Alder Hey Children's NHS
NHS Foundation Trust

Medication Safety Mandatory Training

Medication Safety Committee

April 2017

Andrea Gill & Judith Martin

How to complete this training package

This teaching package can be viewed electronically via power-point or you can print a copy of the handouts (suggest print 2 slides per page to keep the font readable!)

Once completed, please print off a copy of the last slide, complete with your manager and then forward it to the Learning and Development Department so your training record can be updated trainingrecords@alderhey.nhs.uk

This training must be undertaken by all staff involved in using medicines every 3 years.

Medication Safety

- This teaching package aims to alert staff to the risks involved when medicines are administered to children and the measures that can be taken to improve safety and prevent harm related to use of medicines in Alder Hey

- A medication error is defined as **"any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of health professional, patient or consumer"**

- Medication errors are the most common clinical incident reported at Alder Hey. Although the vast majority have not caused harm to the patient, many have required additional monitoring or treatment to prevent harm. Medication errors can also cause great anxiety for the patient, parent and staff involved and therefore the Trust is committed to ensuring action is taken to prevent errors occurring. We want to ***"Get it Right First Time!!"***

How can we prevent medication errors?

- ***Positive Safety Culture***
  - We strive to encourage reporting of medication incidents and near-misses and ensuring follow-up and investigations identify any actions that can be taken to prevent a similar incident happening again. See intranet for more information **http://intranet/corporateservices/SitePages/Incident%20Reporting.aspx**
  - Medication Safety Officers work with department managers to provide support to staff involved in medication errors. They can be contacted via mso@alderhey.nhs.uk

- ***Education and Training***

  By highlighting potential errors we can help prevent them happening through:
  - Medication Safety Newsletters (http://intranet/SitePages/Medication%20Safety%20Newsletter.aspx)
  - Risk alerts http://intranet/SiteAssets/SitePages/Medication%20Safety%20Newsletter/Desmopressin%20IV%20Acicolvir.pdf
  - Safer Times
  - Training sessions
  - We want to ensure staff are able to accurately perform the calculations required to check doses and administer medicines appropriate. The SN@P package can be used to support this

How can we prevent medication errors?

- ***Electronic Prescribing and Medicines Administration (EPMA)***

  The Meditech EPMA system is constantly being reviewed and adapted in-order to improve medication safety. The following safety measures have already been included:

  - Allergy data is checked against all new items prescribed
  - Drug interactions are flagged to prescribers
  - Default doses and frequencies are included for some medicines
  - BNFC can be accessed directly – Please check all medicines even if they have been administered before
  - Information about administration is clearly recorded and easily accessed
  - Delayed and omitted doses are less likely as due doses flag in work list

