NHS
National Patient Safety Agency

Patient safety alert

20

Alert

28 March 2007

Immediate action	☐
Action	☑
Update	☐
Information request	☐

Ref: NPSA/2007/20

Promoting safer use of injectable medicines

The National Patient Safety Agency (NPSA) received around 800 reports a month to its National Reporting and Learning System (NRLS) relating to injectable medicines between January 2005 and June 2006. This represents approximately 24 per cent of the total number of medication incidents. The majority of these resulted in no or low harm to patients. However, there were 25 incidents of death and 28 of serious harm reported between January 2005 and June 2006.

Research evidence indicates that the incidence of errors in prescribing, preparing and administering injectable medicines is higher than for other forms of medicine.[1-2] In one study, at least one error occurred in 49 per cent of intravenous medicine doses prepared and administered on hospital wards; one per cent were judged to be potentially severe errors; and 29 per cent potentially moderate errors[1] (more details about this study are included in the background section on page 6).

Using data from the NRLS and other evidence,[3] the NPSA has identified a number of latent system risks and is making recommendations that can make the use of injectable medicines safer.

Action for the NHS and the independent sector

The NPSA is recommending that all NHS and independent sector organisations in England and Wales take the following steps:

1. Undertake a risk assessment of injectable medicine procedures and products in all clinical areas to identify high risks, and develop an action plan to minimise them.
2. Ensure there are up-to-date protocols and procedures for prescribing, preparing and administering injectable medicines in all clinical areas.
3. Ensure essential technical information on injectable medicines is available and accessible to healthcare staff in clinical areas at the point of use.
4. Implement a 'purchasing for safety' policy to promote procurement of injectable medicines with inherent safety features.
5. Provide training for, and supervision of, all healthcare staff involved in prescribing, administering and monitoring injectable medicines.
6. As part of the annual medicines management audit programme, healthcare organisations should include an audit of medication practice with injectable medicines.

For response by:
- All NHS and independent sector organisations in England and Wales

For action by:
- The chief pharmacist/pharmaceutical adviser should lead the response to this alert, supported by the chief executive, medical director, nursing director and clinical governance lead/risk manager

We recommend you also inform:
- Clinical governance leads and risk managers
- Medical staff
- Nursing staff
- Pharmacy staff
- Radiographers
- Operating theatre practitioners and assistants
- Patient advice and liaison service staff in England
- Procurement managers

The NPSA has informed:
- Chief executives of acute trusts, primary care organisations, mental health trusts, ambulance trusts, local health boards in England and Wales
- Chief executives/regional directors and clinical governance leads of strategic health authorities (England) and regional offices (Wales)
- Healthcare Commission
- Healthcare Inspectorate Wales
- Business Services Centre (Wales)
- Independent Healthcare Advisory Services
- Medicines and Healthcare products Regulatory Agency
- NHS Purchasing and Supply Agency
- Welsh Health Supplies
- Royal colleges and societies
- NHS Direct
- Relevant patient organisations and community health councils in Wales
- Independent Healthcare Forum
- Commission for Social Care Inspection

Action deadlines for the Safety Alert Broadcast System (SABS)

Deadline (action underway): 2 July 2007
Action plan to be agreed and actions started

Deadline (action complete): 31 March 2008
All actions to be completed

Further information about SABS can be found at:
www.info.doh.gov.uk/sar2/cmopatie.nsf

Further information on the action points

1 Undertake a risk assessment of injectable medicine procedures and products in all clinical areas to identify high risks, and develop an action plan to minimise them.

The NPSA recommends that a pharmacist and a senior practitioner(s) from the relevant clinical area carry out a risk assessment of injectable medicine products and procedures at least once a year. This should be done again before new injectable products or procedures are introduced.

The NPSA has developed a risk assessment tool that can help identify high-risk injectable medicine products and practices. This is available from **www.npsa.nhs.uk/health/alerts**

Measures that can improve patient safety are outlined below.

