**Clinical Guideline**

**Neonatal Unit Intravenous Guidelines**

#

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**The primary references used for this document were BNF for Children 2016-2017, BMJ Publishing, London and Trissel LA, Handbook on Injectable Drugs 18th Edition 2014, American Society of Health-System Pharmacists, Bethesda, Maryland USA. Both are available at** [**www.medicinescomplete.com**](http://www.medicinescomplete.com)**.**

**Where other references were used, these have been highlighted in each monograph.**

This guideline contains advice about how to prescribe a maximum infusion rate.

Maximum infusion rates are used because dose ranges are often prescribed as quantity/unit time ie microgram/kg/minute or mmol/kg/day. As weights increase the volume required may exceed the infusion rate previously calculated.

The maximum infusion rate is used to avoid confusion about maximum dose prescribed.

Always prescribe a maximum infusion rate by following advice in this guideline.

Never give more than the maximum specified rate.

If a baby requires more than the specified maximum rate the prescription must be rewritten with a revised maximum rate.

**You must never ever give more than the stated maximum infusion rate.**

|  |  |
| --- | --- |
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| **Author:**  | Neil Caldwell, Consultant Pharmacist, Children’s Services |
| **Approved by:**  | 1. Children’s Guideline and Procedures Group 2. WCCGM |
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# Cheshire and Mersey Neonatal Network Safe Medicines Guide

*Neil A Caldwell, Consultant Pharmacist, Children’s Services, Wirral University Teaching Hospital NHS Foundation Trust/Liverpool John Moores University*

*Nim Subhedar, Consultant Neonatologist, Liverpool Women’s NHS Foundation Trust and*

*Oliver Rackham, Consultant Paediatrician, Wirral University Teaching Hospital NHS Foundation Trust*

The following information is intended to complement advice on safe prescribing and administration of medicines within the British National Formulary for Children, the Neonatal Formulary and individual Trust’s medicine management policies or medicine guides. It is informed by results generated from a network wide point prevalence study which examined doses of medicine used within the neonatal network.

* Prescribers should always ask the person who is going to administer the medicine, whether the prescription they have just *“written”* is clear and which can be administered reliably. The clarity of the prescription is best judged by the person who has been instructed to give the medicine, and not by the prescriber. If it is not clear and is ambiguous in the eyes of the person charged with giving the dose, it is not a safe prescription and should not be accepted. Prescribers should respond positively to suggestions for improving the clarity of such orders. If the prescription is ambiguous it must be rewritten to avoid any confusion.
* When calculating a dose of medicine, the prescriber should consider the pharmacology of each medicine and its therapeutic index, ie the difference between an effective dose and one more likely to produce dose related toxicity. For many drugs the dose of medicine can be rounded to an easily administered volume. If you are unsure whether to round the dose of medicine please discuss with a pharmacist or senior clinician.
* Doses of medicine should be physically able to be measured. Remember that syringes can deliver medicines to the following degree of accuracy:

     1mL syringe, can give up to 1mL in 0.01mL increments

     2mL syringe, can give up to 2.5mL in 0.1mL increments

     5mL syringe, can give up to 5mL in 0.2mL increments.

Prescribers should bear this in mind when prescribing doses. If a drug solution contains 15mg/mL, a 4mg dose, equal to 0.266666ml cannot be measured. Prescribe 4.5mg, a dose volume of 0.3mL instead.

* When prescribing medicines that require complex calculation of dose volume, write the prescription with as much information as possible.

Compare the following two prescriptions for the same dose of sodium.

Which is likely to be easiest to administer safely, accurately and consistently?

Sodium chloride 30% 1mmol po qds

Sodium chloride 30% solution (containing 5mmol/mL) give 0.2mL po each day at 0800, 1200, 1800 and 2200.

If a dose of medicine is prescribed which requires the person giving the medicine to do a calculation to work out the volume of medicine, the prescription should be written so that the strength of solution and dose volume is clearly documented.