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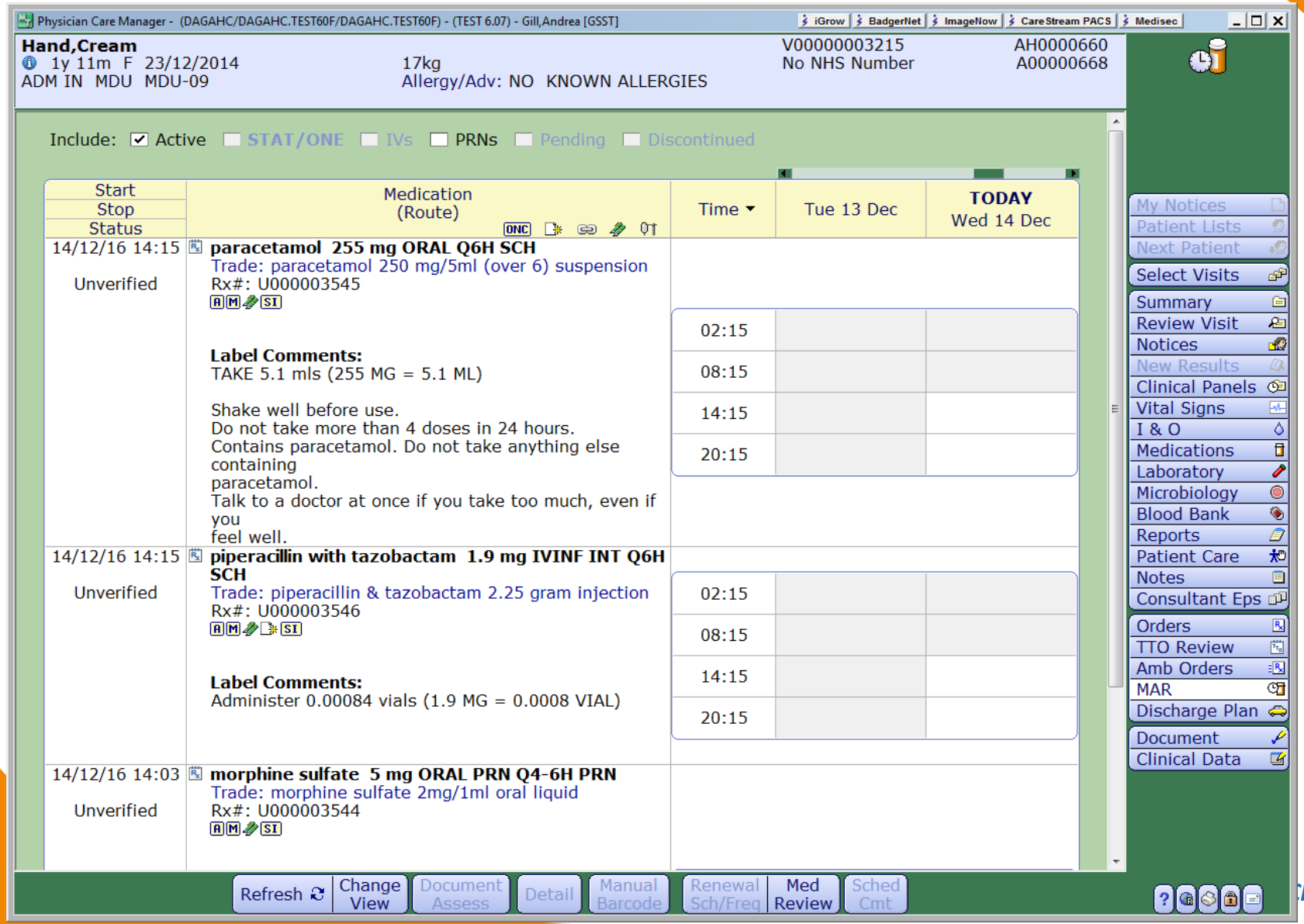
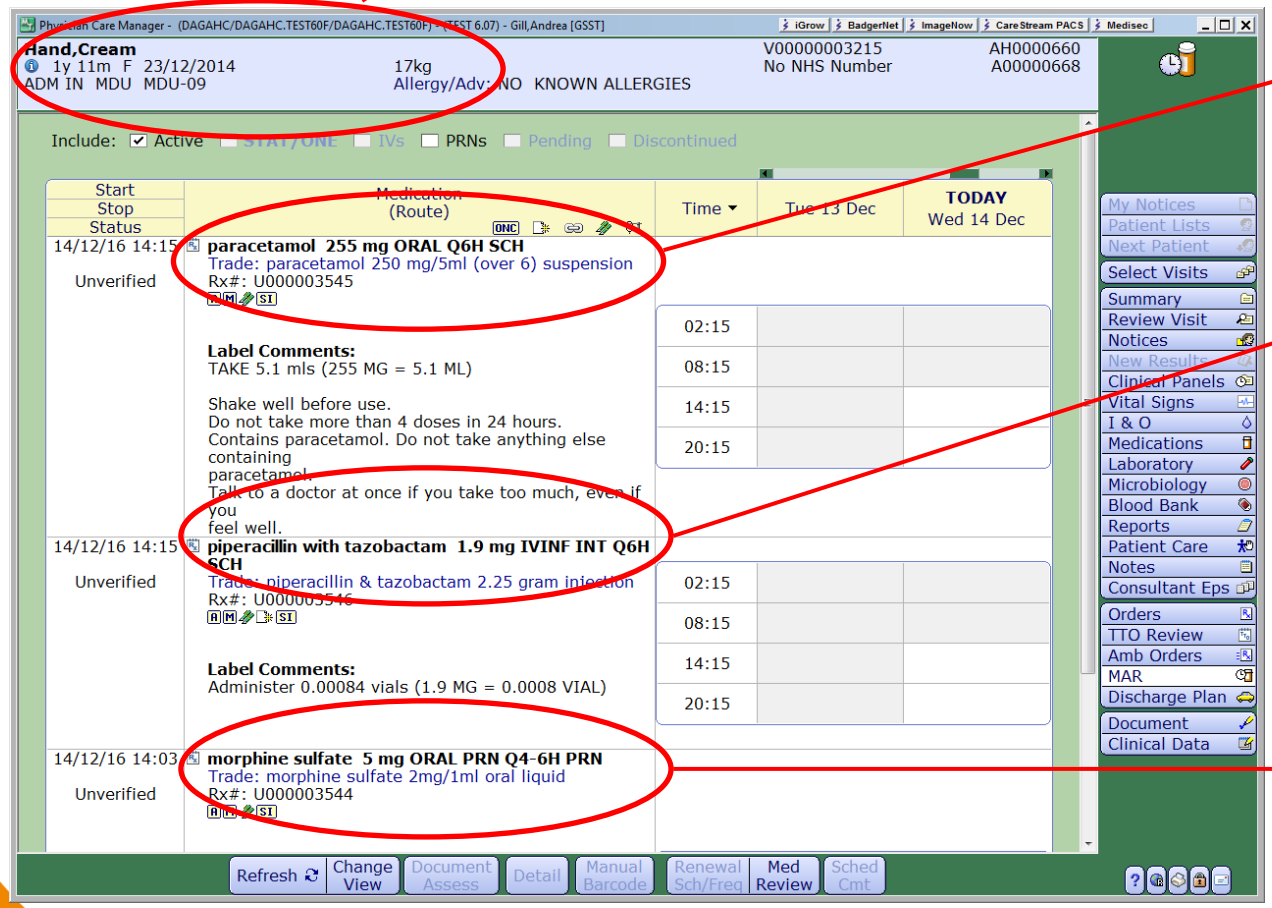
Errors are still possible on Meditech.

How many errors can you identify for this 23 month old?



Children

23 month old would normally weigh 11kg



23 month old should have 120mg/5ml paracetamol

Should be 1900mg rather than 1.9mg

Dose based on 17kg but should be based on ideal body weight

Types of Medication errors

Medication errors which could happen to any type of patient

- Wrong patient is given medication
- Wrong medication is selected
- Patient is given a medication to which they are allergic
- Medication is given by the wrong route
- Medication is given at the wrong time or omitted

Medication errors more likely to happen in paediatrics

- Wrong weight is used to calculate the dose required
- Wrong amount is calculated to be administered
- Decimal point error happens during calculation
- Error during manipulation of a preparation intended for adults e.g. dissolve a 50mg tablet in 10mls and give 2mls
- Error during reconstitution of intravenous drugs

Examples of errors that have occurred when administering medicines:

1. Calculation errors

260mg IV paracetamol administered to a 2.6kg neonate. Dose prescribed as 26mg but when drawn up using 10mg/ml vial, withdrew 26mls instead of 2.6mls.

This was a TEN TIMES OVERDOSE

2. Maximum dose not observed

Patient treated with oral Ciprofloxacin for a gastrointestinal infection with a dose of 20mg/kg twice daily. Patient weight was 50kg and prescribed as 1000mg twice daily, maximum dose is 750mg.

3. Confusion between mg and ml

Patient's Furosemide dispensed from a community pharmacy as 40mg/5ml, medication history taken as 3ml once daily. Prescribed as 3ml once daily. Alder Hey strength is 50mg/5ml. A dose of 30mg given instead of 24mg.

