Flush:** NS, G **Sodium content:** 0.1 mmol/100 mg vial 0.6 mmol/500 mg vial **Other comments:** dose adjusted according to levels Contains sodium metabisulphite, which may cause hypersensitivity reactions, particularly in asthmatics The IV route is preferred at as absorption of drug after IM injection may be erratic	**The following data assume amikacin is infused into the Y-site as a 5 mg/mL solution. Amikacin solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, G10, H, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** ciprofloxacin, doxapram, fluconazole, foscarnet, metronidazole, **Y-site compatible when diluted in G or NS:** caffeine, calcium gluconate, chloramphenicol, clindamycin, dexamethasone, labetolol, magnesium sulphate, midazolam, morphine, ondansetron, pethidine, remifentanil, suxamethonium **Y-site compatible when diluted in NS:** aminophylline **Y-site compatible when diluted in G:** amiodarone, granisetron **Incompatible:** amoxicillin, amphotericin, benzylpenicillin, cefotaxime, ceftazidime, ceftriaxone, cefuroxime, co-amoxiclav, flucloxacillin, furosemide, imipenem with cilastatin, propofol, thiopental
	(I) IV infusion **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Add required dose to 100 mL or 250 mL of infusion fluid	Over 30 minutes		
	IM **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Aminophylline					
Ampoule 250 mg/10 mL *Non-proprietary* Hameln (UK)	**Loading dose** (I) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Adults: add the required dose to 250 mL NS or G Paediatrics: dilute to 1 mg/mL with NS or G. At UCLH 500 mg is added to 500 mL diluent and used for both the load and the maintenance	Usually over 20–30 minutes Maximum rate: 25 mg/minute	**Infusion-related adverse events:** tachycardia, confusion, palpitations, arrhythmias, nausea, headache, convulsions. Adverse effects may be reduced by slowing the infusion rate **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 8.8–10 (undiluted) **Flush:** NS **Sodium content:** nil **Other information:** low volume paediatric doses may be delivered via a syringe pump Doses are adjusted according to plasma theophylline concentrations	**The following data assume aminophylline is infused into the Y-site as a 2 mg/mL solution. Aminophylline solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** esmolol, fluconazole, foscarnet, linezolid, propofol 1% **Y-site compatible when diluted in G or NS:** acetylcysteine, alfentanil, amikacin, caffeine, ceftazidime, clonidine, ethanol, fentanyl, granisetron, heparin sodium, labetolol, magnesium sulphate, meropenem, morphine, pipericillin with tazobactam, ranitidine, remifentanil, rocuronium, sodium nitroprusside, tacrolimus, thiopental, vecuronium **Incompatible:** adrenaline, amiodarone, atracurium, cefotaxime, ceftriaxone, ciprofloxacin, clarithromycin, clindamycin, doxapram, insulin, noradrenaline, ondansetron, vancomycin
	Maintenance dose (C) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Adults: add the required dose to 500 mL NS or G Paediatrics: as per loading dose	Adults: 0.5 mg/kg per hour Paediatrics: 0.5–1 mg/kg per hour dependent on age (see cBNF)		
	In fluid restriction (I) or (C) infusion via a syringe pump via a central line (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Dilute to 50 mL with NS or G	As above		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Amiodarone hydrochloride					
Ampoule 150 mg/3 mL *Non-proprietary* Opal Healthcare (UK)	**Loading dose** (I) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Add dose (usually 5 mg/kg) to 250 mL G (see other comments) **Fluid restriction:** dilute to 50 mL G and give via central line (unlicensed)	Over 20 minutes to 2 hours	**Infusion-related adverse events:** bradycardia, hypotension, nausea. Rapid administration may result in circulatory collapse **ECG monitoring required** **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 3–5 undiluted (IMS) **Flush:** G **Sodium content:** nil **Other comments:** amiodarone solutions of less than 0.6 mg/mL are unstable. For loading doses less than 150 mg or maintenance doses of less than 300 mg withdraw fluid from the bag prior to dilution to ensure a final concentration of at least 0.6 mg/mL The formulation contains a surfactant which reduces drop size. Wherever possible administer using an infusion pump to avoid underdosing When possible administer amiodarone via a central line to minimise vein irritation. However, it may be given by a large peripheral vein if a patient does not have central access	**The following data assume amiodarone is infused into the Y-site as a 0.6–2.1 mg/mL solution** **Compatible fluids:** G **Y-site compatible ready-diluted medicines:** ciprofloxacin, esmolol, fluconazole **Y-site compatible when diluted in G:** acetylcysteine, adrenaline, amikacin, alfentanil, atracurium, calcium chloride, ceftriaxone, cefuroxime, clarithromycin, clonidine, dobutamine, dopamine, fentanyl, gentamicin, insulin, lidocaine, labetolol, methylprednisolone, midazolam, morphine, noradrenaline, remifentanil, rocuronium, vecuronium **Incompatible:** NS, aminophylline, drotrecogin alfa, furosemide, heparin sodium, sodium bicarbonate, sodium nitroprusside
	Maintenance dose (C) IV infusion, via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Add dose (usually 15 mg/kg) to 500 mL G (see other comments) **Fluid restriction:** dilute to 50 mL G and give via central line (unlicensed)	Over 24 hours		
Minijet 300 mg/10 mL *Non-proprietary* International Medication Systems (UK)	IV bolus, during resuscitation or other emergency 1 2 3 4 5 6 7 8 NPSA risk rating: 2; however, this is a high risk intervention only to be performed by those competent in life support	Ready diluted. If Minijet not available the dose may be drawn from the ampoule and diluted to 10 mL with G	During resuscitation: as fast as possible followed by a flush Other indications: minimum 3 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Amoxicillin		**⚠ This is a penicillin. Check allergy status before administration**			
Vial 250 mg 500 mg *Non-proprietary* Wockhardt (UK)	**Adults, children and neonates:** IV bolus (preferred method, but see comments) 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	**If using a whole vial:** add 5 mL W to 250 mg vial or 10 mL W to 500 mg vial **If using part of a vial:** add 4.8 mL to 250 mg vial or 9.6 mL to 500 mg vial. This gives a 50 mg/mL solution	Over 3–4 minutes	**Infusion-related adverse events:** nausea, vomiting, hypersensitivity reactions including rash, fever, joint pain and angioedema **pH:** 8–10 (after reconstitution with W) **Flush:** NS **Sodium content:** 0.7 mmol/250 mg vial 1.4 mmol/500 mg vial **Displacement value:** 250 mg vial: 0.2 mL 500 mg vial: 0.4 mL Wockhardt, CP and GSK brand amoxicillin have the same displacement values **Other comments:** (a) for doses above 30 mg/kg in children and neonates, the dose should be given as an infusion (b) if pain on IM injection is a problem reconstitute with lidocaine 1% (unlicensed diluent)	**The following data assume amoxicillin is infused into the Y-site as a 20 mg/mL solution. Amoxicillin solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS sodium chloride 0.45%, G10 **Incompatible:** amikacin, ciprofloxacin, gentamicin, midazolam, tobramycin
	Adults and children: (I) IV infusion 1 **2** 3 4 **5** 6 7 8 NPSA risk rating: 2	Reconstitute the vial as above. Add the solution to 50–250 mL NS, G or GS	Over 30–60 minutes		
	Neonates: (I) IV infusion via a syringe pump 1 2 **3** 4 **5** **6** **7** 8 NPSA risk rating: 4	Add 4.8 mL to 250 mg vial or 9.6 mL to 500 mg vial. This gives a 50 mg/mL solution	Over 30 minutes		
	IM 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	Add 1.5 mL W to the 250 mg vial or 2.5 mL W to 500 mg vial. Shake vigorously to dissolve. See comment (b)			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Amphotericin liposomal (AmBisome)					
Vial 50 mg AmBisome Gilead (UK)	(I) IV infusion, preferably via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Add 12 mL W to each vial. Shake vigorously to make a 4 mg/mL solution. Withdraw the required dose into a syringe and add to a bag of G through the 5 micron filter provided. The final concentration of amphotericin in the bag should be 0.2 mg/mL to 2 mg/mL	Usually over 30–60 minutes Doses above 5 mg/kg should be given over 2 hours	**Infusion-related adverse events:** fever, chills, rigors, headache, nausea, muscle, chest and joint pain, tachycardia, hypotension, dyspnoea, rash, hypersensitivity reactions **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 5–6 (diluted in G) **Osmolarity:** 280–290 mOsmol/L **Flush:** G **Sodium content:** 0.8 mmol/vial **Other comments:** at the start of a new course of AmBisome treatment a test dose of 1 mg over 10 minutes should be given. If there are no signs of hypersensitivity 30 minutes after the dose, therapy may be continued	**Incompatible:** NS **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Amphotericin (as deoxycholate complex: Fungizone)					
Vial 50 mg Fungizone E R Squibb (UK)	(I) IV infusion, preferably via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 7	Add 10 mL W to each vial to make a 5 mg/mL solution Prepare the G for infusion by adding 1 mL phosphate buffer to each 250 mL G used (see other comments) **Peripheral use:** withdraw the required dose and dilute with 50 times its volume of buffered G to produce a solution of approximately 10 mg/100 mL. This may require removal of G from the bag prior to the addition of drug **Central administration:** dilute dose with 10 times its volume of buffered glucose (unlicensed use)	Over 2–4 hours May be extended to 6 hours if adverse reactions a problem	**Infusion-related adverse events:** fever, chills, headache, nausea, muscle and joint pain, hypersensitivity reactions **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 5.7 (10 mg in 100 mL G) **Osmolality:** 256 mOsmol/kg (10 mg in 100 mL G) **Flush:** G **Sodium content:** 0.4 mmol/vial **Other comments:** at the start of a new course of Fungizone a test dose of 1 mg over 20–30 minutes should be given. If there are no signs of hypersensitivity 30 minutes after the dose, therapy may be continued Pharmacy will supply phosphate buffer with Fungizone. Add 1 mL buffer to each 250 mL G used, prior to the addition of amphotericin. Adding buffer ensures the G is above pH 4.2. Precise measurement of buffer is not necessary as long as a minimum of 1 mL is added to each 250 mL of G, i.e. more can be added without harmful effect **Example calculation:** a 70 mg dose requires 14 mL of the 5 mg/mL solution. Volume of G required = $14 \times 50 = 700$ mL. Hence withdraw 300 mL from a 1 L G bag, add 3 mL buffer to the bag, mix, and then add the Fungizone	**Incompatible:** G solutions below pH 4.2, NS, amikacin, benzylpenicillin, calcium chloride, calcium gluconate, ciprofloxacin, fluconazole, foscarnet, granisetron, lidocaine, linezolid, magnesium sulphate, meropenem, ondansetron, pipericillin with tazobactam, propofol, remifentanil **Unlicensed practice at UCLH:** pethidine 50 mg may be added to the bag if patient suffers infusion-related fever or chills Heparin sodium 500–1000 units may be added to the bag if phlebitis occurs

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Anti-human thymocyte immunoglobulin, rabbit (rabbit ATG)					
Vial 25 mg Thymoglobuline Genzyme (UK)	**Test dose:** (I) IV infusion via a volumetric infusion pump, into a central line or a large peripheral vein 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Reconstitute each vial with 5 mL W. Withdraw 0.5 mL and add to 100 mL bag NS or G	Over 1 hour, through a filter (see comments)	**Infusion-related adverse events:** nausea, vomiting, diarrhoea. Hypersensitivity reactions including fever, chills, rash, itching, dyspnoea, hypotension. Thrombophlebitis **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 5.8–6.3 (diluted in NS), 5.5–5.9 (diluted with G) **Flush:** NS **Sodium content:** 0.2 mmol/vial **Displacement value:** negligible **Other comments:** a 0.2 micron filter should be attached to the administration set to remove particles which may be present in the drug solution. Filters are sent from pharmacy with the drug Test dose gives 2.5 mg rabbit ATG Adult and adolescent premedication: 30 minutes prior to rabbit ATG give paracetamol 1 g PO and chlorphenamine 10 mg IV. Do not premedicate prior to the test dose	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	Treatment dose: (I) IV infusion via a volumetric infusion pump, into a central line or a large peripheral vein 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Reconstitute each vial with 5 mL W. Further dilute to a convenient volume of NS or G At UCLH the dose is usually added to 250–500 mL NS	**Aplastic anaemia in adolescents:** over 12 hours **Other indications:** over at least 6 hours For all indications the drug must be given through a filter (see other comments)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Aprotinin (unlicensed)					
Vial 500,000 units/50 mL *Non-proprietary* Nordic (Sweden)	**Loading dose:** (I) IV infusion via a central line with a volumetric infusion pump **1** 2 3 4 5 **6** **7** 8 NPSA risk rating: 3	Ready diluted Total loading dose is 200 mL (2 million units)	First 50 mL over 10 minutes, followed by 150 mL over 20 minutes (equivalent to 300 mL/hour for 10 minutes, then 900 mL/hour for 20 minutes)	**Infusion-related adverse events:** hypersensitivity reactions including bradycardia, hypotension, tachycardia, rash, dyspnoea. Injection site reactions including thrombophlebitis **pH:** 5–7 **Osmolarity:** 290 mOsmol/L **Flush:** NS **Sodium content:** 8 mmol/vial **Test dose:** 10 minutes prior to the test dose give chlorphenamine 10 mg IV and ranitidine 150 mg IV. Give a 1 mL IV bolus test dose 10 minutes prior to the load. If there are no signs of hypersensitivity the remaining doses may be administered	**Do not administer with any other medicines or infusion fluids**
	Maintenance dose: (I) IV infusion via a central line with a volumetric infusion pump **1** 2 3 4 5 **6** **7** 8 NPSA risk rating: 3	Ready diluted Maintenance dose infusion is equivalent to 0.5 million units/hour	50 mL/hour until the end of the operation		
	Pump prime dose 1 2 3 4 5 6 7 8 NPSA risk rating: N/A	Ready diluted	200–300 mL is added to the priming volume of the extracorporeal circuit of the cardiopulmonary bypass machine		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
L-arginine hydrochloride (unlicensed)					
Ampoule 12 g/20 mL *Non-proprietary* Martindale (UK)	**For urea cycle disorders:** (I) IV infusion via a volumetric infusion pump, followed by a (C) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 6	**For ornithine transcarbamylase deficiency:** add 1.75 mL to 500 mL bag of G10 **For citrullinaemia and arginosuccinic aciduria:** add 8.75 mL to 500 mL G10 **For all indications:** also add 12.5 mL sodium benzoate 200 mg/mL and 12.5 mL sodium phenylbutyrate 200 mg/mL to the G10 bag	Give the first bag over 90 minutes Give subsequent infusions at 2 mL/kg per hour Administer through a 0.2 micron filter, available from pharmacy	**Infusion-related adverse events:** nausea, vomiting, flushing, headache, injection site irritation **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 4–6 (undiluted L-arginine) **Osmolarity:** hypertonic **Flush:** NS, G or G10 **Sodium content:** L-arginine ampoules contain no sodium. The bag as described contains 31 mmol sodium **Other comments:** the infusion should be continued until hyperammonaemia is resolved. The infusion provides L-arginine 100 mg/kg per day, sodium benzoate 250 mg/kg per day and sodium phenylbutyrate 250 mg/kg per day approximately. Doses may differ to those stated in other pharmaceutical texts To be initiated on the advice of the metabolic consultant	**Compatible fluids:** G10, NS, G **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Artesunate (unlicensed)					
Vial 60 mg *Non-proprietary* Guilin (China) Each vial is provided with 1 mL ampoule of sodium bicarbonate 5%	IV bolus (preferred method) **1** **2** 3 **4** **5** **6** 7 8 NPSA risk rating: 4	Reconstitute each vial with 1 mL sodium bicarbonate 5%. Further dilute with 5 mL NS or G	Over 2 minutes	**Infusion-related adverse events:** nausea, vomiting, abdominal pain, dizziness, headache, ECG changes, arrhythmias **ECG monitoring required prior to initial dose in patients with a cardiac history** **pH:** 7.9 (both methods of reconstitution) **Osmolality:** 429 mOsmol/kg (IV bolus) 549 mOsmol/kg (IM) **Flush:** NS **Sodium content:** negligible **Displacement value:** negligible	**Do not infuse with any other medicines or infusion fluids**
	IM **1** **2** 3 **4** **5** **6** 7 8 NPSA risk rating: 4	Reconstitute each vial with 1 mL sodium bicarbonate 5%. Further dilute with 2 mL NS or G			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Asparaginase (from Escherichia coli – unlicensed)					
Vial 10,000 units *Non-proprietary* Medac (Germany)	Intradermal, for 1000 unit test dose only 1 2 3 4 **5** **6** 7 8 NPSA risk rating: 2	Reconstitute each vial with 4 mL W. See other comments		**Infusion-related adverse events:** hypersensitivity reactions including fever, hypotension, rash, vomiting and bronchospasm. Injection site pain. Hyperglycaemia **pH:** 6.5–7.5 (10,000 units in 4 mL W) **Flush:** NS, G **Sodium content:** nil **Displacement value:** nil **Other comments:** to reconstitute inject W against the wall of the vial and gently rotate to dissolve the drug. To avoid frothing do not inject W directly on to the powder or shake the vial Maximum volume to be injected IM at a single site: 2 mL. Larger volumes should be split and administered in separate sites Test dose to be administered to a marked area of the forearm 4 hours prior to first full dose	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	IM (preferred route) 1 2 3 4 **5** **6** 7 8 NPSA risk rating: 2	As above			
	(I) IV infusion, via a volumetric infusion pump 1 **2** 3 4 **5** **6** **7** 8 NPSA risk rating: 4	Reconstitute each vial with 4 mL W, then add to 250–500 mL NS or G. See other comments	Minimum 2 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Aspirin (DL-lysine acetylsalicylate – unlicensed)					
Vial 500 mg 1 g Aspergic Sanofi-Aventis (France) Each vial is provided with 5 mL ampoule W	IV bolus 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	Reconstitute each vial with 5 mL W	Over 3–5 minutes	**Infusion-related adverse events:** pain at injection site, thrombophlebitis **Flush:** NS **Sodium content:** nil **Other comments:** 900 mg DL-lysine acetylsalicylate is equivalent to 500 mg acetylsalicylic acid (aspirin) At UCLH injectable aspirin may only be given on the advice of a neurologist	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	IV infusion 1 **2** 3 4 **5** 6 7 8 NPSA risk rating: 2	Reconstitute each vial with 5 mL W. Dilute to a convenient volume with NS or G Suggested dilution: add dose to 100–250 mL bag NS or G	Over 20 minutes		
	IM 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	Reconstitute each vial with 5 mL W			
Atenolol					
Ampoule 5 mg/10 mL Tenormin AstraZeneca (UK)	IV bolus 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted. May be further diluted to a convenient volume with NS or G	1 mg/minute	**Infusion-related adverse events:** bradycardia, hypotension, peripheral vasoconstriction resulting in cold extremities, dyspnoea and bronchospasm in susceptible individuals, e.g. asthmatics **ECG monitoring required** **pH:** 5.5–6.5 **Osmolality:** 300 mOsmol/kg **Flush:** NS **Sodium content:** 2 mmol/vial	**The following data assume atenolol is infused into the Y-site as a 0.2 mg/mL solution. Atenolol solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible when diluted in G or NS:** morphine, meropenem, pethidine
	(I) IV infusion 1 **2** 3 4 5 **6** 7 8 NPSA risk rating: 2	Withdraw dose and add to a convenient volume of NS or G Suggested dilution: add to 50–100 mL bag NS or G	Over 20 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Atosiban					
Vial for injection 6.75 mg/0.9 mL Tractocile Ferring (UK)	IV bolus, using the vial for injection **1** **2** 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted	Over 1 minute, followed by the IV infusion	**Infusion-related adverse events:** nausea and vomiting, hyperglycaemia, headache, dizziness, tachycardia, hypotension, hot flushes **pH:** 4.5 (undiluted) **Osmolality:** 310 mOsmol/kg (undiluted) **Flush:** NS **Sodium content:** nil **Other comments:** if therapy is required after the first bag is finished, another 75 mg/100 mL bag should be made and given at 8 mL/hour. Usual maximum total duration of therapy: 48 hours Initial infusion rate is equivalent to 18 mg/hour for the first 3 hours, reducing to 6 mg/hour thereafter	**The following data assume atosiban is infused into the Y-site as a 0.75 mg/mL solution. Atosiban solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H **Y-site compatible when diluted in NS:** co-amoxiclav, erythromycin
Vial for infusion 37.5 mg/5 mL Tractocile Ferring (UK)	(C) IV infusion, via a volumetric infusion pump **1** **2** 3 **4** 5 **6** **7** 8 NPSA risk rating: 5	Withdraw 10 mL fluid from 100 mL bag NS or G. Add two vials for infusion (total 10 mL) to the bag to give a solution of approximately 75 mg/100 mL	Initially 24 mL/hour for 3 hours, then reduce to 8 mL/hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Atracurium besilate					
Ampoule 25 mg/2.5 mL 50 mg/5 mL Tracurium GlaxoSmithKline (UK) Vial 250 mg/25 mL Tracurium GlaxoSmithKline (UK)	**During anaesthesia, or in critical care prior to a continuous infusion:** IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted. May be further diluted to a convenient volume with NS, G or GS	Initially 0.3–0.6 mg/kg over a few seconds Supplemental doses of 0.1–0.2 mg/kg	**Infusion-related adverse events:** flushing, transient hypotension, tachycardia, bronchospasm, hypertension, injection site irritation **pH:** 3.3–3.7 **Flush:** NS **Sodium content:** nil **Other comments:** may be infused at half the normal rate during induced hypothermia as drug inactivation is reduced in this state Hypovolaemic patients or individuals with significant cardiovascular disease should receive the bolus over 60 seconds to minimise hypotensive response Doses and infusion rates of neuromuscular blockers are highly variable and should be adjusted according to response by the anaesthetist. Use of neuromuscular blockers outside critical care and theatres should be considered a high risk intervention For further information regarding the use of atracurium in neonates refer to 'Neonatal monograph – Atracurium' at www.uclhguide.com or the UCLH intranet	**The following data assume atracurium is infused into the Y-site as a 0.5 mg/mL solution. Atracurium solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** esmolol, propofol **Y-site compatible when diluted in G or NS:** acetylcysteine, adrenaline, alfentanil, clarithromycin, clonidine, co-trimoxazole, dobutamine, dopamine, etomidate, fentanyl, insulin, labetolol, meropenem, midazolam, morphine, noradrenaline, pethidine, ranitidine, remifentanil, rocuronium, vancomycin, vecuronium **Y-site compatible when diluted in NS:** erythromycin **Y-site compatible when diluted in G:** amiodarone **Incompatible:** aminophylline, heparin sodium, sodium nitroprusside, thiopental
	During anaesthesia: (I) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	As above	0.3–0.6 mg/kg per hour through the surgical procedure		
	Adjunct to sedation in critical care: (C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	As above	Usually 0.65–0.78 mg/kg per hour Range: 0.27–1.77 mg/kg per hour		
	Neonates – neuromuscular blockade during ventilation or before intubation: IV bolus followed by a (C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	**Neonates under 3.2 kg:** dilute 15 mg to 10 mL with G **Neonates 3.2 kg and over:** draw up 100 mg (10 mL) into a syringe. Do not further dilute	Bolus: 300 microgram/kg over a few seconds Infusion: 5 microgram/kg per minute adjusted according to response Usual maximum 10 microgram/kg per minute		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Atropine sulphate					
Ampoule 600 micrograms/1 mL *Non-proprietary* Hameln (UK)	**Premedication, intra-operative bradycardia, reversal of neuromuscular blockade:** IV bolus/SC bolus/IM **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted. May be further diluted to a convenient volume with NS or G	IV: over 3–5 minutes	**Infusion-related adverse events:** bradycardia, tachycardia, palpitations, arrhythmias **ECG monitoring required**, according to clinical need **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 2.8–4.5 **Osmolarity:** 308 mOsmol/L (Minijet) **Flush:** NS **Sodium content:** 0.2 mmol (Minijet), nil in ampoule or pre-filled syringe **Other comments:** use of atropine during resuscitation is a high risk intervention only to be performed by those competent in life support	**The following data assume atropine is infused into the Y-site as a 0.06 mg/mL solution. Atropine solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** propofol 1% **Y-site compatible when diluted in G or NS:** eptifibatide, etomidate, fentanyl, meropenem, midazolam, morphine, pethidine, ranitidine **Incompatible:** flucloxacillin, heparin, noradrenaline, sodium bicarbonate, thiopental
Pre-filled syringe 1 mg/5 mL (paediatric) 3 mg/10 mL (adult) *Non-proprietary* Aurum t/a Cardinal (UK) Minijet 1 mg/10 mL 3 mg/30 mL *Non-proprietary* International Medication Systems (UK)	**During resuscitation or other emergency:** IV bolus **1** 2 3 4 5 6 7 8 NPSA risk rating: 1, but see comments	Ready diluted Use pre-filled syringes where possible. However, the dose may be drawn from the ampoule	As fast as possible followed by an NS flush		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Augmentin					
see co-amoxiclav					
Azathioprine					
Vial 50 mg Imuran GSK (UK)	(I) IV infusion (preferred method) **1** **2** 3 4 **5** **6** 7 8 NPSA risk rating: 4	Add 5 mL W to the vial. This produces a 10 mg/mL solution Draw up the required dose and add to 50–100 mL bag NS or G	Over 30–60 minutes	**Infusion-related adverse events:** hypersensitivity, dizziness, nausea, vomiting, diarrhoea, rash **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 10–12 (reconstituted), 8–9.5 when diluted **Flush:** at least 50 mL NS **Sodium content:** 0.2 mmol/50 mg vial **Displacement value:** negligible **Other comments:** reconstituted vials and diluted solutions may be stored for up to 24 hours at room temperature	**Compatible fluids:** NS, G, GS, sodium chloride 0.45% **Do not infuse with any other medicines or infusion fluids**
	IV bolus **1** 2 3 4 **5** **6** 7 8 NPSA risk rating: 3	Add 10 mL W to 50 mg vial	Over 1 minute, followed immediately by a 50 mL NS flush		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Benzylpenicillin	⚠ **This is a penicillin. Check allergy status before administration**				
Vial 600 mg Crystapen Genus (UK)	**Adults, children and neonates:** IV bolus (but see comments) 1 2 3 4 **5** **6** 7 8 NPSA risk rating: 2	**If using a whole vial:** add 4–10 mL W or NS to each vial **If using part of a vial:** add 3.6 mL W or NS to the vial. This gives a 150 mg/mL solution	600 mg over 2 minutes or 1200 mg over 4 minutes Maximum rate 300 mg/minute	**Infusion-related adverse events:** rash, itching, nausea, hypersensitivity reactions, injection site reaction **pH:** 5.5–7.5 (reconstituted in W) **Osmolarity:** 276 mOsmol/L **Flush:** NS **Sodium content:** 1.68 mmol/600 mg vial **Displacement value:** 0.4 mL/600 mg vial **Other comments:** in children and neonates, if the dose is greater than 50 mg/kg IV infusion is the preferred method When reconstituting benzylpenicillin many nurses find it easier to dissolve the drug in 2 mL of diluent, withdraw the drug, then further dilute to the final volume Benzylpenicillin 600 mg = benzylpenicillin 1 megaunit (1MU)	**The following data assume benzylpenicillin is infused into the Y-site as a 1.2 mg/mL solution. Benzylpenicillin solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible when diluted in G or NS:** caffeine, chloramphenicol, clarithromycin **Y-site compatible when diluted in NS:** erythromycin **Incompatible:** amikacin, amphotericin, flucloxacillin, gentamicin, methylprednisolone sodium succinate, tobramycin
	Adults and children: (I) IV infusion 1 **2** 3 4 **5** **6** 7 8 NPSA risk rating: 3	Reconstitute the vials as above. Dilute the dose to a convenient volume with NS or G Suggested dilution: add to 50–100 mL bag NS or G	Over 30–60 minutes		
	Neonates: (I) IV infusion via a syringe pump 1 2 **3** 4 **5** **6** **7** 8 NPSA risk rating: 4	Add 3.6 mL W to the vial. This gives a 150 mg/mL solution. Do not further dilute	Over 30 minutes		
	IM 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	**If using a whole vial:** add 2 mL W or NS to the 600 mg vial **If using part of a vial:** add 1.6 mL W or S to the vial. This gives a 300 mg/mL solution			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Bumetanide					
Ampoule 2 mg/4 mL *Non-proprietary* Leo Laboratories (UK)	IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted	Over 3–5 minutes	**Infusion-related adverse events**: rash. Muscular pain with high dose therapy in patients with severe chronic renal failure **pH:** 6.8–7.3 (undiluted) **Osmolarity:** 290 mOsmol/L **Flush:** NS **Sodium content:** negligible	**The following data assume bumetanide is infused into the Y-site as a 0.025 mg/mL solution. Bumetanide solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** doxapram, propofol 1% **Y-site compatible when diluted in G or NS:** clarithromycin, flucloxacillin, granisetron, morphine, pethidine, pipericillin with tazobactam, remifentanil
	(I) IV infusion **1** **2** **3** 4 5 **6** 7 8 NPSA risk rating: 4	Dilute dose in 500 mL of NS, G or GS. The final concentration should be no greater than 25 micrograms/mL (higher concentrations may lead to precipitation)	Over 30–60 minutes		
	IM **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Buprenorphine					
Ampoule 300 micrograms/1 mL Temgesic Schering-Plough (UK)	IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted. May be further diluted with an equal volume of NS	Over 3–5 minutes	**Infusion-related adverse events:** respiratory and CNS depression, itching, sweating, hypotension, brady- and tachycardia **pH:** 3.5–5.5 (undiluted) **Osmolaity:** 280 mOsmol/L **Flush:** NS **Sodium content:** nil **Other comments:** at UCLH IV boluses of opioids should only be used in areas where this has been explicitly sanctioned	**Compatible fluids:** NS, G **Do not infuse with any other medicines or infusion fluids**
	IM 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Buscopan					
***see* hyoscine butylbromide**					
C1 esterase inhibitor					
Vial 500 units Berinert CSL Behring (UK) The vial is supplied with 10 mL W, a filter transfer device, syringe and venepuncture set C1 esterase inhibitor is reconstituted using a needle-free system	IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Follow the instructions on the package insert to produce a 50 unit/mL solution Each reconstituted vial has a final volume of 10 mL Multiple vials may need to be reconstituted before they are drawn into a single syringe for administration	Over 3–5 minutes	**Infusion-related adverse events:** injection site irritation, hypersensitivity reactions **pH:** 6.5–7.5 (undiluted) **Flush:** NS **Sodium content:** 2.1 mmol/vial **Displacement value:** negligible **Other comments:** bring the solvent to room temperature prior to use	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Caffeine and sodium benzoate (unlicensed)					
Ampoule Caffeine base 245 mg with sodium benzoate 255 mg *Non-proprietary* Cardinal Health (UK)	**For low pressure headaches:** (I) IV infusion 1 **2** 3 4 5 6 7 8 NPSA risk rating: 1	Add one ampoule to 1 L NS	Over 1–2 hours	**Infusion-related adverse events:** tachycardia, cardiac arrhythmia **ECG required prior to administration** **pH:** 7–9 (undiluted) **Flush:** NS **Sodium content:** 1.8 mmol/vial **Other comments:** sodium benzoate is added to increase the solubility of caffeine and has no therapeutic effect To be administered only on a neurologist's advice	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Caffeine					
Ampoule Caffeine base 5 mg/1 mL (equivalent to 10 mg/1 mL caffeine citrate) *Non-proprietary* Viridian Pharma (UK)	**Loading dose:** (I) IV infusion via a syringe pump into a central line or large peripheral vein 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Ready diluted Draw up the dose through the filter straw provided. See comment (a) May be further diluted to a convenient volume with NS, GS or G	Usually 10 mg/kg over 30 minutes	**Infusion-related adverse events:** tachycardia, hypertension, hypo- and hyperglycaemia. Irritability and restlessness on withdrawal **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 2–3 (undiluted) **Flush:** NS **Sodium content:** 0.13 mmol/1 mL vial **Other comments:** (a) the manufacturer provides a filter straw as glass particles may be produced when the ampoule is opened. Filtering the solution removes the particles (b) doses are expressed in terms of caffeine base	**The following data assume caffeine base is infused into the Y-site as a 5 mg/mL solution. Caffeine base solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** doxapram **Y-site compatible when diluted in G or NS:** adrenaline, amikacin, calcium gluconate, cefotaxime, ceftazidime, clindamycin, dexamethasone, dobutamine, dopamine, fentanyl, lidocaine, morphine, pancuronium, phenylephrine, sodium nitroprusside, tobramycin
	Maintenance dose (I) IV infusion via syringe pump into a central line or large peripheral vein 1 2 3 4 5 6 7 8 NPSA risk rating: 6 Maintenance dose is usually started 24 hours after initial loading dose	As above	Usually 2.5–5 mg/kg over 10 minutes. Occasionally up to 10 mg/kg may be required		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Calcium chloride					
Pre-filled syringe 10% (6.8 mmol/10 mL equivalent to 1000 mg/10 mL) *Non-proprietary* Martindale (UK)	**During resuscitation:** IV bolus **1** 2 3 4 5 6 7 8 NPSA risk rating: 1 but see comment (a)	Ready diluted Use the pre-filled syringes or Minijet containing the 10% solution whenever possible Otherwise the dose may be drawn from the ampoule. Note the ampoule contains more calcium than the syringe/Minijet	Usually 10 mL of the 10% solution is given as fast as possible, followed immediately by a 20 mL NS flush	**Infusion-related adverse events:** vasodilatation, hypotension, arrhythmias, fainting, tingling sensation, taste disturbances, nausea, sweating **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **Osmolarity**: 2040 mOsmol/L (10% solution) **pH:** 5–8 **Flush:** NS **Other comments:** (a) bolus administration of calcium chloride during resuscitation is a high risk intervention only to be performed by those competent in life support (b) at UCLH hypocalcaemia is usually corrected with calcium gluconate. However, calcium chloride is the salt of choice in hyperkalaemia	**The following data assume calcium chloride is infused into the Y-site as a 100 mg/mL solution. Calcium chloride solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** doxapram **Y-site compatible when diluted in G:** amiodarone **Incompatible:** amphotericin, ceftriaxone, disodium pamidronate, dobutamine, propofol, sodium bicarbonate, thiopental, tobramycin, zoledronic acid
Vial for Minijet 10% (6.8 mmol/10 mL equivalent to 1000 mg/10 mL) *Non-proprietary* International Medication Systems (UK)	**Urgent correction of hypocalcaemia, ECG changes and/or arrhythmias due to hyperkalaemia:** IV bolus **1** 2 3 4 5 6 7 8 NPSA risk rating: 1 but see comment (a)	As above	Usually 10 mL of the 10% solution over 5 minutes		
Ampoules 14.7% (10 mmol/10 mL equivalent to 1470 mg/10 mL) *Non-proprietary* Martindale (UK)					

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Calcium gluconate					
Ampoule 1 g/10 mL *Non-proprietary* Hameln (UK) This is calcium gluconate 10% Each 1 mL contains 0.23 mmol Ca (equivalent to 8.4 mg/mL Ca)	**Urgent correction of hypocalcaemia, arrhythmias in hyperkalaemia:** IV infusion (preferred method) **1** **2** **3** 4 5 **6** 7 8 NPSA risk rating: 4	Add 1–2 ampoules to 100 mL bag NS or G	**Adults:** over 10 minutes **Children:** 0.11 mmol calcium/kg (maximum 4.5 mmol) over 5–10 minutes	**Infusion-related adverse events:** flushing, hypotension, arrhythmias, vein and injection site irritation **ECG monitoring required** **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 6–8.2 (undiluted) **Osmolality:** 276 mOsmol/kg (undiluted) **Flush:** NS **Sodium content:** nil **Other comments:** various calcium infusions are in use at UCLH. The suggested method is intended as a guide and other infusions may be prescribed according to the urgency of correction and fluid status of the patient. A 10 mL/kg dose of the suggested preparation for correction of severe hypocalcaemia in adults is expected to raise plasma calcium by 0.3–0.5 mmol/L Further details of doses may be found in the BNF and BNF for Children	**The following data assume calcium gluconate is infused into the Y-site as a 100 mg/mL solution. Calcium gluconate solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** doxapram **Y-site compatible when diluted in G or NS:** amikacin, caffeine, midazolam, tacrolimus **Incompatible:** amphotericin, ceftriaxone, clindamycin, dobutamine, disodium pamidronate, flucloxacillin, fluconazole, meropenem, methylprednisolone, thiopental, tobramycin, zoledronic acid
	Urgent correction of hypocalcaemia, arrhythmias in hyperkalaemia: IV bolus via a central line or large peripheral vein **1** **2** **3** 4 5 **6** 7 8 NPSA risk rating: 4 **Preferred method in fluid restriction and emergencies**	**Adults:** use undiluted **Children and neonates:** dilute each 1 mL calcium gluconate 10% with 4 mL NS or G. In emergencies may be given undiluted	**Adults:** give each ampoule over a minimum of 5 minutes **Children and neonates:** 2.5 mL/kg of the diluted solution over 5–10 minutes		
	Correction of severe hypocalcaemia (adults): (I) or (C) IV infusion via a volumetric infusion pump into a large peripheral vein **1** **2** 3 **4** 5 **6** **7** 8 NPSA risk rating: 5	Suggested preparation: withdraw 100 mL from a 1 L bag G or NS. Add 10 calcium gluconate 10% ampoules (100 mL) to the bag (see other comments)	50 mL/hour For urgent correction the infusion may be given over 4–6 hours		

Formulation	Method	Dilution	Rate	Comments	Compatibility
Calcium gluconate *continued*					
Ampoule 1 g/10 mL *Non-proprietary* Hameln (UK) This is calcium gluconate 10% Each 1 mL contains 0.23 mmol Ca (equivalent to 8.4 mg/mL Ca)	**Correction of severe hypocalcaemia (neonates and children):** (C) IV infusion, via a volumetric infusion pump into a large peripheral vein 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute the dose to a convenient volume with NS or G Each 1 mL calcium gluconate 10% must be diluted with at least 4 mL NS or G	**Children:** maximum rate 0.045 mmol/kg per hour **Neonates:** maximum rate 0.022 mmol/kg per hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Carboxypeptidsase G2					
***see* glucarpidase**					

Formulation	Method	Dilution	Rate	Comments	Compatibility
Caspofungin					
Vial 50 mg 70 mg Cancidas MSD (UK)	**Adults:** (I) IV infusion **1** **2** 3 4 **5** 6 7 8 NPSA risk rating: 3	Allow vial to reach room temperature **70 mg dose:** add 10.5 mL NS or W to the vial. This gives a 7.2 mg/mL solution. Withdraw 10 mL and add to a 250 mL bag NS **50 mg dose:** add 10.5 mL NS or W to the vial. This gives a 5.2 mg/mL solution. Withdraw 10 mL of the solution and add to 250 mL bag NS	Over 60 minutes	**Infusion-related adverse events:** pain/ tenderness at injection site, hypersensitivity reactions including rash and bronchospasm. Also fever, headache, tachycardia, flushing, nausea, diarrhoea and sweating **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 6.6 (50 mg reconstituted in 10.5 mL W) **Osmolarity:** approximately 300 mOsmol/L (50 mg in 250 mL NS) **Flush:** NS **Sodium content:** negligible **Displacement value:** negligible **Other comments**: using the recommended method for infusion in adults gives a 52 mg or 72 mg dose. This overage is not considered significant in adults. However, the actual concentration of the reconstituted solution should be taken into consideration when calculating doses for children The reconstituted vial should be used within 1 hour of preparation. The diluted solution may be refrigerated, but should be used within 24 hours of preparation	**Compatible fluids:** NS, H, sodium chloride 0.45% **Incompatible:** G **Do not infuse with any other medicines or infusion fluids**
	Children: (I) IV infusion **1** **2** 3 4 **5** **6** 7 8 NPSA risk rating: 4	Reconstitute as above, then draw up the required dose taking into consideration the solution concentrations detailed above. Add the dose to 250 mL NS **Fluid restriction:** doses up to 50 mg may be diluted in 100 mL NS or H	Over 60 minutes		
	Fluid restriction (adults or children): (I) IV infusion **1** **2** **3** 4 **5** **6** 7 8 NPSA risk rating: 5	Dilute dose with NS to a final concentration of 0.5 mg/mL For a 50 mg dose: add to 100 mL NS For a 70 mg dose: add to 140 mL NS. This will require removal of solution from a 250 mL bag	Over 60 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Cefotaxime					
Vial 500 mg 1 g 2 g *Non-proprietary* Wockhardt (UK)	**For doses less than 2 g:** IV bolus 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	**If using a whole vial:** add 2 mL W to 500 mg vial, 4 mL W to 1 g vial or 10 mL W to 2 g vial **If using part of a vial:** add 1.8 mL W to 500 mg vial or 3.5 mL to 1 g vial. This gives a 250 mg/mL solution Alternatively, add 8.8 mL to 2 g vial to produce a 200 mg/mL solution	Over 3–5 minutes	**Infusion-related adverse events:** rash, itching, nausea, hypersensitivity reactions, injection site reaction. Rarely: arrhythmias with rapid injection **pH:** 4.5-6.5 (100 mg/mL solution in W) **Flush:** NS **Sodium content:** 1 mmol/500 mg vial 2.1 mmol/1 g vial 4.2 mmol/2 g vial **Displacement values:** 0.2 mL/500 mg vial 0.5 mL/1 g vial 1.2 mL/2 g vial CP, Sandoz and ACSD brand cefotaxime have similar displacement values **Other comments:** use with caution in patients with penicillin allergy. Approximately 10% cross-sensitivity	Cefotaxime may be added to a metronidazole 500 mg/100 mL bag **The following data assume cefotaxime is infused into the Y-site as a 20 mg/mL solution. Cefotaxime solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H **Y-site compatible ready-diluted medicines:** metronidazole **Y-site compatible when diluted in G or NS:** aciclovir, caffeine, granisetron, magnesium sulphate, morphine, noradrenaline, ondansetron, pethidine, remifentanil **Incompatible:** amikacin, aminophylline, fluconazole, gentamicin, tobramycin, sodium bicarbonate
	For doses 2 g or greater: (I) IV infusion 1 **2** 3 4 **5** 6 7 8 NPSA risk rating: 2	Reconstitute the vial as above, then add to 50–100 mL NS or G	Over 20–60 minutes		
	IM 1 **2** 3 4 5 6 7 8 NPSA risk rating: 1	Add 2 mL W to 500 mg vial, 4 mL W to 1 g vial or 10 mL W to 2 g vial Doses above 1 g should be divided and administered at different sites If pain on injection is a problem, may be reconstituted with lidocaine 1%			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ceftazidime					
Vial 500 mg Fortum GSK (UK) Vial 1 g *Non-proprietary* Sandoz (UK) Vial 2 g *Non-proprietary* Wockhardt (UK)	**For doses less than 2 g:** IV bolus 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	**If using a whole vial:** add 5 mL W or NS to 500 mg vial or 10 mL W or NS to 1 g or 2 g vials **If using part of a vial:** add 4.5 mL W or NS to 500 mg vial or 9.1 mL W or NS to 1 g vial. This gives a 100 mg/mL solution Alternatively add 8.5 mL W or NS to 2 g vial to produce a 200 mg/mL solution	Over 3–5 minutes	**Infusion-related adverse events:** rash, itching, nausea, hypersensitivity reactions, injection site reaction **pH:** 5–7.5 **Flush:** NS **Osmolality:** 329 mOsmol/kg (1 g in 10 mL W) **Sodium content:** 1.1 mmol/500 mg vial 2.3 mmol/1 g vial 4.5 mmol/2 g vial **Displacement value:** 0.5 mL/500 mg 0.9 mL/1 g vial 1.5 mL/2 g vial Displacement values are similar for Wockhardt, Sandoz, CP, Genus, Flynn and GSK brand ceftazidime **Other comments:** use with caution in patients with penicillin allergy. Approximately 10% cross-sensitivity Reconstituted vials and diluted solutions are stable for 24 hours when refrigerated	**The following data assume ceftazidime is infused into the Y-site as a 40 mg/mL solution. Ceftazidime solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H **Y-site compatible ready-diluted medicines:** doxapram, linezolid, propofol 1% **Y-site compatible when diluted in G or NS:** adrenaline, aminophylline, dobutamine, flucloxacillin, insulin, ketamine, morphine, pethidine, ondansetron, remifentanil, tacrolimus **Y-site compatible when diluted in NS:** furosemide **Incompatible:** amikacin, ciprofloxacin, gentamicin, midazolam, ranitidine, sodium bicarbonate, thiopental, tobramycin
	For doses 2 g or greater: (I) IV infusion 1 **2** 3 4 **5** 6 7 8 NPSA risk rating: 2	Reconstitute vial as above. Further dilute the dose with 50–100 mL NS or G	Over 20–30 minutes		
	IM 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	Use 500 mg or 1 g vials only Add 1.5 mL W or NS to 500 mg vial or 3 mL to 1 g vial. For doses greater than 1 g, inject at two separate injection sites If pain on injection a problem, may be reconstituted with lidocaine 0.5% or 1%		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ceftriaxone (adults)					
Vial 250 mg 1 g *Non-proprietary* Demo/Noridem t/a Fannin (UK)	**For doses less than 2 g:** IV bolus 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	**If using a whole vial:** add 10 mL W to 1 g vial **If using part of a vial:** add 9 mL W to 1 g vial to give a 100 mg/mL solution	Over 2–4 minutes	**Infusion-related adverse events:** rash, itching, nausea, hypersensitivity reactions, injection site reaction **pH:** 6–8 (reconstituted in W) **Osmolarity:** 180–200 mOsmol/L reconstituted in W **Flush:** NS **Sodium content:** 250 mg vial – negligible 3.6 mmol/1 g vial 7.2 mmol/2 g vial **Displacement value:** Noridem vials: 0.2 mL/250 mg vial 1 mL/1 g vial Wockhardt vial: 1 mL/2 g vial **Other comments:** use with caution in patients with penicillin allergy. Approximately 10% cross-sensitivity	**The following data assume ceftriaxone is infused into the Y-site as a 20 mg/mL solution. Ceftriaxone solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** foscarnet, linezolid, propofol 1% **Y-site compatible when diluted in G or NS:** aciclovir, drotrecogin alfa, granisetron, morphine, pantoprazole, pethidine, remifentanil, tacrolimus, zidovudine **Y-site compatible when diluted in G:** amiodarone **Incompatible:** H, amikacin, aminophylline, calcium chloride, calcium gluconate, clindamycin, gentamicin, labetolol, thiopental
Vial 2 g *Non-proprietary* Wockhardt (UK)	**For doses of 2 g or greater:** (I) IV infusion 1 **2** 3 4 **5** 6 7 8 NPSA risk rating: 2	**If using 1 g vial:** reconstitute as above, then add the dose to a 100 mL bag NS or G **If using the whole 2 g vial:** withdraw 20 mL NS or G from 100 mL bag and use to reconstitute 2 g vial. Return contents of vial to the bag **If using part of the 2 g vial:** withdraw 19 mL NS or G from 100 mL bag and use to reconstitute 2 g vial. This gives a 100 mg/mL solution. Return the required dose to the bag	Over 30 minutes		
	IM injection 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	Add 1 mL lidocaine 1% to 250 mg vial, 3.5 mL to 1 g vial or 7 mL to 2 g vial Doses greater than 1 g should be divided and administered at more than one site			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ceftriaxone (children and neonates)					
Vial 250 mg 1 g *Non-proprietary* Demo/Noridem t/a Fannin (UK)	**Doses under 50 mg/kg (children):** IV bolus 1 2 3 4 **5** **6** 7 8 NPSA risk rating: 2	**If using a whole vial:** add 5 mL W to 250 mg vial or 10 mL W to 1 g vial **If using part of a vial:** add 4.8 mL W to 250 mg vial to give a 50 mg/mL solution Alternatively add 9 mL W to 1 g vial to give a 100 mg/mL solution	Over 2–4 minutes	**Infusion-related adverse events:** rash, itching, nausea, hypersensitivity reactions, injection site reaction **pH:** 6–8 (reconstituted in W) **Osmolarity:** 180–200 mOsmol/L reconstituted in W **Flush:** NS **Sodium content:** 250 mg vial – negligible 3.6 mmol/1 g vial 7.2 mmol/2 g vial **Displacement value:** Noridem vial: 0.2 mL/250 mg vial 1 mL/1 g vial Wockhardt vial: 1 mL/2 g vial **Other comments:** children over 50 kg should be dosed as adults Use with caution in patients with penicillin allergy. Approximately 10% cross-sensitivity For IM administration: see ceftriaxone (adults) monograph	Do not infuse calcium containing infusion fluids, including intravenous nutrition, at the same time as ceftriaxone into children or neonates. Concomitant infusion may result in precipitates in urine and lungs **See adult monograph for compatibilities**
Vial 2 g *Non-proprietary* Wockhardt (UK)	**Doses of 50 mg/kg or above (children):** (I) IV infusion 1 **2** 3 4 **5** **6** 7 8 NPSA risk rating: 3	**If using 250 mg or 1 g vial:** reconstitute as above, then add the dose to a 50 mL bag NS or G **If using the whole 2 g vial:** withdraw 20 mL NS or G from 50 mL bag and use to reconstitute 2 g vial. Return contents of vial to the bag **If using part of the 2 g vial:** withdraw 19 mL NS or G from 50 mL bag and use to reconstitute 2 g vial. This gives a 100 mg/mL solution. Return the required dose to the bag	Over 30 minutes		
	Neonates: (I) IV infusion via a syringe pump 1 **2** 3 **4** **5** **6** **7** 8 NPSA risk rating: 5	Add 4.8 mL W to 250 mg vial to give a 50 mg/mL solution Alternatively add 9 mL W to 1 g vial to give a 100 mg/mL solution Dilute the required dose to a convenient volume with NS or G	Over 60 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Cefuroxime					
Vial 250 mg Zinacef GSK (UK) Vial 750 mg 1.5 g *Non-proprietary* Flynn Pharma (UK)	IV bolus 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	**If using a whole vial:** add 2 mL W to 250 mg vial, 6 mL W to 750 mg or 15 mL W to 1.5 g vial. May be further diluted to a convenient volume with NS or G **If using a part vial:** add 1.8 mL W to 250 mg vial, 5.5 mL W to 750 mg or 10.9 mL W to 1.5 g vial. This gives a 125 mg/mL solution	Over 3–5 minutes	**Infusion-related adverse events:** rash, itching, nausea, hypersensitivity reactions, injection site reaction **pH:** 6–8.5 (10% solution Zinacef) **Osmolarity:** 314 mOsmol/kg (30 mg/ml in NS) **Flush:** NS **Sodium content:** 0.6 mmol/250 mg vial (GSK) 1.7 mmol/750 mg vial (Flynn) 3.4 mmol/1.5 g vial (Flynn) **Displacement value:** 0.2 mL/250 mg vial (GSK) 0.5 mL/750 mg vial (Flynn) 1.1 mL/1.5 g vial (Flynn) Displacement values for GSK, Britannia and Flynn brand cefuroxime are the same **Other comments:** use with caution in patients with penicillin allergy. Approximately 10% cross-sensitivity	Cefuroxime may be added to a metronidazole 500 mg/100 mL bag **The following data assume cefuroxime is infused into the Y-site as a 30 mg/mL solution. Cefuroxime solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, G10, H, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** foscarnet, metronidazole, linezolid, propofol **Y-site compatible when diluted in G or NS:** flucloxacillin, granisetron, morphine, ondansetron, pethidine, remifentanil, tacrolimus **Y-site compatible when diluted in G:** amiodarone **Incompatible:** amikacin, ciprofloxacin, fluconazole, gentamicin, labetolol, sodium bicarbonate, thiopental, tobramycin
	(I) IV infusion 1 **2** 3 4 **5** 6 7 8 NPSA risk rating: 2	Reconstitute as above, then add to 50–100 mL NS or G	Over 30 minutes		
	IM 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	Add 1 mL W to 250 mg vial, 3 mL W to 750 mg vial or 6 mL W to 1.5 g vial If giving 1.5 g, split the dose and give in two separate injection sites			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Cernevit (multivitamins)					
Vial Cernevit Baxter (UK) Each vial contains *dl*-alpha tocopherol 11.2 units, ascorbic acid 125 mg, biotin 69 micrograms, colecalciferol 220 units, cyanocobalamin 6 micrograms, folic acid 414 micrograms, glycine 250 mg, nicotinamide 46 mg, pantothenic acid (as dexpanthenol) 17.25 mg, pyridoxine hydrochloride 5.5 mg, retinol (as palmitate) 3500 units, riboflavin (as dihydrated sodium phosphate) 4.14 mg, thiamine (as cocarboxylase tetrahydrate) 3.51 mg	(I) IV infusion 1 **2** 3 4 **5** 6 7 8 NPSA risk rating: 2	Add 5 mL W or NS to the vial Add dose to 50–100 mL NS or G	Over 10–20 minutes	**Infusion-related adverse events:** anaphylaxis may occur, especially in those hypersensitive to thiamine **pH:** 5.5–6.5 (in 5 mL W) **Osmolarity:** 308 mOsmol/L **Flush:** NS, G **Sodium content:** 1.04 mmol/vial **Displacement value:** 0.5 mL/vial	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids** **May be added to intravenous nutrition (TPN) by pharmacy**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Chloramphenicol					
Vial 1 g Kemicetine Pharmacia (UK)	IV bolus, into a large peripheral vein (preferred method) **1** **2** 3 4 **5** **6** 7 8 NPSA risk rating: 3	Add 9.2 mL W or NS to 1 g vial. This gives a 100 mg/mL solution	Over at least 1 minute	**Infusion-related adverse events:** dry mouth, nausea, vomiting, diarrhoea, rash, visual disturbances, tingling sensation in extremities **pH:** 6.4–7 **Osmolality:** 533 mOsmol/kg (100 mg/mL solution) **Flush:** NS **Sodium content:** 3.1 mmol/1 g vial **Displacement value:** 0.8 mL/1 g vial Add 9.2 mL diluent to 1 g vial to make a 100 mg/mL solution **Other comments:** absorption of drug after IM administration may be slow and erratic. The IV bolus is the preferred method	**The following data assume chloramphenicol is infused into the Y-site as a 10 mg/mL solution. Chloramphenicol solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H **Y-site compatible ready-diluted medicines:** esmolol, foscarnet, metronidazole **Y-site compatible when diluted in G or NS:** aciclovir, amikacin, benzylpenicillin, magnesium sulphate, morphine, pethidine, tacrolimus **Incompatible:** fluconazole, vancomycin
	IV infusion **1** **2** 3 4 **5** **6** 7 8 NPSA risk rating: 4	Add 9.2 mL W or NS to 1 g vial. This gives a 100 mg/mL solution Withdraw the required dose and add to convenient volume NS, G or GS	Over 20–30 minutes, as determined by the final fluid volume		
	IM **1** **2** 3 4 **5** **6** 7 8 NPSA risk rating: 3	Add 1.7 mL W or NS to 1 g vial to obtain a 400 mg/mL solution			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Chlorphenamine maleate (chlorpheniramine maleate)					
Vial 10 mg/1 mL *Non-proprietary* Archimedes (UK)	IV bolus 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted. May be further diluted to a convenient volume with NS	Over at least 1 minute	**Infusion-related adverse events:** drowsiness, blurred vision, nausea, vomiting, diarrhoea, headache, dry mouth, palpitations, hypotension (on rapid injection) **pH:** 4–5.2 (undiluted) **Osmolality:** approximately 290 mOsmol/kg **Flush:** NS **Sodium content:** 0.3 mmol/1 mL	**Compatible fluids:** NS, G **Do not infuse with any other medicines or infusion fluids**
	IM/SC 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ciclosporin (cyclosporin)					
Ampoule 50 mg/1 mL 250 mg/5 mL Sandimmun Novartis t/a Sandoz (UK)	(I) or (C) IV infusion via a volumetric infusion pump or syringe pump **1** **2** **3** 4 5 **6** **7** **8** NPSA risk rating: 6	Dilute dose with NS or G to give a final concentration of 0.5–2.5 mg/mL The dose should be prepared and administered with PVC-free equipment. At UCLH all syringes are PVC-free, and haematology wards stock PVC-free administration sets. The dose may be diluted in Baxter Viaflow bags as these are also PVC-free	Usually over 2–6 hours In special circumstances the infusion may be given over 24 hours (unlicensed)	**Infusion-related adverse events:** headache, tremor, hypertension, nausea, vomiting, abdominal pain, diarrhoea, muscle cramps, paraesthesia **pH:** 6–7 (undiluted) **Flush:** NS **Sodium content:** nil **Other comments:** non-PVC equipment held at UCLH at time of writing: Terumo/BD Plastipak syringes, B Braun Infusomat Space PVC-free Line, Baxter Viaflow infusion bags Infusion solution contains polyoxyethylene hydrogenated castor oil which leaches plasticiser from PVC equipment. It may also cause 'anaphylactoid' reactions Contains ethanol	**Compatible fluids:** NS, G **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Cidofovir					
Ready prepared bag from UCLH pharmacy production, containing the prescribed dose of cidofovir.	(I) IV infusion via a volumetric infusion pump using the ready prepared bag (preferred method) **1** 2 3 4 5 6 **7** 8 NPSA risk rating: 4	Ready diluted See comment (a)	Over 1 hour	**Infusion-related adverse events:** nephrotoxicity (see comments), headache, shortness of breath, nausea, vomiting, rash, fever, chills **pH:** 7.4 (diluted in NS) **Osmolality:** 600 mOsmol/kg (undiluted), 270–333 mOsmol/kg (diluted in 100 mL NS) **Flush:** NS **Sodium content:** 2.5 mmol/5 mL vial **Other comments:** (a) the ready prepared bag is the preferred option as it avoids preparation of a potentially toxic medicine on the ward. To obtain a supply contact pharmacy when cidofovir is prescribed (b) probenicid and hydration fluids may be administered prior to cidofovir to minimise the risk of nephrotoxicity	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
Vial 375 mg/5 mL Vistide Gilead (UK)	(I) IV infusion via a volumetric infusion pump **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4	Add the dose to a 100 mL bag NS Care should be taken when preparing the dose as cidofovir may cause toxicity in the event of exposure	Over 1 hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ciprofloxacin					
Vial 100 mg/50 mL Ciproxin Bayer (UK) Vial 200 mg/100 mL 400 mg/200 mL *Non-proprietary* Claris (UK)	(I) IV infusion into a large peripheral vein **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted	**Adults:** 200 mg dose over 30 minutes 400 mg dose over 60 minutes **Children:** over 60 minutes	**Infusion-related adverse events:** nausea, diarrhoea, vomiting, rash, injection site reactions **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 3.9–4.5 (Claris, Bayer) **Osmolarity:** 300–320 mOsmol/L (Claris) **Osmolality:** 285–317 mOsmol/kg (Bayer) **Flush:** NS **Sodium content:** 7.7 mmol/50 mL 15.4 mmol/100 mL 30.8 mmol/200 mL	**The following data assume ciprofloxacin is infused into the Y-site as a 2 mg/mL solution (from the vial). Ciprofloxacin solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, G10, GS, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** linezolid, metronidazole **Y-site compatible when diluted in G or NS:** amikacin, clarithromycin, digoxin, dobutamine, gentamicin, lidocaine, morphine, remifentanil **Y-site compatible when diluted in G:** amiodarone **Incompatible:** aminophylline, amoxicillin, amphotericin, benzylpenicillin, clindamycin, co-amoxiclav, dexamethasone, heparin sodium, pipericillin with tazobactam, propofol

