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

Contents

Index of monographs

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.

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UCL HOSPITALS

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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.

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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 Jahne 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.

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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 nontouch 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