4. Delay in administration

Desmopressin was delayed in a patient as nurse unfamiliar with the medication. This is used to treat diabetes insipidus and is considered a life sustaining medication in this situation. This is a critical medicine and must be given within one hour – see critical medicine list (http://intranet/DocumentsPolicies/Documents/Critical%20Medicines%20List%20for%20Alder%20Hey.pdf)

5. Unfamiliarity with storage requirements

Patient started on Amlodipine liquid and this was left out of the fridge, this meant that it could not be used. Patient's medication was given late as this then had to be made by pharmacy.

6. Unfamiliarity with correct gestational age

Patient age documented on Meditech as one month old but corrected gestational age was 36 weeks. Aminoglycoside pathway used was for over 44weeks and therefore prescribed gentamicin as 7mg/kg once daily instead of using the neonate pathway and prescribing a dose of 5mg/kg once daily.

7. Dose not checked with the BNFc

IV Co-Amoxiclav prescribed as three times a day for a neonate. However in neonates the dosing should be twice daily.

8. Unfamiliarity with patient's condition

Renal patient prescribed Meropenem: This patient should have received an adjusted dose for renal impairment.

9. Pathway not followed

Tobramycin prescribed based on patients actual weight. However patient was overweight for age. This should be prescribed using ideal body weight according to Aminoglycoside pathway.

Why do errors happen?

- Read the following scenario and identify how many factors contributed to the medication error reaching the patient:

A 6 month old boy was admitted to hospital with a lower respiratory tract infection. His parents did not have English as a first language and were very distressed. The nurses obtained his weight from a recent entry in his Red Book which stated "18" . They transferred this weight onto Meditech as 18kg. Numerous bleeps to the locum on-call were required before he was able to come to the ward, and bleeps continued during the prescribing of the IV antibiotics and paracetamol. Doses were due at the same time as the 7am handover. The patient's nurse needed to leave due to her own child being unwell so two of the other night nurses administered 540mg IV amoxicillin and 270mg of IV paracetamol.

Two hours later it was discovered that the baby weighed 18 lb (8kg) and the baby should have received 240mg IV amoxicillin and 120mg of IV paracetamol.

The following factors contributed to this medication error:

Watch out for Human Factors

Human factors can be a contributing factor in patient safety incidents.
Work safer by recognising the elements below:

- Cognition and mental workload
  - Stress, reliance on memory, seeing what you expect to see
- Distractions
- The physical environment
  - Clutter, overstocking
- Physical demands
  - Tiredness
- Device/product design
- Teamwork
  - Briefing/debriefing
- Process design

Top Tips To Prevent Administration Errors

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Refer to the BNFC

Double check the patient's name band and check for allergies

Use the Paediatric Injectable Therapy Guidelines

→ E.g. Check the diluent required, how to administer a medicine

Calculate drug doses independently before comparing the answer.

← Involve a 3rd checker for discrepancies

Use a calculator

Double check dose with the 2nd checker, even if it has been given before

Label drugs and infusion rates at the start of an infusion or a rate change

Contact ward pharmacist or Medicines Information if required

Note the unit of measurement

← E.g. Microgram, milligram, insulin units

Watch out for look-a-like/sound-a-like drug

→ E.g. Phosphate Sandoz and Sando K

Ensure the drug has not been given.

← Check anaesthetic sheets post-op, Check with A&E, parents/career, self administration

Identify the route is intended and appropriate, and use the correct equipment

Take care with TPN - the lipid rate is always lower than the pharmacy solution rate

Remain with the child until the full dose has been given

When an incident occurs, it is the patient who suffers

Follow the 5 Rights to prevent an incident occurring:

1. Drug
2. Amount
3. Route
4. Patient
5. Time

Remember: Who Can Administer Medicines?

Medicine administration must be performed by two registered nursing staff trained and competent in drug administration, or by a doctor, pharmacist or approved HCP or assistant (MMC 11.3.1 click here for more information)

1. Right Drug

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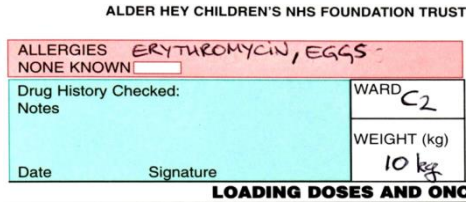
Medicines may be confused because packaging is very similar in appearance or the medicine name sounds the same e.g. Aminophylline and Amitriptyline.

- Please always read the drug name and strength on the manufactures packaging carefully
- Perform an independent double-check
- Question orders for drugs and doses that are illegible or that appear unsafe

Example

Prescribing: A child with pulmonary atresia was treated with prostacyclin. No improvement in the child's condition was observed. On review at this time it was realised the child should have been prescribed prostaglandin.


ALDER HEY CHILDREN'S NHS FOUNDATION TRUST

ALLERGIES ERYTHROMYCIN, EGGS
NONE KNOWN

Drug History Checked:
Notes

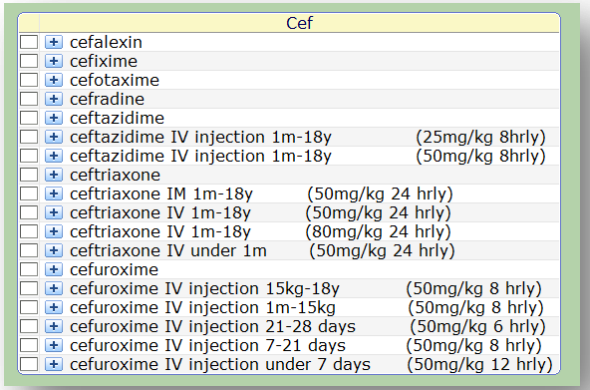
WARD C2

WEIGHT (kg) 10 kg

Date Signature

LOADING DOSES AND ONC

- ✓ Read the medication order carefully
- ✓ Check and verify if it's the right name and form:
  - Check the MAR/prescription chart
  - Check the drug
  - Check the medication label
  - Check allergies for the drug
  - Fluids: Check against script every time!