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Clarithromycin					
Vial 500 mg Klaricid Abbott (UK)	(I) IV infusion via a large peripheral vein **1** **2** 3 4 **5** 6 7 8 NPSA risk rating: 3	**500 mg dose:** add 10 mL W to vial. Dilute to 250 mL with NS, G or GS **Doses less than 500 mg:** add 10 mL W to vial to give a 50 mg/mL solution. Dilute each 1 mL of drug with 25 mL of NS, G or GS e.g. dilute a 100 mg dose to 50 mL The final concentration should not exceed 2 mg/mL	Over 1 hour	**Infusion-related adverse events:** injection site reactions, taste disturbances. Rapid administration may cause arrhythmias **pH:** 4.8–6 (reconstituted) **Flush:** NS **Sodium content:** negligible **Displacement value:** accounted for during reconstitution step. When 10 mL W is added to the vial a 500 mg in 10 mL solution is made **Other comments:** use the vial within 24 hours of reconstitution Use the diluted solution within 6 hours of preparation	**The following data assume clarithromycin is infused into the Y-site as a 4 mg/mL solution. Clarithromycin solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** ciprofloxacin, metronidazole **Y-site compatible when diluted in G or NS:** atracurium, benzylpenicillin, bumetanide, dobutamine, dopamine, insulin, lidocaine, ranitidine, vancomycin, vecuronium **Y-site compatible when diluted in G:** amiodarone **Incompatible:** aminophylline, heparin sodium
	Fluid restriction (unlicensed): (I) IV infusion into a central line using a volumetric infusion pump or syringe pump **1** **2** 3 4 **5** 6 7 8 NPSA risk rating: 3	**500 mg dose:** add 10 mL W to vial. Withdraw 10 mL from a 100 mL bag NS, G or GS, then add the dose to the bag **Doses less than 500 mg:** add 10 mL W to vial to give a 50 mg/mL solution. Dilute each 1 mL of drug to 10 mL with NS, G or GS e.g. dilute a 100 mg dose to 20 mL The final concentration should not exceed 5 mg/mL	Over 1 hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Clindamycin					
Ampoule 300 mg/2 mL 600 mg/4 mL *Non-proprietary* Villerton (Luxembourg) Distributed by Bowmed t/a Arrow (UK)	(I) IV infusion **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Dilute with NS or G. The final concentration should be no greater than 18 mg/mL Suggested dilutions: **dose 300–900 mg:** add to 50 mL bag NS or G **dose 901–1200 mg:** add to 100 mL bag NS or G	300 mg: over 10 minutes 600 mg: over 20 minutes 900 mg: over 30 minutes 1200 mg: over 40 minutes Maximum rate: 30 mg/minute	**Infusion-related adverse events:** hypotension and cardiopulmonary arrest associated with too rapid infusion. Abscess formation at injection site after IM administration **pH:** 5.5–7 (undiluted) **Osmolality:** 833 mOsmol/kg (undiluted) **Flush:** NS **Sodium content:** negligible	**The following data assume clindamycin is infused into the Y-site as a 12 mg/mL solution. Clindamycin solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** foscarnet **Y-site compatible when diluted in G or NS:** aciclovir, amikacin, caffeine, gentamicin, magnesium sulphate, morphine, pethidine, tacrolimus, zidovudine **Incompatible:** aminophylline, calcium gluconate, ceftriaxone, doxapram
	IM 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted Doses greater than 600 mg should be split and administered at separate sites			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Clonazepam					
Ampoule 1 mg/1 mL Rivotril Roche (UK)	IV bolus **1** **2** 3 4 5 6 7 8 NPSA risk rating: 2	Dilute each ampoule with 1 mL W	Maximum rate: 1 mL/minute (0.5 mg/minute)	**Infusion-related adverse events:** drowsiness, hypotension, respiratory depression, paradoxical agitation, thrombophlebitis **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 3.8 (undiluted), 3.4–4.3 (diluted 1:1 with W) **Flush:** NS **Sodium content:** nil **Other comments:** (a) clonazepam adsorbs to PVC so should preferably be given using PVC-free equipment. Non-PVC equipment held at UCLH at time of writing: Terumo/BD Plastipak syringes, B Braun Infusomat Space PVC-free Line, Baxter Viaflow infusion bags (b) contains benzyl alcohol, ethanol and propylene glycol	**Compatible fluids:** NS, G, GS, G10 **Do not infuse with any other medicines or infusion fluids**
	(I) IV infusion via volumetric infusion pump **1** **2** **3** 4 5 **6** **7** **8** NPSA risk rating: 6	Add up to three ampoules to 250 mL NS, G or G10 Preferably administer with PVC-free equipment; see comment (a)	Over 30–60 minutes, according to patient response		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Clonidine hydrochloride					
Ampoule 150 micrograms/1 mL Catapres Boehinger Ingelheim (UK)	IV infusion **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Add dose to a convenient volume (usually 50–100 mL) of NS or G	Over 10–15 minutes	**Infusion-related adverse events:** dizziness, sedation, dry mouth, hypotension, hypertensive crisis with sudden withdrawal **pH:** 4–4.5 (undiluted) **Osmolality:** 272 mOsmol/kg **Flush:** NS **Sodium content:** 0.1 mmol/mL **Other comments:** when stopping clonidine the rate of infusion should be reduced over several hours to minimise the risk of hypertensive crisis	**The following data assume clonidine is infused into the Y-site as a 20 microgram/mL solution. Clonidine solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids**: NS, G, GS **Y-site compatible ready-diluted medicines:** esmolol **Y-site compatible when diluted in G or NS:** acetylcysteine, adrenaline, alfentanil, atracurium, dobutamine, dopamine fentanyl, heparin sodium, insulin, labetolol, midazolam, morphine, noradrenaline, remifentanil, rocuronium, sodium nitroprusside, vecuronium **Y-site compatible when diluted in G:** amiodarone
	(C) IV infusion via a syringe pump (unlicensed) **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4	Dilute four ampoules to 30 mL with NS or G. This gives a 20 microgram/mL solution	Usually 1.25–5 mL/hour adjusted according to blood pressure and level of sedation This is equivalent to a rate of 25–100 micrograms/hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Co-amoxiclav ⚠ **This is a penicillin. Check allergy status before administration**					
Vial 600 mg *Non-proprietary* CP Pharmaceuticals (UK) Contains amoxicillin 500 mg and clavulanic acid 100 mg	IV bolus 1 2 3 4 **5** **6** 7 8 NPSA risk rating: 2	**For 600 mg or 1.2 g doses:** add 10 mL W to 600 mg vial or 20 mL W to 1.2 g vial **If a part vial is required:** add 9.5 mL to 600 mg vial or 19.1 mL to 1.2 g vial. This produces a 60 mg/mL solution	Over 3–5 minutes	**Infusion-related adverse events:** hypersensitivity, itching, rash **pH:** 8–10 (600 mg reconstituted in 10 mL W) **Osmolarity:** 355 mOsmol/L (reconstituted) 316 mOsmol/L (1.2 g in 100 mL NS) **Flush:** NS **Sodium content:** 1.6 mmol/600 mg vial (CP Pharmaceuticals), 2.7 mmol/1.2 g vial (Arrow) **Displacement value:** 0.5 mL/600 mg vial 0.9 mL/1.2 g vial Displacement values for GSK (Augmentin), Pliva and Teva co-amoxiclav are the same as above **Other comments:** use vials within 20 minutes of reconstitution. Complete infusion within 4 hours of dilution	**The following data assume co-amoxiclav is infused into the Y-site as a 10 mg+2 mg/mL solution. Co-amoxiclav solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, H, potassium chloride 40 mmol/L in NS **Y-site compatible ready-diluted medicines:** ciprofloxacin **Y-site compatible when diluted in NS:** atosiban, clarithromycin **Incompatible:** G, amikacin, gentamicin, midazolam, morphine, sodium bicarbonate, tobramycin
Vial 1.2 g *Non-proprietary* Bowmed t/a Arrow (UK) Contains amoxicillin 1000 mg and clavulanic acid 200 mg	(I) IV infusion 1 **2** 3 4 **5** **6** 7 8 NPSA risk rating: 3	Reconstitute the vial as above **Doses up to 600 mg:** add dose to 50 mL NS **Doses 601–1200 mg:** add to 100 mL NS	Over 30–40 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Codeine phosphate					**For IM or SC use only**
Ampoule 60 mg/mL *Non-proprietary* South Devon Healthcare (UK)	IM **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted		**Infusion-related adverse events:** respiratory and CNS depression, hypotension, pain at injection site **pH:** 3–6 **Osmolarity:** 295 mOsmol/L **Sodium content:** nil **Other comments:** codeine phosphate may be given as an SC bolus if the IM route is not appropriate (unlicensed)	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Colistimethate sodium (colistin sulphomethate sodium)					
Vial 1 million units 2 million units Colomycin Injection Forest Laboratories UK Limited (UK)	(I) IV infusion **1** **2** 3 4 **5** 6 **7** 8 NPSA risk rating: 4	Reconstitute 1 million units with 5 mL W or NS or 2 million units with 10 mL W or NS, then further dilute to 50 mL NS	Over 30 minutes	**Infusion-related adverse events:** injection site pain. Excessive doses may cause neuro- and nephrotoxicity **pH:** 7.3–7.8 (in NS), 7.6–8.3 (in W) **Osmolality:** 288–335 mOsmol/kg (in NS), 7–55 mOsmol/kg (in W) **Flush:** NS **Sodium content:** less than 0.5 mmol in any strength vial **Displacement value:** 1 million unit vial: 0.02 mL 2 million unit vial: 0.04 mL **Other comments:** 1 mg colistimethate sodium is equivalent to approximately 12,500 units	**Compatible fluids:** NS, G, GS, H **Do not administer with any other medicines or diluents**
	IV bolus via central line only **1** 2 3 4 **5** 6 7 8 NPSA risk rating: 2	Reconstitute each 1 million units with 5 mL W or NS	Over 5 minutes		
	IM **1** 2 3 4 **5** 6 7 8 NPSA risk rating: 2	Reconstitute each 1 million unit vial with 1 mL W			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Colistin					
***see* colistimethate sodium**					

Compound sodium lactate (Hartmann's/Ringer's lactate solution)					
Bag 500 mL, 1 L *Non-proprietary* Baxter (UK) Contains: sodium 131 mmol/L potassium 5 mmol/L calcium 2 mmol/L chloride 111 mmol/L lactate 29 mmol/L	**Hydration fluid and diluent for medicines:** (I) or (C) IV infusion **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted	According to patient need **Adults:** usually 35 mL/kg over 24 hours **Children:** usually 5 mL/kg per hour	**Infusion-related adverse events:** hypersensitivity reactions including itching, facial swelling, rash, bronchospasm. Anxiety (as a result of the lactate component). Hyperhydration may cause heart failure and peripheral and pulmonary oedema **pH:** 5–7 **Osmolarity:** 278 mOsmol/L **Flush:** NS **Sodium content:** 131 mmol/L	**See individual drug monographs for drug compatibilities** **Up to 160 mmol potassium chloride may be added to 1 L of compound sodium lactate. However, the addition of potassium to infusion bags is restricted to critical care and some theatres at UCLH** **Up to 100 mmol of magnesium sulphate may be added to 1 L of compound sodium lactate**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Co-trimoxazole					
Ampoule 480 mg/5 mL Septrin GSK (UK) Each ampoule contains trimethoprim 80 mg and sulfamethazole 400 mg	(I) IV infusion into a central line or large peripheral vein **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	**Doses up to 480 mg**: add to 100 mL NS or G **Doses 481–960 mg:** add to 250 mL NS or G **Doses 961–3840 mg:** add to 500 mL NS or G **Doses 3841 mg and above:** add to 1 L NS or G	**Doses up to 3840 mg:** over 60–90 minutes **Doses 3841 mg and above:** over a minimum of 2 hours If nausea is a problem the infusion time may be increased	**Infusion-related adverse events:** skin rash (discontinue infusion), thrombophlebitis, headache, nausea, diarrhoea **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **Osmolality:** 833 mOsmol/kg (480 mg in 100 mL NS) **pH:** 9.6–10.5 (undiluted) **Flush:** NS **Sodium content:** 1.7 mmol/5 mL vial **Other comments:** (a) inspect the solution for cloudiness at time of preparation and immediately before and during administration. The dilution with G in fluid restriction may result in particle formation, in which case it should be discarded (b) contains ethanol and sodium metabisulphite. The latter may cause hypersensitivity reactions, particularly in asthmatics	**The following data assume co-trimoxazole is infused into the Y-site as a 0.8 mg+4 mg/mL solution. Co-trimoxazole solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, G10 **Y-site compatible when diluted in G or NS:** aciclovir, atracurium, granisetron, magnesium sulphate, morphine, pethidine, piperacillin with tazobactam, remifentanil, tacrolimus **Incompatible:** fluconazole, linezolid
	Fluid restriction: (I) IV infusion into a central line or large peripheral vein **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Dilute each 480 mg ampoule with 75 mL G. This will require removal of fluid from a G infusion bag. See comment (a)	Over 1 hour		
	Fluid restriction: (I) IV infusion into a central line via a syringe pump (unlicensed) **1** 2 3 4 5 **6** **7** 8 NPSA risk rating: 3	Give undiluted	Over 60–90 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Crisantaspase (asparaginase from *Erwinia chrysanthemi*)					
Vial 10,000 units Erwinase EUSA Pharma (Europe) Limited (UK)	Intradermal, for 1000 unit test dose only 1 2 3 4 **5** **6** 7 8 NPSA risk rating: 2	Reconstitute each vial with 1 mL NS See comments		**Infusion-related adverse events:** hypersensitivity reactions including fever, hypotension, rash, vomiting and bronchospasm. Injection site pain, hyperglycaemia **pH:** 6–7.5 **Flush:** NS **Sodium content:** less than 0.01 mmol/vial **Displacement value:** nil **Osmolality:** 285 mOsmol/kg **Other comments:** (a) test dose to be administered to a marked area of the forearm 4 hours prior to first full dose (b) to reconstitute inject the W against the wall of the vial and gently rotate to dissolve the drug. To avoid frothing do not inject W directly on to the powder or shake the vial	**Do not infuse with any other medicines or infusion fluids**
	IM (preferred route) 1 2 3 4 **5** **6** 7 8 NPSA risk rating: 2	Reconstitute each vial with 1 mL NS			
	IV bolus 1 2 3 4 **5** **6** 7 8 NPSA risk rating: 2	Reconstitute each vial with 1 mL NS	Over 1 minute		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Cyclizine lactate					
Ampoule 50 mg/1 mL Valoid Amdipharm (UK) Ampoule 50 mg/1 mL *Non-proprietary* Martindale (UK)	IV bolus **1** **2** 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted **Local practice at UCLH:** further dilute to 10 mL with W, NS or G Immediately after dilution, and again just before injection, check the solution for signs of precipitation. Discard if there is any cloudiness or haze formation	Over 3–5 minutes See comment (a)	**Infusion-related adverse events:** drowsiness, headache, rash, tachycardia, dry mouth, blurred vision, urinary retention, insomnia **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 3.3–3.7 (undiluted) **Flush:** NS, G **Sodium content:** nil **Other comments:** (a) rapid bolus administration may cause a burning sensation/phlebitis. As the volume of undiluted solution is small it may be further diluted to enable easier bolus administration. The solution should be checked immediately prior to injection and discarded if cloudy (b) for further information about the use of cyclizine in palliative care refer to local syringe driver guidelines	**Compatible in a syringe for (C) SC infusion:** dexamethasone, diamorphine, dihydrocodeine, fentanyl, glycopyrronium, haloperidol lactate, hyoscine butylbromide, hyoscine hydrobromide, levomepromazine, metoclopramide, midazolam, morphine, octreotide, ondansetron, oxycodone **See section A15 for further details**
	Nausea and vomiting in palliative care: (C) SC infusion via a syringe driver (unlicensed) **1** **2** **3** **4** 5 **6** **7** 8 NPSA risk rating: 6	Dilute to a convenient volume with W May be mixed with other medicines in the same syringe	Over 24 hours See comment (b)		
	IM/SC bolus **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Dalteparin sodium					
Pre-filled syringe 2,500 units/0.2 mL 5,000 units/0.2 mL 7,500 units/0.3 mL 12,500 units/0.5 mL 15,000 units/0.6 mL 18,000 units/0.72 mL Graduated pre-filled syringe 10,000 units/1 mL Vial 100,000 units/4 mL (multi-dose) Ampoule 10,000 units/1 mL (single use) All preparations marketed as: Fragmin Pharmacia (UK)	**Thromboprophylaxis. Treatment of thromboembolism or unstable angina:** SC bolus **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted		**Infusion-related adverse events:** injection site reactions including pain and bruising **pH:** 5–7.5 **Osmolality:** 250–450 mOsmol/kg (10,000 units/mL ampoule) 250–750 mOsmol/kg (100,000 units/4 mL multi-dose vial) **Flush:** NS **Other comments:** (a) only the 10,000 units/1 mL ampoule and 100,000 units/4 mL vial are licensed for IV administration (b) 100,000 units/4 mL multi-dose vial: once opened use within 14 days. The vial contains benzyl alcohol (c) at UCLH heparin sodium is the preferred anticoagulant for prevention of clotting during haemofiltration	**Compatible fluids:** NS, G, GS Do not infuse with any other medicines or infusion fluids
	Prevention of clotting during haemodialysis and haemofiltration: IV bolus. See comments. **1** 2 **3** 4 5 **6** 7 8 NPSA risk rating: 3	Dilute with suitable volume of NS or G	Over 3–5 minutes		
	Prevention of clotting during haemodialysis and haemofiltration: (I) or (C) IV infusion via a syringe pump. See comments **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	Dilute with suitable volume of NS or G	Consult summary of product characteristics for details		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Danaparoid sodium					
Ampoule 750 units/0.6 mL Orgaran Organon Laboratories Limited (UK)	IV bolus (prior to an infusion) **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted	Over 3–5 minutes	**Infusion-related adverse events:** pain and bruising may occur at SC injection site **pH:** 7 **Osmolality:** 290 mOsmol/kg **Flush:** NS, G, GS **Sodium content:** less than 0.1 mmol/vial **Other comments:** IV danaparoid is licensed for heparin-induced thrombocytopenia, SC danaparoid is licensed for thromboprophylaxis Contains sodium sulphite, which may cause hypersensitivity reactions, particularly in asthmatics Contains glycosaminoglycuronans derived from porcine and bovine mucosa	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	(C) IV infusion via a syringe pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	Dilute 24 mL of danaparoid to 30 mL with NS or G. This gives a 30,000 units/30 mL solution. Each 1 mL of the diluted solution contains 1000 units of danaparoid	Refer to the heparin-induced thrombocytopenia guidelines on the UCLH intranet or local HIT guidelines The rates of administration at UCLH are unlicensed and based on the American College of Chest Physicians' guidelines for the treatment of HIT		
	SC **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Dantrolene sodium					
Vial 20 mg Dantrium Proctor & Gamble t/a SpePharm (UK)	IV bolus into a central line or large peripheral vein **1** 2 3 4 **5** **6** 7 8 NPSA risk rating: 3	Add 60 mL W to the vial	Usually 1 mg/kg over a few minutes	**Infusion-related adverse events:** injection site reactions including pain and thrombophlebitis. Rash **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 9.5 (reconstituted in W) **Osmolarity:** 274 mOsmol/L **Flush:** W **Sodium content:** negligible **Displacement value:** negligible **Other comments**: use solution within 6 hours of reconstitution	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Desferrioxamine mesilate					
Vial 500 mg *Non-proprietary* Mayne t/a Hospira (UK) Vial 2 g Desferal Ciba t/a Novartis (UK)	(I) or (C) SC infusion via a volumetric infusion pump or a portable infusion device **1** **2** **3** 4 **5** **6** **7** 8 NPSA risk rating: 6 (for an infusion prepared on the ward)	Add 5 mL W to the 500 mg vial, or 20 mL W to the 2 g vial. Further dilute to a convenient volume with NS, G or GS Ready-made reservoirs may be obtained from pharmacy for portable infusion devices	**Chronic iron overload:** usually 20–60 mg/kg over 8–24 hours	**Infusion-related adverse events:** flushing, tachycardia, hypotension, itching, especially with rapid infusion. Injection site pain, swelling, burning **pH:** 3.5–5.5 (undiluted, Hospira) 5–5.4 (100 mg/mL solution, Ciba) **Osmolarity:** 281 mOsmol/L (100 mg/mL solution, Ciba) **Flush:** NS **Sodium content:** nil (Hospira, Ciba) **Displacement value:** 0.32 mL/500 mg (Mayne) 1.5 mL/2 g vial (Ciba) For IV injection: add 4.7 mL W to the 500 mg vial to obtain a 500 mg/5 mL solution **Other comments:** consult product literature for doses and administration details for aluminium overload, diagnosis of certain anaemias and iron storage disease	**Compatible fluids:** NS, G, GS **Incompatible:** heparin **Do not infuse with any other medicines or infusion fluids**
	(I) or (C) IV infusion via a volumetric infusion pump **1** **2** **3** 4 **5** **6** **7** 8 NPSA risk rating: 6	As above	**Chronic iron overload:** as above **Iron poisoning:** usually 15 mg/kg per hour, reduced after 4–6 hours. Total daily dose: 80 mg/kg		
	IM **1** 2 3 4 **5** **6** 7 8 NPSA risk rating: 3	Add 5 mL W to the 500 mg vial, or 20 mL W to the 2 g vial	Doses above 5 mL should be injected at multiple sites to minimise pain on injection		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Desmopressin acetate					
Ampoule 4 micrograms/1 mL DDAVP Ferring (UK) Ampoule 15 micrograms/1 mL Octim Ferring (UK)	(I) IV infusion 1 **2** 3 4 5 **6** **7** 8 NPSA risk rating: 3	Add dose to 50 mL NS For low doses dilute to concentration not less than 1 microgram/mL e.g. add 1 mL (4 micrograms) to 3 mL NS to give a concentration of 1 microgram/mL	Over 20 minutes	**Infusion-related adverse events:** hypotension, tachycardia, facial flushing **pH:** 4.5 (DDAVP) 3.5–5 (Octim) **Osmolality:** 300 mOsmol/kg **Flush:** NS **Sodium content:** 0.4 mmol/1 mL vial (both strengths) **Other comments:** the 4 micrograms/mL preparation is licensed for IM administration	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**
	SC/IM (see comments) 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Dexamethasone					
Ampoule 4 mg/1 mL of dexamethasone base *Non-proprietary* Organon	IV bolus 1 **2** 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted. May be further diluted to a convenient volume with NS or G	Over 3–5 minutes	**Infusion-related adverse events:** transient tingling/ burning in the perineal area, particularly on rapid administration. Psychiatric reactions including mood changes. Gastric irritation, hypertension, hyperglycaemia. Rarely, cardiovascular collapse, hypersensitivity reactions **pH:** 7–8.5 **Flush:** NS **Sodium content:** negligible (Organon), 0.2 mmol/vial (Hospira) **Other comments:** the manufacturers of dexamethasone may state the content of their product according to the base or the phosphate salt of the drug. At UCLH dexamethasone is prescribed as the **base**, i.e. to give dexamethasone 4 mg take 1 mL of the Organon product or 1.2 mL of the Mayne/Hospira product	**The following data assume dexamethasone base is infused into the Y-site as a 3.3 mg/mL solution. Dexamethasone solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** fluconazole, foscarnet **Y-site compatible when diluted in G or NS:** amikacin, caffeine, flucloxacillin, meropenem, tacrolimus **Y-site compatible when diluted in NS:** furosemide **Incompatible:** ciprofloxacin, doxapram **Compatible in a syringe for (C) SC infusion:** cyclizine, diamorphine, dihydrocodeine, fentanyl, glycopyrronium, haloperidol lactate, hyoscine butylbromide, hyoscine hydrobromide, levomepromazine, metoclopramide, midazolam, morphine, octreotide, ondansetron, oxycodone **See Section A15 for further details**
Vial 6.6 mg/2 mL of dexamethasone base (containing 8 mg/2 mL dexamethasone sodium phosphate) *Non-proprietary* Hospira (UK) t/a Mayne **See comments regarding preparations**	(I) IV infusion 1 **2** 3 4 5 **6** 7 8 NPSA risk rating: 2	Add the dose to 100 mL bag NS or G	Over 15 minutes		
	IM/SC/intra-articular 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted			
	Palliative care: (C) SC infusion via a syringe driver (unlicensed) **1** **2** **3** **4** 5 **6** **7** 8 NPSA risk rating: 6	Dilute to a convenient volume with W, NS or G. May be mixed with other medicines in the same syringe	Over 24 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Diamorphine hydrochloride					
Ampoule 5 mg 10 mg 30 mg 100 mg 500 mg *Non-proprietary* Wockhardt (UK)	IV/SC bolus/IM 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Add 1 mL W to 5 mg, 10 mg, 30 mg or 100 mg ampoule Add 2 mL W to 500 mg ampoule May be further diluted to a convenient volume with NS or G See comment (a)	**IV bolus:** over a few seconds Myocardial infarction or pulmonary oedema: usually 1 mg/min	**Infusion-related adverse events:** respiratory and CNS depression, itching, sweating, hypotension, brady- and tachycardia **pH:** 2.5–6 **Flush:** NS **Sodium content:** nil **Other comments:** (a) at UCLH IV boluses of opioids should only be used in areas where this has been explicitly sanctioned (b) for further information about the use of diamorphine in palliative care refer to local syringe driver guidelines	**Compatible in a syringe for (C) SC infusion:** cyclizine, dexamethasone, glycopyrronium, haloperidol lactate, hyoscine butylbromide, hyoscine hydrobromide, levomepromazine, midazolam, metoclopramide, octreotide, ondansetron **See Section A15 for further details**
	Analgesia in palliative care or sickle cell crisis: (C) IV or SC infusion via a syringe pump or syringe driver 1 2 3 4 5 6 7 8 NPSA risk rating: 7	As above For SC use W is the preferred diluent For IV use G is the preferred diluent Diamorphine may be mixed with other drugs in the same syringe, particularly when used in palliative care See comment (b)	Over 24 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Diazepam emulsion					
Ampoule 10 mg/2 mL Diazemuls Actavis (UK)	IV bolus into a large vein **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted	Maximum rate: 1 mL/minute	**Infusion-related adverse events:** drowsiness, hypotension, respiratory depression, paradoxical agitation **Extravasation**: may cause tissue damage; for management guidelines see Section A7 **pH:** 8 (undiluted) **Flush:** NS **Sodium content:** negligible **Other comments:** (a) to minimise diazepam adsorption to plastic equipment, the drug should be given using PVC-free equipment: Baxter Viaflow bags and the B Braun Infusomat Space PVC-free Line are available at UCLH. Adsorption is thought to be less of a problem with diazepam emulsion (b) contraindicated in patients allergic to egg or soybean (c) diazepam emulsion causes less injection site irritation than diazepam solution	**Other compatible diluents:** Intralipid 10% and 20% **Y-site compatible fluids:** NS, G, GS, G10 **Do not infuse with any other medicines or infusion fluids**
	Tetanus and status epilepticus: (I) IV infusion via a volumetric infusion pump into a large vein **1** **2** **3** 4 5 **6** **7** **8** NPSA risk rating: 6	Add 2–8 mL (10–40 mg) to 100 mL G or G10 Preferably give via a PVC-free administration set. See comment (a) Use within 6 hours of preparation	**Tetanus:** 3–10 mg/kg over 24 hours **Status epilepticus:** usually up to 3 mg/kg over 24 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Diazepam solution					
Ampoule 10 mg/2 mL *Non-proprietary* Hameln (UK)	IV bolus into a large vein **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted	Maximum rate: 1 mL/minute	**Infusion-related adverse events**: drowsiness, hypotension, respiratory depression, paradoxical agitation **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 6.2–7 (undiluted) **Flush:** NS **Sodium content:** negligible **Other comments:** (a) to minimise diazepam adsorption to plastic equipment, the drug should be given using PVC-free equipment: Baxter Viaflow bags and the B Braun Infusomat Space PVC-free Line are available at UCLH. Adsorption is thought to be less of a problem with diazepam emulsion (b) contains propylene glycol and ethanol	**The following data assume diazepam is infused into the Y-site as a 0.2 mg/mL solution. Diazepam solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, GS **Y-site compatible when diluted in G or NS:** dobutamine, remifentanil **Incompatible:** ketamine
	Tetanus and status epilepticus: (I) IV infusion via a volumetric infusion pump into a large vein **1** **2** **3** 4 5 **6** **7** **8** NPSA risk rating: 6	Add dose to convenient volume of NS or G. The final concentration should be no greater than 0.08 mg/mL Preferably give via a PVC-free administration set. See comment (a) Use within 6 hours of preparation	**Tetanus:** 3–10 mg/kg over 24 hours **Status epilepticus:** usually up to 3 mg/kg over 24 hours		
	IM **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted Use only if IV route not available			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Diclofenac sodium					
Ampoule 75 mg/3 mL Voltarol Geigy t/a Novartis (UK) **Voltarol and Dyloject are not interchangeable. Check the method of administration is appropriate for the brand of diclofenac available at the time of preparation**	(I) IV infusion using **Voltarol** brand **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Dilute dose with 100–500 mL buffered NS or buffered G To make the buffered infusion solution add 0.5 mL sodium bicarbonate solution 8.4% to the bag before adding the diclofenac See comments (a) and (b)	**25–50 mg:** over 15 minutes or longer **75 mg:** over 30 minutes or longer	**Infusion-related adverse events**: nausea, vomiting, stomach cramps, dizziness, injection site pain **pH:** 7.8–9 (undiluted) **Flush:** NS **Sodium content:** 0.3 mmol/75 mg ampoule **Other comments:** (a) the buffered solution can also be made by adding 1 mL sodium bicarbonate solution 4.2% (b) the Dyloject brand is formulated to allow IV bolus administration. The Voltarol brand is formulated for IV infusion. Either brand may be used for IM injection (c) maximum daily dose (regardless of route): 150 mg	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	(C) IV infusion using **Voltarol** brand **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	As above	Usual rate 5 mg/hour		
	Deep IM using the Voltarol or Dyloject brands 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted			
Ampoule 75 mg/2 mL Dyloject Javelin Pharmaceuticals (UK)	IV bolus using **Dyloject** brand only **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted See comment (b)	Over a few seconds		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Dicobalt edetate					
Ampoule 300 mg/20 mL *Non-proprietary* Cambridge Laboratories (UK)	IV bolus via a large vein or central line **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted	**Adults:** give one ampoule over 1 minute Follow each dose with 50 mL glucose 50% flush **Children:** 0.12–0.33 mL/kg (maximum 20 mL) over 1 minute	**Infusion-related adverse events:** vomiting, hypotension, tachycardia. Facial swelling, chest pain, sweating and rash may suggest cobalt overdose or anaphylaxis **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 4–7.5 (undiluted) **Flush:** glucose 50% **Sodium content:** nil **Other comments:** dicobalt edetate is used for the treatment of cyanide poisoning. It is toxic, and potentially fatal in the absence of cyanide poisoning. For full management advice contact the National Poisons Information Service or refer to www.toxbase.org Dicobalt edetate may not cause tissue damage itself, but the glucose 50% flush is known to be a risk in extravasation	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Digibind					
see digoxin specific antibody fragments					

Formulation	Method	Dilution	Rate	Comments	Compatibility
Digoxin					
Ampoule 500 micrograms/2 mL Lanoxin GSK (UK) Ampoule (unlicensed) 100 micrograms/1 mL (paediatric) *Non-proprietary* BCM Specials (UK)	(I) IV infusion via a volumetric infusion pump or syringe pump (preferred method) **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4	Dilute the dose to a convenient volume of NS, G or GS Each 1 mL digoxin should be diluted with at least 4 mL diluent **Adults:** dose is usually added to 50–100 mL bag	Preferably over 2 hours. Shorter infusion times may be used in urgent cases Minimum infusion time: 10 minutes, but monitor for signs of digoxin toxicity	**Infusion-related adverse events:** dizziness, blurred or yellow vision, arrhythmias, nausea, vomiting. Rapid administration may cause hypertension **ECG monitoring required** if being loaded/newly initiated for atrial fibrillation or flutter **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 6.7–7.8 (undiluted) **Flush:** NS **Sodium content:** negligible **Other comments:** bolus administration is more likely to cause adverse effects. Patients should be monitored closely for signs of digoxin toxicity, hypertension and reduced coronary flow Contains ethanol and propylene glycol Levels should be taken at least 6 hours after a dose NB digoxin 62.5 microgram tablet = 40 microgram IV	**The following data assume digoxin is infused into the Y-site as a 2.5 microgram/mL solution. Digoxin solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, sodium chloride 0.45%, H, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** ciprofloxacin, linezolid **Y-site compatible when diluted in G or NS:** flucloxacillin, meropenem, morphine, pethidine, remifentanil, tacrolimus **Y-site compatible when diluted in NS:** furosemide **Incompatible:** esmolol
	IV bolus **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Dilute each 1 mL digoxin with at least 4 mL NS or G, e.g. dilute 2 mL digoxin with at least 8 mL NS or G	Over 10 minutes		
	Fluid restriction (unlicensed): IV bolus via a large vein or central line **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Give undiluted	Over 5–10 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Digoxin-specific antibody fragments					
Vial 38 mg Digibind GSK (UK)	(I) IV infusion via a volumetric infusion pump or syringe pump 1 2 **3** 4 5 6 7 8 NPSA risk rating: 7	Add 4 mL W to each vial. 1–20 vials may be required for a single dose. In severe digoxin toxicity up to 80 vials may be required After reconstitution add the vials to a convenient volume of NS. Suggested dilution: add to 100–250 mL NS Administer via a 0.22 micron filter. See comment (b)	Over 30 minutes	**Infusion-related adverse events:** hypersensitivity reactions including rash, shaking, fever and chills **ECG monitoring required during and for at least 24 hours after administration of Digibind** **pH:** 6–8 (reconstituted) **Flush:** NS **Sodium content:** 0.5 mmol/38 mg vial **Other comments:** (a) IV bolus is used if cardiac arrest seems imminent (b) filters are available from pharmacy (c) for formulae to calculate the dose refer to the Digibind summary of product characteristics (d) Digibind interferes with digoxin assays	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**
	IV bolus. See comment (a) 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Reconstitute as above, but do not dilute. Draw up the Digibind into a syringe and administer through a 0.22 micron filter. See comment (b)	Over 3–5 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Dihydrocodeine tartrate					**For IM or SC use only**
Ampoule 50 mg/1 mL *Non-proprietary* Cardinal Health (UK)	IM or SC only **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted		**Infusion-related adverse events:** respiratory and CNS depression, hypotension, pain at injection site **pH:** 3–4.5 **Sodium content:** 0.01 mmol/vial **Other comments**: contains sodium metabisulphite, which may cause hypersensitivity reactions, particularly in asthmatics Dihydrocodeine is rarely used in syringe drivers. Morphine and diamorphine are the opiates of choice in palliative care. For further information about dihydrocodeine in palliative care refer to local syringe driver guidelines	**Compatible in a syringe for (C) SC infusion:** cyclizine, dexamethasone, haloperidol, levomepromazine, midazolam **See Section A15 for further details**
	Analgesia in palliative care: (C) SC infusion via a syringe driver (unlicensed) **1** **2** **3** **4** 5 **6** **7** 8 NPSA risk rating: 6	Dilute to a convenient volume with W, NS or G. May be mixed with other medicines in the same syringe	Over 24 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Dihydroergotamine (unlicensed)					
Ampoule 1 mg/1 mL D.H.E. 45 Novartis (US)	(I) IV infusion via a volumetric infusion pump (preferred method) **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4	Add dose to 100 mL bag NS	Over 1 hour	**Infusion-related adverse events:** nausea, tachycardia, leg cramps, abdominal cramps. Rarely myocardial, cerebral or peripheral ischaemia **ECG required prior to administration** **Extravasation:** may cause tissue damage, for management guidelines, see Section A7 **pH:** 3.4–4.9 (undiluted) **Flush:** NS **Sodium content:** nil **Other comments:** at UCLH dihydroergotamine is used only by neurologists to treat migraine or cluster headaches. The short infusion is preferred as this is less likely to cause nausea than the bolus injection. Ondansetron 8 mg TDS and domperidone 10 mg TDS are given prior to dihydroergotamine to minimise nausea. Nausea may also be further reduced by slowing the infusion rate. Abdominal cramping may be treated with mebeverine or hyoscine butylbromide May also be given by IM and SC injection Contains ethanol and glycerol	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**
	(C) IV Infusion via a volumetric infusion pump **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4	Add three ampoules to 500 mL or 1 L NS	**If diluted to 500 mL:** initially 21 mL/hour **If diluted to 1 L:** initially 42 mL/hour		
	IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted. May be further diluted to a convenient volume with NS	Over 3–5 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Disodium pamidronate					
Vial 15 mg/5 mL 30 mg/10 mL *Non-proprietary* Medac (UK) Plastic ampoule 30 mg/2 mL 90 mg/6 mL *Non-proprietary* CP Pharmaceuticals (UK)	(I) IV infusion via a volumetric infusion pump, preferably into a large vein **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4	Add dose to convenient volume of NS or G At UCLH 90 mg is usually added to a 500 mL bag Maximum concentration: 60 mg/250 mL	Usually 60 mg/hour **Renal impairment:** maximum rate 20 mg/hour	**Infusion-related adverse events:** dizziness, sleepiness, injection site reactions, headache, hypertension, hypotension, nausea, vomiting, fever, flu-like symptoms **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 7–8 (undiluted, Medac) **Flush:** NS **Sodium content:** 0.1 mmol/15 mg vial (Medac) 0.2 mmol/30 mg vial (Medac)	**Compatible fluids:** NS, G, GS **Incompatible:** calcium-containing solutions including calcium chloride, calcium gluconate and H **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Disopyramide					
Ampoule 50 mg/5 mL Rythmodan Sanofi-Aventis (UK)	**Loading dose:** IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted	Usually 2 mg/kg over 5 minutes Maximum loading dose: 150 mg	**Infusion-related adverse events:** sweating (with too rapid administration), arrhythmias, dry mouth, visual disturbances, nausea, vomiting **ECG monitoring required** **pH:** 4–5 (undiluted) **Flush:** NS **Sodium content:** nil **Other comments:** maximum dose 300 mg over first hour and 800 mg in 24 hours (including loading dose)	**Compatible fluids:** NS, G, GS, H **Do not infuse with any other medicines or infusion fluids**
	Maintenance dose: (I) or (C) IV infusion following loading dose, via volumetric infusion pump or syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute to a convenient volume with NS, G or H	Usually 20–30 mg/hour (or 0.4 mg/kg per hour) See comments		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Dobutamine					
Ampoule 250 mg/20 mL *Non-proprietary* Hameln (UK)	**Adults and children:** (C) IV infusion via a volumetric infusion pump or syringe pump into a central line or large peripheral vein 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Dilute dobutamine with NS, G, GS or H to give a solution of 0.5–1 mg/mL **Suggested dilution for adults:** withdraw 40 mL from a 500 mL bag, then add two ampoules to the bag. This gives a 1 mg/mL solution **Suggested dilution for children:** dilute each 1 mL (12.5 mg) of dobutamine to 12.5 mL with NS, G, GS or H to give a 1 mg/mL solution	Initially 2.5–5 micrograms/kg per minute May be increased in 2.5–5 micrograms/kg per minute increments Usual maximum rate: 20 micrograms/kg per minute. Occasionally 40 micrograms/kg per minute rate is used in adults	**Infusion-related adverse events**: tachycardia, hypo- and hypertension, palpitations, anginal pain, nausea, vomiting, peripheral vasoconstriction and shortness of breath **ECG monitoring required** **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 3.5–4 (undiluted) ⚠ **Do not flush the administration set. After infusion is discontinued, disconnect the apparatus, aspirate the catheter/cannula, then flush with NS** **Sodium content:** negligible **Other comments:** for further information about dobutamine in neonates refer to 'Neonatal Monograph – Dobutamine' at www.uclhguide.com or the UCLH intranet or local dobutamine guidelines Dobutamine solutions may turn slightly pink. This does not indicate a significant loss of potency. The solution may still be used	**The following data assume dobutamine is infused into the Y-site as a 1 mg/mL solution. Dobutamine solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, GS, H, potassium chloride 40 mmol/L NS or G **Y-site compatible ready-diluted medicines:** ciprofloxacin, fluconazole, esmolol, linezolid, propofol 1% **Y-site compatible when diluted in NS:** furosemide **Y-site compatible when diluted in G or NS:** acetylcysteine, adrenaline, alfentanil, amiodarone, atracurium, caffeine, ceftazidime, clarithromycin, clonidine, dopamine, eptifibatide, ethanol, fentanyl, glyceryl trinitrate, granisetron, heparin sodium, insulin, labetolol, lidocaine, midazolam, morphine, noradrenaline, pancuronium, pethidine, remifentanil, rocuronium, sodium nitroprusside, streptokinase, tacrolimus, vasopressin, vecuronium, zidovudine
	In fluid restriction in adults and children: (C) IV infusion via a syringe pump into a central line (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 5 **This is the preferred method of administration in critical care areas at UCLH**	**All age groups:** dilute one ampoule to 50 mL NS or G to give a 5 mg/mL solution **Adults only:** alternatively dilute two ampoules to 50 mL to give a 10 mg/mL solution	As above		