* Take great care when calculating doses for infants less than 1kg. Doses are usually expressed in mg/kg or microgram/kg. If the infant’s weight is documented in grams there is a risk that a 10fold overdose may be prescribed. Indomethacin injection is a very high risk drug because of this fact. If a dose of 100microgram/kg is required for a 710g baby a dose of 0.71mg may be prescribed. However the correct dose is 100microgram per 0.71kg hence the correct dose is 70microgram.
* When a drug is prescribed for a fixed number of days eg indomethacin for 6doses or dexamethasone for a fixed course make this clear on the prescription order. It is vital that this is also documented on the administration record to ensure that the correct number of doses have been given. Great care must be taken when prescriptions are rewritten to copy across how many doses have been given in total.
* Corrections, additions or alterations should not be made to prescriptions. If a single aspect of the prescription is to be changed the entire prescription should be rewritten rather than the prescription being amended.
* Think carefully about the times of drug administration. Do you really need a dose of medicine at 0130h or 0200h? Could this be given more safely at 1000h?
* 24 or 48hourly dosing should not be given at midnight because it may be unclear from the record whether the dose was actually given at 0000h on the 16th/ 17th or the 17th / 18th.
* The name of the prescribed medicine should be the same name that appears on the medicinal product. Note that dextrose does not appear on any infusion bag or injection: the correct name is glucose. Saline does not appear on any medicinal product but sodium chloride 0.9% does.

# Double Checking Prompt

**Double-checking prompt for preparation and administration of all intravenous medicines.**

* Please use this prompt every time a dose of intravenous medicine is prepared and administered.
* The top section applies to all medicines that require therapeutic drug monitoring, such as gentamicin, vancomycin, phenytoin sodium and phenobarbital sodium.
* Both members of staff are to use the prompt.
* Ultimate responsibility for the process lies with the nurse who administers the medicine whose additional responsibilities are highlighted in bold.
* If gentamicin is not given within one hour of the due time, please complete a clinical incident form.

|  |  |
| --- | --- |
| **Drug concentration monitoring: Any actions required in the section below should be prioritised to ensure doses are not delayed:** |  |
| 1. **Check date and time of next blood concentration required. Are any blood concentrations required prior to, or following, administration?**
 |  |
| 1. **Do any blood concentration results need action prior to administration of this dose? Do any results need to be checked or interpreted?**
 |  |
| 1. **If yes to question two, has the person responsible for interpretation of result been informed?**
 |  |
| 1. **Have blood concentration results been interpreted by a clinical pharmacist or consultant? If not escalate as per local policy.**
 |  |
| 1. **Does dose or dosing interval need to be changed as a result of blood concentration result? If yes ensure this is actioned.**
 |  |
| **Prescription chart details:** |  |
| 1. Check time recorded when dose last given and frequency prescribed. Is a dose due now?
 |  |
| 1. Is baby’s current weight recorded on prescription chart correct? *Caution: Ensure weight is recent, realistic and written in kg.*
 |  |
| 1. Has correct dose been prescribed based on weight, or based on recommendation from a pharmacist following a clinical pharmacokinetic review? Each checker must calculate dose separately, except for those recommended by a pharmacist following clinical pharmacokinetic review.
 |  |
| 1. Is dosing regimen and frequency correct for gestational age? Check against local neonatal intravenous guideline. *Caution: Any deviation from approved prescribing practices should be escalated as per local policy.*
 |  |
| 10. Has prescription been signed by prescriber? |  |
| **Vial or CIVAS details:** |  |
| 11. Is this the correct medication? |  |
| 12. Is this the correct strength of intravenous injection? |  |
| 13. Has the correct volume been drawn up? Each checker to calculate dose separately.  |  |
| **Administration:** |  |
| 14. Does baby’s identity match patient details on prescription chart? |  |
| 15. Has prescription chart been signed by the administrator/checker with details of time of administration? |  |

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# Aciclovir

**Form** Vials containing either 250mg of aciclovir powder or 250mg/10mL aciclovir solution for intravenous (IV) infusion.