Cef	
cefalexin	
cefixime	
cefotaxime	
cefradine	
ceftazidime	
ceftazidime IV injection 1m-18y	(25mg/kg 8hrly)
ceftazidime IV injection 1m-18y	(50mg/kg 8hrly)
ceftriaxone	
ceftriaxone IM 1m-18y	(50mg/kg 24 hrly)
ceftriaxone IV 1m-18y	(50mg/kg 24 hrly)
ceftriaxone IV 1m-18y	(80mg/kg 24 hrly)
ceftriaxone IV under 1m	(50mg/kg 24 hrly)
cefuroxime	
cefuroxime IV injection 15kg-18y	(50mg/kg 8 hrly)
cefuroxime IV injection 1m-15kg	(50mg/kg 8 hrly)
cefuroxime IV injection 21-28 days	(50mg/kg 6 hrly)
cefuroxime IV injection 7-21 days	(50mg/kg 8 hrly)
cefuroxime IV injection under 7 days	(50mg/kg 12 hrly)

Which of these medicines can be given to a patient with a penicillin allergy?

Azithromycin	Tazocin
Gentamicin	Promixin
Co-amoxiclav	Fluconazole
Erythromycin	Doxycycline

Answers below

Answer: Azithromycin, Gentamicin, Promixin, Erythromycin, Doxycycline, Fluconazole

Recognizing Medication Tampering

- No packaging system is completely safe, it is important to check for signs of tampering before use.
- Inspect the outer packaging of the product.
- If the medicine has a protective packaging and it is broken or missing, do not use the product.

2. Right Amount

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Incident reports involving unclear/wrong dose or frequency or rate of administration make up the largest group of incident types and cause the greatest numbers of deaths and severe harm.

Example from another hospital

A 19 year old patient, weighing 35kg (low weight for age), was prescribed and administered intravenous (IV) paracetamol 1g four times daily over five days. Given her weight, the patient should have received a dose of 525mg four times daily. As a result of the incorrect dose being prescribed and administered, the patient died of liver failure due to paracetamol toxicity.

- ✓ Confirm appropriateness of the dose using a current drug reference (e.g. BNFC)
- ✓ Check **EVERY dose**
  - Also refer to Trust Guidelines available on the Intranet
  - Check whether single doses or total daily doses are stated
  - Always check a patient's weight is ideal for their age.

- ✓ Check others **INDEPENDENTLY**
- ✓ Decimal points:
  - 1kg = 1000g
  - 1g = 1000mg
  - 1mg = 1000 micrograms
  - 1microgram = 1000 nanograms

Test your calculation skills at www.snap.nhs.uk

Inspired by Children

Test Yourself:

(Answers at the bottom of the page)

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1. A baby is prescribed 0.3mg oral Morphine. We stock 100 micrograms/ml oral solution. What is the correct volume to give?

2. A patient is prescribed 1.2grams of IV Amoxicillin. The prepared IV solution is 50mg/ml. Which is volume should be given?

3. 15 kg child with viral encephalitis needs IV aciclovir (500mg/m^2 TDS). What is the dose?

4. Amiodarone injection 50mg/ml is available as a 3ml ampoule. A patient requires 300mg. How many millilitres of amiodarone are required for this dose?

Answers: 1) 3ml 2) 24mls 3) 325mg 4) 6ml

3. Right Route

- ✓ Nurses and HCPs must be trained and demonstrate their competence to administer intravenous drugs and drug infusions
- ✓ Use only routes and administration methods in which you are competent
- ✓ The preparation and administration of any drug given by the intravenous route must be checked (unless specific authority for single nurse administration has been given)
- ✓ Only administer drugs with which you are familiar
- ✓ IM and SC injections and control of simple infusion fluids can be undertaken by registered nurses trained and competent to administer medicines
- ✓ Some infusions **must not** be given intravenously e.g. epidurals, local anaesthetics

- ✓ Check the **appropriateness** of the route ordered
- ✓ See the Intranet for injectable guidelines
- ✓ Ensure the right route is prescribed: PEG vs JEJ vs Oral
- ✓ A new global enteral feeding device connector design (named ENFit) is being introduced. This change will impact all enteral feeding devices within the UK.

Where IV Administration Errors Can Occur:

- Wrong infusion rate
- Wrong dose
- Wrong diluent used
- Inappropriate storage
- Incompatibility
- Mixing multiple medications
- Wrong Patient
- Expired usage

4. Right Patient

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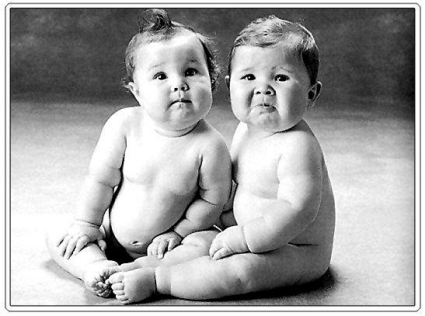
- Confirmation of patient identity is crucial in all aspects of healthcare, Right patient – right care.
- Incidents reported as a mismatch between two patients ('wrong patient') occur at all stages of the medication process.

Example

Administration: Ibuprofen was given in error to a patient who had gastro-intestinal bleeding. Further investigation showed that there were two patients on the ward with similar surnames.

- Check the name on the order and the patient
- Use **2 identifiers**
- **Prepare medication for one individual at a time**
- Give the medication as soon as it is prepared



5. Right Time

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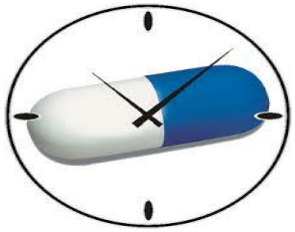
It is not always recognised as a serious error, but incident reports include examples of deaths and severe harm to patients occurring when vital medication, such as antiepileptic's or anticoagulants are forgotten.

- ✓ Check the **frequency** of the ordered medication.
- ✓ Double-check that you are giving the ordered dose at the correct time.
- ✓ Confirm when the **last dose was given**.