Formulation	Method	Dilution	Rate	Comments	Compatibility
Dobutamine *continued*					
Ampoule 250 mg/20 mL *Non-proprietary* Hameln (UK)	**Neonates 3.4 kg or over:** (C) IV infusion via a syringe pump into a central line (unlicensed) **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	Dilute one ampoule to 50 mL NS or G to give a 5 mg/mL solution	**Neonates over 3.4 kg:** 5 micrograms/kg per minute		**Incompatible:** aciclovir, calcium chloride, calcium gluconate, magnesium sulphate, pantoprazole, pipericillin with tazobactam, sodium bicarbonate, sodium nitroprusside
	Neonates under 3.4 kg: (C) IV infusion via a syringe pump into a central line or large peripheral vein (unlicensed) **1** **2** 3 **4** 5 **6** **7** 8 NPSA risk rating: 5	**Neonates up to 1.6 kg:** dilute 30 mg/kg to 10 mL with G **Neonates 1.7–3.3 kg:** dilute 30 mg/kg to 20 mL with G	**Neonates up to 1.6 kg:** 0.1 mL/hour **Neonates 1.7–3.3 kg:** 0.2 mL/hour Both the above infusions give 5 micrograms/kg per minute		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Dopamine hydrochloride					
Ampoule 200 mg/5 mL *Non-proprietary* Hospira (UK)	**Adults:** (C) IV infusion via a volumetric infusion pump into a central line or large peripheral vein 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute dose with NS, G or H to give a 1.6 mg/mL or 3.2 mg/mL solution **To make a 1.6 mg/mL solution:** withdraw 20 mL from a 500 mL bag, then add four ampoules to the bag **To make a 3.2 mg/mL solution:** withdraw 40 mL from a 500 mL bag, then add eight ampoules to the bag	**Adults and children:** 1.6 mg/mL solutions may be given via a peripheral line or central line More concentrated solutions, including the 3.2 mg/mL solution, should be given via a central line only Initially 2.5 micrograms/kg per minute adjusted according to response In severe cases an initial rate of 5 micrograms/kg per minute may be used May be increased in 2.5–5 micrograms/kg per minute increments Usual maximum rate: 20 micrograms/kg per minute. Occasionally 50 micrograms/kg per minute rates are used in adults	**Infusion-related adverse events**: tachycardia, hypo- and hypertension, palpitations, anginal pain, nausea, vomiting, peripheral vasoconstriction and shortness of breath **ECG monitoring required** **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 2.5–5.5 (undiluted) ⚠ **Do not flush the administration set. After an infusion is discontinued, disconnect the apparatus, aspirate the catheter/ cannula, then flush with NS** **Sodium content:** 0.5 mmol/200 mg vial **Other comments:** administration of dopamine should be considered high risk because of the potential for patient harm. It must be performed only by those competent in life support	**The following data assume dopamine hydrochloride is infused into the Y-site as a 3.2 mg/mL solution. Dopamine solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** foscarnet, fluconazole, linezolid, propofol 1% **Y-site compatible when diluted in G:** amiodarone **Y-site compatible when diluted in G or NS:** acetylcysteine, adrenaline, alfentanil, atracurium, caffeine, clarithromycin, clonidine, dobutamine, ethanol, fentanyl, glyceryl trinitrate, granisetron, heparin sodium, insulin, labetolol, lidocaine, midazolam, morphine, noradrenaline, pantoprazole, pipericillin with tazobactam, ranitidine, remifentanil, sodium nitroprusside, streptokinase, rocuronium, vasopressin, vecuronium
	Children: (C) IV infusion via a volumetric infusion pump or syringe pump into a central line or large peripheral vein 1 2 3 4 5 6 7 8 NPSA risk rating: 6	**To make a 1.6 mg/mL solution:** dilute each 1 mL (40 mg) dopamine to 25 mL with NS or G **To make a 3.2 mg/mL solution:** dilute each 1 mL (40 mg) dopamine to 12.5 mL with NS or G			

Formulation	Method	Dilution	Rate	Comments	Compatibility
Dopamine hydrochloride *continued*					
Ampoule 200 mg/5 mL *Non-proprietary* Hospira (UK)	**In fluid restriction in adults and children:** (C) IV infusion via a syringe pump into a central line **1 2 3** 4 5 6 **7** 8 NPSA risk rating: 4 **This is the preferred method of administration in critical care areas at UCLH.**	Dilute one ampoule to 50 mL with NS or G This gives a 4 mg/mL solution	As above	For further information about the use of dopamine in neonates refer to 'Neonatal Monograph – Dopamine' at www.uclhguide.com or the UCLH intranet or local dopamine infusion guidelines	**Incompatible:** aciclovir, esmolol, sodium bicarbonate, thiopental
	Neonates 3.4 kg or over: (C) IV infusion via a syringe pump into a central line **1 2 3** 4 5 6 **7** 8 NPSA risk rating: 4	Dilute one ampoule to 50 mL with NS or G This gives a 4 mg/mL solution	5 micrograms/kg per minute		
	Neonates under 3.4 kg: (C) IV infusion via a syringe pump into a central line **1 2** 3 **4** 5 **6 7** 8 NPSA risk rating: 5	**Neonates up to 1.7 kg:** dilute 30 mg/kg to 10 mL with G **Neonates 1.8–3.3 kg:** dilute 30 mg/kg to 20 mL with G	**Neonates up to 1.7 kg:** 0.1 mL/hour **Neonates 1.8–3.3 kg:** 0.2 mL/hour Both the above infusions give 5 micrograms/kg per minute		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Doxapram hydrochloride					
Ampoule 100 mg/5 mL Dopram Anpharm UK, t/a Goldshield	**Post-operative respiratory depression (adults):** IV bolus **1** 2 **3** 4 5 **6** 7 8 NPSA risk rating: 3	Ready diluted. May be further diluted to a convenient volume with NS or G	1–1.5 mg/kg over 30 seconds Alternatively the infusion below may be given	**Infusion-related adverse events:** sweating, flushing, headache, dizziness, tachycardia, hypertension **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 4.5 (undiluted) **Flush:** NS **Sodium content:** Nil **Other comments:** equivalent (C) infusion rates: Post-operative respiratory depression (adults): 2–3 mg/minute Acute respiratory failure (adults): initially 4 mg/minute for 15 minutes, reduced to 3 mg/minute for 15 minutes, then 2 mg/minute for 15 minutes, then 1.5 mg/minute thereafter	**The following data assume doxapram is infused into the Y-site as a 2 mg/mL solution (from the bottle). Doxapram solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, G10, GS **Y-site compatible ready-diluted medicines:** metronidazole **Y-site compatible when diluted in G or NS:** adrenaline, amikacin, caffeine, calcium chloride, calcium gluconate, ceftazidime, dopamine, folinic acid, gentamicin, insulin, ranitidine, tobramycin, vancomycin **Y-site compatible when diluted in NS:** erythromycin **Incompatible:** aminophylline, clindamycin, diazepam, dexamethasone, sodium bicarbonate, thiopental
Bottle 1 g/500 mL Dopram Anpharm UK, t/a Goldshield	**Adult respiratory conditions:** (C) IV infusion via volumetric infusion pump **1** 2 3 4 5 **6** **7** 8 NPSA risk rating: 3	Ready diluted. This is a 2 mg/mL solution	**Post-operative respiratory depression:** usually 60–90 mL/hour **Acute respiratory failure:** initially 120 mL/hour reducing by 30 mL/hour every 15 minutes until the rate is 60 mL/hour. Give for a further 15 minutes, then reduce to 45 mL/hour thereafter		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Drotrecogin alfa, activated (recombinant activated protein C)					
Vial 5 mg 20 mg Xigris Lilly (UK)	(C) IV infusion via a volumetric infusion pump **1** **2** 3 4 **5** 6 **7** 8 NPSA risk rating: 4	Add 2.5 mL W to 5 mg vial, or add 10 mL W to 20 mg vial. Gently swirl to dissolve the powder; avoid shaking or inverting the vial. This gives a 2 mg/mL solution. Further dilute with NS to give a final concentration of 0.1–0.2 mg/mL Suggested dilutions: **40–66 kg patient:** add 10 mg to 100 mL NS. This gives a 0.1 mg/mL solution **67–135 kg patient:** dilute 20 mg to 100 mL NS. This gives a 0.2 mg/mL solution	24 micrograms/kg per hour for a total of 96 hours The infusion may be stopped and restarted, but the total duration of drug therapy is usually 96 hours **Using the 0.1 mg/mL solution:** 0.24 mL/kg per hour **Using the 0.2 mg/mL solution:** 0.12 mL/kg per hour	**Infusion-related adverse events:** increased risk of bruising/bleeding, headache, pain **pH:** 6 (reconstituted with W) **Osmolality:** 530–650 mOsmol/kg **Flush:** NS **Sodium content:** 0.7 mmol/5 mg vial 3 mmol/20 mg vial **Displacement value:** accounted for during reconstitution step **Other comments:** reconstituted vials may be stored at room temperature for up to 3 hours Solutions that have been diluted with NS must be used within 14 hours. If they are not required immediately they may be refrigerated for up to 12 hours The diluted and refrigerated solution must be used within 24 hours of dilution	**The following data assume drotrecogin alfa is infused into the Y-site as a 1 mg/mL solution. Drotrecogin solutions of a lower concentration will also be compatible with these drugs or fluids** **Y-site compatible fluids:** H, G, GS, potassium chloride 40 mmol/L in NS **Y-site compatible ready-diluted medicines:** fluconazole **Y-site compatible when diluted in NS:** glyceryl trinitrate, vasopressin **Incompatible:** amiodarone, furosemide, gentamicin, heparin, imipenem with cilastatin, insulin, metronidazole, midazolam, noradrenaline, pipericillin with tazobactam, sodium nitroprusside, tobramycin, vancomycin
	Fluid restriction: (C) IV infusion via a syringe pump **1** **2** 3 4 **5** 6 **7** 8 NPSA risk rating: 4	Reconstitute a 20 mg vial as above. Dilute to 50 mL NS. This gives a 0.4 mg/mL solution (unlicensed dilution)	Usually 24 micrograms/kg per hour for up to 96 hours **Using the 0.4 mg/mL solution:** 0.06 mL/kg per hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Eflornithine (unlicensed)					
Bottle 20 g/100 mL Ornidyl Marion Merrel (France) Supplied by the World Health Organisation	(I) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Withdraw the required dose and add it to an empty IV infusion bag. Dilute each 1 mL of eflornithine with 4 mL of W For example, to give a 5 g dose: withdraw 20 mL from the bottle and add to the empty bag. Then draw up 80 mL of water. Add this to the bag so that the final volume is 100 mL See comments	Over 45 minutes, or longer if adverse effects are problematic	**Infusion-related adverse events:** diarrhoea, vomiting, headache, abdominal pain, reversible hearing loss, seizures **pH:** 3–4 (undiluted) **Osmolality:** 290 mOsmol/kg (after dilution) **Flush:** NS **Sodium content:** nil **Other comments:** pharmacy will provide empty TPN bags for the preparation of eflornithine. Otherwise the fluid from a bag of NS may be withdrawn and replaced with the drug and W The bottle is intended for multiple use. After first use label with patient name, date and time and refrigerate. Discard after 24 hours Eflornithine is used only for the treatment of human African trypanosomiasis (sleeping sickness) at UCLH	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Enoximone					
Ampoule 100 mg/20 mL Perfan Inca-Pharm (UK)	**Loading dose:** (I) IV infusion via a syringe pump into a central line or large peripheral vein 1 2 3 4 5 6 7 8 NPSA risk rating: 3 **Note the load is often omitted as it has a strong hypotensive effect**	Dilute one ampoule with 20 mL NS or W. This gives a 2.5 mg/mL solution	**Adults:** usual rate 2.16 mL/kg per hour over 10–30 minutes After a response is achieved the same syringe may be used to give the maintenance infusion, as below See comments (a) and (c) **Children and neonates:** 0.2 mL/kg over 15–30 minutes	**Infusion-related adverse events:** hypotension, arrhythmias, bleeding, headache, dizziness, nausea, vomiting, diarrhoea **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 12 (undiluted) **Flush:** NS if appropriate. Otherwise do not flush the administration set after an infusion: disconnect and aspirate the catheter **Sodium content:** 0.6 mmol/20 mg ampoule **Other comments:** (a) adult load equivalent to 90 micrograms/kg per minute for 10–30 minutes Children's load equivalent to 500 micrograms/kg over 15–30 minutes (b) maintenance equivalent to 5–20 micrograms/kg per minute (c) enoximone should be prepared and given with plastic syringes and administration sets as it is incompatible with glass Contains ethanol and propylene glycol	**Compatible fluids:** NS **Incompatible:** G **Do not infuse with any other medicines or infusion fluids**
	Maintenance dose: (C) IV infusion via a syringe pump into a central line or large peripheral vein 1 2 3 4 5 6 7 8 NPSA risk rating: 3	As above	**Adults, children and neonates:** usual rate 0.12–0.48 mL/kg per hour See comments (b) and (c) Usual maximum daily dose, including load: 24 mg/kg		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ephedrine hydrochloride					
Ampoule 30 mg/1 mL *Non-proprietary* Auden Mackenzie (UK)	IV bolus into a large vein or central line **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Dilute one ampoule to 10 mL with NS This gives a 3 mg/mL solution	**Adults and children 12 or over:** usually 1 mL of the diluted solution over 1 minute Wait a few minutes for response before giving a further 1 mL bolus Most adults require no more than 9 mg in total Maximum licensed total dose: 30 mg/10 mL **Children under 12:** 0.5–0.75 mg/kg over 1 minute, as above	**Infusion-related adverse events:** tachycardia, bradycardia, hypertension, arrhythmias, anginal pain, dizziness, flushing, anxiety, restlessness, nausea, vomiting, headache, confusion **pH:** 5–7 (undiluted) **Flush:** NS **Sodium content:** nil	**Compatible fluids:** G, G10, GS, H **Do not infuse with any other medicines or infusion fluids**
	IM/SC (unlicensed) **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Epoprostenol					
Vial 500 micrograms Flolan GSK (UK) Each vial is supplied with a 50 mL vial of glycine buffer diluent and a 0.22 micron filter	(C) IV infusion via a syringe pump into a central line or large peripheral vein 1 2 3 4 5 6 7 8 NPSA risk rating: 8	Dissolve the powder with 10 mL of the diluent provided. Return the drug solution to the original vial of diluent, mix, then draw up the full 50 mL into a syringe. This gives a 10,000 nanogram/mL 'concentrated' solution. This may be given undiluted Alternatively each 1 mL of the concentrated solution may be diluted with up to 6 mL NS Prior to administration the concentrated and diluted solutions should be filtered using the filter provided	**Perpheral ischaemia (unlicensed):** 1–20 nanograms/kg per minute **Prevention of clotting in extracorporeal circuits:** 1–20 nanograms/kg per minute into the blood supplying the dialyser **Acute primary pulmonary hypertension:** initially 2 nanograms/kg per minute increasing in increments of 1–2 nanograms/kg per minute every 15 minutes according to response	**Infusion-related adverse events:** hypotension, headache, tachycardia, bradycardia, facial flushing, nausea, vomiting, abdominal discomfort, jaw pain **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 10.5 (10,000 nanograms/mL) ⚠ **Do not flush. When the infusion is discontinued, disconnect the administration set and aspirate the catheter/cannula** **Sodium content:** 2.4 mmol/500 microgram vial (after reconstitution with 50 mL buffer) **Displacement value:** negligible **Other comments:** the manufacturer advises there is a 10% loss of potency within 12 hours of preparation. In practice this loss may be compensated for by adjustment of the infusion rate A 1.5 mg vial is also available and may be used in cases requiring high concentrations/rates for prolonged periods, particularly in pulmonary hypertension. For details regarding long-term dosing of epoprostenol in pulmonary hypertension refer to the manufacturer's SPC	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Eptifibatide					
Vial 20 mg/10 mL Integrilin GSK (UK)	IV bolus, followed immediately by the infusion below **1** 2 **3** 4 5 **6** 7 8 NPSA risk rating: 3	Ready diluted Use the vial containing 2 mg/mL solution for injection	Usually 0.09 mL/kg over 3–5 minutes See comment (a)	**Infusion-related adverse events:** increased risk of bleeding, arrhythmias, atrial fibrillation, hypotension **pH:** 5–5.5 (undiluted) **Flush:** NS **Other comments:** (a) bolus dose equivalent to 180 micrograms/kg (b) infusion rate equivalent to 2 micrograms/kg per minute	**The following data assume eptifibatide is infused into the Y-site as a 0.75 mg/mL solution. Eptifibatide solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, potassium chloride 40 mmol/L in NS or G **Y-site compatible when diluted in G or NS:** atropine, dobutamine, glyceryl trinitrate, heparin sodium, lidocaine, metoprolol, midazolam, morphine, pethidine **Y-site compatible when diluted in G:** amiodarone **Incompatible:** furosemide
Vial 75 mg/100 mL Integrilin GSK (UK)	(I) IV infusion via a volumetric infusion pump **1** 2 **3** 4 5 **6** **7** 8 NPSA risk rating: 4	Ready diluted Use the vial containing 0.75 mg/mL solution for infusion	Usually 0.16 mL/kg per hour for up to 96 hours See comment (b)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ergocalciferol (vitamin D2)					⚠ **For IM use only**
Ampoule 300,000 units *Non-proprietary* UCB Pharma (UK)	IM 1 2 3 4 5 6 7 8 NPSA risk rating: 0	Ready diluted Draw up the medicine into a plastic syringe and administer immediately. See comments		**Infusion-related adverse events:** injection site pain **Sodium content:** nil **Other comments:** the manufacturer states ergocalciferol should be given using a glass syringe as some users have reported they were unable to push the syringe plunger after drawing up the medicine. At UCLH nurses have not experienced such problems and continue to administer the drug using plastic syringes	**Do not inject with any other medicines or infusion fluids**
Ergometrine					
Ampoule 500 micrograms/1 mL *Non-proprietary* Hameln (UK)	IM 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted		**Infusion-related adverse events:** headache, dizziness, arrhythmias, palpitations, bradycardia, chest pain, hypertension, shortness of breath, nausea, vomiting, abdominal pain, skin rashes **pH:** 2.7–3.5 (undiluted) **Flush:** NS **Sodium content:** nil	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**
	IV bolus 1 **2** 3 4 5 **6** 7 8 NPSA risk rating: 2	Dilute with 5 mL NS	Over 3–5 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ertapenem					
Vial 1 g Invance Merck, Sharp and Dohme Limited (UK)	(I) IV infusion 1 **2** 3 4 **5** 6 7 8 NPSA risk rating: 2	Reconstitute each vial with 10 mL W or NS. This gives a 100 mg/mL solution Withdraw the required dose and add to 50–100 mL NS	Over 30 minutes	**Infusion-related adverse events:** pain and swelling at administration site, rash, headache, nausea **pH:** 7.5 (in 10 mL W) **Flush:** NS **Sodium content:** 6 mmol/vial **Displacement value:** negligible **Other comments:** use with caution in patients with penicillin allergy. Approximately 10% cross-sensitivity	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	Fluid restriction: (I) IV infusion 1 **2** 3 4 **5** 6 7 8 NPSA risk rating: 2	Reconstitute as above. Withdraw 10 mL fluid from a 50 mL bag NS. Add the vial to give a 20 mg/mL solution	Over 30 minutes		
	IM (unlicensed) 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	Reconstitute with 3.2 mL lidocaine 1%			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Erwinase					
see crisantaspase					

Formulation	Method	Dilution	Rate	Comments	Compatibility
Erythromycin					
Vial 1 g *Non-proprietary* DBL t/a Hospira (UK)	(I) IV infusion **1** **2** 3 4 **5** **6** 7 8 NPSA risk rating: 4	Add 20 mL W to 1 g vial. Further dilute with NS so that the final concentration is no greater than 5 mg/mL Suggested dilutions: **Doses up to 250 mg:** add to 50 mL bag NS **Doses 251–500 mg:** add to 100 mL bag NS **Doses 501–1000 mg:** add to 250 mL bag NS. See comment (a)	**Adults and children:** over 20–60 minutes **Neonates:** over 60 minutes	**Infusion-related adverse events:** arrhythmias and hypotension (associated with rapid infusion), abdominal discomfort, cramp, nausea, vomiting, diarrhoea, thrombophlebitis, venous irritation, hypersensitivity reactions **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 7.1 (5 mg/mL in NS) **Osmolality:** 300 mOsmol/kg (5–10 mg/mL in NS) **Flush:** NS **Sodium content:** nil **Displacement value:** negligible **Other comments:** (a) buffered G may be also used as a diluent. Prepare by adding 5 mL of sodium bicarbonate 8.4% solution to each litre of G, prior to the addition of erythromycin (b) continuous IV infusion of erythromycin is rarely necessary. Consult pharmacy or microbiology prior to initiation	**The following data assume erythromycin is infused into the Y-site as a 5 mg/mL solution. Erythromycin solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, buffered G (see comments) **Y-site compatible ready-diluted medicines:** esmolol, foscarnet **Y-site compatible when diluted in NS:** aciclovir, atracurium, benzylpenicillin, magnesium sulphate, morphine, pethidine, ranitidine, zidovudine **Incompatible:** heparin, linezolid
	Fluid restriction: (I) IV infusion via a central line (unlicensed) **1** **2** 3 4 **5** **6** 7 8 NPSA risk rating: 4	Reconstitute the vial as above. Further dilute with NS so that the final concentration is no greater than 10 mg/mL **For a 1 g dose:** withdraw 20 mL from a 100 mL bag NS and replace with the drug solution	As above		
	(C) IV infusion via a volumetric infusion pump. See comment (b) **1** **2** 3 4 **5** **6** **7** 8 NPSA risk rating: 5	Add 20 mL W to 1 g vial. Further dilute with NS to a concentration of 1 mg/mL For example, add 20 mL reconstituted solution to 1 L NS to give a 1 mg/mL solution	Over 24 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Esmolol hydrochloride					
Vial 100 mg/10 mL Brevibloc Baxter (UK)	**Loading dose:** IV bolus via a central line or large peripheral vein **1** 2 **3** 4 5 **6** 7 8 NPSA risk rating: 3	Ready diluted	**Supraventricular tachycardia:** 0.5 mg/kg over 1 minute	**Infusion-related adverse events:** hypotension, sweating, dizziness, bradycardia, bronchospasm, headache, nausea, vomiting, injection site reactions **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 4.5–5.5 **Osmolarity:** 270–330 mOsmol/L (solution for infusion) **Flush:** NS **Sodium content:** negligible **Other comments:** for further information refer to 'Management of arrhythmias' in the Medical Emergency Guidelines at www.uclhguide.com or the UCLH intranet	**The following data assume esmolol is infused into the Y-site as a 10 mg/mL solution. Esmolol solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, GS, H, sodium chloride 0.45%, potassium chloride 40 mmol/L in G **Y-site compatible ready-diluted medicines:** ciprofloxacin, linezolid, metronidazole, propofol 1% **Y-site compatible when diluted in G or NS:** acetylcysteine, adrenaline, alfentanil, aminophylline, atracurium, clonidine, dobutamine, ethanol, fentanyl, heparin sodium, hydrocortisone sodium succinate, insulin, labetolol, midazolam, morphine, noradrenaline, pancuronium, remifentanil, rocuronium, tacrolimus, vancomycin, vecuronium **Y-site compatible when diluted in G:** amiodarone **Y-site compatible when diluted in NS:** erythromycin, phenytoin **Incompatible:** digoxin, dopamine, lidocaine, pantoprazole, sodium nitroprusside
Bag 2.5 g/250 mL Brevibloc Baxter (UK)	**Maintenance dose:** (I) IV infusion via volumetric infusion pump via a central line or large peripheral vein **1** 2 **3** 4 5 **6** **7** 8 NPSA risk rating: 4	Ready diluted	**Supraventricular tachycardia:** initially 50 micrograms/kg per minute for 4 minutes. If no response an additional 500 microgram/kg bolus should be given (as above), and the rate of infusion should be increased by 50 micrograms/kg per minute This cycle may be repeated up to a maximum infusion rate of 200 micrograms/kg per minute As patient begins to respond the rate should be increased by 25 microgram/kg per minute increments and the time between increments increased to 10 minutes When full response is achieved, maintain the rate of infusion for around 30 minutes, then consider decreasing the dose and switching the patient to an alternative (oral) agent **Perioperative tachycardia and hypertension:** up to 500 micrograms/kg per minute		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ethanol (alcohol – unlicensed)					
Ampoule 100% (2 mL) 100% (5 mL) *Non-proprietary* Martindale Ampoule 90% (10 mL) *Non-proprietary* South Devon Healthcare (UK) **The terms ethanol and alcohol are used interchangeably for these products** **Absolute alcohol is the term often used for ethanol 100%**	**For alcohol withdrawal:** (C) IV infusion, preferably via a central line using a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	**Using ethanol 100%:** remove 25 mL from a 500 mL bag of G. Add 25 mL of ethanol 100% to produce an ethanol 5% solution **Using ethanol 90%:** remove 28 mL from a 500 mL bag of G. Add 28 mL of ethanol 90% to produce an ethanol 5% solution	25 mL/hour titrated according to withdrawal symptoms Maximum rate 150 mL/hour	**Infusion-related adverse events:** CNS and respiratory depression, hypoglycaemia, nausea. General symptoms of alcohol intoxication **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **Flush:** NS, G, H **Sodium content:** nil **Other comments:** (a) doses of ethanol for ethylene glycol poisoning depend on the patient's age, previous ethanol use and renal function. Consult Toxbase or the National Poisons Information Service for further details. The volume of alcohol to administer may be relatively high over a short period, so a 10% solution may be preferred to prevent circulatory overload (b) At UCLH ethanol is used to improve flow through central lines which are suspected of being occluded by fatty deposits from intravenous nutrition (TPN) Dilute 2 mL ethanol 100% with 1 mL WFI to produce an ethanol 67% solution. Instill into the lumen of the catheter and leave for 2 hours or longer then flush. For full central venous catheter management guidelines refer to guidelines at www.uclh.nhs.uk/cvc	**The following data assume ethanol is infused into the Y-site as a 5% solution. Ethanol solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** GS, NS, H, potassium chloride 40 mmol/L in G or NS **Y-site compatible ready-diluted medicines:** esmolol **Y-site compatible when diluted in G:** aminophylline, insulin, thiopental **Y-site compatible when diluted in G or NS:** dobutamine, dopamine
	For ethylene glycol poisoning unresponsive to other measures: (C) IV infusion, preferably via a central line using a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	As above for a 5% solution Alternatively a 10% solution may be made as follows: **Using ethanol 100%:** remove 50 mL from a 500 mL bag of G. Add 50 mL of ethanol 100% **Using ethanol 90%:** remove 56 mL from a 500 mL bag of G. Add 56 mL of ethanol 90%	Refer to Toxbase or the National Poisons Information Service See comments		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Etomidate					
Ampoule 20 mg/10 mL Hypnomidate Janssen-Cilag (UK)	IV bolus, preferably into a large vein **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	May be further diluted to a convenient volume with NS or G	Over 3–5 minutes	**Infusion-related adverse events:** pain at injection site, respiratory depression, hypotension **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 4–7 **Flush:** NS **Sodium content:** negligible Contains propylene glycol	**The following data assume etomidate is infused into the Y-site as a 2 mg/mL solution. Etomidate solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible when diluted in G or NS:** alfentanil, atracurium, fentanyl, lidocaine, midazolam, morphine, phenylephrine, suxamethonium

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Fentanyl					
Ampoule 100 micrograms/ 2 mL 500 micrograms/ 10 mL *Non-proprietary* Auden McKenzie (UK) Pre-filled syringe (unlicensed) 1 mg/50 mL *Non-proprietary* Hospira (UK)	**PCA or NCA for patient 50 kg or greater:** (I) or (C) IV infusion via a patient controlled syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Dilute 1000 micrograms to 50 mL with NS This gives a 20 microgram/mL solution	Background infusion: not usually required Bolus: 20 micrograms (1 mL) over a few seconds Lockout: 5 minutes See comment (a)	**Infusion-related adverse events:** respiratory and CNS depression, itching, sweating, hypotension, brady- and tachycardia **Monitor blood pressure, heart rate, respiratory rate, oxygen saturation, pain and sedation scores** **pH:** 3.5–5.5 (undiluted) **Osmolality**: 308 mOsmol/kg **Flush:** NS **Sodium content:** 0.3 mmol (2 mL ampoule) 1.5 mmol (10 mL ampoule) **PCA** = patient controlled analgesia **NCA** = nurse controlled analgesia **Other comments:** (a) the PCA/NCA syringes described are those typically used at UCLH. Other concentrations, infusion rates and volumes may be used according to local preference and patient need. For further information refer to 'Patient Controlled and Nurse Controlled Analgesia Guideline: Adults and Paediatrics' at www.uclhguide.com or the	**The following data assume fentanyl is infused into the Y-site as a 0.05 mg/mL solution. Fentanyl solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** esmolol, linezolid, propofol 1% **Y-site compatible when diluted in G:** amiodarone **Y-site compatible when diluted in NS:** furosemide **Y-site compatible when diluted in NS or G:** adrenaline, alfentanil, aminophylline, atracurium, atropine, caffeine, clonidine, dobutamine, dopamine, etomidate, glyceryl trinitrate, heparin sodium, insulin, labetolol, midazolam, mivacurium, morphine, noradrenaline, pethidine, ranitidine, remifentanil, rocuronium,
	PCA for patient 50 kg or greater: (I) or (C) SC infusion via a patient controlled syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Dilute 2000 micrograms to 50 mL with NS This gives a 40 microgram/mL solution	Background infusion: not usually required Bolus: 20 micrograms (1 mL) over 1 minute Lockout: 10 minutes		
	PCA for patient less than 50 kg: (C) IV infusion via a patient controlled syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute fentanyl 25 micrograms/kg to 50 mL with NS This gives a 0.5 microgram/kg/mL solution	Background: 0–0.1 micrograms/kg per hour (0–0.2 mL/hour) Bolus: 0.25–0.5 micrograms/kg (0.5–1 mL) over a few seconds Lockout: 5 minutes		
	PCA for patient less than 50 kg: (C) SC infusion via a patient controlled syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute fentanyl 50 micrograms/kg to 50 mL with NS This gives a 1 microgram/kg/mL solution	Background: 0–0.1 micrograms/kg per hour (0–0.1 mL/hour) Bolus: 0.25–0.5 micrograms/kg (0.25–0.5 mL) over 1 minute Lockout: 5–10 minutes		

Formulation	Method	Dilution	Rate	Comments	Compatibility
Fentanyl *continued*					
	NCA for patient less than 50 kg: (C) IV infusion via a nurse controlled syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute fentanyl 25 micrograms to 50 mL with NS This gives a 0.5 microgram/kg/mL solution	Background: 0.25–0.5 micrograms/kg per hour (0.5–1 mL/hour) Bolus: 0.25–0.5 micrograms/kg over a few seconds (0.5–1 mL) Lockout: 30 minutes	UCLH intranet or local hospital guidelines (b) for further information about the use of fentanyl in palliative care refer to local syringe driver/ pump guidelines. Fentanyl is rarely used in syringe drivers as the volume of fentanyl is usually too large for the driver. However, a syringe pump may be used to deliver fentanyl alone, or a combination of drugs compatible with the opioid (c) IV doses of fentanyl have a greater analgesic effect than IM or SC doses (d) at UCLH IV boluses of opioids should only be used in areas where this has been explicitly sanctioned (excluding boluses given through a PCA or NCA pump)	sodium nitroprusside, vecuronium **Incompatible:** phenytoin **Compatible in a syringe for (C) SC infusion:** cyclizine, dexamethasone, glycopyrronnium, haloperidol lactate, hyoscine butylbromide, hyoscine hydrobromide, levomepromazine, metoclopramide, midazolam, octreotide, ondansetron **See Section A15 for further details**
	Adults and children – analgesia in palliative care: (C) SC infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute the dose to a convenient volume with NS or W	Over 24 hours Fentanyl may be mixed with other drugs in the same syringe See comment (b)		
	Adults and children: IV/SC bolus/IM 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Ready diluted May be further diluted to a convenient volume with NS or G for IV administration	**IV:** over 3–5 minutes See comments (c) and (d)		
	Analgosedation in critical care: (C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Dilute 1000 micrograms to 50 mL with NS This gives a 20 microgram/mL solution	Usually 1–5 micrograms/kg per hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Filgrastim					
Pre-filled syringe 30 million units Singleject (0.6 mg/1 mL) 48 million units Singleject (0.96 mg/1 mL) Neupogen Amgen (UK)	SC (preferred method) **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted		**Infusion-related adverse events:** musculoskeletal pain, headaches, occasionally hypersensitivity reactions **pH:** 4 (Neupogen) 4.2 (Ratiograstim) **Osmolarity:** 290 mOsmol/L (Ratiograstim) **Flush:** G **Sodium content:** negligible **Other comments:** do not dilute to concentrations below 0.2 million units/mL In solutions of filgrastim diluted to concentrations below 1.5 million units/mL, human serum albumin (HSA) should be added to a final concentration of 2 mg/mL A 4.5% solution of HSA contains 45 mg/1 mL A 20% solution of HSA contains 200 mg/1 mL	**Compatible:** G with albumin (see comments) **Incompatible:** NS **Do not infuse with any other medicines or infusion fluids**
Pre-filled syringe 30 million units/0.5 mL 48 million units/0.8 mL Ratiograstim Ratiopharm (UK)	(I) IV infusion via a syringe pump **1** **2** 3 **4** 5 **6** 7 8 NPSA risk rating: 4	Dilute in 20 mL G See comments	Over 30 minutes		
Flagyl					
see metronidazole					

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Flecainide acetate					
Ampoule 150 mg/15 mL Tambocor 3M Healthcare t/a Meda (UK)	IV bolus or short IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Ready diluted May be added to 50–100 mL bag G, in which case use a volumetric pump to give the dose	**Adults and children over 12:** usually 2 mg/kg over 10 minutes. Maximum load: 150 mg May be followed by the infusion below See comment (a)	**Infusion-related adverse events:** bradycardia, chest pain, hypotension, palpitations, tachycardia, visual disturbances, dizziness **ECG monitoring required** **pH:** 5–6.5 (undiluted) **Flush:** G **Sodium content:** 1.6 mmol/vial **Other comments:** (a) in patients with sustained ventricular tachycardia or history of cardiac failure initial bolus should be given over at least 30 minutes (b) maximum dose 600 mg in 24 hours (including initial bolus) (c) flecainide may be prescribed as a bolus alone. After assessment of the ECG the patient may then be prescribed a further infusion. If prescribed in this manner the first two boxes of the monograph should be followed to prepare and administer the drug Alternatively flecainide may be prescribed as a bolus immediately followed by an infusion. In this case the bottom row may be followed. This method also provides 2 mg/kg over the first 30 minutes, reduced to 1.5 mg/kg for an hour, further reduced to 0.1–0.25 mg/kg thereafter	**Compatible fluids:** G. May be diluted in 500 mL or more of NS **Do not infuse with any other medicines or infusion fluids**
	(C) IV infusion via a volumetric infusion pump or syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6 **This infusion is given after the above bolus**	Dilute dose to a convenient volume with G The dose may also be added to 500 mL NS. Flecainide should not be added to smaller volumes of NS as this may result in drug precipitation	**Adults and children over 12:** usual rate initially 1.5 mg/kg per hour Reduce to 0.1–0.25 mg/kg per hour thereafter See comment (b)		
	(C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 3 **This method combines the above bolus and infusion.**	Draw up four ampoules into a syringe. This gives a 600 mg/60 mL syringe. The solution contains 10 mg/mL	**Adults and children over 12:** initially 0.2 mL/kg for 30 minutes, reduced to 0.15 mL/kg for 1 hour, then 0.01–0.025 mL/kg per hour thereafter See comment (b)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Flucloxacillin	⚠ **This is a penicillin. Check allergy status before administration**				
Vial 250 mg 500 mg *Non-proprietary* CP Pharmaceuticals t/a Wockhardt (UK)	**For doses up to 1 g:** IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 2	**If using a whole vial:** add 5–10 mL W to 250 mg or 500 mg vial **If using part of a vial:** add 4.8 mL to 250 mg vial, or 9.6 mL W to 500 mg vial. This gives a 50 mg/1 mL solution May be further diluted to a convenient volume with NS or G	Over 3–5 minutes	**Infusion-related adverse events:** nausea, vomiting, hypersensitivity reactions including rash, fever, joint pain and angioedema **pH:** 5–7 (100 mg/mL solution) **Flush:** NS **Sodium content:** 0.6 mmol/250 mg vial 1.1 mmol/500 mg vial **Displacement value:** 0.2 mL/250 mg vial 0.4 mL/500 mg vial	**The following data assume flucloxacillin is infused into the Y-site as a 20 mg/mL solution. Flucloxacillin solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** GS, H, potassium chloride 40 mmol/L in NS or G, sodium bicarbonate 8.4% **Y-site compatible when diluted in G or NS:** bumetanide, ceftazidime, cefuroxime, dexamethasone **Incompatible:** amikacin, atropine, benzylpenicillin, calcium gluconate, gentamicin, morphine, pethidine, tobramycin
	For doses above 1 g: (I) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Reconstitute as above Add the dose to a convenient volume NS, G or GS. Usually added to a 50–100 mL bag NS or G	Over 30–60 minutes		
	IM 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Add 1.5 mL W to 250 mg vial, or 2 mL to 500 mg vial			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Fluconazole					
Vial 50 mg/25 mL 200 mg/100 mL *Non-proprietary* Pliva t/a Teva (UK)	(I) IV infusion 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted If a dose requires a part vial, an infusion pump should be used to administer the drug so the amount of drug given can be accurately measured	Over 10–30 minutes Maximum 10 mL/minute	**Infusion-related adverse events:** headache, rash, abdominal pain, diarrhoea, nausea, dizziness, seizures, dyspepsia, vomiting, anaphylaxis **pH:** 5–6.5 (undiluted) **Osmolarity:** 300–315 mOsmol/L **Flush:** NS **Sodium content:** 3.8 mmol/25 mL vial 15.2 mmol/100 mL vial	**The following data assume fluconazole is infused into the Y-site as a 2 mg/mL solution. Fluconazole solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, G10, G20, H **Y-site compatible ready-diluted medicines:** foscarnet, ganciclovir, linezolid, metronidazole, propofol 1% **Y-site compatible when diluted in G or NS:** aciclovir, amikacin, aminophylline, dexamethasone, dobutamine, folinic acid, heparin sodium, granisetron, meropenem, midazolam, morphine, ondansetron, pancuronium, pethidine, pipericillin with tazobactam, ranitidine, remifentanil, tacrolimus, tobramycin, vancomycin, vecuronium, zidovudine **Y-site compatible when diluted in NS:** drotrecogin **Y-site compatible when diluted in G:** amiodarone **Incompatible:** amphotericin, calcium gluconate, cefotaxime, cefuroxime, chloramphenicol, co-trimoxazole

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Flucytosine					
Bottle 2.5 g/250 mL Ancotil Valeant t/a Meda (UK)	(I) IV infusion via a volumetric infusion pump **1** 2 3 **4** 5 **6** **7** 8 NPSA risk rating: 4	Ready diluted	Over 20–40 minutes	**Infusion-related adverse events:** nausea, vomiting, skin rashes, confusion, hallucinations, convulsions, headache, sedation and vertigo **pH:** 7–7.8 (undiluted) **Osmolality:** 290–320 mOsmol/kg **Flush:** NS **Sodium content:** 34.5 mmol/250 mL vial **Other comments:** store between 18 and 25°C: precipitation may occur if stored below 18°C; prolonged storage above 25°C may lead to decomposition	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Flumazenil					
Ampoule 500 micrograms/5 mL *Non-proprietary* Pliva t/a Teva (UK)	IV bolus  NPSA risk rating: 2	Ready diluted Can be further diluted with NS or G	Over 15–30 seconds	**Infusion-related adverse events:** anxiety, agitation and palpitations after rapid infusion. Other events include headache, watery eyes, flushing, cough, sweating, shivering, injection site pain **pH:** 3.8–4.5 (undiluted) **Flush:** NS **Sodium content:** 0.8 mmol/5 mL vial	**Compatible fluids:** NS, G, H **Do not infuse with any other medicines or infusion fluids**
	(I) IV infusion via syringe pump  NPSA risk rating: 6	Dilute to a convenient volume with NS or G	**Adults:** usual rate 100–400 micrograms/hour **Children and neonates:** usually 2–10 micrograms/kg per hour Maximum 400 micrograms/hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Folinic acid (calcium leucovorin)					
Ampoule 15 mg/2 mL *Non-proprietary* Hospira (UK) Ampoule 30 mg/10 mL Refolinon Pharmacia t/a Pfizer (UK) Vial 350 mg/35 mL *Non-proprietary* Ebewe (Austria) distributed by Wockhardt (UK)	IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted	Usually over 3–5 minutes Maximum rate: 160 mg/minute	**Infusion-related adverse events:** hypersensitivity reactions, agitation, fever, nausea, vomiting **pH:** 6.5–8.5 (undiluted) **Osmolality:** 184–187 mOsmol/kg (Pharmacia), 277 mOsmol/kg (Ebewe) **Flush:** NS **Sodium content:** 0.4 mmol/2 mL ampoule (Hospira) 1 mmol/10 mL ampoule (Pharmacia) 4.6 mmol/350 mg vial (Ebewe)	**The following data assume folinic acid is infused into the Y-site as a 2 mg/mL solution. Folinic acid solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H **Y-site compatible ready-diluted medicines:** doxapram, fluconazole, linezolid **Y-site compatible when diluted in G or NS:** granisetron, heparin sodium, pipericillin with tazobactam, tacrolimus **Y-site compatible when diluted in NS:** furosemide **Incompatible:** foscarnet
	(I) IV infusion **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Dilute the dose to a convenient volume with NS or G	According to the volume of fluid the drug is diluted in Maximum rate: 160 mg/minute		
	IM **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Foscarnet sodium					
Ready prepared bag from UCLH pharmacy production, containing the prescribed dose of foscarnet	(I) IV infusion via a volumetric infusion pump using the ready prepared bag (preferred method) **1** **2** 3 **4** 5 6 **7** 8 NPSA risk rating: 4	**Peripheral line:** administer a 1 L bag of NS or G through the same cannula/catheter as the foscarnet **Central line:** administer without the additional NS or G. Ensure the patient is well hydrated	Give the foscarnet over 2 hours Give the fluids at the same rate as the foscarnet, or faster	**Infusion-related adverse events:** convulsions, thrombophlebitis, fatigue, nausea, vomiting, abdominal pain, headache, dizziness, pins and needles sensation, rash **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 7.2–7.6 (undiluted) **Osmolarity:** 800 mOsmol/L (undiluted) **Flush:** NS **Sodium content:** 62 mmol/250 mL infusion bottle **Other comments:** the additional fluids minimise the risk of nephrotoxicity with foscarnet The ready prepared bag is the preferred preparation as it prevents accidental overdose (by infusion of a whole bottle, when only a part bottle is required). To obtain a supply contact pharmacy when foscarnet is prescribed	**The following data assume foscarnet is infused into the Y-site as a 24 mg/mL solution. Foscarnet solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** metronidazole, fluconazole **Y-site compatible when diluted in G or NS:** amikacin, aminophylline, ceftriaxone, cefuroxime, chloramphenicol, clindamycin, dexamethasone, dopamine, erythromycin, heparin sodium, hydrocortisone sodium succinate, morphine, phenytoin, ranitidine, tobramycin, vancomycin **Y-site compatible when diluted in NS:** furosemide **Incompatible:** aciclovir, amphotericin, calcium gluconate
Infusion bottle 6 g/250 mL Foscavir Astra-Zeneca (UK)	(I) IV infusion via a volumetric infusion pump using the bottle **1** **2** **3** **4** 5 **6** **7** 8 NPSA risk rating: 6	As above Ensure the infusion is stopped when the patient has received the prescribed dose. Usually this will mean using only part of a bottle	As above		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Fragmin					
see dalteparin					