**Use** Treatment of herpes simplex infection.

**Dose** 20mg/kg by IV infusion every 8 hours for 7 to 21days.

|  |  |  |
| --- | --- | --- |
| **Reconstitution****and Method** | **1.** | If the preparation contains dry powder, prepare a stock solution of aciclovir, approximately 25mg/mL, by adding 10mL of water for injection to the vial. Gently shake the vial until the **powder has dissolved completely.**Using the reconstituted (stock) solution **or** the solution for intravenous (IV) infusion: |
|  | **2.** | Withdraw 5mL of sodium chloride 0.9% into a 10mL syringe. |
|  | **3.** | Withdraw 2mL of aciclovir stock solution (25mg/mL) or aciclovir solution for intravenous infusion (25mg/mL) and transfer into the 10mL syringe. Mix well. |
|  | **4.** | Further dilute solution to a final volume of 10mL with sodium chloride 0.9%. The solution now contains aciclovir 5mg/mL. |
|  | **5.** | Give an appropriate volume of aciclovir 5mg/mL solution by IV infusion over 60 minutes. Adjust the volume to the nearest 0.5mg (0.1mL). |

*Remember that 20mg/kg equals 4mL/kg of a 5mg/mL solution*.

**Diluent** Dilute with sodium chloride 0.9% intravenous infusion.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of aciclovir, rounded to the nearest 0.5mg. Indicate the times of administration by circling the appropriate times on the prescription chart.

**Route of Administration** By intravenous infusion over 60 minutes into as largea vein as possible. 5mg/mL can go via a peripheral line. 25mg/mL solution must be administered through a central line only.

**Note** Ready to use syringes available on request from Pharmacy Aseptic Services (Ext 2832).

These syringes must be **stored at room temperature**: do not refrigerate. Discard the solution

if visible turbidity or crystallisation appears in the solution before or during the infusion.

**Caution/side effects** Aciclovir solution is strongly alkaline. Extravascular administration may cause a severe local inflammatory reaction, with possible tissue necrosis. Adequate hydration is essential to reduce risk of crystal formation in urine.

**Incompatibilities** Caffeine citrate, dobutamine, dopamine, gentamicin, meropenem, morphine,

parenteral nutrition and Tazocin®.

Undiluted acicilovir 25mg/mL may be given into a central line.

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# Adenosine

**Form** 6mg/2mL equivalent to 3mg/mL adenosine.

**Reconstitution** Already in solution. Further dilute before administration.

**Use** To stop supraventricular tachycardias.

**Dose** 150 microgram/kg by rapid intravenous injection over 2 seconds. If necessary, repeat injection every 1-2 minutes increasing dose by 50-100 microgram/kg until tachycardia terminated or maximum single dose of 300 microgram/kg given.

**Diluent** Dilute in sodium chloride 0.9%.

**Method** Take 1mL of the 3mg/mL adenosine solution from a 2mL vial and dilute to 3mL with 0.9% sodium chloride. This solution now contains 1mg/mL of adenosine. Withdraw an appropriate volume of the diluted solution and inject as a rapid bolus over 2 seconds, followed by a rapid flush with 0.9% sodium chloride.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

Document the stat dose of adenosine in the once only section.

Round the dose to the nearest 10microgram, or 0.01mL.

**Route of**

**Administration** Administer into a central or large peripheral vein.

**Note** Ready to use syringes available on request from Pharmacy Aseptic Services (Ext 2832).

Intravenous adenosine is not licensed for use in children but is used off-label. Adenosine injection is a stock medicine on Children’s ward in the Emergency Room.

**Caution/** Ensure the patient has continuous ECG monitoring. Cardiorespiratory

**side effects** resuscitation equipment should be immediately available.

**Incompatibilities** Unknown. All other drugs (including fluid and electrolyte solutions) should

 be stopped before administering adenosine.

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# Adrenaline (Epinephrine)

**Form** 1mL vial of 1 in 1000 adrenaline (equivalent to 1mg).

**Reconstitution** Already in solution. Further dilute before administration.

**Use** Systemic hypotension (see notes).

**NB- first-line treatment of hypotension should be with dopamine and/or dobutamine.**

**Dose**  0.1 to 1.5 microgram/kg/minute.

**Diluent** Dilute in sodium chloride 0.9%, glucose 5% or glucose 10%.
Prepare a fresh solution every 24hours.

**Solution for infusion** Choice of concentration will depend on the baby’s weight.

<1kg use SINGLE or DOUBLE strength

≥1kg use DOUBLE or QUAD strength

Draw up adrenaline 1:1000 (1mg/mL) into a syringe:

SINGLE 1.5mL (1.5mg) final concentration 30microgram/mL

DOUBLE 3mL (3mg) final concentration 60microgram/mL

QUAD 6mL (6mg) final concentration 120microgram/mL

Dilute to 50mL with one of the above diluents. Use the table below to calculate the maximum infusion rate. Round this to the nearest 0.5mL.

|  |  |
| --- | --- |
| **Dose** **(microgram / kg / minute)** | **Maximum infusion Rate (mL /kg / hour)**Multiply this number by the weight and then round up to the next 0.5mL increment |
|  | SINGLE | DOUBLE | QUAD |
| 1.5 | 3 | 1.5 | 0.75 |

See next page for a dosing table.