- ✓ E.g. Medicines where timing is critical are included in the **Critical Medicines** list on the intranet
  - ✓ **First dose of IV antibiotics must be given within one hour of decision to prescribe**

Note: Change drug infusion sets every 24 hours or 96 hours depending if a filter is in place.



Errors with specific groups of medicines

Errors resulting in harm are more likely with the following groups of medicines:

- Anticoagulants
- Cytotoxics
- Intravenous Fluids
- Opioid analgesics
- Potassium
- Total Parenteral Nutrition
- Aminoglycosides
- Insulin
- IV Paracetamol

Errors with Anticoagulants

Warfarin and heparin are frequently involved in serious medication errors. Most patients are treated safely with anticoagulants however, if therapy is not monitored properly, or the patient's clinical condition or concurrent drug changes, over or under anticoagulation can result with potentially fatal consequences

Ensuring safe use of warfarin

- Patients should always receive an anticoagulant booklet on discharge from hospital, and should have their INR reviewed within 7 days
- Staff should ensure that patients understand the need for anticoagulation, the possible side effects of treatment, and their own role in ensuring safe and effective management of their condition
- Patients should be made aware of the importance of informing healthcare professionals that they are on anticoagulant therapy before starting any other treatment or taking over the counter medicines, including herbal remedies
- Alder Hey Pharmacy will only provide 1mg tablets or oral solution to ensure patients are clear about the dose they should be taken
- Any in-patient on warfarin should be referred to the **Cardiac Liaison Nurse**.

Errors with Anticoagulants

Ensuring safe use of Heparin

- Heparin is used for flushing IV lines or as a continuous infusion. Errors with heparin have frequently involved selection of the wrong product or calculation errors involving the preparation of an infusion or the rate of administration.
- Flushing guidelines for intravenous lines provide information about which preparation should be used for which type of line (http://intranet/DocumentsPolicies/Documents/Flushing%20Guidelines%20for%20Venous%20Access%20Devices.pdf)
- Heparin infusions are used to therapeutically anti-coagulate a patient aiming for a target APTT (e.g. in patients with clots or following some types of cardiac surgery). In these patients Heparin should be prescribed on a pink heparin prescription chart .
- When heparin is used prophylactically a pink prescription is not required
- All patients on infusions of heparin must have their clotting checked regularly - see guidelines on Intranet for full information
  - http://intranet/DocumentsPolicies/Documents/Heparin%20Policy%20(Medicines%20Management%20Code%20Section%2051).pdf
  - http://intranet/DocumentsPolicies/Documents/Low%20Molecular%20Weight%20Heparin%20(LMWH)%20Guidelines.pdf

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Errors with Anticoagulants

Various tools are available on the intranet to support safe use of Heparin

Which Heparin?

Make sure you read the guidelines and read the label
Heparin must be prescribed before administration

I want to flush a **central line** or an **implantable port**

(NB Use sodium chloride 0.9% for regular flushes of peripheral & central lines)

Use Heparin 10 units per ml

For full information see 'Flushing Guidelines for Venous Access Devices' on intranet. Use "Flush" Order set on Meditech to aid prescribing

I want to flush an **implantable port** once a treatment course has been completed

Use Heparin 100 units per ml

For full information see 'Flushing Guidelines for Venous Access Devices' on intranet. Use "Flush" Order set on Meditech to aid prescribing

I want to prepare an **infusion** or prepare **dialysis** or **haemofiltration fluid**

Use Heparin 1000 units per ml

Consult Heparin Guidelines on Trust intranet

Pharmacy Department June 2016 Alder Hey NHS Foundation Trust

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READY-RECKONER FOR ADDITIVES TO PERITONEAL DIALYSIS (PD) FLUIDS

This chart aims to guide those preparing PD fluids in calculating the actual dose of each additive required in the various bags available.

Drug	Final concentration required	PD fluid bag volume		
		2 litres	2.5 litres	5 litres
Heparin	500 units/litre	1000 units	1250 units	2500 units
Potassium	2 mmol/litre	4 mmol	5 mmol	10 mmol
	3 mmol/litre	6 mmol	7.5mmol	15 mmol
	4 mmol/litre	8 mmol	10 mmol	20 mmol
	5 mmol/litre	10 mmol	12.5 mmol	25 mmol
Vancomycin	15 mg/litre	30 mg	37.5 mg	75 mg
Ceftazidime	125 mg/litre	250 mg	312.5 mg	625 mg

Errors with Cytotoxic drugs

- Trust guidelines on intrathecal chemotherapy must be strictly adhered to. All staff who work in an area where **INTRATHECAL** cytotoxics may be given but who are not trained should sign the negative register stating that they will not have anything to do with this process.

- Dosing errors involving cytotoxic chemotherapy may have more serious consequences due to the potential toxicity of these medicines – please ensure all **calculations are double checked INDEPENDANTLY**

- If you are administering a cytotoxic drug (Orally or IV) additional training and handling precautions may be required – see MMC section 11 for details

- Some cytotoxic chemotherapy should be stopped on admission – check with a senior doctor

Errors with Cytotoxic drugs

- Methotrexate may be used for non-cancer indications e.g. psoriasis, juvenile idiopathic arthritis or inflammatory bowel disease – serious harm has occurred when doses have been given daily rather than weekly.
- **Methotrexate must only be prescribed 'once weekly'**
- All staff should ensure that they are familiar with weekly dosing regimens and should take an active role in ensuring that patients taking methotrexate understand their dose and regimen
- To minimise the risk of dose confusion Alder Hey only stock 2.5mg methotrexate tablets and 10mg/5ml liquid
- Regular blood monitoring of FBC, U&Es and LFTs is required to ensure potentially serious side-effects are minimised
- The first signs of bone marrow suppression may be sore throat, bruising or mouth ulcers. Patients should be advised that if these occur to contact a doctor immediately, also if they develop shortness of breath or nausea and vomiting with abdominal discomfort and dark urine.

Errors with Cytotoxic drugs

Example

A patient died after vincristine was injected into the spine by mistake, when it should have been given intravenously.