Formulation	Method	Dilution	Rate	Comments	Compatibility
Furosemide (frusemide)					
Ampoule 20 mg/2 mL *Non-proprietary* Wockhardt (UK) Ampoule 50 mg/5 mL *Non-proprietary* Antigen t/a Goldshield (UK) Ampoule 250 mg/25 mL *Non-proprietary* Hameln (UK)	IV bolus **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Ready diluted May be further diluted to a convenient volume with NS Give doses over 20 mg as a short infusion	**Adults:** maximum rate 4 mg/minute, i.e. give 20 mg over 5 minutes **Children:** usually 0.1 mg/kg per minute **Neonates:** usually 0.5–1 mg/kg over 10 minutes Maximum rate in children and neonates: 4 mg/minute	**Infusion-related adverse events:** hypotension, headache, dizziness. Hearing disturbances and tinnitus associated with rapid administration **pH:** 8–9.3 (undiluted) **Osmolality:** 275–315 mOsmol/kg (undiluted) **Flush:** NS **Sodium content:** 0.3 mmol/20 mg ampoule (Wockhardt) 4–5 mmol/250 mg ampoule (Hameln) 0.8 mmol/50 mg ampoule (Goldshield) **Other comments:** glucose solutions are unsuitable for diluting furosemide	**The following data assume furosemide is infused into the Y-site as a 3 mg/mL solution. Furosemide solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, H **Y-site compatible ready-diluted medicines:** foscarnet, linezolid, potassium chloride 40 mmol/L in NS, propofol 1% **Y-site compatible when diluted in NS:** acetylcysteine, calcium gluconate, ceftazidime, dexamethasone, digoxin, fentanyl, glyceryl trinitrate, granisetron, heparin, meropenem, noradrenaline pipericillin with tazobactam, remifentanil, sodium nitroprusside, tacrolimus, thiopental **Incompatible:** G, amikacin, amiodarone, drotrecogin, gentamicin, pethidine, tobramycin, vasopressin, vecuronium
	(I) or (C) IV infusion via a volumetric infusion pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	Dilute to a convenient volume with NS	As above Maximum rate: 4 mg/minute		
	Fluid restriction: (I) or (C) IV infusion via a syringe pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	May be given undiluted, or diluted with a small volume of NS	As above Maximum rate: 4 mg/minute		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Fusidic acid					
***see* sodium fusidate**					
Ganciclovir					
Ready prepared bag from UCLH pharmacy production, containing the prescribed dose of ganciclovir.	(I) IV infusion via a volumetric infusion pump **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted	Over 1 hour	**Infusion-related adverse events:** injection site reactions, muscle pain, headaches, pins and needles, dizziness, confusion, ear and eye pain, shortness of breath, cough, diarrhoea, nausea, vomiting and abdominal pain **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 11 **Osmolality:** 314 mOsmol/kg (reconstituted) **Flush:** NS **Sodium content:** 2 mmol/500 mg vial **Displacement value:** 0.3 mL/500 mg vial Add 9.7 mL W to 500 mg vial to obtain 500 mg/10 mL solution **Other comments:** the ready prepared bag should be used whenever possible. Ganciclovir is cytotoxic and requires special handling. Contact pharmacy to obtain a supply	**The following data assume ganciclovir is infused into the Y-site as a 10 mg/mL solution. Ganciclovir solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H **Y-site compatible ready-diluted medicines:** fluconazole, linezolid, propofol 1% **Y-site compatible when diluted in NS or G:** granisetron, remifentanil
Vial 500 mg Cymevene Roche (UK)	(I) IV infusion via a volumetric infusion pump **1** **2** 3 4 **5** **6** **7** 8 NPSA risk rating: 5	Add 9.7 mL W to 500 mg vial. This gives a 50 mg/1 mL solution. Withdraw the required dose and add to NS or G Suggested dilutions: **Doses up to 500 mg:** add to 50–100 mL NS or G **Doses above 500 mg:** add to 100 mL NS or G	Over 1 hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Geloplasma (partially hydrolysed and succinylated gelatine 3%)					
Infusion bag 500 mL Geloplasma Fresenius Kabi (UK)	(I) IV infusion. For rapid administration a blood administration set may be used **1** **2** 3 4 5 6 **7** **8** NPSA risk rating: 3	Ready diluted	Dependent on patient need **Acute blood loss:** 500 mL over 5–10 minutes **Fluid challenge:** 200 mL over 5 minutes	**Infusion-related adverse events:** anaphylaxis may occur. Overly rapid administration may result in circulatory overload **pH:** 5.8–7.0 **Osmolality:** 295 mOsmol/kg **Flush:** NS **Sodium content:** 75 mmol/bag **Other comments:** chloride content 50 mmol/bag When given quickly warm bottle to 37°C if possible	**Y-site compatible:** blood **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Gentamicin					
Vial 80 mg/2 mL Cidomycin Aventis (UK) Vial 20 mg/2 mL *Non-proprietary* Aventis (UK) distributed by Winthrop (UK)	**Adults and children:** (I) IV infusion (preferred method for once daily dosing) 1 2 3 4 5 6 7 8 NPSA risk rating: 4	**Adults:** add dose to 100 mL NS or G **Children:** add dose to 20–50 mL NS or G	Over 1 hour	**Infusion-related adverse events:** nausea, vomiting, rash, dizziness, hearing loss **pH:** 3–4.5 (undiluted) **Flush:** NS, G **Sodium content:** negligible (Cidomycin and Winthrop) **Other comments:** for further information regarding the dose, frequency and monitoring requirements refer to the guidelines 'Gentamicin Dosing Guideline – Adults', 'Gentamicin Once Daily Dosing For Paediatrics and Adolescents' and 'Neonatal Unit Drug Monograph – Gentamicin' at www.uclhguide.com or the UCLH intranet Blood for gentamicin levels should be taken 6–14 hours after the start of a once daily infusion	**The following data assume gentamicin is infused into the Y-site as a 5 mg/mL solution. Gentamicin solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, G10, H **Y-site compatible ready-diluted medicines:** linezolid **Y-site compatible when diluted in G or NS:** granisetron, midazolam, ondansetron, remifentanil **Y-site compatible when diluted in G:** amiodarone **Incompatible:** amoxicillin, benzylpenicillin, cefotaxime, ceftazidime, cefuroxime, chloramphenicol, co-amoxiclav, erythromycin, flucloxacillin, furosemide, heparin, insulin, propofol
	Neonates: (I) IV infusion via syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute dose to a convenient volume with NS or G	Over 30 minutes		
	Adults and children: IV bolus (preferred method for multiple daily dose regimens) 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Ready diluted. May be further diluted to a convenient volume with NS or G	Over 3–5 minutes		
	IM injection 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Glucagon					
Vial 1 mg GlucaGen Novo Nordisk (UK)	SC bolus/IM **1** 2 3 4 **5** 6 7 8 NPSA risk rating: 2	Inject the W in the prefilled syringe into the vial. Shake gently to dissolve the powder. This gives a 1 mg/mL solution		**Infusion-related adverse events:** nausea, vomiting, hypoglycaemia **pH:** 2.5–3.5 (reconstituted) **Flush:** NS, G **Sodium content:** nil **Other comments:** for beta blocker overdose a bolus of 2–10 mg is usually given prior to the infusion **Bolus dose in children:** 50–150 micrograms/kg, maximum 10 mg Glucagon 1 mg = glucagon 1 unit	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	IV bolus **1** 2 3 4 **5** **6** 7 8 NPSA risk rating: 3	As above	**1 mg dose:** over 1 minute **Higher doses:** over 2–5 minutes		
	Beta blocker overdose: (C) IV infusion via volumetric infusion pump or syringe pump (unlicensed) **1** **2** **3** 4 **5** **6** **7** 8 NPSA risk rating: 6	Reconstitute the vial as above, then dilute the dose to a convenient volume with G	Usual rate 50 micrograms/kg per hour See comments		
Glucarpidase (carboxypeptidase G2 – unlicensed)					
Vial 1000 units Voraxaze Protherics UK Limited (UK)	IV bolus 1 2 3 4 **5** **6** 7 8 NPSA risk rating: 2	Reconstitute each vial with 1 mL NS	Usually 50 units/kg over 5 minutes	**Infusion-related adverse events:** hypersensitivity reactions including flushing, itching, rash, headache, hypotension and nausea **Flush:** NS **Sodium content:** nil **Displacement value:** negligible **Other comments:** reconstituted vials may be refrigerated, but must be used within 24 hours	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Glucose (dextrose monohydrate)					
Bag 5% (50 g/L) 50 mL, 100 mL, 250 mL, 500 mL, 1 L Bag 10% (100 g/L) 500 mL, 1 L Bag 15% (150 g/L) 500 mL Bag 20% (200 g/L) 500 mL Bag 50% (500 g/L) 500 mL *Non-proprietary* Baxter (UK) Vial 50% (500 g/L) *Non-proprietary* Hameln Pre-filled syringe 50% 50 ml Minijet IMS (UK)	**Hydration, energy source, or as diluent for administration of medicines:** (C) or (I) IV infusion **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted 5% and 10% solutions may be given peripherally 15%, 20% and 50% should be given via a central line (but see below)	According to the hydration status of the patient	**Infusion-related adverse events:** overly rapid administration of glucose solution may result in hyperglycaemia, hyperhydration and electrolyte disturbances **For solutions greater than 10%:** **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 5%: 4–4.2 Other strengths: 3.5–6.5 **Osmolarity:** 5%: 278 mOsmol/L 10%: 556 mOsmol/L 15%: 834 mOsmol/L 20%: 1112 mOsmol/L 50%: 2780 mOsmol/L **Flush:** NS **Sodium content:** nil. For glucose-sodium infusion fluids refer to the glucose and sodium chloride monograph **Potassium content:** for glucose-potassium infusion fluids refer to the potassium chloride monograph **Energy:** 5%: 200 kcal/L 10%: 400 kcal/L 15%: 600 kcal/L 20%: 800 kcal/L 50%: 2000 kcal/L	**Check individual drug monographs for compatibility data**
	Severe hypoglycaemia: IV bolus via a central line or a large peripheral vein 1 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Use the 10% solution	Usually 250 mL over 10 minutes (or faster if the patient can tolerate it)		
	Severe hypoglycaemia: IV bolus via a central line or a large peripheral vein 1 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Use the 50% solution **Must be administered with great care as extravasation may result in serious tissue damage**	Usually 25–50 mL over 1–2 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Glucose with sodium chloride					
Bag containing sodium chloride 0.18% and glucose 4% 500 mL, 1 L Bag containing sodium chloride 0.45% and glucose 2.5% 500 mL Bag containing sodium chloride 0.45% and glucose 5% 500 mL Bag containing sodium chloride 0.9% and glucose 5% 500 mL Bag containing sodium chloride 0.18% and glucose 10% 500 mL *Non-proprietary* Baxter (UK)	**Hydration, energy source, or as diluent for administration of medicines:** (C) or (I) IV infusion **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted The 0.45%/2.5% and 0.18%/4% solutions can be given peripherally	According to hydration status of the patient	**Infusion related adverse events:** overly rapid administration of glucose with sodium chloride may result in hyperglycaemia, hyperhydration and electrolyte disturbances **Extravasation:** the 0.9%/5%, 0.45%/5% and 0.18%/10% solutions may cause tissue damage; for management guidelines, see Section A7 **pH:** ~4-6 **Osmolarity:** 284 mOsmol/L (0.18%/4% solutions) 293 mOsmol/L (0.45%/2.5% solutions) 432 mOsmol/L (0.45%/5% solutions) 586 mOsmol/L (0.9%/5% solutions) 618 mOsmol/L (0.18%/10% solutions) **Flush:** NS **Sodium content:** 31 mmol/L (0.18% solutions) 77 mmol/L (0.45% solutions) 154 mmol/L (0.9% solutions) **Energy:** 100 kcal/L (2.5% solutions) 160 kcal/L (4% solutions) 200 kcal/L (5% solutions) 400 kcal/L (10% solutions)	**Check individual drug monographs for compatibility data**
	Hydration, energy source, or as diluent for administration of medicines: (C) or (I) IV infusion into a central line or large peripheral vein **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted The 0.9%/5%, 0.45%/5% and 0.18%/10% solutions should be given via a central line or large peripheral vein due to their high osmolarity	According to hydration status of the patient		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Glyceryl trinitrate (nitroglycerin)					
Vial 50 mg/50 mL *Non-proprietary* Hameln (UK) Ampoule 5 mg/5 mL Nitronal Lipha t/a Merck Serono	**Adults:** (C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 3 Give via a PVC-free administration set. See comment (a)	Ready diluted Draw up the required dose into a syringe. The solution contains glyceryl trinitrate 1 mg/mL	Usually 1 mL/hour, adjusted in 1 mL/hour increments every 15 minutes, according to response Usual maximum: 10 mL/hour See comment (b)	**Infusion-related adverse events:** headache, dizziness, flushing, nausea, hypotension, brady- and tachycardia **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 3–5.5 (undiluted, Lipha) 3–4 (Hameln) **Osmolarity:** 265–293 mOsmol/L (Lipha) **Flush:** NS **Other comments**: (a) glyceryl trinitrate binds to PVC. To prevent loss of drug it should be given using PVC-free syringes/giving sets. Non-PVC equipment held at UCLH at time of writing: Terumo/BD Plastipak syringes, B Braun Infusomat Space PVC-free Line (b) adult infusion rate equivalent to 1 mg/hour adjusted in 1 mg/hour increments every 15 minutes. Usual maximum infusion rate: 10 mg/hour (c) infusion rate in children equivalent to 0.2–0.5 micrograms/kg per minute, increased to 1–3 micrograms/kg per minute. Usual maximum 10 micrograms/kg per minute	**Do not infuse other medicines via a Y-site with the 1 mg/mL solution** **If diluted to 400 micrograms/mL the following drugs and fluids are Y-site compatible:** **Compatible fluids:** NS, G, GS, H, sodium chloride 0.45% **Y-site compatible ready-diluted medicines:** propofol 1% **Y-site compatible when diluted in G or NS:** dobutamine, dopamine, eptifibatide, fentanyl, lidocaine, midazolam, morphine, noradrenaline, pancuronium, pantoprazole, remifentanil, sodium nitroprusside, thiopental, vecuronium **Y-site compatible when diluted in NS:** drotrecogin, furosemide **Incompatible:** phenytoin
	Children over 1 month: (C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5 Give via a PVC-free administration set. See comment (a)	Dilute dose to 400 micrograms/mL with NS or G. For example, dilute 5 mg (5 mL) to 12.5 mL with NS or G	Initially 0.03–0.075 mL/kg per hour, increased to 0.15–0.45 mL/kg per hour according to response Usual maximum 1.5 mL/kg per hour See comment (c)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Glycopyrronium bromide with neostigmine metisulfate					
Ampoule Glycopyrronium bromide 500 micrograms with neostigmine metisulfate 2.5 mg/1 mL *Non-proprietary* Anpharm t/a Goldshield (UK)	IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted May be further diluted to a convenient volume with W or NS	Over 10–30 seconds	**Infusion-related adverse events:** dry mouth, arrhythmias, visual disturbances, bradycardia **Extravasation**: may cause tissue damage; for management guidelines, see Section A7 **pH:** 3.4–3.8 (undiluted) **Flush:** NS **Sodium content:** negligible	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Glycopyrronium bromide (glycopyrrolate)					
Ampoule 200 micrograms/1 mL 600 micrograms/3 mL *Non-proprietary* Taro Pharma (UK)	IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted May be further diluted to a convenient volume with NS or G	Over 3–5 minutes	**Infusion-related adverse events**: transient bradycardia followed by tachycardia and palpitations, nausea, vomiting, dizziness, confusion (particularly in the elderly), visual disturbances, dry mouth, flushing, dryness of skin **pH:** 2–3 (undiluted) **Osmolality:** 270–320 mOsmol/kg **Flush:** NS **Sodium content:** 0.15 mmol/1 mL vial 0.5 mmol/3 mL vial **Other comments:** for further information about the use of glycopyrronium in palliative care refer to local syringe driver guidelines	**Compatible fluids:** NS, G, GS **Incompatible:** diazepam, thiopental sodium **Compatible in a syringe for SC (C) infusion:** cyclizine, dexamethasone, diamorphine, fentanyl, haloperidol lactate, levomepromazine, metoclopramide, midazolam, morphine, octreotide, ondansetron, oxycodone **See Section A15 for further details**
	IM 1 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted			
	Drying of respiratory secretions in palliative care: (C) SC infusion via a syringe driver (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute to a convenient volume with NS, G or W May be mixed with other drugs in the same syringe See comments	**Adults and children 12 or over**: usually 0.6–1.2 mg over 24 hours **Children 1 month to 12 years:** usually 12–40 micrograms/kg over 24 hours (maximum 1.2 mg)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Gonadorelin (gonadotrophin-releasing hormone/GnRH/LH–RH)					
Vial 100 micrograms/1 mL HRF 100 Intrapharm (UK)	IV/SC bolus 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	Reconstitute 100 microgram vial with 1 mL of diluent provided	Over a few seconds	**Infusion-related adverse events:** headaches, nausea, light-headedness, abdominal discomfort, flushing, thrombophlebitis, pain and swelling at injection site **pH:** 4–8 (reconstituted in 1 mL diluent provided) **Flush:** NS **Sodium content:** nil	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Granisetron					
Ampoule 1 mg/1 mL 3 mg/3 mL Kytril Roche (UK)	IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Dilute each 1 mg of drug to 5 mL with NS	Over 30 seconds	**Infusion-related adverse events:** headache, skin rash **pH:** 5–7 (undiluted) **Osmolality:** 305 mOsmol/kg **Flush:** NS **Sodium content:** 0.2 mmol/1 mL ampoule 0.5 mmol/3 mL ampoule **Other comments:** for further information refer to the document 'Syringe Driver Guidelines' at www.uclhguide.com or the UCLH intranet	**The following data assume granisetron is infused into the Y-site as a 0.05 mg/mL solution. Granisetron solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H **Y-site compatible ready-diluted medicines:** fluconazole, ganciclovir, linezolid, metronidazole, potassium chloride 40 mmol/L in NS or G, propofol, sodium bicarbonate 8.4% **Y-site compatible when diluted in NS or G:** aciclovir, amikacin, aminophylline, bumetanide, cefotaxime, ceftriaxone, cefuroxime, co-trimoxazole, dobutamine, dopamine, folinic acid, gentamicin, hydrocortisone sodium succinate, imipenem with cilastatin, magnesium sulphate, methylprednisolone sodium succinate, morphine, pipericillin with tazobactam, ranitidine, tobramycin, vancomycin, zidovudine **Y-site compatible when diluted in NS:** furosemide
	(I) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Add dose to 50–100 mL NS or G	Over 10–15 minutes		
	(C) SC infusion via a syringe driver (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute to a convenient volume with NS or W May be mixed with other drugs in the same syringe See comments	Over 24 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Haloperidol					⚠ For IM use only
Ampoule 50 mg/1 mL 100 mg/1 mL Haldol Janssen-Cilag (UK)	Deep IM 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted See comments		**Infusion-related adverse events:** arrhythmia, muscle rigidity, increased salivation, movement disorders, dry mouth, blurred vision, tachycardia and sweating leading to high body temperature **Sodium content:** nil **Other comments:** warm ampoule in hands to aid withdrawal of contents Do not administer more than 3 mL at any one site Contains sesame oil This drug is a depot formulation usually administered once monthly	**Do not mix with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Haloperidol (as lactate)					
Ampoule 5 mg/1 mL *Non-proprietary* Antigen (UK)	IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted. May be further diluted to a convenient volume with NS or G	Over 3–5 minutes	**Infusion-related adverse events:** arrhythmia, muscle rigidity, increased salivation, movement disorders, dry mouth, blurred vision, tachycardia and sweating, pyrexia **ECG monitoring recommended in patients with a cardiac history** **pH:** 2.8–3.6 (undiluted) **Flush:** NS **Sodium content:** nil **Other comments:** for further information about the use of haloperidol in palliative care refer to local syringe driver guidelines	**Compatible in a syringe for (C) SC injection:** cyclizine, dexamethasone, diamorphine, dihydrocodeine, fentanyl, glycopyrronium, hyoscine butylbromide, hyoscine hydrobromide, ketamine, levomepromazine, metoclopramide, midazolam, morphine, octreotide, ondansetron, oxycodone **See Section A15 for further details**
	IM **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted			
	Palliative care (adults): (C) SC infusion via a syringe driver (unlicensed) **1** **2** **3** **4** 5 **6** **7** 8 NPSA risk rating: 6	Dilute to a convenient volume with NS or W. May be mixed with other drugs in the same syringe See comments	**Restlessness/confusion:** 5–15 mg over 24 hours **Nausea and vomiting:** 2.5–10 mg over 24 hours		
	Palliative care (children): (C) SC infusion via a syringe driver (unlicensed) **1** **2** **3** **4** 5 **6** **7** 8 NPSA risk rating: 6	As above	**Nausea and vomiting:** 12–18 years: 1.5–5 mg over 24 hours 1 month to 12 years: 25–85 micrograms/kg over 24 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Hartmann's					
***see* compound sodium lactate**					
Heparin calcium					
Ampoule 5000 units/0.2 mL *Non-proprietary* Wockhardt **Heparin calcium is rarely used. See comments prior to administration**	**For systemic anticoagulation and thromboprophylaxis**: SC bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2 (but see NPSA risk comment under heparin sodium)	Ready diluted		**Infusion-related adverse events:** bleeding. Rarely hypersensitivity reactions, skin necrosis **pH:** 5.5–8 **Sodium content:** nil **Other comments:** at UCLH heparin calcium is used only in rare instances when neither heparin sodium nor dalteparin are appropriate For systemic anticoagulation the dose and frequency of administration are modified according to the patient's aPTT ratio. Seek advice from pharmacy and haematology for monitoring requirements Heparin calcium is licensed for IV injection. However, if the IV route is available heparin sodium is the drug of choice	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Heparin sodium					
Main preparations: Ampoule 5000 units/5 mL 20,000 units/20 mL *Non-proprietary* Leo **Other preparations:** Ampoule 10,000 units/10 mL *Non-proprietary* Leo Multi-dose vial 5000 units/5 mL with preservative *Non-proprietary* Wockhardt	**For systemic anticoagulation (adults):** IV bolus, prior to the infusion below **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2 See comment (d)	Ready diluted, using a 1000 unit/mL solution	75 units/kg over 3–5 minutes; maximum dose 10,000 units. Round to the nearest 2500 units See comment (a)	**Infusion-related adverse events:** bleeding. Rarely hypersensitivity reactions, skin necrosis **pH:** 5.5–8 **Osmolality:** 280–300 mOsmol/kg **Flush:** NS after a bolus. After the infusion is discontinued, disconnect the administration set without flushing. Flush the catheter/cannula with NS **Sodium content:** 0.1–0.2 mmol/mL (vials and ampoules) 93 mmol/500 mL bag **Other comments:** (a) if using the 1000 unit/mL solution: initial bolus dose equivalent to 0.075 mL/kg over 3–5 minutes. The dose should be rounded to the nearest 2.5 mL increment Maximum initial bolus dose: 10 mL (b) to deliver the infusion using the 1000 unit/mL solution: initially infuse 0.018 mL/kg per hour. Round the infusion rate to the nearest 0.1 mL/hour increment Maximum initial rate: 1.5 mL/hour For full instructions for preparation, administration, dose adjustment and monitoring of heparin refer to the document 'Unfractionated Heparin for Systemic Anticoagulation – ADULTS' at www.uclhguide.com or the UCLH intranet or local hospital guidelines	**The following data assume heparin is infused into the Y-site as a 1000 unit/mL solution. Heparin solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** esmolol, fluconazole, foscarnet, ganciclovir, linezolid **Y-site compatible when diluted in G or NS:** acetylcysteine, adrenaline, alfentanil, aminophylline, clonidine, dobutamine, dopamine, eptifibatide, fentanyl, folinic acid, insulin, meropenem, midazolam, morphine, noradrenaline, remifentanil, rocuronium, sodium nitroprusside, vecuronium **Y-site compatible when diluted in NS:** furosemide
	For systemic anticoagulation (adults): (C) IV infusion via a syringe pump **1** 2 3 4 5 **6** **7** 8 NPSA risk rating: 3 See comment (d)	Ready diluted Draw up 40 mL of 1000 unit/mL solution to make a 40,000 units in 40 mL syringe Preferably use the 20,000 unit/20 mL ampoules	Initially 18 units/kg per hour, rounded to nearest 100 units/hour Maximum initial rate 1500 units/hour Adjusted according to aPTT ratio. See comment (b)		
For SC administration, contact pharmacy to discuss which preparation to use. Dalteparin or SC heparin calcium are preferable for these indications. Consult pharmacist and haematologist prior to initiation.	**For thromboprophylaxis or systemic anticoagulation:** SC bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted	Adjusted according to aPTT ratio when used for anticoagulation		

Formulation	Method	Dilution	Rate	Comments	Compatibility
Heparin sodium *continued*					
Bag 1000 units/500 mL *Non-proprietary* Baxter	**For maintenance of arterial patency:** intra-arterial infusion **1** 2 3 4 5 6 **7** 8 NPSA risk rating: 2	Ready diluted	Determined by the procedure	(c) for full details of catheter maintenance including the use of heparin locks and flushes refer to the document 'UCLH Central Venous Catheter Care' at www.uclhguide.com or the UCLH intranet or local hospital guidelines The NPSA has advised heparin solutions should not be routinely used to flush peripheral venous catheters. For further information about flushes refer to Section A8 (d) **NPSA risk:** steps taken at UCLH to minimise risk during heparin administration result in a low NPSA risk rating. However, because of the pharmacological action of the drug, frequent need for aPTT monitoring and dose adjustment, heparin should be considered a high risk intervention in all cases, except when used to flush or lock a central line. Heparin infusions should only be prescribed and administered by those competent to do so and who are familiar with methods required to reverse anticoagulation in an emergency This monograph should only be used in conjunction with local heparin prescribing and administration guidelines	**Incompatible:** amiodarone, atracurium, ciprofloxacin, clarithromycin, desferrioxamine, drotrecogin, erythromycin, gentamicin, hydrocortisone sodium succinate, labetolol, tobramycin
Ampoule 50 units/5 mL 200 units/2 mL *Non-proprietary* Wockhardt	**For maintenance of patency of central venous access devices** **1** 2 3 4 5 6 7 8 NPSA risk rating: 0 **Only to be used to lock or flush central venous catheters**	Ready diluted The 50 units/5 mL should be used to **lock** all types of catheter The 200 units/2 mL should only be used to **flush** the Portacath See comment (c)			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Hydralazine hydrochloride					
Ampoule 20 mg Apresoline Sovereign Medical (UK)	**Hypertension (adults):** IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Reconstitute 20 mg ampoule with 1 mL W, then dilute to 10 mL with NS	Usually 5–10 mg over 3–5 minutes. May be repeated after 20–30 minutes	**Infusion-related adverse events:** tachycardia, palpitations, flushing, headaches, dizziness, nasal congestion, hypotension **Monitor blood pressure and heart rate** **pH**: 3.5–4.2 (after reconstitution with 1 mL W) **Flush:** NS **Sodium content:** nil **Displacement:** negligible **Other comments:** (a) for hypertension both infusions are equivalent to 200–300 micrograms/minute initially, reduced to 50–150 micrograms/minute after a response Target blood pressure is determined by individual patient factors (b) for pre-eclampsia/eclampsia infusion rate equivalent to 10 mg/hour, increasing up to a maximum of 40 mg/hour (c) hydralazine is rarely used in children or neonates at UCLH. For administration instructions refer to the Children's BNF	**Compatible fluids:** H, sodium chloride 0.45% **Incompatible:** G **Do not infuse with any other medicines or infusion fluids**
	Hypertension (adults): (C) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Reconstitute as above, then dilute to 500 mL with NS This gives a 0.04 mg/mL solution	Initially 300–450 mL/hour, reduced to 75–150 mL/hour after an adequate response has been achieved See comment (a)		
	Hypertension (adults): (C) IV infusion via a syringe pump (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Reconstitute three 20 mg ampoules, each with 1 mL W, then further dilute to 60 mL with NS This gives a 1 mg/mL solution	Initially 12–18 mL/hour, reduced to 3–9 mL/hour after an adequate response has been achieved See comment (a)		
	Pre-eclampsia/eclampsia: (C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Reconstitute two 20 mg ampoules, each with 1 mL W, then further dilute to 40 mL with NS This gives a 1 mg/mL solution	Initially 10 mL/hour. The infusion rate should be doubled every 30 minutes to a maximum rate of 40 mL/hour See comment (b)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Hydrocortisone (as sodium succinate)					
Vial 100 mg Solu-Cortef Pharmacia (UK)	IV bolus 1 2 3 4 **5** **6** 7 8 NPSA risk rating: 2	Add 2 mL W to 100 mg vial If a part vial is required, reconstitute the vial with 1.9 mL W to produce a 50 mg/mL solution; see comments	Over 3–5 minutes	**Infusion-related adverse events:** bradycardia, hypotension, hypertension, nausea, vomiting, taste disturbances, muscle pain **pH:** 7–8 (100 mg reconstituted in 2 mL W) **Osmolality:** 292 mOsmol/kg **Flush:** NS **Sodium content:** 0.4 mmol/100 mg vial **Displacement value:** 0.1 mL/100 mg vial Add 1.9 mL W to 100 mg vial to give a 100 mg/2 mL solution	**The following data assume hydrocortisone is infused into the Y-site as a 1 mg/mL solution. Hydrocortisone solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, G10, H, sodium chloride 0.45% **Y-site compatible ready-diluted medicines:** esmolol, foscarnet, linezolid, metronidazole, propofol 1% **Y-site compatible when diluted in G or NS:** aciclovir, atracurium, granisetron, pancuronium, pethidine, piperacillin with tazobactam, remifentanil, tacrolimus, thiopental **Incompatible:** heparin
	(I) IV infusion 1 **2** 3 4 **5** **6** 7 8 NPSA risk rating: 3	Reconstitute as above. Dilute to 100 mL to 1 L NS, G or GS. The final concentration should be no greater than 1 mg/mL **Recommended dilution:** add 100 mg to 100 mL infusion bag	Infuse at a convenient rate, according to the volume of dilution **If diluted in 100 mL:** give over 20 minutes		
	IM 1 2 3 4 **5** **6** 7 8 NPSA risk rating: 2	Reconstitute as for the IV bolus			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Hydroxocobalamin					
Vial 1 mg/1 mL *Non-proprietary* Auden Mackenzie (UK)	IM 1 2 3 4 5 6 7 8 NPSA risk rating: 0	Ready diluted		**Infusion-related adverse events:** nausea, dizziness, fever, chills, injection site irritation, hot flushes **pH:** 4.5–5.5 (undiluted) **Osmolality:** 270–320 mOsmol/kg **Sodium content:** 0.4 mmol/1 mL vial **Other comments:** at UCLH the IV administration of hydroxocobalamin is restricted to patients with thrombocytopenia (platelet count less than 50)	**Do not infuse with any other medicines or infusion fluids**
	IV bolus (unlicensed – see comments) 1 2 3 4 5 6 7 8 NPSA risk rating: 0	Ready diluted	Over 1 minute		
Hyoscine butylbromide (scopolamine butylbromide)					
Ampoule 20 mg/1 mL Buscopan Boehringer Ingelheim (UK)	IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted. May be further diluted to a convenient volume with NS or G	Over at least 1 minute	**Infusion-related adverse events:** hypersensitivity, skin reactions, shortness of breath, tachycardia, hypotension, dizziness, flushing, injection site pain after IM administration **pH:** 3.7–5.5 (undiluted) **Osmolality:** 272 mOsmol/kg **Flush:** NS **Sodium content:** 0.3 mmol/1 mL vial **Other comments:** for further information about the use of hyoscine in palliative care refer to local syringe driver guidelines	**Compatible fluids:** NS, G, GS **Compatible in a syringe for (C) SC infusion:** cyclizine,dexamethasone, diamorphine, fentanyl, haloperidol lactate, levomepromazine, metoclopramide, midazolam, morphine, octreotide, ondansetron, oxycodone **See Section A15 for further details**
	IM 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted			
	Bowel colic in palliative care: (C) SC infusion via a syringe driver (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute to a convenient volume with NS or W May be mixed with other drugs in the same syringe See comments	**Adults:** usually 20–60 mg over 24 hours **Children:** usually 40–60 micrograms/kg over 24 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Hyoscine hydrobromide (scopolamine hydrobromide)					
Ampoule 400 micrograms/1 mL 600 micrograms/1 mL *Non-proprietary* Martindale t/a Cardinal Health (UK)	SC/IM 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted		**Infusion-related adverse events:** drowsiness, blurred vision, dry mouth, bradycardia **pH:** 2.75–3.75 (undiluted) **Flush:** NS **Sodium content:** 0.2 mmol/1 mL ampoule **Other comments:** for further information about the use of hyoscine in palliative care refer to local syringe driver guidelines	**Compatible fluids:** NS, G, GS **Compatible in a syringe for (C) SC infusion:** cyclizine, dexamethasone, diamorphine, fentanyl, haloperidol lactate, levomepromazine, metoclopramide, midazolam, morphine, octreotide, ondansetron, oxycodone **See Section A15 for further details**
	Drying of respiratory secretions in palliative care: (C) SC infusion via a syringe driver (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute to a convenient volume with NS, G or W May be mixed with other drugs in the same syringe See comments	**Adults:** usually 0.6–2.4 mg over 24 hours **Children:** 1.5–2.5 micrograms/kg per hour over 24 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ibuprofen					
Ampoule 10 mg/2 mL Pedea Orphan Europe (UK)	**Closure of ductus arteriosus in neonates:** (I) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5 (6 if diluted)	Ready diluted. May be further diluted to a convenient volume with NS or G	**On day 1:** usually 10 mg/kg over 15 minutes **On the following 2 days:** 5 mg/kg over 15 minutes	**Infusion-related adverse events:** gastrointestinal irritation, nausea, vomiting, bronchospasm, fluid retention **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 7.8–8.2 (undiluted) **Osmolality**: 260–310 mOsmol/kg **Flush:** NS **Sodium content:** 0.3 mmol/2 mL vial **Other comments:** for further information refer to 'Neonatal Drug Monograph Ibuprofen' at www.uclhguide.com or the UCLH intranet or local guidelines	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Iloprost (unlicensed)					
Ampoule 50 micrograms/0.5 mL Ilomedin Bayer Schering Pharma (Netherlands)	**Severe Raynaud's phenomonen (adults):** (I) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Dilute one ampoule to 50 mL with NS. This gives a 1000 nanogram/mL solution Wash spillages from skin immediately: prolonged contact may result in burns	Begin infusion at 0.03 mL/kg per hour for 30 minutes. If tolerated increase dose in increments of 0.03 mL/kg per hour every 30 minutes to a maximum of 0.12 mL/kg per hour On the following day the infusion is started at the highest tolerated rate of the previous day, and increased in similar 0.03 mL/kg per hour increments If a patient cannot tolerate iloprost the dose should be decreased by 0.03 mL/kg per hour increments Usually infused for a total of 6 hours/day for 5 days. In some cases the patient may be prescribed 10 hour infusions for 3 days	**Infusion-related adverse events:** facial flushing, headaches, malaise, nausea, vomiting, abdominal pain, diarrhoea, sweating, sensation of warmth. Stop infusion if side effects are severe **Monitor blood pressure and pulse prior to infusion, every 30 minutes during infusion and 1 hour after** **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 7.8–8.8 (undiluted) **Flush:** NS **Sodium content:** negligible **Other comments:** initial infusion rate equivalent to 0.5 nanogram/kg per minute increasing in 0.5 nanogram/kg per minute increments up to a maximum of 2 nanagrams/kg per minute For further information refer to 'Iloprost in Severe Raynaud's Phenomenon Unresponsive to Other Therapies' at www.uclhguide.com or the UCLH intranet or local guidelines	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Imipenem with cilastatin					
Vial 500 mg imipenem with 500 mg cilastatin Primaxin Merck, Sharp & Dohme Ltd (UK)	**Adults and children:** (I) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 4	**Doses up to 250 mg:** reconstitute the vial with 10 mL NS or G taken from a 50 mL bag. Withdraw the dose and return to the bag **Doses 251–500 mg:** reconstitute the vial with 10 mL NS or G from a 100 mL bag. Withdraw the dose and return to the bag **Doses 501–1000 mg:** reconstitute each vial with 10 mL NS or G from a 250 mL bag. Withdraw the dose and return to the bag	**Doses up to 500 mg:** over 20–30 minutes **Doses above 500 mg:** over 40–60 minutes	**Infusion-related adverse events:** injection site reactions, thrombophlebitis, rash, nausea, vomiting, diarrhoea, headache, shortness of breath, hypotension, palpitations, tachycardia **pH:** 6.5–8.5 (diluted solution) **Osmolarity:** approximately isotonic with the diluent when 500 mg is diluted to 100 mL **Flush:** NS **Sodium content:** 1.7 mmol/500 mg vial **Displacement value:** negligible **Other comments:** use with caution in patients with penicillin allergy. Approximately 10% cross-sensitivity	**The following data assume imipenem with cilasatin is infused into the Y-site as a 2.5 mg+2.5 mg/mL solution. Imipenem with cilasatin solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** foscarnet, linezolid, propofol 1% **Y-site compatible when diluted in G or NS:** aciclovir, ondansetron, remifentanil, tacrolimus, zidovudine **Incompatible:** drotrecogin, gentamicin, mannitol 10%, pethidine, sodium bicarbonate, tobramycin
	Neonates: (I) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Reconstitute the vial with 10 mL G Withdraw the dose and dilute to 5 mg/mL with G	Over 20–30 minutes		
	Fluid restriction: (I) IV infusion via a central line (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Reconstitute each vial with 10 mL NS, then add to 50 mL NS or G This gives a 8.3 mg/mL solution	**Doses up to 500 mg:** over 20–30 minutes **Doses above 500 mg:** over 40–60 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Immunoglobulin, normal human (Flebogamma)					
Bottle 5 g 10 g Flebogamma 50 mg/mL Grifols UK Ltd (UK)	(I) IV infusion via a volumetric infusion pump **1** 2 3 4 5 6 **7** 8 NPSA risk rating: 2	Ready diluted	**Initial rate:** 0.6 mL/kg per hour for 30 minutes with monitoring as described under comments **Titration rate:** If tolerated increase to 1.2 mL/kg per hour for 30 minutes, then increase to a maximum rate of 4.2 mL/kg per hour	**Infusion-related adverse events and monitoring:** chills, hypothermia, headache, fever, vomiting. Rarely hypersensitivity reactions including rash, nausea and arthralgia. Monitor BP, heart rate, oxygen saturation, respiratory rate and temperature during initial rate and hourly during infusion **pH:** 5.0–6.0 **Osmolality:** 240–350 mOsmol/kg ⚠ **Flush:** do not flush the administration set. At the end of the infusion, disconnect the set, aspirate the catheter/cannula, then flush with NS **Sodium content:** 0.08 mmol/5 g bottle 0.16 mmol/10 g bottle **Other comments:** ensure patient is well hydrated prior to infusion to minimise risk of renal impairment The manufacturer recommends Flebogamma is administered through a 15 micron in-line filter. At UCLH all administration sets have such a filter	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Immunoglobulin, normal human (Intratect)					
Bottle 5 g 10 g Intratect 50 mg/mL solution Biotest UK Limited (UK)	(I) IV infusion via a volumetric infusion pump **1** 2 3 4 5 6 **7** 8 NPSA risk rating: 2	Ready diluted	**Initial rate:** 1.4 mL/kg per hour for 30 minutes with monitoring as described in comments **Titration rate:** If tolerated increase to 1.6 mL/kg per hour for 30 minutes, then increase to a maximum rate of 1.9 mL/kg per hour	**Infusion-related adverse events and monitoring:** chills, hypothermia, headache, fever, vomiting. Rarely hypersensitivity reactions including rash, nausea and arthralgia. Monitor BP, heart rate, oxygen saturation, respiratory rate and temperature during initial rate and hourly during infusion **pH:** 5.1–5.2 **Osmolality:** 320–325 mOsmol/kg ⚠ **Flush:** do not flush the administration set. At the end of the infusion, disconnect the set, aspirate the catheter/cannula, then flush with NS **Sodium content:** 5 g bottle less than 0.5 mmol 10 g bottle less than 1 mmol **Other comments:** ensure patient is well hydrated prior to infusion to minimise risk of renal impairment The manufacturer recommends Intratect is administered through a 15 micron in-line filter. At UCLH all administration sets have such a filter	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Immunoglobulin, normal human (Octagam)					
Bottle 5 g 10 g Octagam 50 mg/mL solution Octapharma Limited (UK)	(I) IV infusion via a volumetric infusion pump **1** 2 3 4 5 6 **7** 8 NPSA risk rating: 2	Ready diluted	**Initial rate:** 1 mL/kg per hour for 30 minutes with monitoring as described under comments **Titration rate:** If tolerated increase to 2 mL/kg per hour for 30 minutes, then gradually increase to a maximum rate of 5 mL/kg per hour	**Infusion-related adverse events and monitoring:** chills, hypothermia, headache, fever, vomiting. Rarely hypersensitivity reactions including rash, nausea and arthralgia. Monitor BP, heart rate, oxygen saturation, respiratory rate and temperature during initial rate and hourly during infusion **pH:** 5.1–6.0 **Osmolality:** 310–380 mOsmol/kg **Flush:** NS, G **Sodium content:** 5 g bottle: less than 1.5 mmol 10 g bottle: less than 3 mmol **Other comments:** ensure patient is well hydrated prior to infusion to minimise risk of renal impairment	**Compatible fluids:** NS, G **Do not infuse with any other medicines or infusion fluids**

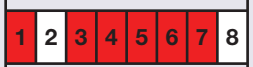
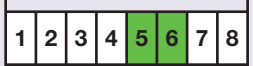
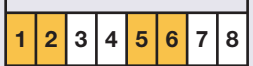
- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Immunoglobulin, normal human (Privigen)					
Bottle 5 g 10 g Privigen 100 mg/mL solution CSL Behring UK Limited (UK)	(I) IV infusion via a volumetric infusion pump **1** 2 3 4 5 6 **7** 8 NPSA risk rating: 2	Ready diluted	**Initial rate:** 0.3 mL/kg per hour for 30 minutes with monitoring as described under comments **Titration rate:** if tolerated increase to 0.6 mL/kg per hour for 30 minutes, then increase to a maximum rate of 4.8 mL/kg per hour	**Infusion-related adverse events:** chills, hypothermia, headache, fever, vomiting. Rarely hypersensitivity reactions including rash, nausea and arthralgia. Monitor BP, heart rate, oxygen saturation, respiratory rate and temperature during initial rate and hourly during infusion **pH:** 4.8 **Osmolality:** 320 mOsmol/kg ⚠ **Flush:** do not flush the administration set. At the end of the infusion, disconnect the set, aspirate the catheter/cannula, then flush with NS **Sodium content:** less than 0.25 mmol/5 g bottle less than 0.50 mmol/10 g bottle **Other comments:** ensure patient is well hydrated prior to infusion to minimise risk of renal impairment The manufacturer recommends Privigen is administered through a 15 micron in-line filter. At UCLH all administration sets have such a filter	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Immunoglobulin, normal human (Vigam)					
Bottle 2.5 g 5 g 10 g Vigam 50 mg/mL solution Bio Products Laboratory (UK)	(I) IV infusion via a volumetric infusion pump, through an administration set with a 15 micron in-line filter **1** 2 3 4 5 6 **7** 8 NPSA risk rating: 2	Ready diluted	**Initial rate:** 0.6 mL/kg per hour for 30 minutes with monitoring as described above **Titration rate:** if tolerated increase to 1.2 mL/kg per hour for 30 minutes, then increase to 2.4 mL/kg per hour for 30 minutes, and continue to gradually increase up to a maximum tolerated rate of 180 mL/hour	**Infusion-related adverse events:** chills, hypothermia, headache, fever, vomiting. Rarely hypersensitivity reactions including rash, nausea and arthralgia. Monitor BP, heart rate, oxygen saturation, respiratory rate and temperature during initial rate and hourly during infusion **pH:** 4.8–5.1 **Osmolality:** 240 mOsmol/kg **Flush:** NS **Sodium content:** 8 mmol/2.5 g bottle 16 mmol/5 g bottle 32 mmol/10 g bottle **Other comments:** ensure patient is well hydrated prior to infusion to minimise risk of renal impairment. Allow product to warm to room temperature before administration	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Indometacin					
Vial 1 mg Indocid PDA Ovation Healthcare International (Ireland)	**Closure of ductus arteriosus in neonates:** (I) IV infusion via a syringe pump  NPSA risk rating: 6	Add 2 mL W to 1 mg vial This gives a 500 microgram/mL solution. Do not further dilute See comment (a)	Usually 100 micrograms/kg over 20 minutes	**Infusion-related adverse events:** gastrointestinal irritation, nausea, vomiting, bronchospasm, fluid retention **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 6–7.5 (Indocid PDA) 7.5–8.5 (Liometacin, undiluted) **Flush:** NS **Sodium content:** negligible (Indocid PDA, Liometacin) **Displacement value:** negligible (Indocid PDA) **Other comments:** (a) the volume of drug may be very small. To ensure the neonate receives the full dose, flush the administration set with NS over 20 minutes to ensure the full dose is delivered. For further information refer to the document 'Neonatal Unit Drug Monograph – Indometacin' at www.uclhguide.com or the UCLH intranet (b) indometacin is used at the National Hospital for Neurology and Neurosurgery for the diagnosis of hemicrania continua and chronic paroxysmal hemicrania. Usual dose: 100 mg IM	**See dilution and comments for compatible fluid** **Do not infuse indometacin with any other medicines or infusion fluids. Indocid PDA must not be reconstituted or diluted with G**
Ampoule (unlicensed) 50 mg Liometacen Promedica (Italy) Each 50 mg ampoule is supplied with 2 mL ampoule W	**Adults:** IM  NPSA risk rating: 2	Reconstitute each ampoule with 2 mL W This gives a 25 mg/mL solution See comment (b)			
	Adults: (I) IV infusion  NPSA risk rating: 4	Reconstitute as above Add one or two reconstituted ampoules to 250–500 mL NS or G	Usual rate 75–100 mL/hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Infliximab					
Vial 100 mg Remicade Schering-Plough Ltd (UK)	(I) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Add 10 mL W to each 100 mg vial. Gently swirl the solution by rotating the vial to dissolve the powder. Do not shake. Allow the reconstituted solution to stand for 5 minutes Add the required dose to the 250 mL bag NS Administer through a 0.2 micron filter (available from pharmacy) Use solution within 3 hours of preparation	Over 2 hours See comments	**Infusion-related adverse events:** hypersensitivity reactions including shortness of breath, rash, itching, tachcardia, hypotension **pH:** 7.0–7.4 (diluted in 250 mL NS) **Osmolality:** 300–400 mOsmol/kg (diluted in 250 mL NS) **Flush:** NS **Sodium content:** negligible **Displacement value:** negligible **Other comments:** 15 minutes prior to infliximab adult patients should be given: hydrocortisone 100 mg IV and chlorphenamine 10 mg IV. Children may be pre-medicated with same drugs, but the doses should be adjusted accordingly. Monitor patient for 1 hour after infusion for hypersensitivity reactions Solutions can be stored between 2 and 8°C for 24 hours after reconstitution and dilution For further information refer to the documents 'Infliximab Ward Nursing Protocol for Gastroenterology Patients' and 'Infliximab Protocol for Rheumatology Patients on Adolescent Unit' at www.uclhguide.com or the UCLH intranet	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Insulin soluble					
Vial 1000 units/10 mL Actrapid Novo-Nordisk (UK) Due to the potential for patient harm and frequent monitoring, insulin infusions should be considered high risk interventions in all cases	**Adults and children:** (C) IV infusion via a syringe pump (unlicensed) **1** **2** 3 **4** 5 **6** **7** 8 NPSA risk rating: 5	Draw up 50 units insulin using an insulin syringe Draw up NS into a 50 mL syringe. Transfer the insulin into the NS syringe. Ensure thorough mixing of the drug and diluent. The final volume of the syringe should be 50 mL The syringe contains 1 unit/mL	According to the prescribed scheme. See comment (a)	**Infusion-related adverse events:** hypoglycaemia. Also pain, itching, inflammation at SC injection site **pH:** 7–7.8 **Flush:** NS **Sodium content:** negligible **Other comments:** (a) insulin syringe pumps are prescribed for a variety of indications at UCLH. For full details refer to the relevant guideline on the intranet. Target blood glucose, fluid therapy and patient management details vary according to the indication Usual initial infusion rates in diabetic patients undergoing surgery: adults 2–4 units/hour, children 0.05 unit/kg per hour Usual initial infusion rates in adults in diabetic emergencies – diabetic ketoacidosis: 6 unit IV bolus followed by 6 unit/hour infusion. Hyperosmolar non-ketotic diabetic coma: 3 units/hour. See comment (e) b) for the GIK infusion: insulin is infused at a constant rate, while potassium and glucose are titrated to maintain potassium within normal range and blood glucose between 4 and 10 mmol/L. To do this potassium 20 mmol is diluted to 50 mL with NS and given at an initial rate of 0.12 mmol/kg per hour. Glucose 50% is given initially at 0.9 mL/kg per hour	**The following data assume insulin is infused into the Y-site as a 1 unit/mL solution. Insulin solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, potassium chloride 40 mmol/L in NS or G, sodium bicarbonate 8.4% **Y-site compatible ready-diluted medicines:** esmolol, propofol 1% **Y-site compatible when diluted in G:** amiodarone
	GIK (glucose–insulin–potassium) infusion for myocardial ischaemia in critical care: (C) IV infusion via a syringe pump (unlicensed) **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4	Prepare a 50 unit in 50 mL syringe, as above	0.075 unit/kg per hour Co-administer with potassium and glucose. See comment (b)		
	IV bolus **1** 2 3 **4** 5 **6** 7 8 NPSA risk rating: 3	Draw up the dose using an insulin syringe, then transfer to a regular 5–10 mL syringe, using a method similar to above. Use NS as the diluent	Over a few seconds		