**How to prescribe**

Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. State whether this is SINGLE, DOUBLE or QUAD strength solution and specify the concentration.

Document the volume of adrenaline to be added to 50mL of solution. Name the diluent. State the dose range required and the corresponding infusion rate.

**For example**: For a 0.85kg baby.

Drug: *Adrenaline 1 in 1000*

Dose: *3mg in 3mL*

Diluent: *Glucose 5%*

Total volume: *to a final volume of 50mL*

Maximum infusion rate: *1.5 mL/hour*

Dose range: *0 to 1.5 microgram/kg/minute*

Other instructions: *This is a DOUBLE strength solution containing 60microgram/mL*

**Route of administration** Administerthrough a central line.

Use umbilical arterial catheter if no other alternative access available.

**Note**

Adrenaline has a profound dose dependant vasopressor effect. The mechanism of the rise in blood pressure is threefold:

* + Direct myocardial stimulation that increases the strength of myocardial contraction
	+ Increase in heart rate

Vasoconstriction in many vascular beds

Adrenaline is sensitive to light and air.

Do not remove the ampoules from the carton until ready to use.

Oxidation causes the adrenaline solution to change from colourless to pink to brown.

Discoloured solutions should not be used.

**Caution/side effects** Hypertension, ectopic beats, tachyarrhythmia, hyperglycaemia, lactic acidaemia, hypokalaemia

**Incompatibilities** Sodium bicarbonate and parenteral lipid solution.

**Further information**: see [hypotension in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

Use this table to give a rough estimate of the required infusion rate. You can use this to check the infusion rate is appropriate.

|  |  |
| --- | --- |
| **Dose Required****(microgram / kg / minute)** | **Infusion Rate (mL /kg / hour)****NB – you must multiply this number by the weight** |
|  | SINGLE | DOUBLE | QUAD |
| 0.1 | 0.2 | 0.1 | 0.05 |
| 0.2 | 0.4 | 0.2 | 0.1 |
| 0.3 | 0.6 | 0.3 | 0.15 |
| 0.4 | 0.8 | 0.4 | 0.2 |
| 0.5 | 1 | 0.5 | 0.25 |
| 0.8 | 1.6 | 0.8 | 0.4 |
| 1 | 2 | 1 | 0.5 |
| 1.5 | 3 | 1.5 | 0.75 |

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# Amoxicillin

**Form** Vials containing 500mg of amoxicillin.

**Reconstitution** Dissolve the powder in 4.8mL water for injection, to give a stock solution containing 100mg/mL or 10mg in 0.1mL of amoxicillin
Use the reconstituted product immediately.

**Use** Broad spectrum penicillin for management of bacterial infections including group B streptococcal infection and Listerial meningitis.
Amoxicillin is NOT a first line antibiotic at WUTH. Use must be authorised by a consultant neonatologist or microbiologist.

**Dose** 50mg/kg/dose every 12 hours if child less than 7 days.

50mg/kg/dose every 8 hours if child 7 to 28 days.

50mg/kg/dose every 6 hours if greater than 28 days.

 Give double dose if suspected meningitis.

**How to prescribe:** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.
Document the dose of amoxicillin.
Round the dose up to the nearest 10mg.
Do not use a decimal point.
Indicate the times of administration by circling the appropriate times on the prescription chart.

**Route of** Administer via a peripheral vein by intravenous bolus injection over

 Administration 3-5 minutes.

**Note** A 50mg/kg/dose of amoxicillin contains 0.1mmol/kg of sodium.

**Caution/side effects** High doses, greater than 50mg/kg, may be associated with CNS

 toxicity including convulsions.

**Incompatibilities** Ciprofloxacin, fluconazole, gentamicin, midazolam hydrochloride,

 sodium bicarbonate, vancomycin hydrochloride and parenteral lipid

 solution.