For high-risk injectable practices:

- Provide written essential technical information and procedures.
- Use injections that are prepared or used in closed, not open, systems.
- Reinforce and audit policy to ensure all syringes and infusions containing injectable medicines that leave the hands of practitioners during use, are labelled.
- Prepare all cytotoxic and total parenteral nutrition (TPN) products, and make all additions to TPN, in the pharmacy department.
- Reinforce a 24-hour expiry date (or less if pharmaceutically required) for infusion products prepared in clinical areas.
- Ensure there are adequate numbers and types of infusion pumps and syringe drivers available.
- Ensure that single-use products are only used to prepare single doses.
- Have an organisation-wide therapeutic protocol that clarifies unlicensed or 'off-label' use of injectable medicines.

For high-risk injectable products:

- Simplify and rationalise the range and presentation of injectable medicines and provide the most appropriate vial or ampoule sizes.
- Provide ready-to-administer or ready-to-use injectable products of standard strength. This will minimise risks when preparing and administering injectable medicines.
- Provide dose calculation tools. For example, dosage charts for a range of body weights that eliminate the need for calculating doses.
- Provide additional guidance on how to prescribe, prepare and administer high-risk injectable medicines that clarifies how to safely prepare and administer them.

- Consider providing pre-printed prescriptions or stickers that makes the prescribing, preparing and administering of high-risk products clearer.
- Use double checking systems such as an independent check by another practitioner, and dose checking software in 'Smart' infusion pumps and syringe drivers.
- Use infusion monitoring forms and check lists for the duration of the administration.

High-risk injectable medicine products and procedures should be added to the local risk register if risk reduction methods cannot be introduced or they will not sufficiently reduce the risk. The NPSA recommends that in such a situation, the healthcare organisation investigates ways to introduce safer products and/or procedures as soon as possible.

Standards for the preparation and manufacture of injectable medicines within hospital pharmacies are set out in EL(97) 52 'Aseptic Dispensing in NHS Hospitals' and the EU Guide on Good Manufacturing Practice.

2 Ensure there are up-to-date protocols and procedures for prescribing, preparing and administering injectable medicines in all clinical areas.

Healthcare organisations should have written protocols and procedures for prescribing, preparing and administering injectable medicines in all relevant areas. It is essential that procedures are clearly documented, reflect local circumstances and describe safe practice that all practitioners can reasonably be expected to achieve. Patient safety incidents commonly result where procedures are absent, incomplete or where staff do not follow written procedures due to a lack of awareness, insufficient knowledge or because they do not agree with them and routinely violate them.

To help healthcare organisations develop local protocols and procedures, the NPSA has produced:

- a multi-disciplinary practice standard which lists the core principles of safe practice;
- an exemplar standard operating procedure for prescribing, preparing and administering injectable medicines.

These are available from **www.npsa.nhs.uk/health/alerts**

3 Ensure essential technical information on injectable medicines is available and accessible to healthcare staff in clinical areas at the point of use.

Some injectable medicines do not have a package insert providing essential technical information about preparation and administration, or the information is insufficient to fully meet the needs of all healthcare staff. For example, an incompatibility between the diluent, infusion, other medicines or administration devices, and associated administration equipment. This technical information is not available in commonly used medicines references such as the British National Formulary.

A detailed guide to the safe preparation and administration of common intravenous medicines is available via NHSnet. The Injectable Guide is produced by pharmacists based in approximately 100 different UK hospitals and co-ordinated by the pharmacy department at Hammersmith Hospitals NHS Trust. A new partnership between The Injectable Guide and United Kingdom Medicines Information Service (UKMi) has been formed to expand and develop the content and availability. Contact details concerning this guide are available at: **www.npsa.nhs.uk/health/alerts**

Healthcare staff need to have full technical information about the following for all injectable medicines products used in clinical areas:

Reconstitution	Manufacturer's recommended solution (diluent) for diluting and reconstituting a freeze-dried powder.
Concentration of final solution	Recommended concentration and volume for administration, stating maximum concentration where applicable.
Example calculations	Examples of dose, preparation and rate of administration calculations.
Dilution/flush solutions	Information concerning physical and chemical compatibility with diluents and infusion fluids.
Stability in solution	Recommended expiry for the prepared final injection or infusion.
Administration rate	For bolus administration and infusion for all routes of administration.
Compatibility information (for commonly used mixtures in specialist areas only)	Mixed in the same syringe or infusion, in administration tubing and at Y-sites and three-way taps where mixing occurs.
Special handling information	If special precautions and handling methods have to be used during preparation and administration e.g. protect from light.
Specialist technical information (where relevant)	pH, osmolarity, sodium content and displacement values.