Formulation	Method	Dilution	Rate	Comments	Compatibility
Insulin soluble *continued*					
Vial 1000 units/10 mL Actrapid Novo-Nordisk (UK) Due to the potential for patient harm and frequent monitoring, insulin infusions should be considered high risk interventions in all cases	**Neonates:** (C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Draw up the dose of insulin using an insulin syringe Draw up NS into a 50 mL syringe. Transfer the insulin into the NS syringe. Ensure thorough mixing of the drug and diluent The final volume of the syringe should be 50 mL See comment (c)	Usual starting rate: 0.01 unit/kg per hour Adjust dose according to blood glucose	(c) for further information refer to the document 'Neonatal Unit Monograph – Insulin' at www.uclhguide.com or the UCLH intranet Local practice in neonates: an hour before an insulin syringe is due for replacement a new insulin syringe should be prepared and the administration set primed. Insulin binds to both the syringe and set; preparation in advance allows insulin to saturate binding sites. It is important to monitor the patient's blood glucose after the syringe change and adjust the rate of insulin infusion accordingly If a new infusion is not prepared in advance, the patient should be given a freshly prepared infusion so treatment is not delayed. However, consider that the new infusion may deliver more insulin per millilitre than the previous syringe (d) for hyperkalaemia management details refer to 'Urgent Reduction of Hyperkalaemia' (e) for management details of diabetic ketoacidosis and hyperosmolar non-ketotic diabetic coma refer to 'Diabetic Emergencies' Both of the above are available at www.uclhguide.com and in the UCLH Medical Emergency Guidelines, available through the UCLH intranet	**Y-site compatible when diluted in G or NS:** acetylcysteine, adrenaline, alfentanil, atracurium, ceftazidime, clarithromycin, clonidine, dobutamine, dopamine, doxapram, ethanol, fentanyl, heparin sodium, labetolol, midazolam, morphine, pantoprazole, remifentanil, rocuronium, sodium nitroprusside, vecuronium **Incompatible:** aminophylline, drotrecogin, methylprednisolone sodium succinate
	Urgent reduction of hyperkalaemia (adults): IV bolus via a central line or a large peripheral vein 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Add 10 units insulin to 50 mL glucose 50% See comment (d)	Over 15 minutes, followed immediately by a glucose infusion		
	IM/SC bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Iron, as sucrose complex (Venofer)					
Ampoule 100 mg/5 mL Venofer Syner-Med Pharmaceutical Products (UK)	(I) IV infusion via volumetric infusion pump (preferred method) 1 2 3 4 5 6 7 8 NPSA risk rating: 4	**For a 100 mg dose:** add one vial to 100 mL NS **For a 200 mg dose:** withdraw 60 mL fluid from a 250 mL NS bag. Add two vials to the bag Both methods give a solution of approximately 1 mg/mL	Administer at 100 mL/hour for the first 15 minutes. If no reaction occurs increase the rate of infusion to 150 mL/hour for 15 minutes, then to 200 mL/hour for the remaining portion of the infusion	**Infusion-related adverse events:** 'anaphylactoid' reactions including hypotension, tachycardia, palpitations, fever, chills, nausea, flushing, dyspnoea. Taste disturbances **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 10.5–11 (undiluted) **Osmolarity:** 1250 mOsmol/L (undiluted) **Flush:** NS **Other comments:** the first 15 minutes of infusion at 100 mL/hour gives 25 mg of iron At UCLH patients are given hydrocortisone 100 mg IV and chlorphenamine 10 mg IV prior to each dose of iron to minimise the risk of 'anaphylactoid' reactions	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**
	IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted	Administer 1 mL test dose over 1–2 minutes. If no reaction occurs within 15 minutes administer the remaining dose at 1 mL/minute If a patient has previously received Venofer without reaction the test dose may be omitted and the full dose may be given at 1 mL/minute		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Isoniazid					
Ampoule 50 mg/2 mL *Non-proprietary* Cambridge Laboratories (UK) **At the time of writing UCLH are currently using Chiesi brand due to stock shortage of the licensed product:** Ampoule 300 mg/5 mL (unlicensed) *Non-proprietary* Chiesi (Spain)	IV bolus 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted	Over 3–5 minutes	**Infusion-related adverse events:** fever, convulsions and numbness in extremities **pH:** 5.6–6 (undiluted, 50 mg/2 mL) **Flush:** NS **Sodium content:** nil **Other comments:** also licensed for intrapleural and intrathecal use	**Do not infuse with any other medicines or infusion fluids**
	IM 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Isoprenaline sulphate (isoproterenol sulfate – unlicensed)					
Ampoule 2.25 mg/2 mL *Non-proprietary* South Devon Healthcare (UK) Ampoule 2 mg/1 mL *Non-proprietary* Martindale (UK)	**Heart block:** (I) IV infusion via a volumetric infusion pump via a central line or large peripheral vein **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4	Add 2.25 mg to 500 mL G or NS. Ensure thorough mixing before administration	Initially 15 mL/hour increasing by 15 mL/hour every 2–3 minutes until satisfactory heart rate is achieved or adverse effects prevent further increases Usual maximum rate: 150 mL/hour	**Infusion-related adverse events:** hypotension, arrhythmias **ECG monitoring required** **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 2.5–3 (undiluted, Martindale, South Devon) **Osmolarity:** 190 mOsmol/L (undiluted, South Devon) **Flush:** NS, G **Sodium content:** 0.2 mmol/1 mL vial (Martindale); negligible (South Devon Healthcare) **Other comments:** infusion rates equivalent to 1.125 micrograms/minute increasing every 2–3 minutes by 1.125 micrograms/minute. Maximum rate 11.25 micrograms/minute. For further information refer to the document 'Arrhythmias – Management (UCLH Medical Emergency Guidelines)' available through the UCLH intranet Isoprenaline sulphate 1.125 mg is equivalent to isoprenaline hydrochloride 1 mg	**Other compatible diluents:** GS, H, sodium chloride 0.45% **Do not infuse with any other medicines or infusion fluids**
	Fluid restriction: (I) IV infusion into a central line via a syringe pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	Dilute 2.25–4.5 mg to 50 mL with G or NS	See other comments for infusion rates in heart block		
Ampoule 100 micrograms/1 mL *Non-proprietary* Martindale (UK)	**Positive chronotrope during surgery:** IV bolus via a central line or a large peripheral vein **1** **2** 3 4 5 6 7 8 NPSA risk rating: 2	Dilute the ampoule to a convenient volume (e.g. 10 mL) with NS or G	20 microgram boluses over 1 minute, as determined by the anaesthetist, titrated according to heart rate/rhythm		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Itraconazole					
Ampoule 250 mg/25 mL Sporanox Janssen-Cilag (UK) Each ampoule is supplied with a 50 mL bag of NS and an extension line with a 0.2 micron filter and a stopcock	(I) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Add the contents of one ampoule to the 50 mL NS bag provided. The bag now contains 250 mg/75 mL (3.33 mg/mL) itraconazole Connect one end of the extension line to the end of the administration set and the other end to the patient's catheter/ cannula so that the fluid is filtered immediately before running into the patient	Over 60 minutes For a 200 mg dose administer 60 mL of the final solution	**Infusion-related adverse events:** headache, dizziness, visual disturbances, hearing loss, hypertension, nausea, rash, swelling at injection site **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 4.2–5.2 (diluted) **Flush:** NS	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ketamine					
Vial 200 mg/20 mL 500 mg/10 mL 1000 mg/10 mL Ketalar Pfizer (UK)	**For induction of general anaesthesia, prior to an infusion:** IV bolus or short infusion **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2 (3 if diluted)	The 200 mg/20 mL and 500 mg/10 mL vials may be used undiluted The 1000 mg/10 mL vial should be diluted with an equal volume of NS or G to produce a 50 mg/mL solution	Usually 0.5–2 mg/kg over at least 1 minute	**Infusion-related adverse events:** respiratory depression, hypertension, tachycardia, hallucinations, delirium, skeletal muscle movement resembling seizure **pH:** 3.5–5.5 (undiluted) **Osmolarity:** 250–350 mOsmol/L (200 mg vial), 300–400 mOsmol/L (500 mg vial) **Flush:** NS **Sodium content:** nil (200 mg and 500 mg vials), 0.3 mmol (1000 mg vial) **Other comments:** ketamine should only be used by anaesthetists and those specifically trained in pain control. Outside theatres, recovery and critical care ketamine administration should be considered a high risk intervention During surgery the dose is determined by the anaesthetist and is influenced by patient factors, the length of the procedure and other anaesthetic agents used	**The following data assume ketamine is infused into the Y-site as a 10 mg/mL solution. Ketamine solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible when diluted in G or NS:** ceftazidime, morphine **Incompatible:** diazepam, doxapram, thiopental
	For maintenance of general anaesthesia, after a bolus, and for sedation in critical care: (C) IV infusion via a syringe pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	Usually diluted to 1 mg/mL with NS or G	10–45 micrograms/kg per minute		
	For induction and maintenance of anaesthesia using bolus injections only: IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	As for above IV bolus	1–4.5 mg/kg over at least 1 minute. Each subsequent injection should be half the induction dose		

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ketamine *continued*					
Vial 200 mg/20 mL 500 mg/10 mL 1000 mg/10 mL Ketalar Pfizer (UK)	**For peri-operative pain control:** (I) SC infusion via a syringe pump (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Dilute dose to 50 mL with NS	Initially 0.3 mg/kg per hour reduced to 0.1 mg/kg per hour in the last hour of the operation	At UCLH ketamine is generally used for pain control, rather than as an anaesthetic agent. It is occasionally used for sedation in critical care, and is particularly useful in asthmatics On the advice of the pain team or a palliative care consultant, ketamine is occasionally used for the control of chronic pain when other agents have failed. Intermittent SC bolus administration may also be occasionally recommended	**Compatible in a syringe for SC injection:** haloperidol lactate, midazolam, morphine, oxycodone **See Section A15 for further details**
	Palliative care: (C) SC infusion via a syringe pump (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute to a convenient volume with NS or W May be mixed with other drugs in the same syringe	Over 24 hours		
	For induction and maintenance of anaesthesia, or for analgesia in recovery: IM 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ketorolac trometamol					
Ampoule 10 mg/1 mL 30 mg/1 mL Toradol Roche (UK)	IV bolus (preferred method) 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted	Over at least 15 seconds	**Infusion-related adverse events:** GI irritation including ulceration and bleeding, renal impairment, fluid retention, dyspnoea (particularly in asthmatics), bradycardia, palpitations **pH:** 6.9–7.9 **Osmolality:** 290 mOsmol/kg **Flush:** NS **Sodium content:** 0.1 mmol/10 mg vial, negliglible in 30 mg vial **Other comments:** contains ethanol IV/IM routes are licensed for a maximum of 48 hours. Switch to oral NSAID or alternative therapy after this time to minimise risk of adverse effect (C) SC infusion should only be initiated by the pain team. This regimen is occasionally used in combination with other drugs in the same syringe in palliative care	**Compatible fluids:** NS, G, GS, H **Do not infuse with any other medicines or infusion fluids**
	IM 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted			
	For chronic pain control: (C) SC infusion (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Dilute to a convenient volume with NS	Over 24 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Labetalol hydrochloride					
Ampoule 100 mg/20 mL Trandate UCB Pharma Ltd (UK)	**Urgent reduction in blood pressure:** IV bolus via a central line or large peripheral vein 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted	Give each 50 mg dose over 1 minute. May be repeated every 5 minutes. Usual maximum total dose: 200 mg	**Infusion-related adverse events:** bradycardia, postural hypotension, tiredness, headache. Patient should lie for at least 3 hours after administration Monitor blood pressure and pulse regularly throughout infusion **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 3.5–4.5 (undiluted) **Flush:** NS **Sodium content:** negligible **Other comments:** rates in the monograph are equivalent to the following: Pre-eclampsia/eclampsia: 40 mg/hour doubled every 30 minutes to a maximum 160 mg/hour Hypertension: usual rate is 120 mg/hour Hypertension after MI: 15 mg/hour increased to a maximum 120 mg/hour	**The following data assume labetolol is infused into the Y-site as a 5 mg/mL solution. Labetolol solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** esmolol, linezolid, metronidazole, propofol 1% **Y-site compatible when diluted in G or NS:** acetylcysteine, alfentanil, amikacin, aminophylline, atracurium, clonidine, dobutamine, dopamine, fentanyl, insulin, midazolam, morphine, noradrenaline, pethidine, remifentanil, rocuronium, sodium nitroprusside, vecuronium **Y-site compatible when diluted in G:** amiodarone **Incompatible:** ceftriaxone, heparin sodium, thiopental, sodium bicarbonate
	Pre-eclampsia/eclampsia: (C) IV infusion via syringe pump via a central line or large peripheral vein 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Dilute two ampoules to 50 mL with NS This gives a 200 mg/50 mL solution	Initially 10 mL/hour. The rate may be doubled every 30 minutes up to a maximum of 40 mL/hour		
	Hypertension due to other causes: (I) IV infusion via volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Withdraw 90 mL from a 250 mL bag of G or GS. Add two ampoules (200 mg) to the infusion bag to give a 1 mg/mL solution	Usual rate: 120 mL/hour **Hypertension after myocardial infarction:** 15 mL/hour increased every 30 minutes to a maximum rate of 120 mL/hour		
	Fluid restriction (unlicensed): (I) or (C) infusion into a central line or large peripheral vein via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Draw up the undiluted solution into a syringe	See other comments for rates		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Lacosamide					
Vial 200 mg/20 mL Vimpat UCB Pharma Limited (UK)	(I) IV infusion **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Add the required dose to 100–250 mL NS or G	Over 15–60 minutes	**Infusion-related adverse events:** injection site pain, redness **pH:** 3.5–5 (undiluted), 3.8–5.1 (in 100–250 mL NS) **Osmolality:** 275–284 mOsmol/kg **Flush:** NS, G **Sodium content:** 2.6 mmol/vial	**Compatible fluids:** NS, G, GS, H **Do not infuse with any other medicines or infusion fluids**
	(I) IV infusion via a syringe pump **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 3 (4 if diluted)	May be administered undiluted, or may be diluted to a convenient volume with NS or G	Over 15–60 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Lenograstim					
Vial 13.4 million units (105 micrograms) 33.6 million units (263 micrograms) Granocyte Chugai Pharma (UK)	SC 1 2 3 4 5 6 7 8 NPSA risk rating: 1	Reconstitute vial with 1 mL W provided. Mix gently until dissolved; do not shake		**Infusion-related adverse events:** injection site reaction **pH:** 6.5 (reconstituted in 1 mL W) **Flush:** NS **Sodium content:** negligible	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	(I) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Reconstitute as above Add dose to 50 mL bag of NS or G The 263 microgram dose may be diluted to 100 mL NS or G, if preferred	Over 30 minutes		
Levetiracetam					
Vial 500 mg/5 mL Keppra UCB Pharma Limited (UK)	(I) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Add required dose to 100 mL NS or G	Minimum 15 minutes	**Infusion-related adverse events:** hypotension, headache, somnolence **pH:** 5–6 (undiluted) **Osmolality:** 3610 mOsmol/kg (undiluted) **Flush:** NS **Sodium content:** 0.31 mmol/vial	**Compatible fluids:** NS, G, GS, H **Do not infuse with other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Levomepromazine hydrochloride (methotrimeprazine hydrochloride)					
Ampoule 25 mg/1 mL *Non-proprietary* Archimedes t/a Link Pharmaceuticals (UK)	IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Dilute with an equal volume of NS before administration	Over 3–5 minutes	**Infusion-related adverse events:** hypotension (particularly in elderly patients), sedation, confusion, pain and irritation at the SC injection site. Dry mouth, blurred vision, urinary retention. Rarely arrhythmias **pH:** 4–5 (undiluted) **Osmolarity:** 290 mOsmol/L **Flush:** NS **Sodium content:** 0.1 mmol/1 mL vial **Other comments:** for further information about the use of levomepromazine in palliative care refer to local syringe driver guideline	**Compatible fluids:** NS **Compatible in a syringe for SC infusion:** cyclizine, dexamethasone, diamorphine, dihydrocodeine, fentanyl, glycopyrronium, haloperidol lactate, hyoscine butylbromide, hyoscine hydrobromide, midazolam, morphine, octreotide, ondansetron, oxycodone **See Section A15 for further details**
	IM/SC bolus (SC route unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted			
	Pain/restlessness/ confusion in palliative care: (C) SC infusion via a syringe driver 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute to a convenient volume with W, NS or G May be mixed with other drugs in the same syringe	**Adults and children over 12:** usually 12.5–200 mg over 24 hours **Children over 1 month:** 0.35–3 mg/kg over 24 hours		
	Nausea/vomiting in palliative care: (C) SC infusion via a syringe driver 1 2 3 4 5 6 7 8 NPSA risk rating: 6	As above	**Adults and children over 12:** usually 5–25 mg over 24 hours **Children over 1 month:** 100–400 micrograms/kg over 24 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Levosimendan (unlicensed)					
Vial 12.5 mg/5 mL Simdax Abbott (Sweden)	(C) IV infusion via a volumetric infusion pump **1** **2** 3 4 5 6 **7** 8 NPSA risk rating: 3	Add one vial to a 250 mL bag NS or G This gives a solution of approximately 50 micrograms/mL	**Using the 50 microgram/mL solution:** initially 0.12 mL/kg per hour May be increased to 0.24 mL/kg per hour if tolerated and if clinically appropriate (although this is not usually required) In the event of adverse effects the rate may be decreased to 0.06 mL/kg per hour See comments (a) and (b) Levosimendan is usually used for a 24 hour period only	**Infusion-related adverse events:** headache, dizziness, hypotension, tachycardia, atrial fibrillation, nausea, vomiting, insomnia **ECG monitoring required** **Flush:** NS **Sodium content:** nil **Other comments:** (a) the initial infusion rate is equivalent to 0.1 microgram/kg per minute, increasing to 0.2 microgram/kg per minute if required/tolerated. If adverse effects occur the dose may be decreased to 0.05 microgram/kg per minute (b) an initial load of 6–12 micrograms/kg over 10 minutes is used in some centres. This is usually omitted due to the occurrence of adverse effects as described above (c) contains ethanol (d) the solution in the vial may turn orange, without an effect on its efficacy	**The following data assume levosimendan is infused into the Y-site as a 50 microgram/mL solution. Levosimendan solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible when diluted in G or NS:** digoxin **Y-site compatible when diluted in NS:** furosemide

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Lidocaine hydrochloride (lignocaine hydrochloride)					
Ampoule 0.5%: 10 mL 1%: 2 mL, 5 mL, 10 mL, 20 mL 2%: 2 mL, 5 mL, 20 mL *Non-proprietary* Goldshield t/a Antigen, Hameln, or Taro (UK) Vial for Minijet 1% (100 mg/10 mL) *Non-proprietary* IMS (UK) Infusion bag 0.2% in 500 mL G 0.4% in 500 mL G *Non-proprietary* Fresenius Kabi (UK)	**For local anaesthesia:** SC/intralesional injection **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted Use the 0.5% or 1% solutions. 2% solutions should be diluted with an equal volume of NS or G		**Infusion-related adverse events:** paraesthesia, CNS and respiratory depression, hypotension, bradycardia, arrhythmias **ECG monitoring required** **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 4–7 (undiluted) **Osmolality:** 270–320 mOsmol/kg (1% and 2%, undiluted, Taro) **Sodium content:** less than 2 mmol for any vial/ampoule or syringe **Flush:** NS **Other comments:** (a) infusion for arrhythmias equivalent to 4 mg/minute for 30 minutes, 2 mg/minute for 2 hours, then 1 mg/minute thereafter Children and neonates are very occasionally prescribed lidocaine for arrhythmias. Consult Children's BNF for advice	**The following data assume lidocaine is infused into the Y-site as a 4 mg/mL solution. Lidocaine solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H, sodium chloride 0.45% **Y-site compatible ready-diluted medicines:** linezolid, potassium chloride 40 mmol/L in NS or G, propofol 1% **Y-site compatible when diluted in G or NS:** caffeine, ciprofloxacin, clarithromycin, dobutamine, dopamine, eptifibatide, etomidate, glyceryl trinitrate, ranitidine, remifentanil, sodium nitroprusside, streptokinase, vasopressin **Y-site compatible when diluted in G:** amiodarone
	Ventricular arrhythmias – loading dose for adults and children 12 and over: IV bolus **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Ready diluted. May be further diluted to a convenient volume with NS or G 10 mL of the 1% solution contains lidocaine 100 mg 5 mL of the 2% solution contains lidocaine 100 mg	50–100 mg over 2 minutes May be repeated after 10 minutes (5 minutes in children) if an infusion has not been started Maximum loading dose: 300 mg		
	Ventricular arrhythmias – maintenance for adults and children 12 and over: (C) IV infusion via a volumetric infusion pump using ready made bags (preferred method) **1** 2 3 4 5 6 **7** 8 NPSA risk rating: 2	Ready diluted The 0.2% solution contains 2 mg/mL The 0.4% solution contains 4 mg/mL See comment (a)	**Using 0.2% bag:** 120 mL/hour for 30 minutes, then 60 mL/hour for 2 hours, then 30 mL/hour thereon **Using 0.4% bag:** 60 mL/hour for 30 minutes, then 30 mL/hour for 2 hours, then 15 mL/hour thereon		

Formulation	Method	Dilution	Rate	Comments	Compatibility
Lidocaine hydrochloride (lignocaine hydrochloride) *continued*					
Ampoule 0.5%: 10 mL 1%: 2 mL, 5 mL, 10 mL, 20 mL 2%: 2 mL, 5 mL, 20 mL *Non-proprietary* Goldshield t/a Antigen, Hameln, or Taro (UK) Vial for Minijet 1% (100 mg/10 mL) *Non-proprietary* IMS (UK) Infusion bag 0.2% in 500 mL G 0.4% in 500 mL G *Non-proprietary* Fresenius Kabi (UK)	**Ventricular arrhythmias – maintenance for adults and children 12 and over:** (C) IV infusion via a volumetric infusion pump using ampoules **1** **2** 3 **4** 5 **6** **7** 8 NPSA risk rating: 5 Only use this method when ready made bags are not available	**Using 1% solution:** withdraw 100 mL from a 500 mL bag NS or G. Add 100 mL of the 1% solution to the bag **Using 2% solution:** withdraw 50 mL from a 500 mL bag NS or G. Add 50 mL of the 2% solution to the bag Both methods provide a 2 mg/mL solution	120 mL/hour for 30 minutes, then 60 mL/hour for 2 hours, then 30 mL/hour thereafter See comment (a)	**Other comments:** *Preparation strengths:* 0.2% solution = 2 mg/mL 0.4% solution = 4 mg/mL 0.5% solution = 5 mg/mL 1% solution = 10 mg/mL 2% solution = 20 mg/mL Ready prepared bags/syringes of local anaesthetic with or without strong opioids are available from the pharmacy, e.g fentanyl with bupivicaine. These should be used for regional anaesthesia in preference to preparation of anaesthetics at ward or theatre level (b) loading dose for headaches equivalent to 1 mg/kg over 15 minutes. Maintenance equivalent to 1–4 mg/minute (c) IV injection of lidocaine should be considered a high risk intervention because of the risk of adverse effect. Lidocaine should be administered only by those competent in its use and in areas where cardiac monitoring is possible	
	Headaches (adults) – loading dose: IV infusion via a volumetric infusion pump (unlicensed) **1** 2 3 4 5 6 **7** 8 NPSA risk rating: 2 At UCLH the administration of lidocaine for headaches is restricted to patients under the care of a headache consultant	Ready diluted. Use the 0.4% ready made infusion bag This is a 4 mg/mL solution	**Optional load if urgent resolution of symptoms required:** 0.25 mL/kg over 15 minutes **Maintenance:** 15–60 mL/hour **Maximum maintenance rate:** 3.4 mg/kg per hour. See comment (b)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Linezolid					
Bag 600 mg/300 mL Zyvox Pharmacia (UK)	(I) IV infusion 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted	Over 30–120 minutes	**Infusion-related adverse events:** injection site reactions, headache, diarrhoea, nausea, taste disturbances **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 4.8 (undiluted) **Osmolarity:** 290 mOsmol/L **Flush:** NS **Sodium content:** 5 mmol/300 mL bag **Other comments:** contains 13.7 g glucose/300 mL bag	**The following data assume linezolid is infused into the Y-site as a 2 mg/mL solution. Linezolid solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** ciprofloxacin, esmolol, fluconazole, potassium chloride 40 mmol/L in NS or G, sodium bicarbonate 8.4%, mannitol 10% **Y-site compatible when diluted in NS:** furosemide **Y-site compatible when diluted in G or NS:** aciclovir, alfentanil, aminophylline, ceftazidime, ceftriaxone, cefuroxime, digoxin, dobutamine, dopamine, fentanyl, folinic acid, ganciclovir, gentamicin, glyceryl trinitrate, granisetron, heparin sodium, hydrocortisone sodium succinate, imipenem with cilastatin, labetolol, lidocaine, magnesium sulphate, mesna, methylprednisolone sodium succinate, midazolam, morphine, ondansetron, pipericillin with tazobactam, ranitidine, remifentanil, tobramycin, vancomycin, vecuronium, zidovudine **Incompatible:** amoxicillin, co-trimoxazole, erythromycin

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Liothyronine sodium					
Vial 20 micrograms *Non-proprietary* Goldshield (UK)	IV bolus 1 2 3 4 **5** **6** 7 8 NPSA risk rating: 2	Reconstitute each vial with 1-2 mL W May be further diluted to 10 mL with W	Over 3–5 minutes	**Infusion-related adverse events:** generally associated with overdose – angina, muscle cramps, tachycardia, arrhythmias, palpitations **pH:** 8.5–11.5 **Flush:** NS **Sodium content:** negligible	**Do not infuse with any other medicines or infusion fluids**
Lorazepam					
Ampoule 4 mg/1 mL Ativan Wyeth (UK)	**Adults and paediatrics (unlicensed in paediatrics except in status epilepticus):** IV bolus, preferably into a large vein **1** **2** 3 4 5 6 7 8 NPSA risk rating: 3	**Status epilepticus:** dilute the dose with an equal volume of NS or W **Other indications:** dilute dose to 10 mL with NS or G	**Status epilepticus:** over a few seconds **Other indications:** give over 3–5 minutes	**Infusion-related adverse events:** CNS and respiratory depression, hypotension, blurred vision, pain and redness at injection site **Flush:** NS **Sodium content:** nil **Other comments:** further dilution for the IV bolus is recommended to enable the drug to be given over 3–5 minutes. This reduces the risk of CNS and respiratory depression, which are more likely to occur with rapid administration Contains propylene glycol. The undiluted solution is viscous	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	Neonates (unlicensed): IV bolus **1** **2** **3** 4 5 6 7 8 NPSA risk rating: 4	Dilute 4 mg ampoule to 40 mL with NS This gives a 100 microgram/mL solution	**Status epilepticus:** give 50 micrograms/kg over 3–5 minutes See comments		
	IM (use when oral or IV routes not possible) 1 **2** 3 4 5 6 7 8 NPSA risk rating: 2	Dilute with an equal volume of NS or W			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

<table>
<tr><th>Formulation</th><th>Method</th><th>Dilution</th><th>Rate</th><th>Comments</th><th>Compatibility</th></tr>
<tr><td colspan="6">Magnesium sulphate (magnesium sulfate)</td></tr>
<tr><td rowspan="2">Ampoule

2.5 g/5 mL
5 g/10 mL

Non-proprietary
Martindale (UK)

Prefilled syringe

2 g/4 mL

Minijet
IMS (UK)

1 g Mg is approximately 4 mmol Mg

2 mL of the 50% solution contains 1 g magnesium sulphate

All products listed above are magnesium sulphate 50%</td><td>Urgent correction of hypomagnesaemia (adults): IV bolus into a large peripheral vein, or a central line

1 2 3 4 5 6 7 8
NPSA risk rating: 4</td><td>Dilute each 1 mL magnesium sulphate 50% with 1.5 mL of NS or G. This gives a 200 mg/mL solution

The solution may be further diluted to any convenient volume</td><td>If diluted to 200 mg/mL: maximum rate 0.75 mL/minute

Diluted to any volume: maximum rate 150 mg/minute</td><td rowspan="2">Infusion-related adverse events: hypermagnesaemia may result in nausea, vomiting, flushing, hypotension and arrhythmias

Extravasation: the undiluted solution may cause tissue damage; for management guidelines, see Section A7

pH: 5.5–7

Osmolality: approximately 2700 mOsmol/kg (undiluted)

Flush: NS

Sodium content: negligible

Other comments:
magnesium sulphate 50% is very hypertonic. When therapy is not urgent, it should be administered as an infusion, rather than as a bolus, to minimise the risk of vein irritation</td><td rowspan="2">The following data assume magnesium sulphate is infused into the Y-site as a 8 mmol/500 mL solution. Magnesium solutions of a lower concentration will also be compatible with these drugs and fluids

Compatible fluids: NS, G, GS, H

Y-site compatible ready-diluted medicines: metronidazole, potassium chloride 40 mmol/L in NS or G, propofol 1%

Y-site compatible when diluted in G or NS: amikacin, aminophylline, cefotaxime, chloramphenicol, clindamycin, co-trimoxazole, erythromycin, granisetron, linezolid, morphine, ondansetron, pethidine, pipericillin with tazobactam, remifentanil, sodium nitroprusside, vancomycin

Incompatible: amphotericin, thiopental, tobramycin, zoledronic acid</td></tr>
<tr><td>Urgent correction of hypomagnesaemia (paediatrics and neonates): IV bolus into a large peripheral vein, or a central line

1 2 3 4 5 6 7 8
NPSA risk rating: 4</td><td>Dilute each 1 mL magnesium sulphate 50% with 4 mL of NS or G. This gives a 100 mg/mL solution

The solution may be further diluted to any convenient volume provided the final concentration does not exceed 100 mg/mL

Fluid restriction: dilute to 200 mg/mL as per adults</td><td>Maximum rate: 10 mg/kg per minute</td></tr>
</table>

Formulation	Method	Dilution	Rate	Comments	Compatibility
Magnesium sulphate (magnesium sulfate) *continued*					
Ampoule 2.5 g/5 mL 5 g/10 mL *Non-proprietary* Martindale (UK) Prefilled syringe 2 g/4 mL Minijet IMS (UK) 1 g Mg is approximately 4 mmol Mg 2 mL of the 50% solution contains 1 g magnesium sulphate All products listed above are magnesium sulphate 50%	**Hypomagnesaemia:** (I) IV infusion (preferred method) **1** **2** **3** 4 5 **6** 7 8 NPSA risk rating: 4	Dilute to a convenient volume with NS, G or GS	**Adults:** typically 4 mmol/hour Maximum 150 mg/minute **Paediatrics and neonates:** maximum 10 mg/kg per minute	Magnesium sulphate is administered at various doses and infusion rates for eclampsia, pre-eclampsia, severe exacerbation of asthma and during resuscitation. Consult local guidelines and the BNF for further details	
	IM 1 **2** **3** 4 5 **6** 7 8 NPSA risk rating: 3	**Adults:** may be used undiluted, or diluted with an equal volume of NS or G **Paediatrics:** dilute each 1 mL magnesium sulphate 50% with 1.5 mL of NS or G			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Mannitol					
Bag 10% 500 mL Bag 20% 250 mL, 500 mL Baxter (UK) 1 mL of the 10% solution contains 100 mg mannitol 1 mL of the 20% solution contains 200 mg mannitol	**Osmotic diuresis:** (I) IV infusion into a central line or large peripheral vein **1** 2 **3** 4 5 **6** 7 8 NPSA risk rating: 3 The 20% solution should be given through an administration set with a 15 micron in-line filter. At UCLH all administration sets have such a filter	Ready diluted	According to indication and urgency of treatment. See comments (a) and (b) **Usual adult infusion rate:** 30–50 mL/hour of the 10% solution **Usual infusion rate in children:** 5–15 mL/kg per hour of the 10% solution	**Infusion-related adverse events:** fluid overload peripheral and pulmonary oedema, and rarely heart failure. Hypotension, thrombophlebitis **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 4.5–7 **Osmolarity:** 549 mOsmol/L (10% solution) 1098 mOsmol/L (20% solution) **Flush:** NS **Sodium content:** nil **Other comments:** (a) mannitol may be used for – the promotion of diuresis in acute renal failure – reduction of intracranial pressure and cerebral oedema – reduction of intraocular pressure – promotion of elimination of renally excreted toxic substances Mannitol may not be the first line treatment for these indications (b) the dose depends on the age, weight, indication and urgency of treatment. For full details refer to the manufacturer's SPC. In the treatment of poisoning refer to the National Poisons Information Service or TOXBASE (c) mannitol may crystallise out of solution at low temperatures. Warm the bags to 50–70°C to dissolve the crystals. Allow the solution to reach body temperature prior to infusion	**The following data assume mannitol is infused into the Y-site as a 10% solution. Mannitol solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible ready-diluted medicines:** linezolid, propofol 1% **Y-site compatible when diluted in G or NS:** ondansetron, pipericillin with tazobactam, remifentanil **Incompatible:** blood, imipenem with cilastatin, meropenem The addition of sodium or potassium chloride to the 20% solution may result in mannitol precipitation

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Melarsoprol (unlicensed)					
Ampoule 180 mg/5 mL Aventis (France) Supplied to UCLH by the World Health Organisation	IV bolus via a central line or large peripheral vein **1** 2 **3** 4 5 **6** 7 8 NPSA risk rating: 3 (but see other comments)	Ready diluted **Handle with care:** contains arsenic	Over 3–5 minutes	**Infusion-related adverse events:** hypertension, renal impairment, nausea, vomiting, fever, shock, convulsions, encephalopathy, coma. Severe injection site irritation if given peripherally **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **Flush:** NS **Sodium content:** nil **Other comments:** melarsoprol is a highly irritant drug formulated in propylene glycol and ethanol. It is incompatible with aqueous solutions. However, at UCLH the drug is flushed through the catheter with NS to ensure the full dose is delivered to the patient. Melarsorpol administration should be considered high risk because of the serious and severe adverse effects it may cause Melarsoprol is used only for the treatment of human African trypanosomiasis (sleeping sickness) at UCLH	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Mepiridine					
***see* pethidine**					

Formulation	Method	Dilution	Rate	Comments	Compatibility
Meropenem					
Vial 500 mg 1 g Meronem Astra Zenca (UK)	IV bolus 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1 (2 if part vial used)	Add 10 mL W to 500 mg vial or 20 mL to 1 g vial If a part vial is required, reconstitute the vial with the volumes suggested under 'Displacement value' (see comments)	Over 5 minutes	**Infusion-related adverse events:** pain and swelling at administration site, rash, headache, nausea **pH:** 7.3–8.3 (50 mg/mL reconstituted solution) **Osmolality:** 331 mOsmol/kg (50 mg/mL reconstituted solution) **Flush:** NS **Sodium content:** 2 mmol/500 mg vial 3.9 mmol/1 g vial **Displacement value:** 0.4 mL/500 mg vial, 0.9 mL/1 g vial Add 9.6 mL W to 500 mg vial to give 500 mg/10 mL solution Add 19.1 mL W to 1 g vial to give a 1 g/20 mL solution **Other comments:** use with caution in patients with penicillin allergy. Approximately 10% cross-sensitivity	**The following data assume meropenem is infused into the Y-site as a 50 mg/mL solution. Meropenem solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** fluconazole, linezolid, potassium chloride 40 mmol/L in NS or G **Y-site compatible when diluted in G or NS:** aminophylline, atenolol, atracurium, dexamethasone, digoxin, furosemide, heparin sodium, morphine, noradrenaline **Incompatible:** aciclovir, amphotericin, calcium gluconate, mannitol 10%, ondansetron, zidovudine
	(I) IV infusion 1 **2** 3 4 **5** 6 7 8 NPSA risk rating: 2 (3 if part vial used)	Reconstitute as above. **Doses up to 500 mg:** add to 50–100 mL bag NS or G **Doses over 500 mg:** add to 50–250 mL bag NS or G	Over 15–30 minutes		
	Fluid restriction (unlicensed): IV bolus via a central line or large peripheral vein 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	Add 5 mL W to 500 mg vial or 10 mL W to 1 g vial	Over 5 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Mesna					
Ampoule 400 mg/4 mL 1 g/10 mL Uromitexan Baxter (UK)	IV bolus 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted	Over 3–5 minutes	**Infusion-related adverse events:** adverse effects are much more likely to be caused by the chemotherapy with which mesna is administered. However, mesna itself may occasionally cause nausea, vomiting, diarrhoea, fatigue and headache. Rarely hypersensitivity reactions may occur **pH:** 6.5–8.5 **Flush:** NS **Sodium content:** 2.1 mmol/400 mg vial 5.3 mmol/1 g vial **Other comments:** the method of mesna delivery is determined by the patient's chemotherapy regimen	**Compatible fluids:** NS, G, GS, H **Y-site compatible when diluted in G or NS:** ondansetron **May be infused with some cytotoxic drugs. Contact pharmacy for compatibility information**
	(C) IV infusion via a volumetric infusion pump 1 **2** 3 4 5 **6** **7** 8 NPSA risk rating: 3	Dilute to a convenient volume with hydration fluids, e.g. NS or G	Over 24 hours		
	IV Infusion 1 **2** 3 4 5 **6** **7** 8 NPSA risk rating: 3	Dilute to a convenient volume, e.g. 100 mL with NS or G	Over 15–30 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Metaraminol (unlicensed)					
Ampoule 10 mg/1 mL *Non-proprietary* Torbay General Hospital (UK)	**Intraoperative hypotension:** IV bolus via a large peripheral vein or a central line **1** **2** 3 4 5 6 7 8 NPSA risk rating: 2	Dilute one ampoule to 20 mL NS	Give 0.5–1 mL over a few seconds, followed by a 20 mL NS flush (see other comments)	**Infusion-related adverse events:** arrhythmias, tachycardia, hypertension **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 3.2–4.5 (undiluted) **Osmolality:** 305 mOsmol/kg (undiluted) **Flush:** NS after a bolus ⚠ **Do not flush** the administration set after an infusion: disconnect, aspirate catheter/cannula, then flush with NS **Sodium content:** 0.1 mmol/vial **Other comments:** the rate/frequency of administration of metaraminol is determined by the anaesthetist and is titrated to the patient's mean arterial pressure. Some clinicians prefer metaraminol over other pressor agents as it causes a less pronounced rise in blood pressure Contains sodium metabisulphite which may cause hypersensitivity reactions, particularly in asthmatics	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**
	Intraoperative hypotension: (C) IV infusion via a syringe pump into a central line or a large peripheral vein **1** **2** 3 **4** 5 6 **7** 8 NPSA risk rating: 4	Dilute one ampoule to a convenient volume with NS	Initially 0.5 mg/hour adjusted according to blood pressure		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Methylene blue					
see **methylthioninium chloride**					

Formulation	Method	Dilution	Rate	Comments	Compatibility
Methylprednisolone acetate					
Vial 40 mg/1 mL 80 mg/2 mL Depo-Medrone Pfizer t/a Pharmacia (UK)	Deep IM **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted		**Infusion-related adverse events:** anaphylaxis, post-injection flare, muscle pain and weakness **pH:** 3.5–7 (undiluted) **Sodium content:** 0.1 mmol/1 mL vial **Other comments:** this preparation must only be given via the routes listed in the monograph	**Do not inject with any other medicines or infusion fluids**
	Intra-articular, periarticular, intrabursal, intralesional injection and injection into the tendon sheath. **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Methylprednisolone (as sodium succinate)					
Vial 40 mg 125 mg 500 mg 1 g Solu-Medrone Pfizer t/a Pharmacia (UK) 40 mg vial is supplied with 1 mL W 125 mg vial is supplied with 2 mL W 500 mg vial is supplied with 7.8 mL W 1 g vial is supplied with 15.6 mL W	**Doses up to 250 mg:** IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Reconstitute the vial with the W provided. May be further diluted to a convenient volume with NS or G. If a part vial is used, reconstitute the vial with the volumes suggested under 'Displacement value' (see comments)	Over at least 5 minutes	**Infusion-related adverse events:** bradycardia, hypotension, hypertension, nausea, vomiting, taste disturbances, muscle pain. Arrhythmia, cardiac arrest and circulatory collapse associated with rapid infusion **pH:** 7–8 (reconstituted with W) **Flush:** NS **Sodium content:** 0.4 mmol/40 mg vial 0.6 mmol/125 mg vial 2.4 mmol/500 mg vial 4.9 mmol/1 g vial **Displacement value:** negligible/40 mg vial 0.1 mL/125 mg vial 0.6 mL/500 mg vial 1.1 mL/1 g vial Add 1.9 mL W to 125 mg vial to obtain 125 mg/2 mL solution Add 9.4 mL W to the 500 mg vial to obtain a 500 mg/10 mL solution Add 18.9 mL to the 1 g vial to obtain a 1 g/20 mL solution **Other comments:** the infusion rate for cord compression is equivalent to 5.4 mg/kg per hour Methylprednisolone may be given by IM injection	**The following data assume methylprednisolone is infused into the Y-site as a 5 mg/mL solution. Methylprednisolone solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** linezolid, metronidazole **Y-site compatible when diluted in G or NS:** ceftazidime, granisetron, midazolam, pipericillin with tazobactam, remifentanil **Y-site compatible when diluted in G:** amiodarone **Incompatible:** benzylpenicillin, calcium gluconate, insulin, ondansetron, propofol
	Doses of 250 mg and above: (I) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Reconstitute as above Further dilute to a convenient volume of NS or G	**General indications:** over at least 30 minutes **Spinal cord compression:** 30 mg/kg over 15 minutes followed by the infusion below		
	Spinal cord compression: (C) IV infusion via volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Reconstitute two 1 g vials as above. Add to a 250 mL bag NS This gives a 7.1 mg/mL solution (approximately)	Start 45 minutes after the above infusion. Infuse at rate of 0.76 mL/kg per hour for 23 hours See comments		
	Fluid restriction: (I) or (C) IV infusion via a syringe pump (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 4	**General indications:** reconstitute with the W provided. May be further diluted to a convenient volume with NS or G **Cord compression:** reconstitute two 1 g vials as above, but do not further dilute. This gives a 60 mg/mL solution	**Doses over 250 mg:** over 30 minutes **Spinal cord compression:** 0.09 mL/kg per hour for 23 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Methylthioninium chloride (methylene blue)					
Ampoule 100 mg/10 mL (1%) *Non-proprietary* Martindale (UK)	**Hypotension associated with septic shock:** IV bolus, preferably via a central line (unlicensed) **1** 2 3 **4** 5 **6** 7 8 NPSA risk rating: 3	Ready diluted	2 mg/kg over 2 minutes, through a filter (see other comments)	**Infusion-related adverse events:** nausea, chest and abdominal pain, dizziness, headache, sweating, confusion, hypertension **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 3–4.5 (undiluted) **Flush:** NS **Sodium content:** nil **Other comments:** a 0.2 micron filter should be attached to the administration set. This removes glass particles, which may be created on opening the ampoule, which are difficult to see because of the strong blue colour of the drug. Filters are sent from pharmacy with the drug	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**
	Methaemoglobinaemia (licensed) or ifosfamide induced encephalitis (unlicensed): IV bolus, preferably via a central line **1** 2 3 **4** 5 **6** 7 8 NPSA risk rating: 3	Ready diluted	Over 3–5 minutes, through a filter (see other comments)		
	Ifosfamide induced encephalitis: IV infusion, preferably via a central line (unlicensed) **1** **2** 3 **4** 5 **6** 7 8 NPSA risk rating: 4	Add to 100 mL bag NS	Over 15–30 minutes, through a filter (see other comments)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Metoclopramide hydrochloride					
Ampoule 10 mg/2 mL *Non-proprietary* Goldshield t/a Antigen (UK)	IV bolus 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted May be further diluted to a convenient volume with NS	Over 1–2 minutes	**Infusion-related adverse events:** drowsiness, dystonic reactions (e.g. facial and skeletal muscle spasms) particularly in children and young adults **pH:** 3–5 (undiluted) **Flush:** NS **Sodium content:** 0.3 mmol/2 mL vial **Other comments**: for further information about the use of metoclopramide in palliative care refer to local syringe driver guidelines	**Compatible fluids:** NS, G, GS, H **Compatible in a syringe for (C) SC infusion:** cyclizine, dexamethasone, diamorphine, fentanyl, glycopyrronium, haloperidol lactate, hyoscine butylbromide, hyoscine hydrobromide, morphine, octreotide, ondansetron, oxycodone **See Section A15 for further details**
	IM 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted			
	(C) SC infusion via a syringe driver (unlicensed) **1 2 3 4** 5 **6 7** 8 NPSA risk rating: 5	Ready diluted May be mixed with other drugs in the same syringe See comments			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Metoprolol tartrate					
Ampoule 5 mg/5 mL Betaloc Astra Zeneca (UK)	IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2 (3 if diluted)	Ready diluted May be further diluted to a convenient volume with NS or G	Maximum rate 1–2 mg/minute	**Infusion-related adverse events:** bradycardia, palpitations, shortness of breath, nausea, fatigue, cold hands and feet **pH:** 5.5–6.9 (undiluted) **Osmolarity:** 290 mOsmol/L **Flush:** NS **Sodium content:** 0.8 mmol/5 mL vial **Other comments:** (C) infusion initial rate equivalent to 0.04 mg/kg per hour, typically titrated to 0.1 mg/kg per hour	**The following data assume metoprolol is infused into the Y-site as a 1 mg/mL solution. Metoprolol solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G **Y-site compatible when diluted in G or NS:** eptifibatide, morphine
	(C) IV infusion via syringe pump (unlicensed) **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5 Use restricted to critical care, theatres and high dependency areas where appropriate cardiac monitoring can be carried out	Dilute four ampoules to 50 mL with NS or G. This gives a 0.4 mg/mL solution	Usual starting rate 0.1 mL/kg per hour Titrate according to patient response, typically up to 0.25 mL/kg per hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Metronidazole					
Bag 500 mg/100 mL *Non-proprietary* Baxter (UK)	(I) IV infusion 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1 (3 for children/neonates)	Ready diluted	**Adults:** usually one bag over 20 minutes **Children:** usually 1.5 mL/kg (maximum 500 mg) over 20–30 minutes **Neonates:** 3 mL/kg load over 20–30 minutes, followed 24 hours later by 1.5 mL/kg See comments	**Infusion-related adverse events:** nausea and vomiting, metallic taste in mouth **pH:** 4.5–6 **Osmolarity:** 308 mOsmol/L **Flush:** NS **Sodium content:** 13.5 mmol/100 mL bag **Other comments:** children's dose equivalent to 7.5 mg/kg Neonatal doses equivalent to 15 mg/kg load, followed by 7.5 mg/kg thereafter For further information regarding neonatal use refer to 'Neonatal Drug Monograph – Metronidazole' available at www.uclhguide.com or the UCLH intranet	**The following data assume metronidazole is infused into the Y-site as a 5 mg/mL solution. Metronidazole solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** esmolol, foscarnet, linezolid **Y-site compatible when diluted in G or NS:** aciclovir, amikacin, cefotaxime, cefuroxime, chloramphenicol, ciprofloxacin, clarithromycin, doxapram, fluconazole, granisetron, hydrocortisone sodium succinate, magnesium sulphate, methylprednisolone sodium succinate, midazolam, noradrenaline, pethidine, remifentanil, pipericillin with tazobactam, tacrolimus **Incompatible:** co-amoxiclav, drotrecogin

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Mexiletine hydrochloride (unlicensed)					
Ampoule 250 mg/10 mL Mexitil Boehringer Ingelheim (UK)	**Load:** IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted	Usually 5–10 mL given at 1 mL/minute, followed by an infusion	**Infusion-related adverse events:** hypotension, bradycardia, worsening of arrhythmia, heart block, atrial fibrillation, confusion, dizziness, nausea and vomiting **ECG monitoring required** **pH:** 5–6 **Flush:** NS **Sodium content:** 0.3 mmol/vial **Other comments:** loading infusion rates equivalent to 250 mg/hour for the first hour, then 125 mg/hour for the next 2 hours Maintenance infusion rate equivalent to 0.5 mg/hour After dilution mexiletine is stable for 8 hours. Prepare a fresh infusion after 8 hours if further infusion is required	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	Load continued (after the bolus): (I) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Add the contents of two ampoules to a 500 mL bag of NS or G This gives a solution of approximately 1 mg/mL	250 mL/hour for 1 hour, then reduce the rate to 125 mL/hour See comments		
	Maintenance (after the loading infusion): (C) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Add one ampoule to a 500 mg bag of NS or G This gives a solution of approximately 0.5 mg/mL	60 mL/hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Midazolam					
Ampoule 5 mg/5 mL 10 mg/5 mL 10 mg/2 mL *Non-proprietary* Hameln (UK)	**Conscious sedation and anaesthesia premedication:** IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted. May be further diluted to a convenient volume with NS, G or GS **Children less than 15 kg:** use a 1 mg/1 mL solution	**Adults:** 2 mg/minute 5–10 minutes prior to the procedure **Children**: total dose over 2–3 minutes Repeated until the desired level of sedation is achieved	**Infusion-related adverse events:** respiratory depression, paradoxical agitation, hypotension, bradycardia, nausea, vomiting **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 2.9–3.7 **Osmolality:** 275–305 mOsmol/kg **Flush:** NS **Sodium content:** 0.8 mmol (5 mg/5 mL vial) 0.7 mmol (10 mg/5 mL vial) 0.3 mmol (10 mg/2 mL vial)	**The following data assume midazolam is infused into the Y-site as a 1 mg/mL solution. Midazolam solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** ciprofloxacin, esmolol, fluconazole, linezolid, metronidazole, potassium chloride 40 mmol/L in NS or G, propofol 1% **Y-site compatible when diluted in G:** amiodarone **Incompatible:** amoxicillin, ceftazidime, co-amoxiclav, drotrecogin, pantoprazole, sodium bicarbonate
	Induction of anaesthesia: IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	As above	**Adults**: over 20–30 seconds **Children:** over 2–5 minutes		
	Sedation in combination with anaesthetics: (C) IV infusion via a syringe pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	As above	**Adults:** 0.03–0.1 mg/kg per hour **Children:** not recommended		
	Status epilepticus in neonates: IV bolus followed by a (C) IV infusion (unlicensed) **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	Dilute to 1 mg/mL with G	Bolus: 0.15–0.2 mg/kg over 5 minutes Infusion: initially 0.06 mg/kg per hour increased by 0.06 mg/kg per hour every 15 minutes until seizures controlled Maximum rate: 0.3 mg/kg per hour		