**Further information**: see [sepsis in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

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# Amphotericin (AmBisome®) Liposomal

**Note** Amphotericin is available in two formulations, liposomal and non-liposomal. The following information refers only to the liposomal formulation and specifically the brand of Ambisome®. Preparations are NOT interchangeable and should be prescribed by generic and brand name.

**Form** Ready to use pre-filled syringe dispensed from Pharmacy Aseptic Unit containing a concentration between 0.5 and 2mg/mL.

**Reconstitution** Do not dilute further.

**Use** Treatment of suspected or proven systemic fungal infection in neonates. Liposomal amphotericin (AmBisome®) should be restricted to those individuals with renal impairment or when used in conjunction with potentially nephrotoxic drugs such as intravenous furosemide or gentamicin.

**Dose** Starting dose 1mg/kg once daily, especially if renal impairment.

Increase dose by 1mg/kg every day up to 5mg/kg once daily.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of liposomal amphotericin Ambisome®, rounded to the nearest 0.1mg. Indicate administration times by circling the appropriate schedule time on the prescription chart. Ensure generic and brand name are stated.

**Route of** Infuse the prescribed amount over 30 to 60 minutes. **Do not administer**

**Administration** with any other infusion.

Before giving liposomal amphotericin, (AmBisome®), **flush the line with 1mL of glucose 5%.**

After infusion of liposomal amphotericin (AmBisome®) attach a syringe containing glucose 5% to the giving set and **infuse 2mL of glucose 5% at the same rate as used to administer the liposomal amphotericin (AmBisome**®**).**

**Test dose** A test dose is not required but observe neonate closely following the first dose for allergic type reactions.

**Note**

**Caution/side effects** Amphotericin (AmBisome®) is a toxic drug with many adverse

 effects including renal impairment. Anaemia is common and

 hypokalaemia, flushing, generalised pain, convulsions, leucopenia

 and anaphylaxis may occur. Fever, vomiting and rigors can occur

 during or after intravenous infusion. Liposomal amphotericin

 (AmBisome®) is less toxic than conventional non-lipid

 amphotericin, particularly with respect to nephrotoxicity.

**Incompatibilities** Sodium chloride 0.9%. Liposomal amphotericin (AmBisome®) must

 **not** come into contact with any product other than glucose 5%.

**References**: Neonatal Formulary, Blackwell Publishing, London web commentary at: [http://www.neonatalformulary.com/pdfs/commentary/AMPHOTERICIN-B-(commentary).pdf](http://www.neonatalformulary.com/pdfs/commentary/AMPHOTERICIN-B-%28commentary%29.pdf) accessed 16th March 2016

**Further information**: see [fungal infection in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

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# Amphotericin (Fungizone®) Non-lipid

**Note** Amphotericin is available in two formulations, liposomal and non-liposomal. The following information refers only to the non-lipid formulation and specifically the brand Fungizone®. Preparations are **not** interchangeable and should be prescribed by generic and brand name.

**Form:** Ready to use pre-filled syringe dispensed from Pharmacy
 Aseptic Unit

**Reconstitution** Do not further dilute syringe provided

**Use** Treatment of suspected or proven systemic fungal infection in neonates.

**Dose** 1mg/kg once a day for 7days then 1mg/kg once every 48hours. Incremental treatment is not appropriate and a “test dose” is not necessary in a neonate. Treatment is usually continued for 4weeks.

**Route of**

**Administration** Administer the prescribed amount by slow intravenous (IV) infusion over 4 hours. **The infusion must be protected from light.**

Do not administer with any other infusion solutions or IV feeding solutions. If IV access is problematic please discuss with a pharmacist who may advise alternative therapy.

Do not use the infusion solution if there is any evidence of precipitation or foreign matter.

Do not use a PALL filter with amphotericin (Fungizone®) infusion.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of amphotericin (Fungizone®) in mg and state the infusion rate, namely, “Infuse over 4 hours.” Ensure generic and brand name are stated.

**Product Expiry and Storage** 7 days in fridge for pre-filled syringes from Pharmacy Aseptic Unit. Protect from light.

Before giving amphotericin (Fungizone®), **flush the line with 1mL of glucose 5%**. Infuse the prescribed amphotericin dose over 4 hours.