Errors with IV fluids

Spot the difference !?

The most frequently reported IV fluid incident in Alder Hey is selection of the wrong bag of IV fluid

**** CHECK THE LABEL AGAINST THE PRESCRIPTION ****
when it starts and at every handover

Inspired by Children

Errors with IV fluids

Have you checked the rate?

Have you used a burette for every child less than 10kg?

Is the right fluid running through the right pump?

Opioid Analgesics

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Opiates are available in a wide range of dosage forms and strengths leading to confusion. Patients also differ in their requirements.
'One patient's therapeutic dose may be another patient's overdose.'

- Confusion between opiate preparations may occur as a result of similar names such as Morphine and Oramorph®, Fentanyl and Alfentanil, or due to a lack of knowledge and awareness of the range of preparations available.
- Inappropriate dose conversions can lead to patients receiving overdoses or underdoses.
- Staff should be familiar with the range of oral opiate products available and the usual frequencies in which they are prescribed and administered.
- Oral opiates tablets have differing potencies and release characteristics. These should always be prescribed using brand name.
- Use the opioid guidelines
  http://intranet/DocumentsPolicies/Documents/Prescribing%20of%20Oral%20Opioids%20at%20Alder%20Hey.pdf)
  - Examples may include post-operative pain guidelines and palliative care guidelines.

Morphine oral solution is available in two strengths:
100 micrograms/ml for doses of 500 micrograms or less
2mg/ml for all doses greater than 500micrograms

Opioid Analgesics

Patients receiving injectable or high dose oral opiates should be monitored carefully. The opiate antagonist, naloxone, should be available and staff should be trained in its use. It should be prescribed in advance to allow its administration in an emergency when IV opiates are prescribed. There is a naloxone kit for patients who weigh under 10kg.

Prescribers must ensure that when a dose increase is intended, that the calculated dose is safe for the patient (e.g. In children a dose increase of greater than 30% should be discussed with a senior clinician).

In order to calculate a rate the following calculation can be used:-

$$\frac{\text{Amount of drug in syringe (mg)}}{\text{Total volume in syringe (ml)}} \times \frac{\text{Rate of infusion (ml/hr)}}{\text{Child's weight (kg)}} = \text{Dose rate (mg/kg/hr)}$$

Test Yourself:

A 20kg child receiving 2 ml/hour of morphine infusion 20 mg in 50ml.
Are they receiving:-

a) 20 micrograms/kg/hour
b) 10 micrograms/kg/hour
c) 40 micrograms/kg/hour

Answer is below

Remember: Even small overdoses can produce respiratory depression particularly in an opioid naive patient.

Answer:

$\frac{20}{50} \times \frac{2}{20} = 0.04$ (mg/kg/hr) x 1000 = 40 micrograms/kg/hr

Controlled Drugs

- The CD administration record is signed by the registered Health Care Practitioner administering the drug.
- The administration is witnessed by a second registered Health Care Practitioner who signs the register
- The small quantities of non-administered part-ampoule or part-vial CDs can be put into a sharps bin. Larger volumes (such as discontinued infusions or PCAs/NCAs) must be rendered irretrievable on disposal.
- The disposal of part of a CD wasted at administration, or a dose prepared but not administered, is witnessed by two practitioners (nurse, doctor, pharmacist, ODP). Where only part of the contents of an ampoule or vial are used the entry made in the ward CD record book should clearly show how much was given to the patient and how much was discarded i.e record **Xmg administered and Xmg wasted**. The drug name, strength and remaining volume of infusions, e.g. PCA/NCA should be recorded on a separate waste page in the Ward/Department CD Record Book.
- The **stock quantity** of CDs is usually **verified at the beginning of each shift**
- **Any discrepancies in stock quantity are reported immediately** to the Lead Nurse who promptly investigates. The Chief Pharmacist, or deputy, is informed if the discrepancy is not explained.

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Doctor death at Royal Orthopaedic Hospital sparks drug review

4 March 2015 | Birmingham & Black Country Share

- A doctor who worked at the Royal Orthopaedic Hospital in Birmingham, is believed to have been self-medicating for back pain.
- An inquest heard he died at his home in Wychbold after injecting himself with a toxic cocktail of painkillers. He was injecting himself with bupivacaine, morphine and diamorphine.
- The hospital said its drug control procedures had since been tightened.
- The BBC understands the member of staff who has resigned was the head of nursing.
- "Following Dr 's death, a thorough external review of our drug regulation systems revealed concerns with the documentation process for the use and disposal of our controlled drugs within operating theatres," said chief executive.
- Four hospital workers have been suspended and a fifth has resigned after a senior anaesthetist accidentally killed himself.

Potassium

It is widely used intravenously in diluted solutions to treat hypokalaemia. Nonetheless, deaths have been reported as a result of the inadvertent use of intravenous potassium concentrate. Rapid administration of concentrated potassium chloride solution causes cardiac arrest and is frequently fatal.

PLEASE THINK: A Potassium Incident

- A patient died minutes after being given an intravenous antibiotic injection, which had been accidentally diluted with strong potassium instead of sterile water.

In order to reduce risk of such errors concentrated solution is stored in the CD cupboard

Potassium Chloride and Potassium Dihydrogen Phosphate ampoules can only be used on PICU, HDU, Oncology and renal units.

- Concentrated potassium chloride ampoules should not be transferred between clinical areas.
- All supplies should be made directly from the pharmacy department.
- Policy on intravenous Potassium Chloride:

http://intranet/DocumentsPolicies/Documents/Policy%20on%20Intravenous%20Potassium%20Chloride%20and%20Potassium%20Phosphate%20(Medicines%20Management%20Code%20Section%2049.1).pdf

The below Potassium products are Designated controlled drugs and are only available from Pharmacy. *They must never be transferred between wards.*

1. Potassium Chloride Concentrate 15% (20mmol in 10ml),
2. Strong Potassium Infusion (25mmol in 50ml),
3. Potassium Phosphate for injection
4. Any infusion of potassium containing 50mmol or more in 500ml

PICU, HDU and Oncology have ready-made 'Strong Potassium Infusion' containing 0.5mmol/ml (50ml vials). Ready made solutions should be prescribed where possible.