Formulation	Method	Dilution	Rate	Comments	Compatibility
Midazolam *continued*					
Ampoule 5 mg/5 mL 10 mg/5 mL 10 mg/2 mL *Non-proprietary* Hameln (UK)	**Sedation in critical care (adults):** IV bolus followed by a (C) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Ready diluted. May be further diluted to a convenient volume with NS, G or GS In UCLH critical care a 100 mg in 50 mL syringe is prepared using 2 mg/mL ampoules	Bolus given in increments of 1–2.5 mg over 20–30 seconds. Wait 2 minutes between increments Infusion: 0.5–6 mg/hour titrated according to sedation score	**Other comments:** (a) the maintenance rate of infusion should be reviewed on an hourly basis to ensure the minimum required dose is administered. Where possible doses above 10 mg/hour should be avoided as this may lead to anxiety (b) the maintenance rate for sedation may be reduced in hypovolaemic, vasoconstricted, renally impaired or hypothermic patients (c) prolonged infusion may result in tolerance, and subsequently higher infusion rates may be required to maintain sedation (d) midazolam may also be given as an IM injection (e) for further information about the use of midazolam in status epilepticus in neonates refer to 'Neonatal Unit Drug Monograph – Midazolam' at www.uclhguide.com or the UCLH intranet, or local hospital guidelines	**Y-site compatible when diluted in G or NS:** acetylcysteine, adrenaline, alfentanil, amikacin, atracurium, atropine, calcium gluconate, cefotaxime, clonidine, digoxin, dobutamine, dopamine, eptifibatide, erythromycin, etomidate, fentanyl, gentamicin, glyceryl trinitrate, heparin sodium, insulin, labetolol, methylprednisolone, sodium succinate, morphine, mivacurium, noradrenaline, pethidine, remifentanil, rocuronium, sodium nitroprusside, tobramycin vancomycin, vecuronium **Compatible in a syringe for (C) SC infusion:** cyclizine, dexamethasone, diamorphine, dihydrocodeine, fentanyl, glycopyrronnium, haloperidol lactate, hyoscine butylbomide, hyoscine hydrobromide, levomepromazine, metoclopramide, morphine, octreotide, ondansetron, oxycodone **See Section A15 for further details**
	Sedation in critical care (children over 6 months): IV bolus followed by a (C) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 6	As above	Bolus 0.05–0.2 mg/kg over 2–3 minutes Infusion: 0.06–0.12 mg/kg per hour		
	Sedation in critical care (children under 6 months and neonates): IV bolus followed by a (C) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Gestational age less than 32 weeks or babies less than 1.6 kg: dilute 2 mg to 10 mL with G. This gives a 200 microgram/mL solution Gestational age 32 weeks or babies greater than 1.6 kg: dilute 10 mg to 10 mL with G. This gives a 1000 microgram/mL solution	Bolus: not recommended Gestational age less than 32 weeks or babies less than 1.6 kg: 30 micrograms/kg per hour Gestational age 32 weeks or babies greater than 1.6 kg: 60 micrograms/kg per hour		
	Palliative care: (C) SC infusion via a syringe driver 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute to a convenient volume with NS or W May be mixed with other drugs in the same syringe	Over 24 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Mivacurium					
Ampoule 10 mg/5 mL Mivacron GSK (UK)	IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted May be further diluted to a convenient volume with NS, G or GS	**Doses up to 0.15 mg/kg:** over 5–15 seconds **Doses above 0.15 mg/kg:** over 30 seconds See comment (a)	**Infusion-related adverse events:** skin flushing, redness and itching, hypotension, transient tachycardia, bronchospasm **pH:** 4.5 (undiluted) **Flush:** NS **Sodium content:** nil **Other comments:** (a) give IV bolus over 60 seconds in patients with asthma, cardiovascular disease or those who are sensitive to falls in arterial blood pressure (b) initial adult (I) infusion rate equivalent to 8–10 micrograms/kg per minute Initial child (I) infusion rate equivalent to 11–14 micrograms/kg per minute (c) doses and infusion rates of neuromuscular blockers are highly variable and should be adjusted according to response by the anaesthetist. Use of neuromuscular blockers outside critical care and theatres should be considered a high risk intervention	**The following data assume mivacurium is infused into the Y-site as a 2 mg/mL solution. Mivacurium solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, GS, H **Y-site compatible when diluted in G or NS:** alfentanil, fentanyl, midazolam **Incompatible:** phenytoin, sodium bicarbonate, thiopental
	(I) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5 See comment (c)	As above	**Adults:** usually 0.5–0.6 mg/kg per hour, adjusted every 3 minutes by 0.06 mg/kg per hour according to response **Children 2 months and older:** initially 0.66–0.84 mg/kg per hour If used with inhaled anaesthetic, patient may require only half the above infusion rate to maintain neuromuscular blockade See comment (b)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

- This page is intentionally blank

Formulation	Method	Dilution	Rate	Comments	Compatibility
Morphine sulphate					
Ampoule 10 mg/1 mL *Non-proprietary* Hameln (UK) Ampoule 1 mg/1 mL (unlicensed) 15 mg/1 mL 30 mg/1 mL 30 mg/1 mL (preservative free) 40 mg/1 mL (preservative free) 60 mg/2 mL *Non-proprietary* Martindale (UK) Pre-filled syringe (unlicensed) 50 mg/50 mL *Non-proprietary* Hospira (UK) Ampoule 100 mg/50 mL *Non-proprietary* Aurum t/a Martindale (UK)	**PCA or NCA for patient 50 kg or greater:** (I) or (C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Dilute 50 mg to 50 mL with NS This gives a 1 mg/mL solution	Background infusion: not usually required Bolus: 1 mg (1 mL) over a few seconds Lockout: 5 minutes See comment (a)	**Infusion-related adverse events:** respiratory and CNS depression, itching, sweating, hypotension, brady- and tachycardia **Monitor blood pressure, heart rate, respiratory rate, oxygen saturation, pain and sedation scores** **pH:** 2.5–4.5 (undiluted, Martindale) 3.4–3.8 (undiluted, Hameln) **Osmolality**: 270–310 mOsmol/kg **Flush:** NS **Sodium content:** 0.1 mmol/1 mL vial, 0.1 mmol/2 mL vial (Martindale), 0.1 mmol/1 mL vial (Hameln) **PCA** = patient controlled analgesia **NCA** = nurse controlled analgesia **Other comments:** (a) the PCA/NCA syringes described are those typically used at UCLH. Other concentrations, infusion rates and volumes may be used according to local preference and patient need. For further information refer to 'Patient Controlled and Nurse Controlled Analgesia Guideline: Adults and Paediatrics' at www.uclhguide.com or the UCLH intranet or local hospital guidelines	**The following data assume morphine sulphate is infused into the Y-site as a 1 mg/mL solution. Morphine solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** esmolol, fluconazole, foscarnet, linezolid, metronidazole, potassium chloride 40 mmol/L in NS or G, propofol 1% **Y-site compatible when diluted in G:** amiodarone **Y-site compatible when diluted in G or NS:** acetylcysteine, adrenaline, alfentanil, amikacin, aminophylline, atenolol, atracurium, atropine, bumetanide, caffeine, cefotaxime, ceftazidime, ceftriaxone, cefuroxime, chloramphenicol, clindamycin, clonidine, co-trimoxazole, digoxin, dobutamine, dopamine, eptifibatide, erythromycin, etomidate, fentanyl,
	PCA or NCA for patient 50 kg or greater: (I) or (C) SC infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Dilute 100 mg to 50 mL with NS This gives a 2 mg/mL solution	Background infusion: not usually required Bolus: 2 mg (1 mL) over 1 minute Lockout: 10 minutes		
	PCA for patient less than 50 kg: (C) IV infusion via a patient controlled syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute morphine sulphate 1 mg/kg to 50 mL with NS This gives a 20 microgram/kg/mL solution	Background: 2–8 micrograms/ kg per hour (0.1–0.4 mL/hour) Bolus: 10–20 micrograms/ kg (0.5–1 mL) over a few seconds Lockout: 5 minutes		
	PCA for patient less than 50 kg: (C) SC infusion via a patient controlled syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute morphine sulphate 2 mg/kg to 50 mL with NS This gives a 40 microgram/kg/ml solution	Background: 2–8 micrograms/ kg per hour (0.1–0.4 mL/hour) Bolus: 10–20 micrograms/kg (0.25–0.5 mL) over a few seconds Lockout: 10 minutes		
	NCA for patient less than 50 kg: (C) IV infusion via a nurse controlled syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute morphine sulphate 1 mg/kg to 50 mL with NS This gives a 20 microgram/kg/mL solution	Background: 10–20 micrograms/ kg per hour (0.5–1 mL/hour) Bolus: 10–20 micrograms/kg over a few seconds (0.5–1 mL) Lockout: 20 minutes		

Formulation	Method	Dilution	Rate	Comments	Compatibility
Morphine sulphate *continued*					
	Adults and children: IV/SC bolus/IM 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Ready diluted May be further diluted to a convenient volume with NS or G for IV administration	**IV:** over 3–5 minutes See comments (b) and (c)	(b) at UCLH IV boluses of opioids should only be used in areas where this has been explicitly sanctioned (excluding boluses given through a PCA or NCA pump) (c) IV doses of morphine have a greater analgesic effect than oral, IM or SC doses. Approximate conversion: 1 mg IV = 1–1.5 mg IM/SC = 2–3 mg PO (d) for further information about the use of morphine in neonates refer to the document "Neonatal Drug Monograph – Morphine" at www.uclhguide.com or the UCLH intranet or local hospital guidelines (e) initial infusion rate in neonates is equivalent to 10 micrograms/kg per hour increasing to a usual maximum of 40 micrograms/kg per hour (f) for further information about the use of morphine in palliative care refer to local syringe driver guidelines (g) morphine is also used in critical care areas for analgosedation. Usually a morphine sulphate 30-60 mg is made up to 50 mL with NS. It is infused as a (C) IV infusion via a syringe pump at a rate of 1–10 mg/hour	glyceryl trinitrate, granisetron, heparin sodium, insulin, ketamine, labetolol, magnesium sulphate, metoprolol, meropenem, midazolam, noradrenaline, ondansetron, pancuronium, pipericillin with tazobactam, ranitidine, remifentanil, rocuronium, sodium nitroprusside, thiopental, tobramycin, vancomycin, vecuronium, zidovudine **Incompatible:** aciclovir, flucloxacillin **Compatible in a syringe for (C) SC infusion:** cyclizine, dexamethasone, glycopyrronium, haloperidol lactate, hyoscine butylbromide, hyoscine hydrobromide, ketamine, levomepromazine, metoclopramide, midazolam, octreotide, ondansetron **See Section A15 for further details**
	Neonates: IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Ready diluted May be further diluted to a convenient volume with G	**Pain and sedation whilst ventilated:** 50–100 micrograms/kg over 3–5 minutes, followed by the infusion below **Acute pain:** 50–100 micrograms/kg over 3–5 minutes **Opiate withdrawal (after maternal exposure):** initially 40 micrograms/kg over 3–5 minutes, repeated every 4 hours See comment (d)		
	Neonates: (C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute morphine sulphate 1 mg/kg to 10 mL with G	Initially 0.1 mL/hour titrating according to need. Usual maximum 0.4 mL/hour See comment (e)		
	Adults and children – analgesia in palliative care: (C) SC infusion via a syringe driver 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute the dose to a convenient volume with NS or W	Over 24 hours Morphine may be mixed with other drugs in the same syringe See comment (f)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Mycophenolate mofetil					
Vial 500 mg Cellcept Roche (UK)	(I) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Withdraw 110 mL G from a 250 mL G bag to leave 140 mL G Add 14 mL G to each 500 mg vial Add the contents of **two** reconstituted 500 mg vials (total 1 g) to 140 mL G to give a final concentration of 6 mg/mL	Over 2 hours	**Infusion-related adverse events:** headache, tingling sensation in limbs, tachycardia, hypotension, hypertension, vomiting, abdominal pain, nausea, shortness of breath **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 2.4–4.1 (reconstituted and final infusion solution) **Flush:** G **Sodium content:** 0.1 mmol/500 mg vial **Displacement value:** 0.45 mL/500 mg vial. When added to the final infusion bag the displacement volume is accounted for	**Compatible fluids:** G **Incompatible:** NS, GS **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Naloxone hydrochloride					
Vial for Minijet 400 micrograms/1 mL *Non-proprietary* International Medication Systems (UK) Pre-filled syringe 2 mg/2 mL *Non-proprietary* Aurum t/a Martindale (UK) Ampoule 400 micrograms/1 mL *Non-proprietary* CP Pharmaceuticals (UK)	**Respiratory *depression* due to opioid use (adults):** IV bolus **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Ready diluted Dose may be diluted to a convenient volume with W, NS or G	0.1–0.2 mg over a few seconds, followed by 0.1 mg every 2 minutes See comments	**Infusion-related adverse events:** nausea, vomiting, sweating, tachycardia, hyperventilation, hypertension, shakiness **pH:** 3–4 (undiluted, Aurum) **Osmolality:** 301 mOsmol/kg **Flush:** NS **Sodium content:** 0.3 mmol/2 mL (Aurum) **Other comments:** initial boluses are given until the patient can be roused and respiratory rate is above 10. An infusion may then be started if deemed necessary If IV access cannot be obtained naloxone may be given IM or SC, although onset of action may be slower via these routes For further information refer to the document 'Managing Drug Overdoses' and 'Emergency Treatment of Acute Pain' through the UCLH intranet, or local hospital guidelines	**Compatible fluids:** NS, G **Do not infuse with any other medicines or infusion fluids**
	Respiratory *arrest* caused by opioid overdose (adults): IV bolus **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Ready diluted Dose may be diluted to a convenient volume with W, NS or G	Give 0.4–2 mg in 200 microgram increments, each over a few seconds Wait 2 minutes before administration of another dose in similar increments		
	Post-bolus infusion (adults): (C) IV infusion via volumetric infusion pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	Add 2 mg to 250–500 mL NS or G	Usual starting dose is 60% of initial IV bolus dose (as above) infused over 1 hour, then adjusted according to respiratory rate and level of consciousness For example, if a patient requires a total of 1 mg in the initial bolus, the infusion should be started at 0.6 mg/hour		
	Fluid restriction or where high doses are required (adults): (C) IV infusion via a syringe pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	Dilute 10 mg to 50 mL with NS or G			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Neostigmine metisulfate (neostigmine methylsulphate)					
Ampoule 2.5 mg/1 mL *Non-proprietary* Hameln (UK)	IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted May be further diluted to a convenient volume of NS or W before use	Give slowly over 3–5 minutes For reversal of non-depolarising neuromuscular blockade give over 1 minute	**Infusion-related adverse events:** bradycardia, arrhythmias (particularly in the elderly), nausea, vomiting, diarrhoea, contraction of pupils, abdominal cramps, salivation, sweating **pH:** 4.5–6.5 (undiluted) **Flush:** NS **Sodium content:** 0.2 mmol/1 mL vial **Other comments:** when giving neostigmine, atropine should always be available to counteract cholinergic reactions	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**
	IM/SC **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Nimodipine					
Vial 10 mg/50 mL Nimotop Bayer (UK) The vial is provided with a PVC-free administration set and Y-connector (stopcock)	(C) IV infusion into central line via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6 **If the patient does not have a central line, nimodipine may be given via a large peripheral vein. This is an unlicensed method of administration and may cause vein irritation**	Ready diluted Draw up the solution into a 50 mL syringe. Attach the syringe to one arm of the Y-connector with the administration set provided. Attach a 1 L bag of NS, G or H to the other arm of the Y-connector. The fluid should be given at 40 mL/hour See comments	**Patients under 70 kg:** 2.5 mL/hour, increasing after 2 hours to 5 mL/hour according to blood pressure **Patients 70 kg or greater:** 5 mL/hour, increasing after 2 hours to 10 mL/hour	**Infusion-related adverse events:** tachycardia, bradycardia, headache, rash, hypotension, sweating, feeling of warmth, flushing, injection site reactions **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 6–7.5 (undiluted) **Osmolality:** 740 mOsmol/kg (undiluted) **Flush:** NS **Sodium content:** negligible **Other comments:** nimodipine is incompatible with PVC containers and administration sets. The Terumo and BD Plastipak syringes currently used at UCLH are PVC-free Protect infusion line and syringe from direct sunlight. The drug is stable for 10 hours in diffuse daylight or fluorescent light Contains alcohol and polyethylene glycol	**Compatible fluids:** NS, G, H **Do not infuse with any other medicines or infusion fluids**

Nitroglycerin

***see* glyceryl trinitrate**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Noradrenaline acid tartrate (norepinephrine bitartrate)					
Ampoule 4 mg/2 mL (equivalent to 2 mg/2 mL noradrenaline base) 8 mg/4 mL (equivalent to 4 mg/4 mL noradrenaline base) *Non-proprietary* Hospira (UK) These are noradrenaline base 1:1000 preparations	(I) or (C) IV infusion into a central line via a volumetric or syringe pump (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 6 Use restricted to critical care and high dependency areas with cardiac monitoring	Dilute a 4 mg or 8 mg ampoule to 50 mL with G or GS	0–100 micrograms/minute adjusted according to response	**Infusion-related adverse events:** hypertension, bradycardia, headache, peripheral ischaemia **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 3–4 (undiluted) ⚠ **Flush:** do not flush the administration set. After infusion is discontinued, disconnect the apparatus and flush the cannula/catheter with NS **Sodium content:** 0.6 mmol/4 mL vial **Other comments:** administration of noradrenaline via the IV route should be considered high risk because of the potential for patient harm. It must be performed only by those competent in life support At other centres noradrenaline acid tartrate is administered at 0.01–0.4 micrograms/kg per minute	**The following data assume noradrenaline acid tartrate is infused into the Y-site as a 0.08 mg/mL solution. Noradrenaline solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H **Y-site compatible ready-diluted medicines:** esmolol, potassium chloride 40 mmol/L in NS or G **Y-site compatible when diluted in G or NS:** acetylcysteine, adrenaline, alfentanil, atracurium, clonidine, dobutamine, dopamine, fentanyl, glyceryl trinitrate, heparin sodium, labetolol, meropenem, midazolam, morphine, remifentanil, rocuronium, sodium nitroprusside, vecuronium **Y-site compatible when diluted in NS:** furosemide **Y-site compatible when diluted in G:** amiodarone **Incompatible:** aminophylline, drotrecogin, pantoprazole, ranitidine

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Nozinan					
***see* levomepromazime**					

Formulation	Method	Dilution	Rate	Comments	Compatibility
Octreotide					
Ampoule 50 micrograms/1 mL 100 micrograms/1 mL 500 micrograms/1 mL Multidose vial 1 mg/5 mL Sandostatin Novartis (UK)	SC (preferred method) **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted See comment (a)		**Infusion-related adverse events:** injection site reactions, gastrointestinal disturbances, bradycardia, tachycardia, hypoglycaemia, hyperglycaemia, arrhythmia **ECG and blood pressure monitoring required for IV doses** **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 3.9–4.5 **Flush:** NS **Sodium content:** negligible **Other comments:** (a) allow injection solution to reach room temperature before administration to minimise injection site discomfort (b) to prepare a 200 microgram dose: take 2 mL of 100 micrograms/mL solution and dilute with 2–18 mL NS. Use within 8 hours of preparation (c) for further information about the use of octreotide in palliative care refer to local syringe driver guidelines	**Compatible fluids:** NS **Incompatible:** G, GS **Compatible in a syringe for (C) SC infusion:** cyclizine, dexamethasone, diamorphine, fentanyl, glycopyrronium, haloperidol lactate, hyoscine butylbomide, hyoscine hydrobromide, levomepromazine, metoclopramide, midazolam, morphine, ondansetron, oxycodone **See Section A15 for further details**
	IV bolus **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Dilute each 1 mL octreotide with 1–9 mL NS. See comment (b) **Fluid restriction** (unlicensed): use undiluted	Over 3–5 minutes		
	Reduction of intestinal secretions in palliative care: (C) SC infusion via a syringe driver (unlicensed) **1** **2** 3 **4** 5 **6** **7** 8 NPSA risk rating: 5	Dilute to a convenient volume with NS May be used in combination with other drugs in the same syringe	Usually 300–600 micrograms over 24 hours		
Vial 20 mg 30 mg Sandostatin LAR Novartis (UK)	Deep IM (into gluteal muscle) using Sandostatin LAR 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	Add 2.5 mL of the diluent provided by running it inside the wall of the vial. Wait 2–5 minutes for diluent to wet the powder, then swirl vial gently until a uniform suspension is achieved. Do not shake the vial			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Omeprazole					
Vial for injection 40 mg Losec Astra-Zeneca (UK) Vial for infusion 40 mg *Non-proprietary* Arrow Generics (UK) t/a Bowmed	IV bolus **1** 2 3 4 **5** 6 7 8 NPSA risk rating: 2	Reconstitute the Losec 'vial for injection' with 10 mL diluent (provided)	Over 5 minutes	**Infusion-related adverse events:** thrombophlebitis, headache **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 8.8–9.2 (vial for injection in 10 mL W) **Flush:** NS **Sodium content:** vial for injection 0.1 mmol/vial **Displacement value:** negligible **Other comments:** non-proprietary omeprazole for infusion is not licensed for reconstitution with NS. However, UCLH pharmacy advises NS should be used as it is more stable than solutions made with G Vial for injection contains propylene glycol	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	(I) IV infusion **1** **2** 3 4 **5** 6 7 8 NPSA risk rating: 3	Withdraw 5 mL G or NS from a 100 mL bag, then use to reconstitute the 'vial for infusion'. Return the solution to the bag See comments regarding the choice of diluent	Over 20–30 minutes		
	(C) IV infusion (unlicensed) **1** **2** 3 **4** **5** **6** **7** 8 NPSA risk rating: 6	Reconstitute two 40 mg 'vials for infusion', each with 5 mL NS, taken from the same 100 mL bag. Return the reconstituted vials back to the bag to give an 80 mg/100 mL solution	10 mL/hour (8 mg/hour) Usually continued for 70 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ondansetron					
Ampoule 4 mg/2 mL *Non-proprietary* Focus (UK)	IV bolus/IM 1 2 3 4 5 6 7 8 NPSA risk rating: 0	Ready diluted May be further diluted to a convenient volume with NS or G	IV: over 3–5 minutes	**Infusion-related adverse events:** headache, flushing, hiccups. Dizziness and blurred vision reported with rapid administration **pH:** 3.3–4 (undiluted) **Flush:** NS **Sodium content:** less than 1 mmol/vial (both strengths) **Other comments:** for further information about the use of ondansetron in palliative care refer to local syringe driver guidelines	**The following data assume ondansetron is infused into the Y-site as a 1 mg/mL solution. Ondansetron solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** fluconazole, linezolid, mannitol 10% **Y-site compatible when diluted in G or NS:** amikacin, cefotaxime, ceftazidime, cefuroxime, gentamicin, imipenem with cilastatin, magnesium sulphate, mesna, morphine, pipericillin with tazobactam, ranitidine, remifentanil, vancomycin, zidovudine **Incompatible:** aminophylline, amphotericin, methylprednisolone, meropenem, sodium bicarbonate **Compatible in a syringe for (C) SC infusion:** cyclizine, dexamethasone, diamorphine, fentanyl, glycopyrronium, haloperidol lactate, hyoscine butylbromide, hyoscine hydrobromide, levomepromazine, metoclopramide, midazolam, morphine, octreotide, oxycodone **See Section A15 for further details**
Ampoule 8 mg/4 mL *Non-proprietary* Wockhardt (UK)	(I) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 1 (2 if multiple vials used)	Add dose to 50–100 mL NS or G	Over 15 minutes		
	(C) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 3 (4 if multiple vials used)	Add dose to 50–100 mL NS or G	1 mg/hour		
	Nausea and vomiting in palliative care: (C) SC infusion via a volumetric infusion pump (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute to a convenient volume with NS, G or W May be mixed with other drugs in the same syringe See comments	**Adults and children 12 and over:** usually 8–32 mg over 24 hours **Children 1 month to 12 years:** usually 8–12 mg over 24 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ornithine aspartate (unlicensed)					
Vial 5 g/10 mL Hepa-Merz Merz (Germany)	(I) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Add dose to convenient volume of NS, G, GS or G10 Each ampoule must be diluted with at least 80 mL fluid Maximum concentration: 6 ampoules may be added to 500 mL fluid	Maximum rate 5 g/hour	**Infusion-related adverse events:** nausea, vomiting **pH:** 6.2–7.2 (undiluted) **Osmolarity:** 1200 mOsmol/L (undiluted) **Flush:** NS **Sodium content:** nil **Other comments:** at UCLH ornithine is reserved for the treatment of hepatic encephalopathy. It may be initiated only on the instruction of a hepatology consultant	**Compatible fluids:** NS, G, GS, G10 **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Oxycodone hydrochloride					
Ampoule 10 mg/1 mL 20 mg/2 mL Oxynorm Napp (UK)	**Patient or nurse controlled analgesia (PCA or NCA):** (I) or (C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Dilute 50 mg to 50 mL with NS This gives a 1 mg/mL solution	Background infusion: not usually required Bolus: 1 mg (1 mL) over a few seconds Lockout: 5 minutes See comment (c)	**Infusion-related adverse events:** respiratory and CNS depression, itching, sweating, hypotension, brady- and tachycardia **Monitor blood pressure, heart rate, respiratory rate, oxygen saturation, pain and sedation scores** **pH:** 4.5–5.5 **Osmolality:** 285 mOsmol/kg **Flush:** NS **Sodium content:** 0.1 mmol/10 mg vial 0.2 mmol/10 mg vial **Other comments:** (a) for further information about the use of oxycodone in palliative care refer to local syringe driver guidelines (b) at UCLH IV boluses of opioids should only be used in areas where this has been explicitly sanctioned (excluding boluses given through a PCA or NCA pump) (c) the syringe described is given as an example. At UCLH oxycodone PCAs/NCAs are used only after it has been established that morphine and fentanyl are inappropriate or ineffective in a particular patient. As the patient is likely to have had previous exposure to opioids the concentration of oxycodone in the syringe and the need for a background infusion are highly variable. Oxycodone should be used only on the advice of a palliative care consultant *Approximate* conversions: Oxycodone 1 mg IV = morphine 2 mg IV Oxycodone 1 mg IV = oxycodone 2 mg PO	**The following data assume oxycodone is infused into the Y-site as a 1 mg/mL solution. Oxycodone solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Compatible in a syringe for (C) SC infusion:** cyclizine, dexamethasone, diamorphine, glycopyrronium, haloperidol lactate, hyoscine butylbromide, hyoscine hydrobromide, levomepromazine, metoclopramide, midazolam, octreotide, ondansetron **See Section A15 for further details**
	Adults and children – analgesia in palliative care: (C) SC infusion via a syringe driver 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute the dose to a convenient volume with NS or W	Over 24 hours Oxycodone may be mixed with other drugs in the same syringe See comment (a)		
	Adults and children: IV/SC bolus/IM 1 2 3 4 5 6 7 8 NPSA risk rating: 3	**IV:** dilute each 1 mL of drug to 10 mL with NS, G or W. This gives a 1 mg/mL solution **IM/SC:** ready diluted	**IV:** over 1–2 minutes See comment (a)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Oxytocin					
Ampoule 5 units/1 mL 10 units/1 mL Syntocinon Alliance (UK)	**After caesarean section, prevention of uterine haemorrhage and incomplete, inevitable or missed abortion:** IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted May be further diluted to a convenient volume with NS	Over 3–5 minutes For some indications the bolus may be followed by an infusion	**Infusion-related adverse events**: rapid administration may cause hypotension. Also arrhythmias, rash, headache, tachycardia, bradycardia, nausea, vomiting **Monitor fetal heart rate continuously. Monitor maternal blood pressure and heart rate hourly** **pH:** 3.7–4.3 (undiluted) **Flush:** NS **Sodium content:** negligible **Other comments:** for further information refer to the documents 'Guideline for the use of Oxytocin in Labour' and 'Guideline for the Management of Postpartum Haemorrhage and Massive Obstetric Haemorrhage, or local hospital guidelines'. Doses in use at UCLH may be different to licensed doses Prolonged administration of oxytocin in G may result in water intoxication and hyponatraemia Boluses may be given by IM injection if IV access unavailable (unlicensed route of administration)	**Compatible fluids:** NS, G, GS, H, sodium bicarbonate 1.4% **Do not infuse with any other medicines or infusion fluids**
	Induction or enhancement of labour: (C) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Add 10 units to 500 mL NS or G See comments	Initially 3 mL/hour. The infusion rate should be doubled every 30 minutes during the first stage of labour, or every 15 minutes during the second stage of labour, according to the strength and frequency of contractions		
	Post-partum haemorrhage: (I) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Add 40 units to 500 mL NS See comments	Usual rate 125 mL/hour over 4 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility

Pabrinex

see **vitamins B and C**

Pamidronate

see **disodium pamidronate**

Formulation	Method	Dilution	Rate	Comments	Compatibility
Pancuronium bromide					
Ampoules 4 mg/2 mL *Non-proprietary* Hospira (UK)	**Adjunct to anaesthesia (adults):** IV bolus **1** 2 **3** 4 5 **6** 7 8 NPSA risk rating: 3	Ready diluted May be further diluted to a convenient volume with NS or G	50–100 micrograms/kg over a few seconds May be supplemented with further doses of 10–20 micrograms/kg	**Infusion-related adverse events:** hypertension, arrhythmia, injection site reactions, drooling **pH:** 3.8–4.2 (undiluted) **Osmolality:** 338 mOsmol/kg **Flush:** NS **Sodium content:** 0.3 mmol/vial **Other comments:** doses and infusion rates of neuromuscular blockers are highly variable and should be adjusted according to response by the anaesthetist. Use of neuromuscular blockers outside critical care and theatres should be considered a high risk intervention	**The following data assume pancuronium bromide is infused into the Y-site as a 0.05 mg/mL solution. Pancuronium solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** esmolol, fluconazole, propofol 1% **Y-site compatible when diluted in G or NS:** caffeine, dobutamine, glyceryl trinitrate, etomidate, hydrocortisone sodium succinate, morphine, vancomycin
	Adjunct to anaesthesia (children and neonates): IV bolus **1** 2 **3** 4 5 **6** 7 8 NPSA risk rating: 3	As above	100 micrograms/kg over a few seconds May be supplemented with further doses – **children:** 20 micrograms/kg **neonates:** 50 micrograms/kg		
	Adjunct to sedation in critical care (adults): IV bolus **1** 2 **3** 4 5 **6** 7 8 NPSA risk rating: 3	As above	60 micrograms/kg over a few seconds Given every 60–90 minutes according to patient response		
	Adjunct to sedation in critical care (adults): (C) IV infusion via a syringe pump (unlicensed) **1** 2 **3** 4 5 **6** **7** 8 NPSA risk rating: 4	As above	Usual rate 1–10 mg/hour adjusted according to patient response		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Pantoprazole					
Vial 40 mg Protium Nycomed UK Limited (UK)	IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Reconstitute each vial with 10 mL NS	Over 2–5 minutes	**Infusion-related adverse events:** thrombophlebitis, headache **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 9.8–10 (in 10 mL NS) 9.0–9.2 (diluted to 100 mL NS) **Osmolarity:** approximately 300 mOsmol/L after reconstitution and dilution **Flush:** NS **Sodium content:** 0.1 mmol/vial **Displacement value:** negligible **Other comments:** may be diluted with glucose 10% (C) Infusion usually continued for 70 hours	**The following data assume pantoprazole is infused into the Y-site as a 0.8 mg/mL solution. Pantoprazole solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, potassium chloride 40 mmol/L in NS or G **Y-site compatible when diluted in G or NS:** ceftriaxone, dopamine, glyceryl trinitrate, insulin, remifentanil, sodium nitroprusside, vecuronium **Incompatible:** adrenaline, dobutamine, esmolol, midazolam, noradrenaline, ranitidine
	(I) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Reconstitute each vial with 10 mL NS. Add the contents of the vial to a 100 mL bag of NS or G	Over 15 minutes		
	(C) IV infusion (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Reconstitute two 40 mg vials, each with 10 mL NS taken from the same 100 mL bag. Return the reconstituted vials to the bag to give an 80 mg/100 mL solution	10 mL/hour (8 mg/hour)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Papaveretum					
Ampoule 15.4 mg/1 mL *Non-proprietary* Martindale (UK) Each ampoule contains: morphine hydrochloride 13.16 mg codeine hydrochloride 1.04 mg and papaverine hydrochloride 1.2 mg	**Premedication prior to an operation (adults):** IM/SC **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted Usual dose: 0.5–1 mL		**Infusion-related adverse events:** CNS and respiratory depression, bradycardia, palpitations, tachycardia and facial flushing, sweating, rashes, itching **pH:** 2.5–4 (undiluted) **Flush:** NS **Sodium content:** negligible **Other comments:** at UCLH IV boluses of opioids should only be used in areas where this has been explicitly sanctioned Contains sodium metabisulphite, which may cause bronchospasm in susceptible individuals	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	Enhancement of anaesthesia or pain (adults): IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 3	Ready diluted May be further diluted to a convenient volume with NS or G See comments	Usually 3.85–7.7 mg over 3–5 minutes This is equivalent to 0.25–0.5 mL of the solution in the ampoule		
Paracetamol					
Vial 500 mg/50 mL 1 g/100 mL Perfalgan Bristol Myers Squibb (UK)	(I) IV infusion 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1 (2 if diluted)	Ready diluted May be further diluted to 1 mg/mL in NS or G, i.e. dilute the contents of a 1 g vial to 1 L with NS or G	Over 15 minutes Give over 1 hour if diluted	**Infusion-related adverse events:** hypotension, hypersensitivity **pH:** 5.5 **Osmolality:** 300 mOsmol/kg **Flush:** NS **Sodium content:** 0.1 mmol/50 mL vial 0.2 mmol/100 mL vial	**Y-site compatible:** NS, G, GS **Other drugs should not be added to the bottle due to the lack of supporting stability data** **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Pegaspargase (unlicensed)					
Vial 3750 units/5 mL Oncaspar Medac (Germany)	IM (preferred route) 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted		**Infusion-related adverse events:** hypersensitivity reactions including fever, hypotension, rash, vomiting and bronchospasm. Hyperglycaemia. Injection site pain **pH:** 7.3 (undiluted) **Flush:** NS, G **Osmolality:** 361–399 mOsmol/kg (undiluted) **Sodium content:** 0.93 mmol/vial **Other comments:** IM doses greater than 3 mL in adults (2 mL in children) should be split and given in separate sites	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	(I) IV infusion **1 2** 3 **4** 5 **6** 7 **8** NPSA risk rating: 4	Add the dose to a 100 mL bag of NS or G Administer via a Y-site with NS or G running in the other arm of the connector	Over 1–2 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Pentamidine isetonate					
Vial 300 mg Pentacarinat Sanofi-Aventis (UK)	(I) IV infusion into a large vein or central line 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Add 4.8 mL W to 300 mg vial. This gives a 60 mg/1 mL solution Dilute required dose to 50–250 mL NS or G See comments	Over at least 60 minutes.	**Infusion-related adverse events**: severe hypotension, hypoglycaemia, dizziness, flushing, injection site reactions **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 4.5–6.5 (reconstituted) **Flush:** NS **Sodium content:** nil **Displacement value:** 0.15 mL/300 mg vial Add 4.8 mL W to 300 mg vial to give a concentration of 300 mg/5 mL **Other comments:** keep patient supine to reduce risk of severe hypotension Consider pre-hydration with 500 mL to 1 L NS to prevent renal toxicity in susceptible patients For further information refer to the document 'Pneumocystis Carinii Pneumonia (PCP) in HIV Infection' on the UCLH intranet or local treatment guidelines	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	Deep IM, preferably into gluteal muscles 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Reconstitute as above			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Pethidine hydrochloride (meperidine hydrochloride)					
Ampoule 50 mg/1 mL 100 mg/1 mL *Non-proprietary* Auden Mckenzie (UK)	IM (preferred method) SC bolus **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted		**Infusion-related adverse events:** respiratory depression, drowsiness, itching, sweating, hypotension, bradycardia and tachycardia **pH:** 4–6 (undiluted) **Flush:** NS **Sodium content:** negligible **Other comments:** (a) at UCLH IV boluses of opioids should only be used in areas where this has been explicitly sanctioned (b) the SC syringe pump is generally restricted to use in palliative care (c) pethidine PCA pumps are rarely used at UCLH. Contact the acute pain team prior to initiation. For further information refer to 'Patient and Nurse Controlled Analgesia Policy – Adults and Paediatrics' at www.uclhguide.com or the UCLH intranet	**The following data assume pethidine hydrochloride is infused into the Y-site as a 10 mg/mL solution. Pethidine solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, G10, H, sodium chloride 0.45% **Y-site compatible ready-diluted medicines:** fluconazole, metronidazole, potassium chloride 40 mmol/L in NS or G **Y-site compatible when diluted in G or NS:** amikacin, atenolol, atropine, bumetanide, cefotaxime, ceftazidime, ceftriaxone, cefuroxime, chloramphenicol, clindamycin, digoxin, dobutamine, eptifibatide, fentanyl, hydrocortisone sodium succinate, labetolol, magnesium sulphate, midazolam, ranitidine, vancomycin **Y-site compatible when diluted in NS:** erythromycin **Incompatible:** flucloxacillin, furosemide, imipenem
	IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Dilute to a convenient volume with NS or G See comment (a)	Over 3–5 minutes		
	(C) SC infusion via a syringe driver (unlicensed) **1** **2** **3** **4** 5 **6** **7** 8 NPSA risk rating: 6	Dilute to a convenient volume with NS or W. May be administered with other drugs in the same syringe See comment (b)	Over 24 hours		
	(I) or (C) IV infusion via a syringe pump **1** **2** **3** **4** 5 **6** **7** 8 NPSA risk rating: 6	Dilute the required dose to 50 mL. Typically 500 mg is diluted to 50 mL with NS or G See comment (c)	Bolus dose and background infusion rate set by the anaesthetist or pain consultant		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Phenobarbital sodium (phenobarbitone sodium)					
Ampoule 15 mg/1 mL 30 mg/1 mL 60 mg/1 mL 200 mg/1 mL *Non-proprietary* Martindale (UK)	**Seizures in adults:** IV bolus via a large vein or central line **1** **2** **3** **4** 5 **6** 7 8 NPSA risk rating: 5	Dilute each 1 mL of drug with 10 mL W	**Load:** 10 mg/kg **Maintenance**: 1 mg/kg Maximum rate: 100 mg/minute. See comments (a) and (d)	**Infusion-related adverse events:** CNS and respiratory depression, hypotension, involuntary eye movements **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 10–11 (undiluted) **Flush:** NS **Sodium content:** 0.1 mmol/15 mg vial 0.2 mmol/30 mg vial 0.3 mmol/60 mg vial 0.8 mmol/200 mg vial **Other comments:** (a) loads of up to 20 mg/kg are used at the National Hospital for Neurology and Neurosurgery (b) after a phenobarbital injection other agents are preferred for the management of seizures in paediatrics. Refer to 'Status Epilepticus' at www.uclhguide.com or the UCLH intranet (c) for further information refer to the document 'Neonatal Unit Drug Monograph – Phenobarbitone' at www.uclhguide.com or the UCLH intranet (d) levels should be taken at least 2 hours after a dose (e) because of the risk of serious adverse effects phenobarbital injection should be considered a high risk intervention	**Do not infuse with other medicines or infusion fluids**
	Status epilepticus in children: IV bolus via a large vein or central line **1** **2** **3** **4** 5 **6** 7 8 NPSA risk rating: 5	As above	20 mg/kg over 10 minutes **Maintenance:** not usually used. See comment (b)		
	Seizures in neonates: (I) IV infusion via syringe pump via a large vein or a central line **1** 2 **3** **4** 5 **6** **7** 8 NPSA risk rating: 5 (6 if dilution made)	Use the 15 mg/mL ampoule If unavailable dilute the higher strength ampoule to 15 mg/mL with W	**Loading dose:** 20 mg/kg over 20 minutes. If ventilated may be followed with a further two loads of 10 mg/kg **Maintenance:** 5 mg/kg over 20 minutes. See comments (c) and (d)		
	IM/SC **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Phenoxybenzamine hydrochloride					
Ampoules 100 mg/2 mL *Non-proprietary* Forley (UK)	(I) IV infusion, preferably via a central line **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Add dose to a 250 mL or 500 mL bag NS	Over at least 2 hours, but not more than 4 hours	**Infusion-related adverse events:** hypotension, compensatory tachycardia, dizziness, sedation, constriction of pupils, nasal congestion Frequent blood pressure monitoring required during infusion **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 2.5–3.1 (undiluted) **Flush:** NS **Sodium content:** nil **Other comments:** contact with the drug solution may cause skin irritation Contains ethanol and polyethylene glycol	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Phentolamine mesilate					
Ampoule 10 mg/1 mL Rogitine Alliance (UK)	IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted May be further diluted with NS	Over a few seconds	**Infusion-related adverse events:** hypotension, compensatory tachycardia, dizziness, nausea, vomiting, nasal congestion Frequent blood pressure monitoring required after injection **pH:** 3.5–5 (undiluted) **Flush:** NS **Sodium content:** negligible **Other comments:** contains sodium metabisulfite, which may cause hypersensitivity reactions in some individuals, particularly asthmatics SC phentolamine may be used to treat extravasation of vasoconstrictor drugs, e.g. adrenaline	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**
	IM/SC **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Phenylephrine hydrochloride					
Ampoule 10 mg/1 mL *Non-proprietary* Waymade t/a Sovereign Medical (UK)	IV bolus **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Add one ampoule to 9 mL W	Over 3–5 minutes	**Infusion-related adverse events:** hypertension, headache, vomiting, bradycardia, tachycardia, arrhythmia, palpitations, fainting, flushing **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 4.5–6.5 (undiluted) **Flush:** NS **Sodium content:** negligible	**The following data assume phenylephrine hydrochloride is infused into the Y-site as a 1 mg/mL solution. Phenylephrine solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, GS, G10, potassium chloride 40 mmol/L in NS or G, H, sodium chloride 0.45% **Y-site compatible when diluted in G or NS:** etomidate, remifentanil
	(I) IV infusion via volumetric infusion pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	Add one ampoule to 500 mL NS or G This will give a final concentration of 20 micrograms/mL	Titrate according to patient response Initial maximum rate 180 micrograms/minute (540 mL/hour) Adjust to 30–60 micrograms/minute (90–180 mL/hour) according to response		
	IM/SC **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Phenytoin sodium					
Ampoule 250 mg/5 mL *Non-proprietary* Beacon (UK)	**Adult and paediatric maintenance doses:** IV bolus via a large vein or a central line **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted	**Adults:** maximum rate 50 mg/minute (1 mL/minute) **Paediatric under 50 kg:** maximum rate 1 mg/kg per minute **Paediatric 50 kg or above:** as per adults	**Infusion-related adverse events:** hypotension, arrhythmias, dizziness, confusion, tingling sensation in limbs, respiratory and CNS depression **ECG and blood pressure monitoring required** **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 10–12.3 **Osmolality:** 312 mOsmol/kg (500 mg in 100 mL NS) **Flush:** NS **Sodium content:** 1 mmol/vial **Other comments:** 0.2 micron filters will be supplied from pharmacy with the drug. Phenytoin tends to precipitate an hour after dilution Take levels 18–24 hours after a load. For maintenance therapy take levels pre-dose or 4–6 hours post dose Adult and paediatric loading doses should be given as an infusion while maintenance doses should be given as a bolus. All neonatal doses are given undiluted via a syringe driver Phenytoin may be given IM but doses are not equivalent to the IV route and are not appropriate for status epilepticus	**The following data assume phenytoin is infused into the Y-site as a 10 mg/mL solution. Phenytoin solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS **Y-site compatible ready-diluted medicines:** esmolol, foscarnet **Incompatible:** G, GS, aciclovir, fentanyl, glyceryl trinitrate
	Adult and paediatric loading doses: (I) IV infusion via a syringe pump or volumetric infusion pump, through a large vein or a central line **1** **2** **3** 4 5 **6** **7** **8** NPSA risk rating: 6	Add dose to 50–250 mL NS The concentration of the diluted solution should not exceed 10 mg/mL	As above Give through a 0.2 micron filter The full dose should be given within an hour of preparation		
	Neonates: IV bolus into a large vein or a central line via a syringe driver **1** 2 **3** 4 5 **6** **7** 8 NPSA risk rating: 4	Ready diluted	Over 20 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Phosphates neutral					
Bottle 50 mmol/500 mL Polyfusor Fresenius-Kabi (UK) Each Polyfusor also provides sodium 81 mmol and potassium 9.5 mmol	**Moderate hypophosphataemia (adults):** (I) IV infusion via a volumetric infusion pump **1** 2 **3** 4 5 **6** **7** 8 NPSA risk rating: 4	Ready diluted	Usually 7.5 mL/hour for 12 hours (equivalent to 9 mmol over 12 hours) **It is common to use only a small proportion of the bottle. To avoid overdosing the patient ensure the infusion is stopped when the prescribed volume has been infused**	**Infusion-related adverse events:** excess correction may result in hyperphosphataemia, which in turn may result in severe hypocalcaemia **pH:** 7–7.7 **Osmolarity:** 281 mOsmol/L **Flush:** NS **Sodium content:** 81 mmol/bottle **Other comments:** repeat infusions should be administered on the basis of phosphate levels and symptoms of hypophosphataemia	**Compatible fluids:** NS, GS, G, G10, sodium chloride 0.45% **Incompatible:** H **Do not infuse with any other medicines or infusion fluids**
	Severe hypophosphataemia (adults): (I) IV infusion, via a volumetric infusion pump **1** 2 **3** 4 5 **6** **7** 8 NPSA risk rating: 4	Ready diluted	2–5 mL/kg over 6–12 hours, repeated if necessary Usual maximum dose over 24 hours: 30 mmol In critical care up to 50 mmol may be given over 24 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Phytomenadione					
Ampoule 10 mg/1 mL Konakion MM Roche (UK) Konakion MM and Konakion Paediatric contain the same drug solution, but are presented in different volumes to aid dosing	**Adults and children:** IV bolus (preferred method) 1 2 3 **4** 5 **6** 7 8 NPSA risk rating: 2	Withdraw the dose and dilute to 10–20 mL G See comment (b)	Over 3–5 minutes	**Infusion-related adverse events:** injection site reactions, rarely hypersensitivity reactions **pH:** 5.3–6.6 (undiluted, Konakion MM and Konakion MM Paediatric) **Osmolality:** 80 mOsmol/kg (undiluted, Konakion MM and Konakion MM Paediatric) **Flush:** G **Sodium content:** 0.1 mmol/1 mL (Konakion MM), negligible (Konakion MM Paediatric) **Other comments:** (a) after dilution check the solution in the syringe is clear. Use immediately after preparation and discard any syringe with turbid solution (b) the listed dilutions are outside the manufacturer's recommendations but are standard practice at UCLH. Dilution of the bolus dose facilitates administration over 3–5 minutes. Dilution of the infusion as recommended avoids the need to remove a volume of solution from an infusion bag (b) Konakion MM Paediatric (2 mg/0.2 mL) is also licensed for oral use	**Compatible fluids:** G **Do not infuse with any other medicines or infusion fluids**
	Adults and children: (I) IV infusion **1 2** 3 **4** 5 **6** 7 **8** NPSA risk rating: 4	Add required dose to a 50–100 mL bag G Protect solution and administration set from light once mixed	Over 15–30 minutes		
Ampoule 2 mg/0.2 mL Konakion MM Paediatric Roche (UK)	**Neonates:** IM (preferred method) 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted			
	Neonates: IV bolus 1 2 3 **4** 5 **6** 7 8 NPSA risk rating: 2	Withdraw the dose and dilute to a convenient volume with G See comment (b)	Over 3–5 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Piperacillin with tazobactam ⚠ **This is a penicillin. Check allergy status before administration**					
Vial 2.25 g (2 g piperacillin+ 0.25 g tazobactam) 4.5 g (4 g piperacillin+ 0.5 g tazobactam) *Non-proprietary* Wockhardt (UK)	IV bolus 1 2 3 4 **5** **6** 7 8 NPSA risk rating: 2	**If using a whole vial:** add 10 mL W or NS to the 2.25 g vial, or 20 mL W or NS to the 4.5 g vial **If using part of a vial:** add 8.4 mL W or NS to the 2.25 g vial Alternatively add 16.8 mL W or NS to the 4.5 g vial This will give a final concentration of 225 mg/1 mL	Over 3–5 minutes	**Infusion-related adverse events:** hypersensitivity, hypotension, thrombophlebitis **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 5–7 (reconstituted in W), 4.5–6.5 (reconstituted in NS) **Flush:** NS **Sodium content:** 4.7 mmol/2.25 g vial 9.4 mmol/4.5 g vial **Displacement value:** 1.6 mL/2.25 g vial 3.2 mL/4.5 g vial **Other comments:** generic preparations of piperacillin with tazobactam may be compatible with a different range of drugs and diluents to the Tazocin brand. The compatibilities stated here are for the generic product, since this is the preferred product at UCLH	**The following data assume piperacillin with tazobactam is infused into the Y-site as a 40 mg+5 mg/mL solution. Piperacillin with tazobactam solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** fluconazole, linezolid, metronidazole **Y-site compatible when diluted in NS:** furosemide **Y-site compatible when diluted in G or NS:** aminophylline, bumetanide, co-trimoxazole, dopamine, folinic acid, granisetron, hydrocortisone sodium succinate, magnesium sulphate, mesna, methylprednisolone sodium succinate, morphine, ranitidine, remifentanil, zidovudine **Incompatible:** H, aciclovir, amikacin, amphotericin, ciprofloxacin, dobutamine, drotrecogin, gentamicin, tobramycin, vancomycin
	(I) IV infusion 1 **2** 3 4 **5** **6** 7 8 NPSA risk rating: 3	Reconstitute as above, then add dose to a convenient volume NS (minimum 50 mL)	Over 20–30 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Potassium canrenoate (unlicensed)					
Ampoule 20 mg/1 mL Aldactone Roche (Germany)	IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted	Give slowly over 3–5 minutes Maximum rate 100 mg/minute	**Infusion-related adverse events:** pain at injection site with rapid administration, headache, hypersensitivity, hypotension, transient confusion with high doses **Flush:** NS **Sodium content:** 1.4 mmol/vial	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	(I) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Add dose to a convenient volume of NS or G **Adults:** usually added to 250 mL bag NS	Over 30 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Potassium chloride					
Bag *Non-proprietary* Baxter, Ivex and Fresenius Kabi (UK) In sodium chloride 0.9%: 10 mmol in 500 mL 20 mmol in 100 mL, 500 mL and 1 L 40 mmol in 100 mL, 500 mL and 1 L 60 mmol in 1 L In glucose 5%: 20 mmol in 500 mL and 1 L 40 mmol in 1 L In glucose 10%: 10 mmol in 500 mL 20 mmol in 500 mL In sodium chloride 0.18% and glucose 4%: 10 mmol in 500 mL 20 mmol in 500 mL and 1 L 40 mmol in 1 L	**Prevention or treatment of hypokalaemia:** (I) or (C) IV infusion via a volumetric infusion pump **1** 2 3 4 5 6 **7** 8 NPSA risk rating: 2 with ready prepared bags; 5 if vials added to a bag Concentrations of greater than 40 mmol/L potassium should preferably be given by a central line, or via a large peripheral vein	Ready diluted products should be used whenever possible If addition of potassium chloride concentrate to a bag is required, ensure thorough mixing by repeated inversion and tapping of the additive port	**Adults:** usual maximum rate 10 mmol/hour **Paediatrics:** usual maximum rate 0.2 mmol/kg per hour Faster rates may be used (see other comments regarding ECG monitoring)	**Infusion-related adverse events:** rapid administration may cause hyperkalaemia, arrhythmias, heart block and cardiac arrest. Phlebitis and pain at injection site **ECG monitoring is required if the rate of infusion is greater than 20 mmol/hour** **ECG monitoring required in children if the rate of infusion is 0.5 mmol/kg per hour or greater** **ECG monitoring required if the concentration of potassium for infusion is greater than 80 mmol/L** **pH:** generally 3.5–6.5 (glucose-potassium bags) 4.5–7 (sodium chloride- potassium bags) **Osmolarity:** 318 mOsmol/L (20 mmol/L in G) 358 mOsmol/L (40 mmol/L in G) 388 mOsmol/L (40 mmol/L in NS) 348 mOsmol/L (20 mmol/L in NS) **Flush:** NS **Sodium content:** 15 mmol/500 mL (0.18% solutions) 77 mmol/L (0.45% solutions)	**The following data assume potassium chloride is infused into the Y-site as a 40 mmol/L solution. Potassium solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, GS, G10, H **Y-site compatible ready-diluted medicines:** ciprofloxacin, linezolid, sodium bicarbonate 8.4%, propofol 1% **Y-site compatible when diluted in NS:** co-amoxiclav, drotrecogin, furosemide **Y-site compatible when diluted in G:** amiodarone
	Treatment of hypokalaemia in fluid restriction in critical care: IV infusion via syringe pump into a central line **1** **2** 3 4 5 6 **7** 8 NPSA risk rating: 3	Dilute two ampoules of potassium chloride concentrate to 50 mL with G. This gives a syringe containing 40 mmol potassium in 50 mL G, i.e. 0.8 mmol potassium/mL	As above		