4 Implement a 'purchasing for safety' policy to promote procurement of injectable medicines with inherent safety features.

The NPSA recommends that policies advocate the purchase of injectable medicines that include technical information about how they should be prepared and administered, and are designed in such a way as to promote safer practice.

It is preferable that only licensed ready-to-administer or ready-to-use injectable medicines are procured and supplied. The NPSA suggests that NHS organisations should work with the pharmaceutical industry to identify new products and formulations that could make practice safer.

Frequently, an unlicensed injectable medicine has to be prepared from a licensed product in clinical areas before the prescribed medicine can be administered to the patient. Where these products have been assessed as high or moderate-risk, they should be prepared and/or supplied by a pharmacy or alternative risk reduction methods should be used to improve patient safety.

Ready-to-use and ready-to-administer products that cannot be prepared in the hospital pharmacy department should be sourced from NHS manufacturing units or commercial 'specials' manufacturers. It is essential that the quality of these medicines is assessed and approved by an appropriate quality assurance pharmacist before being purchased.

5 Provide training for, and supervision of, all healthcare staff involved in prescribing, administering and monitoring injectable medicines.

Injectable medicine therapy can be complex and the variable levels of knowledge, training and competence amongst healthcare staff can put patients at risk. For example, unsafe handling or poor aseptic (non-touch) technique can lead to contamination of the injection, and harm or infect the patient. Calculation errors made during prescribing and preparing the injectable medicine can lead to administering the wrong dose and/or at the wrong concentration or rate. Additionally, many products require special handling procedures which, if not known or followed, can present health and safety risks to the member of staff carrying out the procedure and the environment.

Local organisations must ensure that healthcare staff who prescribe, prepare and administer injectable medicines have received training and have the necessary work competences to undertake their duties safely.

During training, it should be reinforced to healthcare staff that patient safety incidents with injectable medicines must be reported and will be reviewed through the organisation's usual risk management procedures.

There must also be local systems for clinical supervision where senior staff oversee and assess work competences of less experienced staff.

Using the Skills for Health format, the NPSA has developed four proposed work competences that can help local healthcare organisations define the required knowledge and skills for working with injectable medicines. These competences are:

- prescribing injectable medicines;
- preparing injectable medicines;
- administering injectable medicines;
- monitoring administration.

All are available from **www.npsa.nhs.uk/health/alerts**

The NPSA will work with Skills for Health to develop these proposed competences as National Workforce Competences.

The *National infusion devices training programme* has been developed by the NHS Core Learning Unit and the NPSA. The programme helps healthcare staff gain competence and confidence in using infusion devices, leading to safer and more efficient use. The programme is available either face-to-face or through an e-learning package. To find out more go to **www.clpu.nhs.uk**

6 As part of the annual medicines management audit programme, healthcare organisations should include an audit of medication practice with injectable medicines.

Healthcare organisations should include an audit of medication practice with injectable medicines as part of their annual medicines management report. It should include a summary of risk assessment results, incident reports, compliance with NPSA recommendations and in-year actions and improvement. It should have an action plan for improving any poorly performing aspects of the system. The report should be communicated to Clinical Governance Committees and Drugs and Therapeutics Committees each year. This information should also be used as part of the performance management process by external organisations. Developing key performance indicators can help with monitoring.

Suggested indicators are:

- percentage of clinical areas that have a copy of all necessary technical information and procedures for injectable medicines;
- percentage of staff, including junior medical staff, who have received training on safely using injectable medicines in the last three years, and have achieved the required level of competence;
- percentage of clinical areas that have a documented risk assessment of injectable products and procedures;
- the number of high-risk procedures at baseline assessment and again after the introduction of risk reduction methods;
- the number of high-risk products at baseline assessment and again after the introduction of risk reduction methods;
- details of remaining high-risk products and procedures that need to be added to the risk register.

A template audit checklist has been produced by the NPSA and is available from **www.npsa.nhs.uk/health/alerts**

The cost of implementing the NPSA's recommendations

The cost of implementing these recommendations will vary depending on current local practice.