Learning Points

- Administer potassium orally rather than intravenously where possible – not more than one route
- Potassium should be prescribed in millimole (mmol) of potassium and the infusion rate should be stated when administered intravenously.
- Check serum potassium levels during intravenous infusions
- Infusions containing more than 20mmol potassium in 500ml should be given via a central vein.
- High rates of potassium infusion can cause cardiac arrhythmias and rates greater than 0.2mmol/kg/hour must be approved by senior medical staff

Examples of Potassium Products

Strong Potassium Infusion
(25mmol in 50ml)

Potassium Chloride Concentrate 15%
(20mmol in 10ml)

Total Parenteral Nutrition (TPN)

The administration of TPN can be given as two solutions - a "Pharmacy" solution (containing carbohydrates and proteins) and a lipid emulsion (containing fats).
Once a child requiring long-term TPN has more stable biochemical requirements, the solution can be changed to an "all-in-one" mix.
TPN given in two separate solutions has been involved in medication errors, mostly involving the rate of administration.

- ✓ Always check rate of Pharmacy Solution & Lipid
- ✓ Check rate at handover

Baby died after nurse fed her day's worth of food in an hour

A seven-day-old baby died after a nurse accidentally fed her a day's worth of food through a feeding tube in just one hour, inquest hears.

TPN

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Learning Points:

- **Double check pump rates** before an infusion is started. **Trace the line** back into the pump to ensure the pharmacy solution and the lipid solution rates do not get mixed up.

- Prescribers should record the type of lipid emulsion E.g. **Lipofundin, SMOF** and **include the percentage.**

- TPN rates must not exceed the rate recommended by Pharmacy. As TPN is custom made to meet the biochemical requirements of the patient, increasing the rate will lead to administering too much of the fluid, electrolytes and drugs contained in the bag. If a patient needs more fluid, a separate maintenance solution must be prescribed and administered until Pharmacy can accommodate new requirements in the TPN.

- *Trust procedure for the administration of TPN should be followed TPN training workshops are available*

Example 1

- Following GI surgery, a fifteen year old girl on continuous TPN had increased fluid requirements.
- The doctor increased the prescribed rate for the "Pharmacy" solution and the nurse then increased the rate on the pump as prescribed.
- Blood results received later that day reported increased serum potassium and calcium levels. The patient needed urgent treatment to correct.

Example 2

- A four-year old child with short-gut syndrome needed continuous TPN. Pharmacy solution prescribed at a rate of 56mLs/hour over 24 hours and 20% lipofundin at a rate of 6.2 mLs/hour over 20 hours. The administration sets and fluid bags were changed at 6pm by two nurses.
- At 2am, one of the infusion pumps began to alarm. The lipid emulsion bag was found to be empty. On inspection of the infusion pumps, the Pharmacy solution was running at a rate of 6.2mLs/hour and the lipofundin was set at 56mLs/hour

The lipid was incorrectly given at the Pharmacy solution rate

Aminoglycosides

Aminoglycoside antibiotics (gentamicin, amikacin and tobramycin) require **therapeutic drug monitoring** to ensure effective antibiotic therapy whilst also minimising the risk of serious adverse effects such as renal toxicity and ototoxicity.

There are two aminoglycoside pathways available for the safe and effective use of IV aminoglycosides: Gentamicin, Tobramycin, Amikacin

1. **Neonatal** Aminoglycoside Guidelines and Pathway :

- http://intranet/DocumentsPolicies/Documents/Neonatal%20Aminoglycoside%20Guidelines%20and%20Pathway.pdf

2. Aminoglycoside Guidelines and Pathway for Children **over 44 weeks**

- http://intranet/DocumentsPolicies/Documents/Aminoglycoside%20Guidelines%20and%20Pathway%20for%20Children%20over%2044%20weeks.pdf

Aminoglycosides

Remember: If a child is overweight for their age, dose on ideal body weight

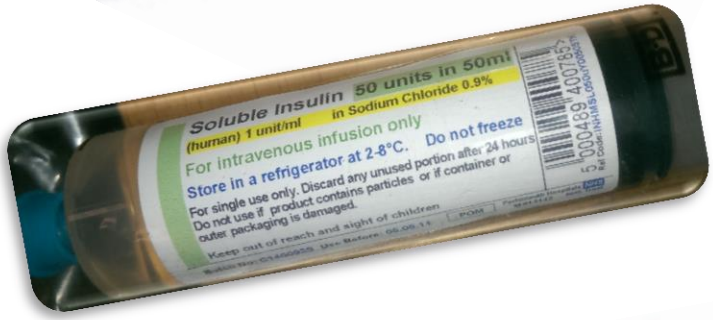
The local aminoglycoside protocol clarifies the initial dose and frequency, blood level monitoring requirements, and arrangements for subsequent dosing adjustments based on blood levels.

Errors with gentamicin account for 15% of all neonatal medication errors. In 2010, the NPSA made recommendations to reduce the risks of using IV gentamicin in neonates.

- ✓ A double-checking prompt should be used during the preparation and administration of gentamicin.
- ✓ The prescribed dose should be given within one hour of the prescribed time.

Obese children are defined as those with a BMI >98th centile of the UK 1990 reference chart for age and sex.
Overweight children are those with a BMI >91st centile of the reference chart.

Errors with Insulin



In order to prevent serious errors the following guidance must be followed:

- Regular or bolus doses of sub-cutaneous insulin must be given using an **insulin syringe or pen device**
- Do not draw insulin from a pen cartridge using a needle or insulin syringe.
- **Use prefilled syringes** containing insulin 50 units in 50ml

If other infusion concentrations are required an insulin syringe must be used to measure the dose of insulin - these are kept in all areas that stock insulin and available from pharmacy

- When labelling syringes always us the word **UNITS** – never abbreviate. Prescriptions must also contain the full work UNITS

Intravenous Paracetamol

Accidental overdoses of IV paracetamol have occurred in infants and neonates due to confusion between the dose in "mg" and the dose in "ml" and where the dose prescribed was not adjusted for the patient's weight.