Formulation	Method	Dilution	Rate	Comments	Compatibility
Potassium chloride *continued*					
In sodium chloride 0.18% and glucose 5%: 20 mmol in 500 mL In sodium chloride 0.18% and glucose 10%: 10 mmol in 500 mL* In sodium chloride 0.45% and glucose 2.5%: 20 mmol in 1 L* In sodium chloride 0.45% and glucose 5%: 20 mmol in 500 mL Ampoule 20 mmol/10 mL *Non-proprietary* Auden McKenzie (UK) * unlicensed	**GIK (glucose–insulin–potassium) infusion for myocardial ischaemia in critical care:** (C) IV infusion into a central line via a syringe pump **1** **2** **3** 4 5 6 **7** 8 NPSA risk rating: 4	Dilute 20 mmoL ampoule to 50 mL with NS. This gives a 0.4 mmol/mL solution	Initial rate 0.12 mmol/kg per hour See comment (b)	**Other comments:** (a) in line with NPSA Patient Safety Alert 1, potassium chloride 20 mmol/10 mL is stocked only in designated areas and is treated as a controlled drug at UCLH The NPSA has classified the accidental administration of potassium chloride concentrate as a 'never event'. See www.npsa.nhs.uk for further details b) for the GIK infusion: insulin is infused at a constant rate, while potassium and glucose are titrated to maintain potassium within normal range and blood glucose between 4 and 10 mmol/L. To do this potassium 20 mmol is diluted to 50 mL with NS and given at an initial rate of 0.12 mmol/kg per hour. Glucose 50% is given initially at 0.9 mL/kg per hour	**Y-site compatible when diluted in G or NS:** aciclovir, adrenaline, amikacin, aminophylline, atracurium, atropine, calcium gluconate, cefuroxime, clarithromycin, dexamethasone, digoxin, dobutamine, dopamine, ethanol, fentanyl, flucloxacillin, granisetron, insulin, lidocaine, magnesium sulphate, meropenem, methylprednisolone sodium succinate, midazolam, morphine, noradrenaline, pantoprazole, pethidine, piperacillin with tazobactam, phenylephrine, ranitidine, remifentanil, sodium nitroprusside, suxamethonium, zidovudine

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Prochlorperazine mesilate					**For IM use only**
Vial 12.5 mg/1 mL Stemetil Sanofi-Aventis t/a Castlemead (UK)	IM 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted		**Infusion-related adverse events:** restlessness after large doses, postural hypotension (particularly in the elderly), arrhythmias, tachycardia, dry mouth, respiratory depression, injection site reactions Monitor blood pressure and heart rate **pH:** 6.2–6.4 (undiluted) **Flush:** NS **Sodium content:** 0.1 mmol/1 mL vial	**Do not infuse with any other medicines or infusion fluids**
Procyclidine hydrochloride					
Vial 10 mg/2 mL Kemadrin Auden Mackenzie (UK)	IM 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted		**Infusion-related adverse events:** dry mouth, blurred vision, nausea, vomiting, tachycardia, dizziness **pH:** 3.9–4.5 (undiluted) **Flush:** NS	**Do not infuse with any other medicines or infusion fluids**
	IV bolus 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted	Over 3–5 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Promethazine hydrochloride					
Ampoule 25 mg/1 mL Phenergan Sanofi-Aventis (UK)	Deep IM 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted		**Infusion-related adverse events:** drowsiness, dizziness, restlessness, headache, blurred vision, dry mouth, pain at injection site, palpitations, hypotension **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 5–6 (undiluted) **Osmolality:** 291 mOsmol/kg **Flush:** NS **Sodium content:** negligible **Other comments:** maximum parenteral dose 100 mg	**Do not inject with any other medicines or infusion fluids**
	Emergency use for anaphylaxis: IV bolus **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Dilute each 1 mL of drug with 9 mL of W This gives a 2.5 mg/mL solution	Maximum rate 25 mg/minute		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Propofol (emulsion)					
Ampoule 1% 20 mL Propoven Fresenius Kabi (UK) Vial 1%, 2% 50 mL Propoven Fresenius Kabi (UK) Pre-filled syringe 1%, 2% 50 mL Diprivan Astra Zeneca (UK) Diprivan pre-filled syringes are intended for use with the Diprifusor TCI System	**Induction of general anaesthesia:** IV bolus using the 1% preparation **1** 2 **3** 4 5 **6** 7 8 NPSA risk rating: 3	Ready diluted	Give each 40 mg increment over 10 seconds until anaesthesia achieved Usual total dose required: 1.5–2.5 mg/kg. See comment (a)	**Infusion-related adverse events:** injection site pain, hypotension, bradycardia, cardiorespiratory depression **pH:** 7.5–8.5 (undiluted, Diprivan) **Osmolality:** 280 mOsmol/kg (undiluted, Diprivan 1%) **Flush:** NS **Sodium content:** negligible (Diprivan) **Other comments:** (a) children under 8, adults over 55 and those with co-morbidities: give 20 mg boluses. May require a reduced total dose to achieve anaesthesia (b) 1 mL of the 1% preparation contains propofol 10 mg 1 mL of the 2% preparation contains propofol 20 mg (c) doses and infusion rates of anaesthetic agents are highly variable and should be adjusted according to response by the anaesthetist. Use of anaesthetic agents outside critical care and theatres should be considered a high risk intervention (d) To dilute propofol 1% in a bag: withdraw a volume of infusion fluid equal to that of the propofol dose from an infusion bag. Add the propofol to the bag and ensure thorough mixing. Each 1 mL of propofol may be diluted with up to 4 mL of infusion fluid. Discard any unused solution after 6 hours (*continued on next page*)	**The following data assume propofol is infused into the Y-site as a Diprivan 1% solution. The formulations of Diprivan and Propoven (and other generic propofol) are sufficiently different that compatibility data for Diprivan cannot be extrapolated to them** **Compatible fluids:** NS, G, GS. See comment (d) **Y-site compatible ready-diluted medicines:** esmolol, fluconazole, ganciclovir, potassium chloride 40 mmol/L in NS or G, sodium bicarbonate 8.4%, mannitol 10% **Y-site compatible when diluted in G or NS:** aciclovir, adrenaline, alfentanil, aminophylline, atracurium 0.5 mg/mL, atropine, bumetanide, ceftazidime, ceftriaxone, fentanyl, lidocaine, pancuronium, ranitidine, remifentanil, thiopental, suxamethonium, vancomycin, vecuronium **Y-site compatible when diluted in NS:** furosemide, imipenem, ketamine **Y-site compatible when diluted in G:** cefuroxime, dobutamine, dopamine, glyceryl trinitrate, granisetron, hydrocortisone, insulin, meropenem, midazolam, morphine
	Maintenance of general anaesthesia: (C) IV infusion via a syringe pump or volumetric infusion pump **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4 (5 if diluted)	Ready diluted Each 1 mL of propofol 1% may be diluted with up to 4 mL of infusion fluid to aid administration. See comment (d)	**Adults:** usually 4–12 mg/kg per hour **Children:** usually 9–15 mg/kg per hour		
	Maintenance of anaesthesia: IV bolus using the 1% preparation **1** 2 **3** 4 5 **6** 7 8 NPSA risk rating: 3	Ready diluted	Give 25–50 mg increments over 10 seconds through the procedure		

Formulation	Method	Dilution	Rate	Comments	Compatibility
Propofol (emulsion) *continued*					
Ampoule 1% 20 mL Propoven Fresenius Kabi (UK) Vial 1%, 2% 50 mL Propoven Fresenius Kabi (UK) Pre-filled syringe 1%, 2% 50 mL Diprivan Astra Zeneca (UK) Diprivan pre-filled syringes are intended for use with the Diprifusor TCI System	**Sedation in critical care:** (C) IV infusion via a syringe pump or volumetric infusion pump **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4 (5 if diluted)	Ready diluted Each 1 mL of propofol 1% may be diluted with up to 4 mL of infusion fluid to aid administration. See comment (d)	Usually 0.3–4 mg/kg per hour adjusted according to the required depth of sedation	Diprivan 1% may be diluted in this manner with G, but Propoven 1% may be diluted with G or NS For all dilutions the final concentration of propofol must not be less than 2 mg/mL, i.e. more dilute solutions should not be prepared Propofol 2% should not be diluted but may be administered through a Y-site with NS, G or GS running through the other arm of the connector. The 1% preparation may also be administered through a Y-site. The Y-site must be close to the site of injection (e) the lipid component of all propofol preparations is a medium for microbial growth. Therefore, to minimise the risk of giving a contaminated product, a fresh drug infusion must be prepared at regular intervals. If the drug is diluted at the time of preparation, the infusion should be changed 6 hours after preparation. However, if propofol is not diluted during preparation, the drug infusion should be changed 12 hours after preparation. In both cases the administration set should also be changed (f) propofol is formulated as an oil-in-water emulsion made with soya-oil. Propofol is contraindicated in those patients hypersensitive to peanuts or soya	**Incompatible:** amikacin, amphotericin, calcium chloride, ciprofloxacin, gentamicin, metoprolol, tobramycin
	Sedation for surgical and diagnostic procedures: IV bolus followed by (C) IV infusion via a syringe pump or volumetric infusion pump **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4–5 for infusion (3 for bolus)	As above	Initial bolus: 0.5–1 mg/kg Infusion: 1.5–4.5 mg/kg per hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Propranolol hydrochloride					
Ampoule 1 mg/1 mL Inderal Astra Zeneca (UK)	IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted May be further diluted to a convenient volume with NS or G	Give each 1 mg dose over 1 minute May be repeated at 2 minute intervals to a maximum of 10 mg Usual maximum if patient under anaesthesia: 5 mg	**Infusion-related adverse events:** bradycardia, hypotension, bronchospasm, headache **ECG monitoring required when used for arrhythmias** **pH:** 2.8–4.1 (undiluted) **Osmolality:** 28 mOsmol/kg (undiluted) **Flush:** NS **Sodium content:** nil	**Compatible fluids:** NS, G, GS **Do not inject with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Protamine sulphate					
Ampoule 50 mg/5 mL *Non-proprietary* UCB (UK) Ampoule 100 mg/10 mL *Non-proprietary* Waymade t/a Sovereign (UK)	IV bolus **1** **2** **3** 4 5 **6** 7 8 NPSA risk rating: 3	Ready diluted May be further diluted with NS or G	Over 10 minutes Maximum rate: 5 mg/minute	**Infusion-related adverse events:** rapid administration may cause hypotension and 'anaphylactoid' reactions. Sensation of warmth, flushing of the skin, bradycardia, dyspnoea **APTT monitoring required. At UCLH this is done 10–15 minutes after protamine is given** **pH:** 2.5–3.5 (UCB and Sovereign) **Osmolality:** 290 mOsmol/kg (Sovereign) **Flush:** NS **Sodium content:** 1.5 mmol/10 mL vial (Sovereign), negligible (UCB) **Other comments:** the dose of protamine is dependent on the amount and type of heparin to be neutralised, its route of administration and the time elapsed since it was last given. For full details refer to 'Therapeutic Anticoagulation in Adults' available through the UCLH intranet or the manufacturer's prescribed information Generally 1 mg protamine sulphate neutralises 80–100 units heparin when given within 30 minutes of heparin. If a longer time has elapsed since heparin administration, less protamine is required.	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	IV infusion via a syringe pump or volumetric infusion pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	Add the dose to 50–100 mL NS or G	Over 10 minutes Maximum rate: 5 mg/minute		
	(C) IV infusion via a syringe pump or volumetric infusion pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	Dilute to a convenient volume with NS or G	Usually given over 8–16 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Protirelin					
***see* thyrotropin releasing hormone**					
Quinine dihydrochloride (unlicensed)					
Ampoules 300 mg/1 mL *Non-proprietary* Martindale (UK)	(I) IV infusion via volumetric infusion pump **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4	Add dose to 250–500 mL NS	Over 4 hours	**Infusion-related adverse events**: tinnitus, headache, flushed skin, nausea, hypoglycaemia, confusion, cardiovascular effects Monitor blood glucose levels **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 1.5–3 (undiluted) **Flush:** NS **Sodium content:** nil	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	Fluid restriction: (I) IV infusion into a central line via a syringe pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	Dilute to 30 mg/mL with NS and G, e.g. dilute contents of each ampoule with 8 mL NS	Over 4 hours		
Rabbit ATG					
***see* anti-human thymocyte immunoglobulin**					

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ranitidine					
Ampoule 50 mg/2 mL Zantac GSK (UK)	IV bolus (preferred method) **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	**Adults:** dilute one ampoule to 20 mL with NS **Children:** dilute each 1 mL drug to 10 mL NS. This gives a 2.5 mg/mL solution **Fluid restriction:** give undiluted	**Adults:** over 2 minutes **Children:** over 3 minutes	**Infusion-related adverse events:** bradycardia (on rapid administration), headache, dizziness, blurred vision, muscle and joint pain **pH:** 6.8–7.1 (undiluted) **Osmolality:** 285 mOsmol/kg (50 mg diluted to 20 mL NS) 248 mOsmol/kg (undiluted) **Flush:** NS **Sodium content:** 0.1 mmol/2 mL vial **Other comments:** may also be given as an IM injection	**The following data assume ranitidine is infused into the Y-site as a 2 mg/mL solution. Ranitidine solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H **Y-site compatible ready-diluted medicines:** fluconazole, foscarnet, linezolid, potassium chloride 40 mmol/L in NS or G **Y-site compatible when diluted in G or NS:** adrenaline, aminophylline, atropine, ceftazidime, clarithromycin, digoxin, dopamine, dobutamine, doxapram, fentanyl, granisetron, lidocaine, morphine, ondansetron, pethidine, piperacillin with tazobactam, propofol 1%, remifentanil, sodium nitroprusside, tacrolimus, vancomycin **Y-site compatible when diluted in NS:** erythromycin **Incompatible:** atracurium, noradrenaline
	(I) IV infusion **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Add the dose to 50–100 mL bag NS	Over 2 hours		
	(C) IV infusion **1** **2** **3** 4 5 **6** 7 8 NPSA risk rating: 4	Dilute dose to 100 mL with NS	0.125–0.25 mg/kg per hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Rasburicase					
Vial 1.5 mg 7.5 mg Fasturtec Sanofi-Aventic (UK)	(I) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Reconstitute vial with solvent supplied (1 mL for 1.5 mg vial, 5 mL for 7.5 mg vial). Swirl gently, do not shake Further dilute solution to 50 mL with NS	Over 30 minutes	**Infusion-related adverse events:** hypotension, bronchospasm, rhinitis, allergic-type reactions including rash, urticaria and anaphylaxis, fever **pH:** 7.7–8.3 (reconstituted) **Osmolality:** 320 mOsmol/kg **Flush:** NS **Sodium content:** 0.1 mmol/1.5 mg vial 0.5 mmol/7.5 mg vial **Displacement value:** nil	**Compatible fluids:** NS **Incompatible:** G **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Remifentanil					
Vial 1 mg 2 mg 5 mg Ultiva GSK (UK)	**Induction of anaesthesia:** IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Add 1 mL NS or W to 1 mg vial, 2 mL NS or W to 2 mg vial or 5 mL NS or W to 5 mg vial Further dilute to 20–250 micrograms/mL with NS or G	**Adults and children over 12:** usually 0.25–1 microgram/kg over at least 30 seconds **Children:** not recommended for induction	**Infusion-related adverse events:** respiratory depression, bradycardia, hypotension, skeletal muscle rigidity **pH:** 2.5–3.5 (reconstituted with G) ⚠ **Flush:** NS after a bolus. Do not flush the administration set after an infusion: disconnect the apparatus, aspirate the cannula/catheter, then flush with NS **Sodium content:** nil **Displacement value:** negligible **Other comments:** the use of remifentanil during surgery is highly specialised. Doses and infusion rates are highly variable, dependent on the patient, procedure and other agents used. Infusion rates stated here are taken from literature and the manufacturer's information, and are meant only as a guide. Individual anaesthetists and critical care physicians are best placed to decide how remifentanil is administered to their patients	**The following data assume remifentanil is infused into the Y-site as a 0.25 mg/mL solution. Remifentanil solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H, sodium chloride 0.45% **Y-site compatible ready-diluted medicines:** esmolol, fluconazole, ganciclovir, linezolid, metronidazole, potassium chloride 40 mmol/L in NS or G, propofol 1%, sodium bicarbonate 8.4%, mannitol 10% **Y-site compatible when diluted in NS:** furosemide **Y-site compatible when diluted in G or NS:** acetylcysteine, aciclovir, adrenaline, alfentanil, amikacin, aminophylline, amiodarone, atracurium, bumetanide, cefotaxime, ceftazidime, ceftriaxone, cefuroxime, ciprofloxacin, clonidine, co-trimoxazole, diazepam, digoxin, dobutamine, dopamine, fentanyl, gentamicin, glyceryl trinitrate, heparin sodium, hydrocortisone sodium succinate, insulin, imipenem, labetolol, lidocaine, magnesium sulphate, methylprednisolone sodium succinate, midazolam, morphine, noradrenaline, ondansetron, phenylephrine, pipericillin with tazobactam, ranitidine, rocuronium, sodium nitroprusside, thiopental, tobramycin, vancomycin, vecuronium, zidovudine **Incompatible:** amphotericin
	Maintenance of anaesthesia: (I) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	As above	**Adults and children over 12:** **– ventilated patients:** 0.05–2 micrograms/kg per minute **– spontaneously breathing patients:** initially 0.04 microgram/kg per minute adjusted according to response; usual range 0.025–0.1 microgram/kg per minute **Children 1–12 years:** 0.05–1.3 micrograms/kg per minute		
	Analgosedation in critical care: (C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute dose to 50 mL with NS or G Typically 2–5 mg is diluted to 50 mL Occasionally up to 20 mg may be used	**Adults:** 0.05–0.5 microgram/kg per minute, adjusted according to response		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Rifampicin (rifampin)					
Vial 600 mg Rifadin Sanofi-Aventis (UK)	(I) IV infusion **1** **2** 3 4 **5** **6** 7 8 NPSA risk rating: 4	Reconstitute vial with diluent provided. Swirl gently to dissolve the contents of the vial Further dilute solution with 500 mL NS, G or G10	Over 2–3 hours	**Infusion-related adverse events:** hypersensitivity, fever, skin rashes, nausea, vomiting, phlebitis, pain at infusion site. Red colour may be present in urine, sputum, sweat and tears. Soft contact lenses may be permanently discoloured and should not be worn during therapy **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 8.3 (reconstituted vial) **Flush:** NS **Sodium content:** 0.6 mmol/vial **Other comments:** the full dose should be given within 3 hours of preparation. Rifampicin may both degrade and precipitate after this time	**Compatible fluids:** NS, G, GS, G10 **Do not infuse with any other medicines or infusion fluids**
	Fluid restriction (unlicensed): (I) IV infusion via a large vein or central line **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4	Reconstitute vial with diluent provided. Swirl gently to dissolve the contents of the vial Further dilute solution with 100 mL NS or G	Over at least 30 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ritodrine hydrochloride					
Ampoule 50 mg/5 mL Yutopar Durbin (UK)	IV infusion via a syringe pump (preferred method) **1** **2** 3 **4** 5 **6** **7** 8 NPSA risk rating: 5	Dilute three ampoules to 50 mL with G This gives a 3 mg/mL solution	Initially 1 mL/hour increasing in 1 mL/hour increments every 10 minutes until contractions stop or maternal heart beat reaches 140 beats per minute Usual maximum: 7 mL/hour	**Infusion-related adverse events:** tachycardia, palpitations, arrhythmias, tremor, headache, muscle cramps, pulmonary oedema **ECG monitoring required** **Flush:** NS, G **Other comments:** (a) both infusions are equivalent to an initial rate of 50 micrograms/minute increasing in 50 microgram/minute increments every 10 minutes. Usual maximum: 350 micrograms/minute Continued for 12–48 hours after the contractions have stopped (b) the syringe is the preferred method as this delivers a smaller volume of fluid to the patient, thus minimising the risk of pulmonary oedema during labour (c) at UCLH atosiban is the first-line agent for premature labour	**Compatible fluids:** G **Do not infuse with any other medicines or infusion fluids**
	(I) IV infusion via a volumetric infusion pump **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4	Add three ampoules to a 500 mL bag G This gives a solution of approximately 0.3 mg/mL	Initially 10 mL/hour increasing in 10 mL/hour increments every 10 minutes until contractions stop or maternal heart beat reaches 140 beats per minute Usual maximum: 70 mL/hour		
	IM **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted	Usually 1 mL (10 mg) every 3–8 hours continued for 12–48 hours after contractions have stopped		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Rituximab					
Vial 100 mg/10 mL 500 mg/50 mL MabThera Roche (UK) For inpatients at UCLH rituximab is diluted by pharmacy and supplied to the ward as a ready to administer infusion. In the outpatient department nurses are required to dilute the medicine themselves	IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Add the dose to a suitable volume of NS or G so that the final concentration is 1–4 mg/mL. Invert gently to avoid foaming **Suggested dilutions:** **For 1 g dose:** withdraw 100 mL from a 250 mL bag NS or G. Add the dose to the bag to produce a 4 mg/mL solution **For 500 mg dose:** withdraw 50 mL from a 250 mL bag NS or G. Add the dose to the bag to produce a 2 mg/mL solution	**For the first infusion:** initially 50 mg/hour for the first 30 minutes, increasing by 50 mg/hour at 30 minute intervals up to a maximum infusion rate of 400 mg/hour **For subsequent infusions:** initially 100 mg/hour for the first 30 minutes, increasing in 100 mg/hour increments at 30 minute intervals up to a maximum infusion rate of 400 mg/hour **Suggested infusion rates:** **1 g dose, first infusion:** initially 12.5 mL/hour, increasing in increments of 12.5 mL/hour every 30 minutes up to a maximum rate of 100 mL/hour **1 g dose, subsequent infusions:** initially 25 mL/hour, increasing in increments of 25 mL/hour every 30 minutes up to a maximum rate of 100 mL/hour **500 mg dose, first infusion:** initially 25 mL/hour, increasing in increments of 25 mL/hour every 30 minutes up to a maximum rate of 200 mL/hour **500 mg dose, subsequent infusions:** initially 50 mL/hour, increasing in increments of 50 mL/hour every 30 minutes up to a maximum rate of 200 mL/hour	**Infusion-related adverse events:** cytokine release syndrome, characterised by bronchospasm, hypotension, fever, chills, rigors, rash, itching and angioedema **pH:** 6.5 **Osmolality:** 360 mOsmol/kg (undiluted) **Flush:** NS **Sodium content:** 2.4 mmol/100 mg vial 12 mmol/500 mg vial **Other comments:** 30–60 minutes prior to rituximab adult patients should be premedicated with methylprednisolone sodium succinate 100 mg IV, chlorphenamine 10 mg IV and paracetamol 1 g PO to minimise the risk of cytokine release syndrome. Correspondingly lower doses of the same drugs may be given as premedication in children	**Compatible fluids:** NS, G **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Rocuronium bromide					
Vial 50 mg/5 mL 100 mg/10 mL Esmeron Organon (UK)	IV bolus  NPSA risk rating: 1	Ready diluted	Over a few seconds	**Infusion-related adverse events:** hypotension, tachycardia, injection site pain **Extravasation:** state risk **pH:** 3.8–4.2 (undiluted) **Osmolality:** 300 mOsmol/kg **Flush:** NS **Sodium content:** negligible **Other comments:** older patients, and those with hepatic or renal impairment, may require lower bolus doses and infusion rates. Recommended initial infusion rate: 0.3–04 mg/kg per hour Doses and infusion rates of neuromuscular blockers are highly variable and should be adjusted according to response by the anaesthetist. Use of neuromuscular blockers outside critical care and theatres should be considered a high risk intervention	**The following data assume rocuronium is infused into the Y-site as a 10 mg/mL solution. Rocuronium solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H **Y-site compatible ready-diluted medicines:** esmolol **Y-site compatible when diluted in G or NS:** acetylcysteine, adrenaline, alfentanil, aminophylline, amiodarone, atracurium, clonidine, dobutamine, dopamine, fentanyl, heparin sodium, insulin, labetolol, midazolam, morphine, noradrenaline, remifentanil, sodium nitroprusside, vecuronium
	(I) IV infusion via a syringe pump  NPSA risk rating: 3	Ready diluted May be further diluted to a convenient volume with NS, G or GS	**Adults under intravenous anaesthesia**: usually 0.3–0.6 mg/kg per hour **Adults under inhaled anaesthesia:** 0.3–0.4 mg/kg per hour **Children:** initial rates as per adults, but may require higher infusion rates to maintain blockade		
	Adjunct to sedation for adults in critical care: (C) IV infusion  NPSA risk rating: 7	Ready diluted May be further diluted to a convenient volume with NS, G or GS	Usually 0.3–0.6 mg/kg per hour Note at UCLH other neuromuscular blockers are preferred for this indication		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Salbutamol (albuterol)					
Ampoule 500 micrograms/1 mL Ventolin Injection Allen and Hanburys (UK)	**For bronchospasm:** IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Draw up the contents of one ampoule 'for injection' into a syringe and dilute to 10 mL with W	Over 3–5 minutes	**Infusion-related adverse events:** tachycardia, palpitations, arrhythmias, tremor, headache, muscle cramps, pulmonary oedema (when given for premature labour) **ECG monitoring required for infusions** **pH:** 3.4–3.6 (undiluted, both preparations) **Flush:** NS **Sodium content:** 0.2 mmol/vial for injection 0.8 mmol/vial for infusion **Other comments:** the rate of salbutamol delivery is the same in both methods of administration for bronchospasm (a) adult infusion rate equivalent to 5 micrograms/minute initially, maximum 20 micrograms/minute. Increase in increments of 1.5 mL/hour (i.e. 5 micrograms/minute) every 15 minutes (b) paediatric infusion rate equivalent to initial 1–2 micrograms/kg per minute, maximum 5 micrograms/kg per minute. Increase in increments of 0.3 mL/kg per hour (i.e. 1 microgram/kg per minute) every 15 minutes. Doses above 2 micrograms/kg per minute should be given in high dependency unit or paediatric intensive care In fluid restriction, undiluted solutions may be given via a central line (unlicensed)	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	For bronchospasm: SC bolus or IM 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Ready diluted			
Ampoule 5 mg/5 mL Ventolin Infusion Allen and Hanburys (UK)	**For bronchospasm in adults:** (C) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Add one ampoule 'for infusion' to 500 mL bag NS, G or GS to produce a 10 microgram/1 mL solution	Initially 30 mL/hour adjusted according to response. Maximum rate of infusion: 120 mL/hour		
	For bronchospasm in adults or children: (C) IV infusion via a syringe pump (unlicensed dilution) 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Draw up the contents of two ampoules 'for infusion' into a syringe and dilute to 50 mL with NS, G or W. This gives a 200 microgram/mL solution	**Adults:** initially 1.5 mL/hour. Maximum: 6 mL/hour **Children:** initially 0.3–0.6 mL/kg per hour. Usual maximum: 1.5 mL/kg per hour		

Formulation	Method	Dilution	Rate	Comments	Compatibility
Salbutamol (albuterol) *continued*					
Ampoule 5 mg/5 mL Ventolin Infusion Allen and Hanburys (UK)	**For premature labour:** (C) IV infusion via a syringe pump (preferred method) 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Draw up the contents of two ampoules 'for infusion' into a syringe and dilute to 50 mL with G This gives a 200 microgram/mL solution	Initially 3 mL/hour, increasing every 10 minutes according to response. See other comments Maximum rate: 13.5 mL/hour	**Other comments for use in labour:** continue the infusion for 1 hour after contractions have stopped, then halve the rate of infusion. Halve the rate of infusion every 6 hours thereafter until it is deemed safe to stop therapy. Maximum duration of therapy: 48 hours Both methods provide roughly the same dose of salbutamol: initially 10 micrograms/minute increasing up to a maximum 45 micrograms/minute. However, the syringe pump is the preferred method as the lower volume minimises the risk of pulmonary oedema Maternal heart rate must be regularly monitored and should not be allowed to rise above 140 beats/minute At UCLH atosiban is the first-line agent for premature labour	
	For premature labour: (C) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Add two vials to 500 mL G to give a solution of approximately 20 micrograms/mL	Initially 30 mL/hour, increasing every 10 minutes according to response. See other comments Maximum rate: 135 mL/hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Scopolamine					
***see* hyoscine**					
Secretin (unlicensed)					
Ampoule 100 units (equivalent to secretin pentahydro-chloride 29 nanograms) Secrelux Sanochemia (Germany)	IV bolus **1** 2 3 4 **5** **6** 7 8 NPSA risk rating: 3	Reconstitute each ampoule with 10 mL NS (provided)	Usually 1 unit/kg over 30 seconds to 2 minutes	**Infusion-related adverse events:** flushing, transient hypotension and hypoglycaemia. Hypersensitivity reactions may occur **pH:** 2.5–3.5 **Flush:** NS **Sodium content:** nil **Displacement value:** negligible	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**
	IV infusion via a syringe pump **1** **2** **3** 4 **5** **6** **7** 8 NPSA risk rating: 5	As above	Usually 1 unit/kg over 1 hour		
Septrin					
***see* co-trimoxazole**					

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Sodium benzoate (unlicensed)					
Ampoule 1 g/5 mL *Non-proprietary* Martindale (UK) Ampoule 2 g/10 mL Amzoate Special Products (UK)	**For urea cycle disorders:** (I) IV infusion via a volumetric infusion pump, followed by a (C) IV infusion through a large vein or central line **1 2 3 4 5 6 7 8** NPSA risk rating: 6	Add 12.5 mL of sodium benzoate 200 mg/mL to 500 mL bag G10 Add L-arginine and sodium phenylbutyrate to the same bag (see L-arginine monograph for full details)	Give the first bag over 90 minutes Give subsequent infusions at 2 mL/kg per hour Administer through a 0.2 micron filter	**Infusion-related adverse events:** nausea, vomiting, flushing, headache, injection site irritation **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **Osmolarity:** hypertonic **pH:** 5–5.5 (undiluted sodium benzoate) **Flush:** NS, G or G10 **Sodium content:** 7 mmol (5 mL vial), 14 mmol (10 mL vial) **Other comments:** for urea cycle disorders, including ornithine transcarbamylase deficiency, citrullinaemia and arginosuccinic aciduria, the infusion should be continued until hyperammonaemia is resolved. To be initiated on the advice of the metabolic consultant Usual dose in hepatic failure at UCLH: 2 g QDS When sodium benzoate is added to an infusion bag, and other drugs are mixed with the infusion, the solution does not need to be administered through an additional filter.	**Compatible fluids:** NS, G, GS, sodium chloride 0.45% **Do not infuse with any other medicines or infusion fluids**
	For hyperammonaemia associated with hepatic failure: (I) IV infusion, preferably via a central line **1 2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Add the dose to 100 mL G or NS **Fluid restriction:** dilute to 50 mg/mL	Over 90–120 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Sodium bicarbonate					
1.26% 500 mL bottle (Polyfusor) Fresenius-Kabi (UK) 4.2% 5 mL, 10 mL ampoules (unlicensed) South Devon Healthcare (UK), Martindale (UK) 500 mL bottle (Polyfusor) Fresenius-Kabi (UK) 8.4% 100 mL bottle B Braun (UK) 200 mL bottle (Polyfusor) Fresenius-Kabi (UK)	**Correction of metabolic acidosis (adults and children):** (I) IV infusion via a volumetric infusion pump into a peripheral line, usually using the 1.26% solution **1** 2 **3** 4 5 **6** **7** 8 NPSA risk rating: 4	Ready diluted	Usually 13–33 mL/kg over 4–8 hours according to the base deficit. This is equivalent to 2–5 mmol/kg bicarbonate over 4–8 hours	**Infusion-related adverse events:** excess bicarbonate may result in metabolic alkalosis, hypokalaemia and hypocalcaemia **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 8.6 **Osmolarity:** 1.26%: 301 mOsmol/L 4.2%: 1004 mOsmol/L 8.4%: 2008 mOsmol/L **Flush:** NS **Sodium content:** 1.26%: 75 mmol/500 mL 4.2%: 250 mmol/500 mL 8.4%: 100 mmol/100 mL **Other comments:** 1 mL sodium bicarbonate 8.4% contains 1 mmol bicarbonate 1 mL sodium bicarbonate 4.2% contains 0.5 mmol bicarbonate 1 mL sodium bicarbonate 1.26% contains 0.15 mmol bicarbonate	**The following data assume sodium bicarbonate is infused into the Y-site as an 8.4% solution. Bicarbonate solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, G10, GS, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** linezolid, propofol 1% **Y-site compatible when diluted in G or NS:** adrenaline, flucloxacillin, granisetron, insulin, remifentanil, tacrolimus **Incompatible:** amiodarone, calcium chloride, cefotaxime, cefuroxime, co-amoxiclav, dobutamine, dopamine, doxapram, imipenem, labetolol, midazolam, mivacurium, ondansetron
	Correction of metabolic acidosis (adults and children): (I) IV infusion via a volumetric infusion pump or syringe pump into a central line using the 4.2% or 8.4% solution **1** 2 **3** 4 5 **6** **7** 8 NPSA risk rating: 4 if undiluted, 5 if diluted	Ready diluted May be further diluted with NS, G or GS	As above		
	Correction of metabolic acidosis (neonates): (I) IV infusion via a syringe pump **1** **2** **3** **4** 5 **6** **7** 8 NPSA risk rating: 6 if diluted, 5 if given undiluted	In emergencies give the 4.2% preparation undiluted via a central line. Otherwise the 4.2% solution may be diluted with an equal volume of W and given peripherally	According to base deficit		

Formulation	Method	Dilution	Rate	Comments	Compatibility
Sodium bicarbonate *continued*					
	For hydration or sodium replacement: (I) IV infusion of the 1.26% solution via a peripheral line or central line **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted	According to the hydration status and plasma sodium level of the patient See comment (a)	(a) sodium bicarbonate 1.26% may be given as a hydration fluid when it is undesirable to administer chloride, e.g. in hyperchloraemic acidosis (b) urine may be alkalinised prophylactically in some chemotherapy regimens to aid the clearance of methotrexate. The dose of sodium bicarbonate is based on urine pH. Sodium bicarbonate may also be given to increase clearance in the case of methotrexate toxicity For alkalinisation of urine in the case of other drugs (e.g. salicylate) toxicity seek specialist advice from the National Poisons Information Service (NPIS). Patient management, doses and infusion rates of sodium bicarbonate vary according to the nature of the toxicity (c) administration of sodium bicarbonate 8.4% during resuscitation should be considered high risk and should be performed only by those competent in advanced life support	
	Alkalinisation of urine to increase clearance of acidic drugs/poisons: (I) IV infusion via a volumetric infusion pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 4	**Using the 1.26% solution:** may be given undiluted via a peripheral line **Using the 4.2% or 8.4% solution:** via a central line	According to local protocol or on the basis of advice from the National Poisons Information Service See comment (b)		
8.4% 10 mL, 50 mL pre-filled syringe IMS (UK)	**Acidosis associated with cardiac arrest (adults and children):** IV bolus of the 8.4% solution **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2 but see comment (c)	Ready diluted Preferably use the pre-filled syringe	1–2 mmol/kg over a few seconds, followed immediately by a NS flush Usual maximum dose: 50 mmol		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Sodium chloride					
Bag 0.9% 50 mL, 100 mL, 250 mL, 500 mL, 1 L Baxter (UK) Bag 0.45% 500 mL Baxter (UK)	**Hydration, sodium replacement or as a diluent for the administration of medicines:** (C) or (I) IV infusion **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted 0.45% and 0.9% may be given peripherally	According to hydration status or serum sodium	**Infusion-related adverse events:** excess administration of sodium chloride 0.9% (or more concentrated) may result in peripheral and pulmonary oedema, hypernatraemia and hyperchloraemia. Other electrolyte disturbances may occur when used as the sole hydration fluid. Solutions 1.8% or more concentrated may cause vein irritation Hyponatraemia may occur with sodium chloride 0.45% **Extravasation: solutions 1.8% or greater** may cause tissue damage; for management guidelines, see Section A7 **pH:** 4.5–7 **Osmolarity:** 154 mOsmol/kg (0.45% solutions) 308 mOsmol/kg (0.9% solutions) 616 mOsmol/kg (1.8% solutions) 924 mOsmol/kg (2.7% solutions) 1711 mOsmol/kg (5% solutions) **Sodium content:** 77 mmol/L (0.45% solutions) 154 mmol/L (0.9% solutions) 308 mmol/L (1.8% solutions) 462 mmol/L (2.7% solutions) 856 mmol/L (5% solutions) **Other comments:** 0.9% sodium chloride may be given as an SC infusion	**See individual drug monographs for drug compatibilities**
Ampoule 0.9% 5 mL, 10 mL B Braun (UK)	**Flush for peripheral or central lines:** IV bolus **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted Use the 0.9% solution	Refer to Section A8 for further details about flushes		
Polyfusor 0.9%, 1.8%, 2.7%, 5% 500 mL Fresenius Kabi (UK) For sodium preparations containing potassium or glucose, refer to the respective monographs For glucose and sodium chloride infusions refer to the glucose and sodium chloride monograph	**Hyponatraemia or water intoxication:** (C) or (I) infusion via a central line 1 2 **3** 4 5 **6** **7** 8 NPSA risk rating: 4	If not diluted the 1.8%, 2.7% and 5% solutions must be given via a central line. The solution may be diluted by co-administration with another fluid via a Y-site	According to hydration status and serum sodium		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Sodium fusidate					
Vial 500 mg *Non-proprietary* Leo (UK) Each vial is provided with 10 mL vial buffer	(I) IV infusion via a volumetric infusion pump **1** **2** 3 4 **5** 6 **7** 8 NPSA risk rating: 4	Reconstitute each 500 mg vial with 10 mL buffer Add the required dose to a 500 mL bag NS, G or GS	Over 6 hours if given peripherally Over 2 hours if given centrally	**Infusion-related adverse events:** nausea, vomiting, injection site irritation, thrombophlebitis **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 7.2 (in buffer) **Osmolality:** 285 mOsmol/kg **Flush:** NS **Sodium content:** 3.1 mmol/vial **Displacement value:** negligible **Other comments:** disturbances in liver function have been associated with high doses and rapid infusion of sodium fusidate. To minimise risk to the patient switch to oral therapy as soon as possible.	**Compatible fluids:** NS, G, GS, H **Do not administer with any other medicines or infusion fluids**
	Fluid restriction: (I) IV infusion via a volumetric infusion pump (unlicensed method) **1** **2** 3 4 **5** 6 **7** 8 NPSA risk rating: 4	Reconstitute each 500 mg vial with 10 mL buffer provided **For peripheral use:** add the required dose to 250 mL bag NS or G **For central use:** add the required dose to 100 mL bag NS or G	Over 6 hours		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Sodium nitrite (unlicensed)					
Ampoule 300 mg/10 mL *Non-proprietary* Martindale (UK)	**Cyanide poisoning:** IV bolus via a large peripheral vein or central line **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted	Over 5–20 minutes **Paediatric:** 0.12–0.33 mL/kg (maximum 10 mL) over 5–20 minutes	**Infusion-related adverse events:** nausea, vomiting, headache, flushing, hypotension, tachycardia, dyspnoea. Overdose may cause methaemoglobinaemia **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 6–8.5 (undiluted) **Osmolarity:** hypertonic **Flush:** NS **Sodium content:** 4.4 mmol/vial **Other comments:** sodium nitrite is a second-line agent for severe cyanide poisoning. For full details of management of cyanide poisoning refer to TOXBASE or the National Poisons Information Service It is used prior to the administration of sodium thiosulphate	**Do no infuse with any other medicines or infusion fluids**

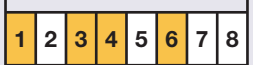
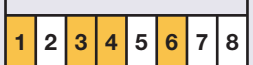
- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Sodium nitroprusside (unlicensed)					
Vial 50 mg/2 mL *Non-proprietary* Hospira (USA)	**Hypertensive crisis:** (C) IV infusion via a syringe pump **1** **2** 3 4 5 **6** **7** **8** NPSA risk rating: 5	Dilute one vial to 50 mL with G This gives a 1000 microgram/mL solution See comment (a)	Usual initial rate 0.03 mL/kg per hour. Increase the rate of infusion every 5 minutes by 0.03 mL/kg per hour until target blood pressure achieved Maximum rate 0.48 mL/kg per hour See comment (b)	**Infusion-related adverse events:** hypotension, nausea, vomiting, headache, abdominal pain, bradycardia, tachycardia, infusion site irritation. Side effects caused by cyanide metabolites include sweating, hyperventilation, arrhythmias and metabolic acidosis **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 3.5–6 ⚠ **Flush:** do not flush the administration set. After infusion is discontinued, disconnect the apparatus and flush the cannula/catheter with NS or G **Sodium content:** 0.3 mmol/vial **Other comments**: (a) nitroprusside degrades if exposed to light. Protect infusion solution and tubing from light using aluminium foil or light-protective plastic (b) initial infusion rate is equivalent to 0.5 microgram/kg per minute, increasing in increments of 0.5 microgram/kg per minute. Maximum infusion rate equivalent to 8 micrograms/kg per minute Maximum rate is above that stated in other pharmaceutical texts	**The following data assume sodium nitroprusside is infused into the Y-site as a 1000 microgram/mL solution. Nitropusside solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, potassium chloride 40 mmol/L in NS or G **Y-site compatible when diluted in G or NS:** adrenaline, alfentanil, aminophylline, clonidine, dobutamine, dopamine, fentanyl, glyceryl trinitrate, heparin sodium, insulin, lidocaine, magnesium sulphate, midazolam, morphine, noradrenaline, ranitidine, remifentanil, rocuronium, vecuronium **Y-site compatible when diluted in NS:** furosemide, insulin **Incompatible:** amiodarone, atracurium, drotrecogin, esmolol
	(C) IV infusion via a volumetric infusion pump **1** **2** **3** 4 5 **6** **7** **8** NPSA risk rating: 6	Add dose to 250–1000 mL G	Usual initial rate 0.5 microgram/kg per minute. Increase the rate of infusion every 5 minutes by 0.5 microgram/kg per minute until target blood pressure achieved Maximum rate 8 micrograms/kg per minute		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Sodium phenylbutyrate (unlicensed)					
Ampoule 2 g/5 mL *Non-proprietary* Martindale (UK) Ampoule 2 g/10 mL Amybutyrate Specials Products Ltd (UK)	**For urea cycle disorders:** (I) IV infusion via a volumetric infusion pump, followed by a (C) IV infusion through a large vein or central line 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Add 12.5 mL of sodium phenylbutyrate 200 mg/mL to 500 mL bag G10 Add L-arginine and sodium benzoate to the same bag (see L-arginine monograph for full details)	Give the first bag over 90 minutes Give subsequent infusions at 2 mL/kg per hour Administer through a 0.2 micron filter	**Infusion-related adverse events:** nausea, vomiting, flushing, headache, injection site irritation **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 7–9 (undiluted) **Osmolarity:** hypertonic **Flush:** NS **Sodium content:** 5.5 mmol (5 mL vial) 11 mmol (10 mL vial) **Other comments:** for urea cycle disorders, including ornithine transcarbamylase deficiency, citrullinaemia and arginosuccinic aciduria, the infusion should be continued until hyperammonaemia is resolved. To be initiated on the advice of the metabolic consultant Sodium phenylbutyrate is prone to precipitation so must be given through a 0.2 micron filter, supplied by pharmacy	**Compatible fluids:** NS, G, GS, G10 **Do not administer with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Sodium stibogluconate					
Vial 10 g pentavent antimony/100 mL Pentostam GlaxoSmithKline (UK)	(I) IV infusion via a volumetric infusion pump (preferred method, unlicensed)  NPSA risk rating: 6	Draw up the required dose through a 5 micron filter. Add to 100 mL bag NS	Over 30 minutes	**Infusion-related adverse events:** tiredness, headache, nausea, joint and muscle pain, injection site irritation, thrombophlebitis, arrhythmias If vomiting, chest pain or coughing occur during injection, administration should be stopped and advice sought from the patient's doctor **ECG monitoring required prior to first dose and every 3 days during therapy** **pH:** 5.3 (undiluted) **Flush:** NS **Sodium content:** 82 mmol/vial **Other comments:** filters are currently held as stock on infectious disease wards at UCLH After first use the vial should be labelled with the patient's name and the date. The vial should be stored in the fridge and may be used for 1 month. The vial is intended for multiple use and contains the preservative chlorocresol IM administration is painful For several indications the manufacturer of sodium stibogluconate recommends a maximum daily dose of 850 mg. However, at UCLH the dose is not capped	**Compatible fluids:** NS **Do not administer with any other medicines or infusion fluids**
	IV bolus  NPSA risk rating: 4	Ready diluted Draw up the required dose through a 5 micron filter prior to administration	Over 5 minutes		
	IM  NPSA risk rating: 4	Ready diluted Filter dose prior to administration (as above)			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Sodium thiosulphate (unlicensed)					
Ampoule 10 g/20 mL *Non-proprietary* Martindale (UK)	**Cyanide poisoning:** IV infusion via a large peripheral vein or a central line **1** 2 **3** 4 5 **6** 7 8 NPSA risk rating: 3	Ready diluted	**Adults:** 25 mL over 10 minutes **Paediatric:** 0.8 mL/kg (maximum 25 mL) over 10 minutes	**Infusion-related adverse events:** injection site irritation **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 6.8–8 **Osmolarity:** hypertonic **Flush:** NS **Sodium content:** 81 mmol/vial **Other comments:** sodium thiosulphate is a second-line agent for severe cyanide poisoning. For full details of management of cyanide poisoning refer to TOXBASE or contact the National Poisons Information Service It is used after the administration of sodium nitrite Each vial also contains sodium sulphite 10 mg	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	Cyanide poisoning: (I) IV infusion via a large peripheral vein **1** 2 **3** 4 5 **6** 7 8 NPSA risk rating: 4	Add dose to 100 mL bag NS or G	As above		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Sodium valproate					
Ampoule 300 mg/3 mL Episenta Beacon (UK)	IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted May be further diluted to a convenient volume with NS or G	Over 3–5 minutes	**Infusion-related adverse events:** nausea, diarrhoea, dizziness, hypersensitivity **pH:** 7.4 **Flush:** NS **Sodium content:** 1.8 mmol/vial	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	(I) or (C) IV infusion via a syringe or volumetric infusion pump **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4	Dilute to a convenient volume with NS or G	Usually over 60 minutes Maximum rate: 20 mg/minute		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Sotalol					
Ampoule 40 mg/4 mL Sotacor Bristol Meyers Squibb (UK)	**Acute arrhythmias:** (I) IV infusion **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Add the required dose to 100 mL bag NS or G	Over 10 minutes	**Infusion-related adverse events:** bradycardia, hypotension, bronchospasm, arrhythmias, fatigue, nausea, vomiting, cold extremities **ECG monitoring required** **pH:** 4.8 **Flush:** NS **Sodium content:** 0.4 mmol/vial	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	Substitution of oral for IV therapy: (C) IV infusion via a volumetric infusion pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	As above	0.2–0.5 mg/kg per hour		
	Diagnosis of ventricular and supraventricular arrhythmias: (I) IV infusion via a volumetric infusion pump or syringe pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	Add the required dose to 50–100 mL bag NS or G	1.5 mg/kg over 10–20 minutes, followed by an infusion of 0.2–0.5 mg/kg per hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Streptokinase					
Vial 1,500,000 units 250,000 units Streptase CSL Behring (UK)	**Thrombolysis after myocardial infarction:** (I) IV infusion via a syringe pump or volumetric infusion pump **1** **2** 3 **4** **5** 6 **7** 8 NPSA risk rating: 5	Add 5 mL NS to the 1,500,000 unit vial Further dilute to 50 mL with NS or G	Over 1 hour If adverse effects are severe may be given over 2 hours	**Infusion-related adverse events:** tachycardia, bradycardia, hypotension, injection site bleeding, nose bleeds, allergic reaction, arrhythmias, headache, muscle pain, fever **ECG monitoring required** **pH:** 6.8–7.5 **Flush:** NS **Sodium content:** 1 mmol/vial **Displacement value:** negligible **Other comments:** streptokinase is licensed for other thromboembolic events, but other agents are used at UCLH for these indications	**The following data assume streptokinase is infused into the Y-site as a 30,000 unit/mL solution. Streptokinase solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids**: NS, G, GS, H **Y-site compatible when diluted in NS or G:** dobutamine, dopamine, lidocaine