The additional cost of preparing in pharmacy or purchasing ready-to-administer and ready-to-use products should be off-set against preparation in the clinical area, which incorporates the cost of the component materials, staff time, wastage and associated risk. 'Smart' infusion pumps incorporating dose checking software can cost up to £1,000 more than other pumps. However, organisations should consider the benefit of the additional features when planning pump replacement programmes.

A toolkit and further information on improving infusion device safety can be found on a website hosted by the NHS Supply Chain at **www.supplychain.nhs.uk**

Background

The risks associated with using injectable medicines in clinical areas have been recognised for some time. In 1976, The Breckenridge Report[4] made recommendations for additional safeguards when adding medicines to intravenous infusions. In 2001, the Audit Commission found evidence that high-risk injectable medicines were often being prepared in clinical areas in English hospitals.[5] More recently, in a risk assessment study of injectable medicine preparation in secondary care acute trusts in the north of England, high-risk products, including cytotoxics, adult parenteral nutrition bags and intra-ocular injections, were being prepared in clinical areas. In addition, there were 53 different strengths of potassium chloride-containing products also being prepared in critical care areas.[6]

In an ethnographic study of the incidence and severity of intravenous drug errors in 10 wards of a teaching and non-teaching hospital in the UK over a six and 10 day period, 249 errors were identified.[1] At least one error occurred in 212 (49 per cent) out of 430 intravenous doses. Three doses (one per cent) had potentially severe errors, 126 (29 per cent) potentially moderate errors and 83 (19 per cent) potentially minor errors. Examples of the three different error types are presented below. Most errors occurred when giving bolus doses or making up drugs that required multiple step preparation. The researcher intervened when serious errors where identified and corrective action was taken, these incidents were still included in the results as an error.

Example of a potentially severe error

The whole contents of a vial containing 125,000 units of heparin were prepared as a continuous infusion, resulting in a five times overdose and the risk of life threatening haemorrhage.

Example of a potentially moderate error

The administration of 80mg furosemide over 45 seconds through a peripheral vein. The recommended duration of administration should have been 20 minutes. Tinnitus and deafness are amongst the side effects reported after rapid administration.

Potential minor errors

Preparation of 1.2g of co-amoxiclav using 10ml instead of 20ml of water for injection. The drug may not dissolve completely when insufficient solvent is used. Concentrated solutions also increase the risk of thrombophlebitis.

Today, injectable medicines are being used to a greater extent in the NHS than ever before but there are few additional safeguards operating. The NHS in Scotland issued a *Good practice statement for the preparation of injections in near patient areas* in 2002.[7] This guidance led to the development of policies and procedures to ensure safe practice in Scottish hospitals, where adherence to safe practice is regularly monitored.[8] Until now, there have been no similar publications for the NHS in England and Wales.

Data extracted from the NPSA's NRLS, for the period January 2005 to June 2006, offers an insight into the level of risk associated with injectable medicine treatment.

Table 1: National Reporting and Learning System reports (January 2005 to June 2006)

Type of incident reported to the NRLS	Number	Per cent of all incidents	Per cent of medication incidents
All incidents	653,674	100.0	n/a
Medication incidents	59,802	8.3	n/a
Injectable medicines incidents	14,228	2.2	23.79

Table 2: Injectable medicines incident reports: degree of harm (January 2005 to June 2006)

Degree of harm (severity)	Number	Per cent of total
Death	25	0.2
Severe	28	0.2
Moderate	728	5.1
Low	2,253	15.8
No harm	11,178	78.6
Reports with inadequate data	16	0.1
Total	**14,228**	**100.0**

Table 3: Injectable medicines incident reports: stage of the medication process (January 2005 to June 2006)

Stage of medication process	Number	Per cent of total
Administration (which may include preparation)	10,394	73.1
Prescribing	1,566	11.0
Preparation of medicines in all locations/dispensing in a pharmacy	1,403	9.9
Monitoring/follow-up of medicine use	647	4.6
Supply or use of over-the-counter (OTC) medicine	61	0.4
Advice	37	0.3
Reports with inadequate data	13	0.1
Other	107	0.8
Total	**14,228**	**100.0**

Table 4: Injectable medicines incident reports: type of medication incident (January 2005 to June 2006)