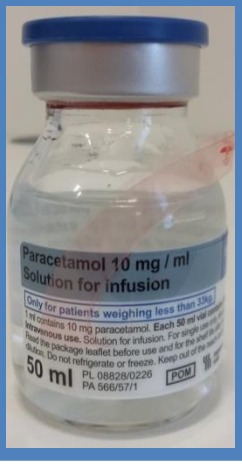
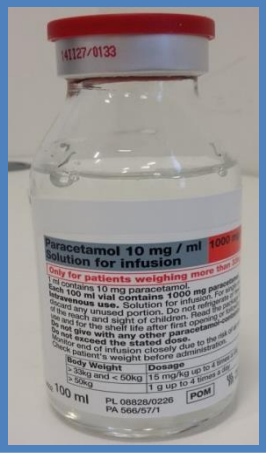
Points to remember:

- **The dose of IV paracetamol is weight based**
- Before giving any dose of IV paracetamol, always check when the last dose was given.
- When administering IV paracetamol, the strength of paracetamol infusion is 10mg/ml
- Review continued need for IV paracetamol and consider enteral route as soon as appropriate.

Please use local policy for dosing of Paracetamol and other Analgesics e.g. Ibuprofen

http://intranet/DocumentsPolicies/Documents/Analgesics%20for%20Babies%20and%20Children%20at%20Alder%20Hey.pdf

Intravenous Paracetamol Products

Paracetamol Infusions			
Presentation	10mL Plastic ampoules	50mL Glass bottles	100mL Glass bottles
When to use	**Any dose up to 150mg** **Infants and children weighing up to 10kg**	**Any doses between 151mg to 500mg** **Children weighing >10kg and <33kg**	**Any doses between 501mg to 1000mg** **Children and adolescents weighing > 33kg**
Cost 2016	£1.80 each	65p each	44p each

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Medical Gases

E.g. Oxygen, Nitrous Oxide

Classified as a drug and must be prescribed

Please read:

Further more detailed information can be found in the Trust Medical Gases Operational Plan on the Intranet sections 7 and 8

http://intranet/DocumentsPolicies/Documents/Medical%20Gases%20Operational%20Management%20Plan.pdf

Hazards of Medical Gases

Oxidising

- At high concentrations oxidising gases will cause even non-flammable materials to burn vigorously (e.g. bedding). For example – if a patient removes their oxygen mask and it is left on the top of the bed with oxygen flowing through it, this will seep into the bedding. If a spark of static occurs, this can ignite the bedding

Pressure

- The pressure in an oxygen cylinder can be up to 150 times the pressure in a car tyre
- If you knock over a cylinder and it breaks at a weak point (normally the neck of the cylinder), it may spin violently or launch forward causing injury to anyone caught in its path

Cold

- Rapid expansion of gas can cause the export valve on the cylinder to become very cold and if touched, can burn the skin

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Investigation of Medication Errors

The following error happened at Alder Hey. We will describe what happened on the next slide. As you are reading through, consider what action you would recommend in order to prevent this happening again.

Inspired by Children

Error investigation part 1

A 6 week old baby weighing 2.8kg was pyrexial and jittery and suspected of having a line infection. The line was cultured and the SpR looking after the patient decided to start Teicoplanin and Gentamicin.

The patient became quite unstable and frequent interruptions happened during the prescribing process including the doctor having to escort the patient to ultrasound.

When they returned the doctor used a calculator to calculate the dose of 10mg/kg and prescribed 280mg of Teicoplanin. *A TEN TIMES OVERDOSE*

The patient then underwent lumbar puncture and required buccal midazolam due to increased seizures. Mum was very anxious and wanted to discuss her concerns frequently with both the nurse and doctor looking after her son.

The patient's primary nurses asked a colleague to help her to start preparing the first dose of Teicoplanin and Ciprofloxacin. They put on red aprons but were frequently interrupted during the process.

Error investigation part 2

The 2 nurses checked the dose of Teicoplanin and found it should be 28mg, not 280mg. The primary nurse contacted the prescriber as she was not sure whether a neonatal dose was required or not due to the patient's age. The doctor informed the nurse that a neonatal dose was not required but that she wanted a "high dose" due to the severity of the infection.

The nurse relayed this information to her colleague. They re-checked the recommended dose of Teicoplanin and identified that it did not exceed the "maximum dose 400mg" and therefore assumed it must be OK.

280mg dose of Teicoplanin was administered at 12 noon

A further dose was administered at midnight as the day staff told the night staff on handover that the doctor wanted a high dose

The error was detected by a pharmacist the following day after a 3rd dose had been given.

Medicines Information were contacted and recommended U&Es were checked as Teicoplanin can cause damage to the kidneys.

What action would you recommend?

The team investigating this incident recommended the following:

- Change “max dose” to “adult dose” for Teicoplanin in the IV guidelines
- Reinforce independent checking
- Review methods of reducing interruptions
- Increase availability of calculators
- Discuss whether we should only use 10mg/kg for Teicoplanin in the trust so there is not confusion between 6mg/kg and 10mg/kg (“high dose”)
- Circulate a risk alert highlighting errors with Teicoplanin
- Include this example when training prescribers
- Ensure 200mg vials of Teicoplanin are available in all areas
- Develop clear instructions regarding corrected gestational age

What else would you suggest?

Medication Safety Contacts

If you would like more information about medication errors or promotion of medication safety please contact our Medication Safety Officers

Judith.Martin@alderhey.nhs.uk

David.Walker@alderhey.nhs.uk

Andrea.Gill@alderhey.nhs.uk

mso@alderhey.nhs.uk

Medication Safety

I have completed this teaching package and will follow up any knowledge gaps highlighted

Name …… Department……
Signature …… Date……

Manager's name…… Title……
Manager's signature…… Date……

Please return to trainingrecords@alderhey.nhs.uk