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Suramin sodium (unlicensed)					
Vial 1 g Germanin Bayer (Germany)	IV bolus **1** **2** 3 4 **5** **6** 7 8 NPSA risk rating: 3	Reconstitute each vial with 10 mL W Shake vigorously to dissolve the powder	Over 5 minutes	**Infusion-related adverse events:** hypersensitivity reactions, including nausea, vomiting, fever, shock and seizures **pH:** 5.5–7 (reconstituted with 10 mL W) **Osmolality:** approximately 300 mOsmol/kg **Flush:** NS **Sodium content:** 4.1 mmol/vial **Displacement value:** negligible **Other comments:** IM injection is extremely painful and may result in tissue necrosis around the injection site. Preferably avoid this route **Test dose:** a 0.1 g IV bolus over 3 minutes should be given prior to the first dose to ensure patient tolerability	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**
	(I) IV infusion **1** **2** 3 4 **5** **6** 7 8 NPSA risk rating: 4	Reconstitute as above, then add to 500 mL NS	Over 2 hours		
	IM, only when venous access cannot be obtained **1** 2 3 4 **5** **6** 7 8 NPSA risk rating: 3	Reconstitute each vial with 10 mL W. Split the dose and inject in different sites (see comments)			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Suxamethonium chloride (succinylcholine chloride)					
Ampoule 100 mg/2 mL Anectine GSK (UK)	**Adjunct to anaesthesia or for intubation:** IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted May be further diluted to a convenient volume with NS or G	**Adults and older children:** usually 1 mg/kg over a few seconds **Children under 1 year and neonates:** usually 2 mg/kg over a few seconds	**Infusion-related adverse events:** bradycardia, tachycardia, skin flushing, rash, muscle pain, malignant hyperthermia **pH:** 3–5 (undiluted) **Osmolality:** 409 mOsmol/kg (undiluted) **Flush:** NS **Sodium content:** nil **Other comments:** doses and infusion rates of neuromuscular blockers are highly variable and should be adjusted according to response by the anaesthetist. Use of neuromuscular blockers outside critical care and theatres should be considered a high risk intervention	**The following data assume suxamethonium chloride is infused into the Y-site as a 2 mg/mL solution. Suxamethonium solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, G10, H, sodium chloride 0.45%, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** propofol 1% **Y-site compatible when diluted in G or NS:** alfentanil, etomidate **Incompatible:** thiopental
	Adjunct to anaesthesia or for intubation: (I) IV infusion via syringe or volumetric infusion pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	Add dose to suitable volume of NS or G to give final solution strength of 1–2 mg/mL e.g. add 200 mg to 100–200 mL NS or G	Usual rate: 2.5–4 mg/minute, adjusted according to patient response Usual maximum rate: 500 mg/hour		
	IM (licensed for children under 1 year only) **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted	4–5 mg/kg		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Synacthen					
***see* tetracosactide**					
Tacrolimus					
Ampoule 5 mg/1 mL Prograf Astellas Pharma Ltd (UK)	(C) IV infusion via a syringe or volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute dose with NS or G to give a final concentration of 4–100 micrograms/mL The dose should be prepared and administered with PVC-free equipment. At UCLH all syringes are PVC-free, and haematology wards stock PVC-free administration sets The dose may be diluted in Baxter Viaflow bags as these are also non-PVC	Over 24 hours	**Infusion-related adverse events:** tachycardia, tremor, headache, seizures, dizziness, visual disturbances, shortness of breath, hypertension **pH:** 6 (10–100 micrograms/mL in NS) **Osmolarity:** 320–588 mOsmol/L (for 10–100 micrograms/mL solution respectively) **Flush:** NS **Sodium content:** nil **Other comments:** non-PVC equipment held at UCLH at time of writing: Terumo/BD Plastipak syringes, B Braun Infusomat Space PVC-free Line, Baxter Viaflow infusion bags Infusion solution contains polyoxyethylene hydrogenated castor oil which leaches plasticiser from PVC equipment. It may also cause 'anaphylactoid' reactions Contains ethanol	**The following data assume tacrolimus is infused into the Y-site as a 1 mg/mL solution. Tacrolimus solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, sodium bicarbonate 8.4% **Y-site compatible ready-diluted medicines:** esmolol, fluconazole, metronidazole **Y-site compatible when diluted in G or NS:** acetylcysteine, aminophylline, calcium gluconate, ceftazidime, ceftriaxone, cefuroxime, chloramphenicol, clindamycin, co-trimoxazole, dexamethasone, digoxin, dobutamine, erythromycin, folinic acid, hydrocortisone, imipenem with cilastatin, remifentanil, vancomycin **Y-site compatible when diluted in NS:** furosemide **Incompatible:** aciclovir

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Tazocin					
***see* piperacillin with tazobactam**					
Teicoplanin					
Vial 200 mg 400 mg Targocid Sanofi Aventis (UK) Each vial is provided with a vial of W	**Indication:** IV bolus 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	Reconstitute each drug vial with the entire vial of W. Slowly inject the W down the vial wall, swirl gently or roll to ensure the powder fully dissolves. If a froth forms, leave for 15 minutes to settle	Over 3–5 minutes	**Infusion-related adverse events:** injection site irritation, nausea, vomiting, headache, dizziness, occasionally fever and rigors. Hypersensitivity reactions including rash, itching, angioedema and shortness of breath **pH:** 7.2–7.8 (in 3 mL W) **Flush:** NS **Sodium content:** 0.4 mmol/200 mg vial 0.5 mmol/200 mg vial **Displacement value:** accounted for. When the powder is reconstituted with the vial of W the final products contain teicoplanin 200 mg/3 mL or 400 mg/3 mL	**Compatible fluids:** NS, G, GS, H **Do not infuse with any other medicines or infusion fluids**
	(I) IV infusion (preferred method in neonates) 1 **2** 3 4 **5** 6 7 8 NPSA risk rating: 2	Reconstitute as above, then add the vial to a convenient volume of NS or G	Over 30 minutes		
	IM 1 2 3 4 **5** 6 7 8 NPSA risk rating: 1	Reconstitute as per IV bolus			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Terbutaline sulphate					
Ampoule 0.5 mg/1 mL 2.5 mg/5 mL Bricanyl AstraZeneca (UK)	**For bronchospasm:** IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Draw up the contents of one ampoule into a syringe and dilute to 10 mL with NS or G	Over 3–5 minutes	**Infusion-related adverse events:** tachycardia, palpitations, arrhythmias, tremor, headache, muscle cramps, pulmonary oedema (when given for premature labour) **ECG monitoring required for infusions** **pH:** 3–5 **Osmolarity:** 300 mOsmol/kg **Flush:** NS **Sodium content:** 0.6 mmol/ampoule **Other comments:** the rate of terbutaline delivery is the same in both methods of administration for bronchospasm: (a) adult infusion rate equivalent to 1.5–2.5 micrograms/minute initially. Maximum rate 3–5 micrograms/minute (b) paediatric infusion rate equivalent to initial 1 microgram/kg per minute. Increase in increments of 0.02 mL/kg per hour (i.e. 2 micrograms/kg per minute) every 15 minutes. Doses above 10 micrograms/kg per minute should be given in high dependency unit or paediatric intensive care	**Compatible fluids:** NS, G, GS, sodium chloride 0.45% **Do not infuse with any other medicines or infusion fluids**
	For bronchospasm: SC bolus or IM 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted			
	For bronchospasm: (C) IV infusion via a volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Add 1.5–2.5 mg to 500 mL NS, G or GS This gives a 3–5 microgram/mL solution	**Adults:** initially 30 mL/hour. Increase in 10 mL/hour increments every 15 minutes to a maximum rate of 60 mL/ hour **Children:** 1–10 micrograms/kg per hour		
	For bronchospasm: (C) IV infusion via a syringe pump (unlicensed dilution) 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Draw up 10 mL of terbutaline solution from the ampoules and dilute to 50 mL with NS or G This gives a 100 microgram/mL solution	**Adults:** initially 0.9–1.5 mL/hour. Maximum 3 mL/hour **Children:** initially 0.01 mL/kg per hour Maximum 0.1 mL/kg per hour		

Formulation	Method	Dilution	Rate	Comments	Compatibility
Terbutaline sulphate *continued*					
Ampoule 0.5 mg/1 mL 2.5 mg/5 mL Bricanyl AstraZeneca (UK)	**For premature labour:** (C) IV infusion via a syringe pump (preferred method) **1** **2** 3 **4** 5 **6** **7** 8 NPSA risk rating: 5	Draw up 10 mL of terbutaline solution from the ampoules and dilute to 50 mL with G This gives a 100 microgram/mL solution	Initially 3 mL/hour for the first 20 minutes, increasing by 1.5 mL/hour every 20 minutes until contractions have stopped. Usual maximum rate 6 mL/hour In exceptional cases 12 mL/hour	**Other comments for use in labour:** continue the infusion for 1 hour after contractions have stopped, then reduce the rate of infusion by 1.5 mL/hour every 20 minutes to the lowest rate which suppresses contractions. Continue infusion at this rate for 12 hours or until it is deemed safe to stop therapy. Maximum duration 48 hours Both methods provide roughly the same dose of terbutaline: initially 5 micrograms/minute, increasing up to a maximum of 10 micrograms/minute (exceptional circumstances 20 micrograms/minute). The syringe pump is the preferred method as the lower volume minimises the risk of pulmonary oedema Maternal heart rate must be regularly monitored and should not be allowed to rise above 140 beats/minute At UCLH atosiban is the first-line agent for premature labour	
	For premature labour: (C) IV infusion via a volumetric infusion pump **1** **2** 3 4 5 **6** **7** 8 NPSA risk rating: 4	Add two vials to 500 mL G to give a solution of approximately 10 micrograms/mL	Initially 30 mL/hour for the first 20 minutes, increasing by 15 mL/hour every 20 minutes until contractions have stopped. Usual maximum rate 60 mL/hour. In exceptional cases 120 mL/hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Terlipressin acetate					
Ampoule 1 mg/8.5 mL Glypressin Ferring Pharmaceuticals Limited (UK)	IV bolus into a large peripheral vein or central line **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted	**Variceal bleeding**: usually 2 mg over 3–5 minutes **Hepatorenal syndrome:** usually 0.5–1 mg over 3–5 minutes **Septic shock unresponsive to noradrenaline (unlicensed use):** usually 0.25 mg over 3 minutes, repeated every 20 minutes, up to a maximum of 4 doses	**Infusion-related adverse events:** abdominal cramps, headache, transient blanching **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 3.5–4 **Osmolarity:** 290 mOsmol/L **Flush:** NS **Sodium content:** 1.3 mmol/ampoule **Other comments:** in septic shock the patient may take up to 20 minutes to respond to the first dose. The (C) infusion is equivalent to 0.1–0.3 mg/hour	**Do not infuse with any other medicines or infusion fluids**
	Septic shock unresponsive to noradrenaline (unlicensed): (C) IV infusion via a syringe pump **1** 2 3 4 5 6 **7** 8 NPSA risk rating: 2	Ready diluted	0.85–2.5 mL/hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Tetracosactide (tetracosactin)					
Ampoule 250 micrograms/1 mL Synacthen Injection Alliance (UK)	**30 minute test**: IV bolus or IM 1 2 3 4 5 6 7 8 NPSA risk rating: 0 (1 if diluted)	Ready diluted	Over a few seconds	**Infusion-related adverse events:** injection site irritation, hypersensitivity reactions including rash, itching, hypotension and shortness of breath **pH:** injection 3.8–4.5, depot 7.8–9.2 (undiluted) **Flush:** NS **Sodium content:** negligible (both vials) **Other comments:** in the 30 minute test cortisol levels are measured immediately before and 30 minutes after injection. Adrenocortical function is considered to be normal if cortisol levels rise by 200 nanomoles/L (70 micrograms/L) or more In the 5 hour test cortisol levels are measured immediately before and 30 minutes, 1, 2, 3, 4 and 5 hours after injection. Adrenocortical function is considered normal if cortisol levels rise steadily to 1000–1800 nanomoles/L Store at 2–8°C until use Depot preparation contains benzyl alcohol	**Compatible fluids:** NS **Do not administer with any other medicines or infusion fluids**
	Paediatric low dose 30 minute test (unlicensed): IV bolus 1 **2** 3 4 5 6 7 8 NPSA risk rating: 1	Add one ampoule to 1 L NS to make a solution of approximately 250 nanograms/mL. Invert the bag several times to ensure mixing before administration Withdraw the required dose from the bag	Over a few seconds		
Ampoule 1 mg/mL Synacthen Depot Alliance (UK)	**5 hour test for differentiation between primary and secondary adrenocortical insufficiency:** IM using the depot preparation 1 2 3 4 5 6 7 8 NPSA risk rating: 0	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Thiopental sodium (thiopentone sodium)					
Vial 500 mg *Non-proprietary* Archimedes t/a Link Pharmaceuticals (UK)	**Induction of anaesthesia:** IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Reconstitute 500 mg vial with 20 mL W. This gives a 25 mg/mL solution May be further diluted to a convenient volume with NS or G	**Adults:** usually 100–150 mg over 15 seconds **Children:** 2–7 mg/kg over 15 seconds May be repeated after 1 minute.	**Infusion-related adverse events:** bronchospasm, respiratory depression, myocardial depression, arrhythmias **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 10–11 (25 mg/mL solution) **Osmolality:** 215 mOsmol/kg (25 mg/mL solution) **Flush:** NS **Sodium content:** 2.3 mmol/500 mg vial **Displacement value:** negligible **Other comments:** infusion rates for status epilepticus and intracranial hypertension equivalent to initial 4 mg/kg per hour, increasing to a maximum of 8 mg/kg per hour Use solutions within 7 hours of preparation Use of anaesthetic agents outside critical care and theatres should be considered a high risk intervention	**The following data assume thiopental sodium is infused into the Y-site as a 25 mg/mL solution. Thiopental solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, sodium chloride 0.45% **Y-site compatible ready-diluted medicines:** propofol 1% **Y-site compatible when diluted in G or NS:** aminophylline, glyceryl trinitrate, ethanol, morphine, remifentanil **Y-site compatible when diluted in NS:** furosemide **Incompatible:** adrenaline, alfentanil, amikacin, atracurium, atropine, calcium chloride, calcium gluconate, dopamine, doxapram, ketamine, labetolol, magnesium sulphate, mivacurium, phenylephrine, suxamethonium, vecuronium
	Status epilepticus unresponsive to other agents: IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 3	As above	**Adults:** 75–125 mg over 15 seconds **Children:** 4 mg/kg over 15 seconds May be followed by the infusion below, if required		
	Intracranial hypertension (adults): IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 6	As above	Usually 250 mg over 5 minutes, repeated up to 20 times, followed by the infusion below		
	Status epilepticus or intracranial hypertension: (C) IV infusion via a syringe pump (unlicensed) 1 2 3 4 5 6 7 8 NPSA risk rating: 7	Reconstitute three 500 mg vials, each with 20 mL W. This gives a 25 mg/mL solution	Initially 0.16 mL/kg per hour, increasing as necessary to a maximum of 0.32 mL/kg per hour See other comments		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Thyrotropin-releasing hormone (protirelin)					
Ampoule 200 micrograms/2 mL *Non-proprietary* Cambridge Laboratories (UK)	IV bolus 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted	Over a few seconds	**Infusion-related adverse events:** nausea, desire to urinate, flushing, dizziness, taste disturbance, increased pulse rate, hypertension **pH:** 4.5–6.5 (undiluted) **Flush:** NS **Sodium content:** nil	**Do not administer with any other medicines or infusion fluids**
Tobramycin					
Ampoule 80 mg/2 mL *Non-proprietary* DBL t/a Hospira (UK)	(I) IV infusion **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Dilute dose in 50–100 mL NS Lower volumes may be used in paediatrics	Over 20–60 minutes	**Infusion-related adverse events:** fever, rash, itching, urticaria, nausea, vomiting, headache, lethargy, pain at injection site, mental confusion and disorientation **pH:** 3.5–6 (undiluted) **Flush:** NS **Sodium content:** negligible **Other comments:** plasma level monitoring is required. Contact pharmacy or microbiology for further information Contains sodium metabisulphite which may cause hypersensitivity reactions in susceptible individuals	**The following data assume tobramycin is infused into the Y-site as a 5 mg/mL solution. Tobramycin solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, G10 **Y-site compatible ready-diluted medicines:** fluconazole, foscarnet, linezolid **Y-site compatible when diluted in G or NS:** aciclovir, doxapram, granisetron, midazolam, morphine, remifentanil, tacrolimus **Y-site compatible when diluted in G:** amiodarone **Incompatible:** amoxicillin, benzylpenicillin, calcium chloride, calcium gluconate, cefotaxime, ceftazidime, ceftriaxone, cefuroxime, co-amoxiclav, drotrecogin, flucloxacillin, furosemide, heparin sodium, imipenem, magnesium sulphate, pipericillin with tazobactam, propofol
	IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted May be further diluted to a convenient volume with NS	Over 3–5 minutes		
	IM 1 2 3 4 5 **6** 7 8 NPSA risk rating: 1	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Tocilizumab					
Vial 80 mg/4 mL 200 mg/10 mL 400 mg/20 mL RoActermra Roche (UK)	(I) IV infusion **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Add the dose to a 100 mL bag NS. Gently invert to mix	Over 1 hour	**Infusion-related adverse events:** hypertension, dizziness, rash, itching, hypersensitivity reactions **pH:** 6.3 **Osmolality:** 290 mOsmol/kg **Flush:** NS **Sodium content:** 80 mg vial: 0.1 mmol 200 mg vial: 0.2 mmol 400 mg vial: 0.4 mmol **Other comments:** diluted solution may be stored at 2–8°C for 24 hours	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Tramadol hydrochloride					
Ampoule 100 mg/2 mL Zydol Grunenthal (UK)	IM (preferred method) 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Ready diluted		**Infusion-related adverse events:** nausea, dizziness, headache, sleepiness, palpitations, tachycardia, sweating, fatigue **pH:** 6–6.8 **Osmolarity:** 290 mOsmol/L **Flush:** NS **Sodium content:** negligible **Other comments:** (a) at UCLH tramadol is very rarely used in a PCA pump or syringe pump. Prior to administration contact the acute pain team or palliative care consultant for advice. For further information about PCA pumps refer to 'Patient Controlled and Nurse Controlled Analgesia Policy – Adults and Paediatrics' available through the UCLH intranet (b) at UCLH IV boluses of opioids should only be used in areas where this has been explicitly sanctioned	**Compatible fluids:** NS, G, GS, H **Do not infuse with any other medicines or infusion fluids**
	(I) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Dilute dose to a convenient volume with NS, G or GS Suggested dilution: add to 50–100 mL NS or G	Over 15 minutes		
	(C) IV infusion via a PCA pump or (C) SC infusion via a syringe driver 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute dose to a convenient volume with NS, G or GS For SC use the dose may be diluted with W	Maximum dose: 400 mg in 24 hours See comment (a)		
	IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted	Over 2–3 minutes See comment (b)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Tranexamic acid					
Ampoule 500 mg/5 mL Cyklokapron Pfizer t/a Pharmacia (UK)	**Adults:** IV bolus **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted May be further diluted to a convenient volume with NS or G	Undiluted solution: maximum rate 1 mL/minute Diluted solutions: maximum rate 100 mg/minute	**Infusion-related adverse events:** dizziness and hypotension after rapid administration. Nausea, vomiting, diarrhoea **pH:** 6.5–8 **Flush:** NS **Sodium content:** nil	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
	Paediatrics: IV bolus **1** **2** 3 4 5 **6** 7 8 NPSA risk rating: 3	Add dose to 50 mL bag of NS or G	Over 10 minutes		
	(C) IV infusion via a volumetric infusion pump or syringe pump **1** **2** **3** 4 5 **6** 7 8 NPSA risk rating: 4	Dilute dose in a convenient volume of NS or G	Usual rate 25–50 mg/kg per day		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Urokinase					
Vial 10,000 units Syner-KINASE Syner-Med Ltd (UK) Vial 50,000 units *Non-proprietary* Medac (UK)	**Unblocking a central venous catheter:** injection into catheter lumen **1** **2** 3 **4** **5** **6** 7 8 NPSA risk rating: 5	Add 4 mL NS to 10,000 unit vial Instil 2 mL (5,000 units) of solution into each blocked lumen	Leave for 1–2 hours. Aspirate lysate and check patency of line with NS. Repeat procedure if necessary Completely blocked catheters may require urokinase to be left overnight See comment (a)	**Infusion-related adverse events:** adverse events unlikely to be drug related when unblocking a catheter. For thrombolysis: warmth, dull ache or pain in treated area. Allergic reactions and fever have been reported **pH:** 6.5–7.5 **Osmolality:** 220 mOsmol/kg (diluted with NS) **Flush:** NS **Displacement value:** negligible **Other comments**: (a) for full details of the techniques used to unblock both partially occluded and completely blocked central venous catheters refer to 'Central Venous Catheter Care Guidelines' available through the UCLH intranet or www.uclh.nhs.uk/cvc (b) urokinase is licensed for thrombolysis of DVT, PE and other thromboembolic events. However, other agents, including dalteparin and alteplase, are the preferred agents at UCLH. Consult manufacturer's summary of product characteristics for dose and administration methods for these indications	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**
	Thromboembolic events: IV bolus followed by (C) IV infusion or infusion directly into thrombosed blood vessel **1** **2** **3** 4 **5** **6** **7** 8 NPSA risk rating: 6	Dilute contents of vial with suitable volume of NS	See comment (b)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Vancomycin					
Vial 500 mg 1 g *Non-proprietary* Flynn Pharma Ltd (UK)	**Adults and children:** (I) IV infusion via a volumetric infusion pump or syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 4 for most adult doses, 6 when part vials used	Add 10 mL W to 500 mg vial or 20 mL W to 1 g vial Further dilute with NS or G so the final concentration is no more than 5 mg/mL Suggested dilutions: **Doses up to 250 mg:** add to 50 mL bag or make up to 50 mL in a syringe **Doses 251–500 mg:** add to 100 mL bag **Doses 501–1250 mg:** add to 250 mL bag **Doses 1251–1500 mg:** add to 500 mL bag See comment (a)	**Doses up to 600 mg:** give over 1 hour **Doses 601-1250 mg:** maximum rate 120 mL/hour of the diluted solution **Doses 1251-1500 mg:** maximum rate 200 mL/hour of the diluted solution This is equivalent to a maximum rate of 10 mg/minute See comment (b)	**Infusion-related adverse events:** tinnitus. Rapid infusion may result in severe hypotension, wheezing, shortness of breath, rash, upper body flushing and muscle spasm **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 2.5–4.5 (500 mg in 10 mL W) **Osmolality:** 291 mOsmol/kg (diluted in NS) **Flush:** NS **Sodium content:** nil **Displacement value:** Flynn and Mayne brand: 0.4 mL/500 mg vial 0.7 mL/1 g vial Add 9.6 mL W to 500 mg vial to obtain 500 mg/10 mL solution Alpharma/Actavis brand vancomycin does not have a significant displacement value	**The following data assume vancomycin is infused into the Y-site as a 5 mg/mL solution. Vancomycin solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, GS, H, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** doxapram, esmolol, fluconazole, foscarnet, linezolid, propofol 1% **Y-site compatible when diluted in G:** amiodarone **Y-site compatible when diluted in G or NS:** aciclovir, amikacin, atracurium, caffeine, clarithromycin, granisetron, magnesium sulphate, midazolam, morphine, ondansetron, pancuronium, pethidine, ranitidine, remifentanil, tacrolimus, zidovudine **Incompatible:** aminophylline, chloramphenicol, drotrecogin, pipericillin with tazobactam

Formulation	Method	Dilution	Rate	Comments	Compatibility
Vancomycin *continued*					
Vial 500 mg 1 g *Non-proprietary* Flynn Pharma Ltd (UK)	**Neonates:** (I) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Add 9.6 mL W to 500 mg vial to give a 500 mg in 10 mL solution. Withdraw the dose and dilute with NS or G so the final concentration is no more than 5 mg/mL	Over 1 hour See comments (a) and (b)	**Other comments:** (a) if a dose requires the use of part of a vial, ensure the displacement value is taken into consideration (b) for dose and monitoring advice, including when to take vancomycin levels, refer to the documents 'Vancomycin Dosing Guidelines – Adults' or 'Neonatal Unit Drug Monograph – Vancomycin' available through the UCLH intranet (c) in exceptional circumstances 20 mg/mL solutions may be given via a central line (d) at UCLH vancomycin continuous infusions are rarely given. Contact pharmacy or microbiology prior to initiation	
	Fluid restriction in adults and children: (I) IV infusion into a central line or large peripheral vein via a syringe pump or volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 4 for most adult doses, 6 when part vials used	Add 10 mL W to 500 mg vial or 20 mL W to 1 g vial Further dilute to a concentration of 10 mg/mL with NS or G, i.e. dilute 500 mg to 50 mL or 1 g to 100 mL with NS or G See comments (a) and (c)	Over 1 hour		
	(C) IV infusion via a syringe or volumetric infusion pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5 (6 when part vials used)	Add 10 mL W to 500 mg vial and 20 mL W to 1 g vial Further dilute with NS or G so the final concentration is no more than 5 mg/mL	Over 24 hours See comments (a) and (d)		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Vasopressin, synthetic (argipressin)					
Ampoule 20 units/1 mL (equivalent to 0.4 mg/1 mL) Pitressin Goldshield (UK)	**For treatment of septic shock:** (C) IV infusion, with a syringe pump, via central line only **1** **2** 3 **4** 5 6 **7** 8 NPSA risk rating: 4	Dilute one ampoule (20 units) to 50 mL with G to give a 0.4 unit/mL solution	Initially 1.5 mL/hour, increased in 1.5 mL/hour increments every 30 minutes to a maximum rate of 6 mL/hour, according to response	**Infusion-related adverse events:** peripheral vasoconstriction, tremor, sweating, myocardial ischaemia, arrhythmia, bradycardia, hypersensitivity reactions **Extravasation:** may cause tissue damage; for management guidelines, see Section A7 **pH:** 3–5 (undiluted) **Flush:** G or NS, if appropriate **Sodium content:** nil **Other comments:** vasopressin infusion should be used only by those experienced in treating shock, and where appropriate life support facilities exist, e.g. critical care Usual maximum rate on UCLH critical care: 4.5 mL/hour, equivalent to 1.8 units/hour (or 0.03 units/minute)	**The following data assume vasopressin is infused into the Y-site as a 0.4 mg/mL solution. Vasopressin solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS **Y-site compatible when diluted in G or NS:** dobutamine, dopamine, lidocaine, pantoprazole **Y-site compatible when diluted in NS:** drotrecogin **Incompatible:** furosemide
	For variceal bleeding (adults): (I) IV infusion via a central line or a large peripheral vein **1** **2** 3 **4** 5 6 7 8 NPSA risk rating: 3	Add one ampoule to 100 mL G bag	Over 15 minutes		
	For diabetes insipidus: SC bolus or IM **1** 2 3 4 5 **6** 7 8 NPSA risk rating: 2	Ready diluted			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Vecuronium bromide					
Vial 10 mg Norcuron Organon (UK) Each vial is supplied with 5 mL ampoule W	**Adjunct to anaesthesia or for intubation (adults and children):** IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Add 5 mL W to vial. This gives a 2 mg/mL solution May be further diluted to a convenient volume with NS, G or GS See comment (a)	**Intubation:** usually 0.08–0.1 mg/kg over a few seconds **Adjunct to anaesthesia:** initially 0.03–0.05 mg/kg over a few seconds, supplemented with additional doses of 0.02–0.03 mg/kg See comment (b)	**Infusion-related adverse events:** flushing, transient hypotension, tachycardia, bronchospasm, hypertension, injection site irritation **pH:** 4 (10 mg in 5 mL W) **Osmolarity:** 290 mOsmol/L (10 mg in 5 mL W) **Flush:** NS **Sodium content:** negligible **Displacement value:** negligible **Other comments**: (a) if desired, vial may be reconstituted with 10 mL W or NS to give a 1 mg/mL solution (b) doses and infusion rates of neuromuscular blockers are highly variable and should be adjusted according to response by the anaesthetist. Use of neuromuscular blockers outside critical care and theatres should be considered a high risk intervention	**The following data assume vecuronium bromide is infused into the Y-site as a 1 mg/mL solution. Vecuronium solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, H **Y-site compatible ready-diluted medicines:** fluconazole, esmolol, linezolid, propofol 1% **Y-site compatible when diluted in G or NS:** acetylcysteine, adrenaline, alfentanil, aminophylline, amiodarone, atracurium, clonidine, clarithromycin, dobutamine, dopamine, fentanyl, glyceryl trinitrate, heparin sodium, insulin, labetolol, midazolam, morphine, noradrenaline, remifentanil, rocuronium **Incompatible:** etomidate, furosemide, thiopental
	Adjunct to anaesthesia (adults and children): (C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Add 5 mL W to vial. Further dilute to a convenient volume with NS, G or GS	Usually 48–54 micrograms/kg per hour See comment (b)		
	Adjunct to sedation in adult critical care: (C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Reconstitute the required number of vials, as above. Further dilute to 50 mL with NS or G Typically 3 vials are diluted to 50 mL to give a 30 mg/50 mL syringe	0–6 mg/hour		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Venofer					
see iron sucrose complex					

Verapamil hydrochloride					
Ampoule 5 mg/2 mL Securon IV Abbott (UK)	IV bolus 1 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted May be further diluted to a convenient volume with NS or G	Over 2 minutes (3 minutes in the elderly)	**Infusion-related adverse events:** bradycardia, hypotension, dizziness, headache, nausea, abdominal pain **ECG monitoring required** **Extravasation:** state risk **pH:** (4–6.5) **Osmolality:** 300 mOsmol/kg **Flush:** NS **Sodium content:** 0.3 mmol/vial	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Vitamins B and C (Pabrinex)					
Ampoules for IV injection Ampoule 1 (5 mL) contains: thiamine hydrochloride 250 mg, riboflavin 4 mg, pyridoxine hydrochloride 50 mg Ampoule 2 (5 mL) contains: ascorbic acid 500 mg, nicotinamide 160 mg, glucose 1000 mg Pabrinex IV High Potency Injection Archimedes (UK)	(I) IV infusion (preferred method) 1 2 3 4 5 6 7 8 NPSA risk rating: 3 (4 if more than one pair added to the bag)	Draw up the contents of ampoule 1 and ampoule 2 into the same syringe. Mix, then add to 50–100 mL NS or G Up to three pairs may be added to one bag	Over 30 minutes	**Infusion-related adverse events:** hypotension, paraesthesia, injection site pain. Rarely: hypersensitivity reactions **Flush:** NS **Other comments:** the Medicines and Healthcare Products Regulatory Agency (MHRA) advises intravenous thiamine is administered over at least 30 minutes in order to minimise the risk of hypersensitivity reactions The IM injection may be split and given at two sites if pain is a problem	**Compatible fluids:** NS, G, GS **Do not infuse with any other medicines or infusion fluids**
Ampoules for IM injection Ampoule 1 (5 mL) contains: as above Ampoule 2 (2 mL) contains: ascorbic acid 500 mg, nicotinamide 160 mg Pabrinex IM High Potency Injection Archimedes (UK)	IM, preferably into the gluteal muscle 1 2 3 4 5 6 7 8 NPSA risk rating: 2	Draw up the contents of ampoule 1 and ampoule 2 into the same syringe, mix, then inject intramuscularly			

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility

Vitamin B12

see hydroxocobalamin

Vitamin D2

see ergocalciferol

Vitamin K

see phytomenadione

Voltarol

see diclofenac

Formulation	Method	Dilution	Rate	Comments	Compatibility
Voriconazole					
Vial 200 mg Vfend Pfizer (UK)	**Doses greater than 50 mg:** (I) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Reconstitute each vial with 19 mL W. This gives a 10 mg/mL solution Further dilute with NS, G or GS to give a final concentration of 0.5–5 mg/mL Suggested dilution: **Doses 50–500 mg:** withdraw the required dose and add to a 100 mL bag of NS or G **Doses above 500 mg**: add to a 250 mL bag NS or G	Usually over 1–2 hours Maximum rate: 3 mg/kg per hour	**Infusion-related adverse events:** peripheral and pulmonary oedema, arrhythmias, bradycardia, tachycardia, hypotension, headache, dizziness, confusion, visual disturbances, nausea, vomiting, rash, dermatitis, hypoglycaemia, injection site reactions, fever, chills, hypersensitivity reactions **pH:** 5.5–7 (undiluted) **Osmolality:** 326 mOsmol/kg (2 mg/mL solution in NS) 367 mOsmol/kg (4 mg/mL solution in NS) **Flush:** NS **Sodium content:** 9 mmol/vial **Displacement value:** 1 mL/vial. Follow the reconstitution instructions to make a 10 mg/mL solution **Other comments:** voriconazole is formulated with the vehicle sulphobutylether beta cyclodextrin sodium (SBECD), which may accumulate in patients with a creatinine clearance of less than 50 mL/minute	**Compatible fluids:** NS, G, GS, H, potassium chloride 20 mmol/L in NS or G, sodium chloride 0.45% **Do not infuse with any other medicines or infusion fluids**
	Doses less than 50 mg: (I) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Reconstitute as above. Further dilute with NS, G or GS to give a final concentration of 0.5–5 mg/mL	As above		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Zanamivir (unlicensed)					
Vial 200 mg/20 mL Relenza GSK (UK)	(I) IV infusion 1 2 3 4 5 6 7 8 NPSA risk rating: 3	Withdraw a volume of fluid equal to the dose from a bag of NS **Suggested dilution:** add to 50–100 mL bag NS See comment (a)	Over 30 minutes	**Infusion-related adverse events:** rarely hypersensitivity reactions including bronchospasm, rash, itching, facial and throat oedema **Osmolality:** 290 mOsmol/kg **Flush:** NS **Other comments:** (a) the final zanamivir concentration should be greater than 0.2 mg/mL (b) at UCLH zanamivir should only be initiated after discussion with a consultant virologist	**Compatible fluids:** NS **Do not infuse with any other medicines or infusion fluids**
	Fluid restriction: (I) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 4	Ready diluted The dose may be further diluted to a convenient volume with NS See comment (a)	Over 30 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Formulation	Method	Dilution	Rate	Comments	Compatibility
Zidovudine					
Vial 200 mg/20 mL Retrovir GlaxoSmithKline (UK)	**For patients unable to take oral zidovudine:** (I) IV infusion via a syringe pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5 (6 in neonates)	Withdraw the required dose and dilute to 2–4 mg/mL with NS or G **Neonates:** dilute to 4 mg/mL with G	Over 1 hour	**Infusion-related adverse events:** headache, dizziness, rash, itching, shortness of breath, nausea, vomiting, muscle pain, malaise, fever **pH:** 5.5 (undiluted) **Flush:** NS	**The following data assume zidovudine is infused into the Y-site as a 4 mg/mL solution. Zidovudine solutions of a lower concentration will also be compatible with these drugs and fluids** **Compatible fluids:** NS, G, GS, potassium chloride 40 mmol/L in NS or G **Y-site compatible ready-diluted medicines:** fluconazole, linezolid **Y-site compatible when diluted in G or NS:** aciclovir, ceftriaxone, clindamycin, dobutamine, granisetron, imipenem with cilastatin, morphine, ondansetron, pipericillin with tazobactam, remifentanil, vancomycin **Y-site compatible when diluted in NS:** erythromycin **Incompatible:** meropenem
	During labour to prevent vertical transmission (unlicensed): (I) IV infusion via a syringe pump **1** **2** **3** 4 5 **6** **7** 8 NPSA risk rating: 5	As above	Start the infusion 4 hours prior to delivery. Give 2 mg/kg over 1 hour, then 1 mg/kg per hour until the umbilical cord is clamped		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

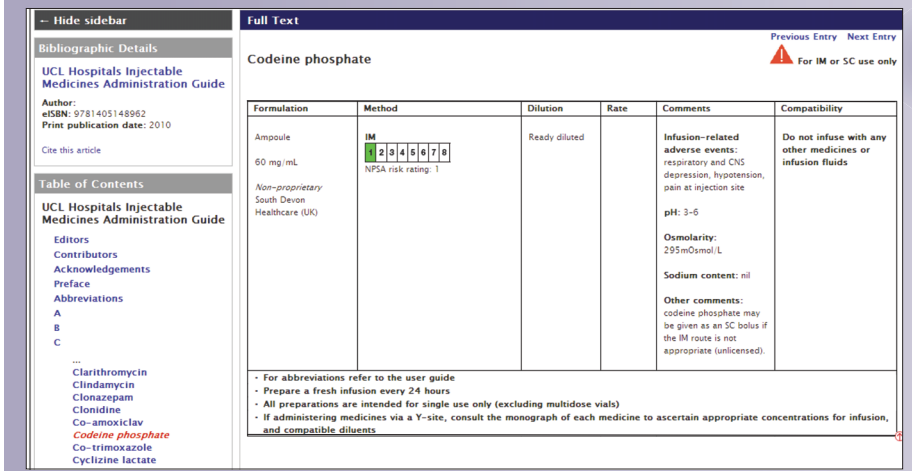
Formulation	Method	Dilution	Rate	Comments	Compatibility
Zoledronic acid					
Bottle 5 mg/100 mL Aclasta Novartis (UK)	IV infusion, using the bottle **1** 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted	Over 15 minutes	**Infusion-related adverse events:** fever, chills, muscle, joint and bone pain, headache, dizziness, influenza-like symptoms **pH:** 6.5 **Osmolality:** 300 mOsmol/kg **Flush:** NS **Sodium content:** vial and bottle: 0.3 mmol **Other comments:** ensure the patient is well hydrated prior to administration to minimise the risk of renal impairment	**Compatible fluids:** NS, G, GS **Incompatible:** calcium-containing solutions including calcium chloride, calcium gluconate and H. Magnesium sulphate **Do not infuse with any other medicines or infusion fluids**
Vial 4 mg Zometa Novartis (UK)	IV infusion, using the vial **1** **2** 3 4 5 6 7 8 NPSA risk rating: 2	Add the dose to a 100 mL bag NS or G	Over 15 minutes		

- For abbreviations refer to the User guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion and compatible diluents

Index of monographs

The UCL Hospitals Injectable Medicines Administration Guide: now available online!

The latest injectable medicines information at the point you need



← Hide sidebar

Bibliographic Details

UCL Hospitals Injectable Medicines Administration Guide

Author:
eISBN: 9781405148962
Print publication date: 2010

Cite this article

Table of Contents

UCL Hospitals Injectable Medicines Administration Guide

Editors
Contributors
Acknowledgements
Preface
Abbreviations
A
B
C
...
Clarithromycin
Clindamycin
Clonazepam
Clonidine
Co-amoxiclav
Codeine phosphate
Co-trimoxazole
Cyclizine lactate

Full Text

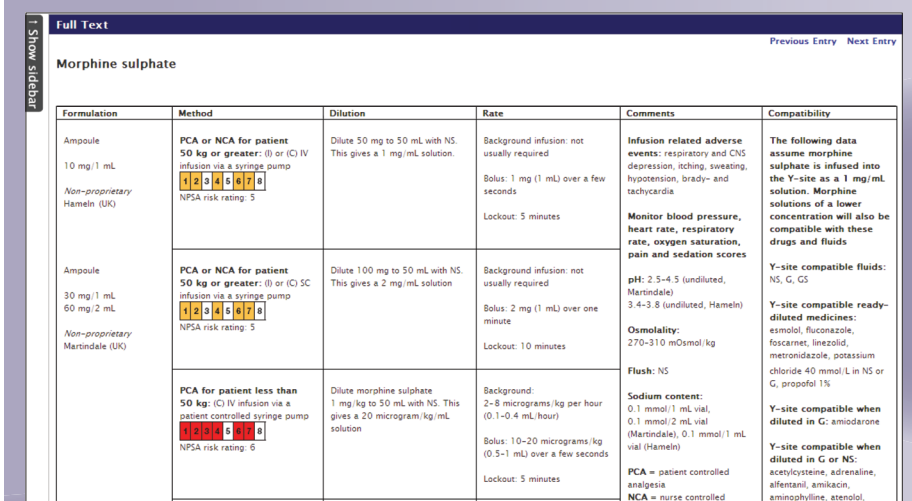
Previous Entry Next Entry

Codeine phosphate

For IM or SC use only

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ampoule 60 mg/mL *Non-proprietary* South Devon Healthcare (UK)	**IM** 1 2 3 4 5 6 7 8 NPSA risk rating: 1	Ready diluted		**Infusion-related adverse events:** respiratory and CNS depression, hypotension, pain at injection site **pH:** 3–6 **Osmolarity:** 295mOsmol/L **Sodium content:** nil **Other comments:** codeine phosphate may be given as an SC bolus if the IM route is not appropriate (unlicensed).	**Do not infuse with any other medicines or infusion fluids**

- For abbreviations refer to the user guide
- Prepare a fresh infusion every 24 hours
- All preparations are intended for single use only (excluding multidose vials)
- If administering medicines via a Y-site, consult the monograph of each medicine to ascertain appropriate concentrations for infusion, and compatible diluents



Show sidebar

Full Text

Previous Entry Next Entry

Morphine sulphate

Formulation	Method	Dilution	Rate	Comments	Compatibility
Ampoule 10 mg/1 mL *Non-proprietary* Hameln (UK)	**PCA or NCA for patient 50 kg or greater:** (I) or (C) IV infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Dilute 50 mg to 50 mL with NS. This gives a 1 mg/mL solution.	Background infusion: not usually required Bolus: 1 mg (1 mL) over a few seconds Lockout: 5 minutes	**Infusion related adverse events:** respiratory and CNS depression, itching, sweating, hypotension, brady- and tachycardia **Monitor blood pressure, heart rate, respiratory rate, oxygen saturation, pain and sedation scores** **pH:** 2.5–4.5 (undiluted, Martindale) 3.4–3.8 (undiluted, Hameln) **Osmolality:** 270–310 mOsmol/kg **Flush:** NS **Sodium content:** 0.1 mmol/1 mL vial, 0.1 mmol/2 mL vial (Martindale), 0.1 mmol/1 mL vial (Hameln) **PCA** = patient controlled analgesia **NCA** = nurse controlled	**The following data assume morphine sulphate is infused into the Y-site as a 1 mg/mL solution. Morphine solutions of a lower concentration will also be compatible with these drugs and fluids** **Y-site compatible fluids:** NS, G, GS **Y-site compatible ready-diluted medicines:** esmolol, fluconazole, foscarnet, linezolid, metronidazole, potassium chloride 40 mmol/L in NS or G, propofol 1% **Y-site compatible when diluted in G:** amiodarone **Y-site compatible when diluted in G or NS:** acetylcysteine, adrenaline, alfentanil, amikacin, aminophylline, atenolol,
Ampoule 30 mg/1 mL 60 mg/2 mL *Non-proprietary* Martindale (UK)	**PCA or NCA for patient 50 kg or greater:** (I) or (C) SC infusion via a syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 5	Dilute 100 mg to 50 mL with NS. This gives a 2 mg/mL solution	Background infusion: not usually required Bolus: 2 mg (1 mL) over one minute Lockout: 10 minutes		
	PCA for patient less than 50 kg: (C) IV infusion via a patient controlled syringe pump 1 2 3 4 5 6 7 8 NPSA risk rating: 6	Dilute morphine sulphate 1 mg/kg to 50 mL with NS. This gives a 20 microgram/kg/mL solution	Background: 2–8 micrograms/kg per hour (0.1–0.4 mL/hour) Bolus: 10–20 micrograms/kg (0.5–1 mL) over a few seconds Lockout: 5 minutes		

Accessible, Practical, Concise

Content-rich websites tend to be complicated and difficult to use, but UCLHguide Online is simple and straightforward ... The site is thoughtfully developed taking into the account the probable user environment – a ward – so that few clicks and enters are needed – IWR Magazine

The UCL Hospitals Injectable Medicines Administration Guide Online is accessible, clear and easy to use and has already become an invaluable tool for nurses and health care professionals in many hospitals. With regular updates drawing on the expertise of a team of specialist pharmacists from UCLH you can be sure you are getting the most up-to-date and definitive information. The easy to navigate format and clear organisation of information on screen means healthcare professionals can quickly access the information they need at the point of care, facilitating professional decision making and promoting patient safety. Access to the online edition provides information about safe use of injectable medicines and ensures this is available at the point of preparation as recommended by the NPSA.

- **Instant online access to the latest information on injectables from anywhere in the hospital**
- **Monographs undergo regular review with updates provided online**
- **Easy to navigate, search and use: information can be obtained quickly and simply**
- **Users can easily 'cut and paste' information from the electronic version**
- **Drug names are linked to allow cross referencing of information, eg Y-site compatibility**

The online UCLH guide is available on annual subscription to hospitals, NHS trusts and clinical practice groups. Go to www.UCLHguide.com to find out more or call Kate Donlan on 01865 476543 (email: kdonlan@wiley.com) for a demo or further information.