Type of medication incident	Number	Per cent of total
Wrong dose, strength or frequency	4,107	28.9
Omitted medicine/ingredient	2,054	14.4
Wrong drug/medicine	1,445	10.2
Wrong quantity	1,232	8.7
Wrong route	724	5.1
Wrong/transposed/omitted medicine label	470	3.3
Wrong formulation	452	3.2
Patient allergic to treatment	433	3.0
Wrong method of preparation/supply	428	3.0
Mismatching between patient and medicine	415	2.9
Adverse drug reaction (when used as intended)	405	2.8
Wrong/omitted/passed expiry date	385	2.7
Contraindication to the use of the medicine	243	1.7
Wrong storage	190	1.3
Wrong/omitted verbal patient directions	24	0.2
Wrong/omitted patient information leaflet	10	0.1
Other	1,016	7.1
Unknown	183	1.3
Reports with inadequate data	12	0.1
Total	**14,228**	**100.0**

Glossary

Administration devices	Medical devices designed to regulate or control, mechanically or electronically, the administration of injections or infusions of medicines.
Aseptic technique (non-touch technique)	Handling technique designed to minimise the risk of microbial contamination of a sterile medicine during preparation.
Bolus (push)	Administration from a syringe of a small volume of a single dose of a sterile solution directly into a tissue, organ or vein, over a short time of, usually, between 30 seconds and 10 minutes.
Clinical areas	Wards, clinical departments, operating theatres, clinics, GP surgeries. In the context of homecare, the term may also be considered to include the patient's home.
Closed system	Packaging and presentation of an injectable medicine, and/or procedures followed, to prepare doses for use which are designed to ensure that the injection solution never comes into direct contact with the open air.
Diluent	Any sterile injection solution, such as water for injection or sodium chloride 0.9%, commonly used to dissolve (reconstitute) or dilute a medicine immediately before administration.
Flush, flushing solution	A sterile solution of diluent such as sodium chloride injection 0.9%, used to purge (flush) access devices (e.g. cannulae) before and/or after injection of a medicine or between injections of different medicines.
Hazard, risk	Any factor, such as a difficult procedure or a complex calculation, with the potential to cause harm if carried out incorrectly.
High-risk procedures	Generic procedures involving the preparation and administration of (medicinal) products that have been identified by risk assessment as most likely to pose a significant risk to patients.
High-risk products	Those (medicinal) products whose preparation and/or administration have been identified by risk assessment as most likely to pose a significant risk to patients.
Infusion	Administration, from a syringe or other rigid or collapsible container e.g. plastic bag, of a volume of sterile solution of an injectable medicine directly into a tissue, organ, vein or artery, at a constant rate, under gravity or by means of an electronic or mechanical pump or other means of rate control, over a defined period usually of at least 10 minutes.
Injectable medicines	Sterile medicines intended for administration by bolus injection, perfusion or infusion by any of the following routes: intravenous, intramuscular, intrathecal, intra-arterial, subcutaneous, intradermal, intraventricular, epidural, intravesicular, intravitreal, intrapleural and intraocular.
Latent risks	Flaws within the overall healthcare system. They can result from decisions made in almost any field that impacts on the delivery of healthcare. For example, environmental building and design, written procedures and management decisions. These strategic decisions can unknowingly create error-provoking conditions and system weaknesses in the workplace.
Licensed medicine	Medicines (medicinal products) placed on the market in the UK require a Marketing Authorisation formerly called a Product Licence. Marketing Authorisations are granted under European Community Council Directives and Regulations by the Medicines and Healthcare products Regulatory Agency (MHRA) and the European Medicines Evaluation Agency (EMEA). Licensed medicines are manufactured or assembled by commercial organisations that have a Manufacturing Licence and operate Good Manufacturing Practice.
Low-risk products	Those (medicinal) products whose preparation and/or administration have been identified by risk assessment as least likely to pose a significant risk to patients.
Luer	A type of connection used to allow connection of syringes and similar medical devices to catheters, cannulae and other access devices.

Multi-dose injectable medicines vs single-dose injectable medicines	Most injections do not contain an antimicrobial preservative and are licensed for single use only i.e. for the preparation of a single dose for administration to one patient on one occasion. Use of single-dose products to prepare more than one dose for the same patient means that a prepared injection or a part-used container must be stored before use and increases the risk of infection; use for more than one patient also adds a risk of cross-infection. Injectable medicines should be treated as intended for single use only unless the label specifically indicates that they are licensed and intended for use on more than one occasion or to provide more than a single dose on any one occasion.
Multi-professional	Doctors, nurses, pharmacists and all other healthcare professionals involved with prescribing, preparing or administering injectable medicines.
'Off-label' use	Use of a licensed medicine in a way not covered by its Manufacturing Authorisation (Product Licence).
Open systems	Packaging and presentation of an injectable medicine, and/or procedures followed to prepare doses for use, which do not prevent the injection solution from coming into direct contact with the open air. Excludes a single withdrawal of solution from an open ampoule into a syringe.
'Purchasing for safety'	Procuring presentations and formulations of medicines approved for use in local medicine formularies. In this process, medicine products are reviewed by purchasing and pharmacy groups, and products that are designed in such a way as to promote safer practice are selected. This process does not involve therapeutic substitution.
Ready-to-administer injectable products	These products require no further dilution or reconstitution and are presented in the final container or device, ready for administration or connection to a needle or administration set. For example, an infusion in a bag with no additive required.
Ready-to-use injectable products	These products require no further dilution or reconstitution before transfer to an administration device. For example, a liquid with an ampule, of the required concentration, that only needs to be drawn up into a syringe.
'Specials'	Unlicensed medicines custom-manufactured to order by hospital pharmacies or other facilities licensed by the MHRA. 'Specials' themselves are not licensed, cannot be advertised for sale and have not been formally assessed for quality, safety or efficacy, responsibility for which rests solely with the prescriber and purchaser.
Unlicensed medicine	A medicine (medicinal product) that does not have a Marketing Authorisation (Product Licence). Unlicensed medicines may be manufactured or assembled (prepared) from licensed products in clinical areas by clinical staff in order to be able to administer a medicine to a patient. Unlicensed medicines may also be manufactured or assembled in controlled environments in hospital pharmacy departments. Units with Specials Manufacturing Licences in hospital pharmacies and commercial organisations are also able to manufacture or assemble unlicensed 'Specials' in controlled environments that are inspected by the MHRA.

Acknowledgements

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Further details

For further details about this patient safety alert, please contact:

Professor David Cousins
Head of Safe Medication Practice
National Patient Safety Agency
4-8 Maple Street
London
W1T 5HD

Tel: 020 7927 9356
Email: **injectable-medicines@npsa.nhs.uk**

For more information on the NPSA, visit **www.npsa.nhs.uk**

For more information about how you can improve patient safety, visit **www.saferhealthcare.org.uk** – one stop for knowledge and innovation for safer healthcare.

References

1 Taxis K and Barber N. Ethnographic study of incidence and severity of intravenous medicine errors. *Br Med J.* 2003; 326: 684-687

2 Cousins DH et al. Medication errors in intravenous medicine preparation and administration: a multicentre audit in the UK, Germany and France. *Qual Saf Health Care.* 2005; 14: 190-195.

3 Taxis K and Barber N. Causes of intravenous medication errors: an ethnographic study. *Qual Saf Health Care* 2003; 12: 343-348

4 Breckenridge A. Department of Health and Social Security. *Report of the working party on the addition of drugs to intravenous infusion fluids.* (1976). [HC976)9].

5 Audit Commission. *A spoonful of sugar: medicine management in NHS hospitals.* (2001).

6 Hardy L and Mellor L. Risk assessment of parenteral product preparation across secondary care acute trusts in the north of England. *Hospital Pharmacist.* 2007; 14: 58-64. Available at: **www.pjonline.com**

7 NHS Scotland. Clinical Resource and Audit Centre. *Good practice statement for the preparation of injections in near-patient areas, including clinical and home environments.* (2002).

8 Millar A et al. The safe preparation of injections in near patient areas. *Hospital Pharmacist.* 2006; 13: 128-30

A patient safety alert requires prompt action to address high risk safety problems.

This patient safety alert was written in the following context:

It represents the view of the National Patient Safety Agency, which was arrived at after consideration of the evidence available. It is anticipated that healthcare staff will take it into account when designing services and delivering patient care. This does not, however, override the individual responsibility of healthcare staff to make decisions appropriate to local circumstances and the needs of patients and to take appropriate professional advice where necessary.