After infusion of amphotericin (Fungizone®), attach a syringe containing glucose 5% to the giving set and **infuse 2mL of glucose 5% at the same rate as used to administer the amphotericin.**

**Note**

**Caution/side effects** Amphotericin is a toxic drug with many adverse effects including

 renal impairment, anaemia, hypokalaemia, flushing, generalised

 pain, convulsions, leucopenia and anaphylaxis. Fever, vomiting

 and rigors can occur during or after intravenous infusion.

Renal and liver function should be monitored during amphotericin

therapy, along with serum potassium, magnesium and phosphate

as low serum levels may occur. Hyperkalaemia and arrhythmias

can result if administered too rapidly. Ensure a sodium intake of at

least 4mmol/kg/day.

No dose reduction is generally required in pre-existing renal failure. Dose reduction may be advisable if amphotericin is suspected of causing nephrotoxicity. A liposomal formulation may be considered if toxicity develops.

**Incompatibilities** Sodium chloride 0.9%. Amphotericin (Fungizone®) must **NOT** come into contact with any product other than glucose 5%.

**Further information**: see [fungal infection in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

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# Atracurium

**Form** Atracurium besilate 10mg/mL solution for injection

**Use** Muscle relaxant in mechanical ventilation

**Reconstitution** Dilute in glucose 5% or sodium chloride 0.9%

**Dose** Initial dose of 0.5mg/kg as an intravenous slow bolus then give by continuous infusion at 0.5-1.5mg/kg/hour.

Infuse at half the usual rate during induced hypothermia as drug metabolism is reduced.

**Loading dose**

|  |  |
| --- | --- |
| **Dose Required** | **Dose Volume (mL / kg)****NB – you must multiply this number by the weight** |
|  | SINGLE | DOUBLE |
| **Bolus** – 0.5 mg/kg | 0.2 | 0.1 |

**Continuous infusion**

|  |  |
| --- | --- |
| **Dose Required****(mg / kg / hour)** | **Infusion Rate (mL / kg / hour)****NB – you must multiply this number by the weight** |
|  | SINGLE | DOUBLE |
| 0.25 | 0.1 | 0.05 |
| 0.5 | 0.2 | 0.1 |
| 1 | 0.4 | 0.2 |
| 1.5 | 0.6 | 0.3 |

**How to prepare a dose Preferred dilution is double strength (5mg/mL):** Draw up 10mL of the 10mg in 1mL solution and add to 10mL of glucose 5% or sodium chloride 0.9% (to create a 5mg per mL solution).

**For babies less than 2kg use single strength (2.5mg/mL):** Draw up 5mL of the 10mg in 1mL solution and add to 15mL of glucose 5% or sodium chloride 0.9% (to create a 2.5mg per mL solution). This is single strength. Babies less than 2kg may need a double strength infusion if fluid restricted.

**How to prescribe** Prescribe initial dose in once only section. Prescribe continuous infusion on a Neonatal Intensive Care Unit Prescription Chart in the Intravenous Infusion section.

Document the amount (in mg) of atracurium to be made up to 20mL with the diluent. Name the diluent on the prescription sheet. State the maximum infusion range and dose range required. State whether this is SINGLE or DOUBLE strength solution and specify the concentration.

**For example:** For a 0.9kg baby.

Drug: *Atracurium besilate*

Dose: *50mg*

Diluent: *Glucose 5%*

Total volume: *to a final volume of 20mL*

Maximum infusion rate: *0.6 mL/hour*

Dose range: *0 to 1.5mg/kg/hour*

Other instructions: *This is a single strength solution containing 2.5mg/mL*

**For example:** For a 2.1kg baby.

Drug: *Atracurium besilate*

Dose: *100mg*

Diluent: *Glucose 5%*

Total volume: *to a final volume of 20mL*

Maximum infusion rate: *0.7 mL/hour*

Dose range: *0 to 1.5mg/kg/hour*

Other instructions: *This is a double strength solution containing 5mg/mL*

**Route of** Central or peripheral line

**Administration**

**Note**

**Caution/side effects** Use with caution in myasthenia gravis and hypothermia as activity is prolonged: lower doses may be required.

Response may be unpredictable in neuromuscular disorders and

those with fluid and electrolyte disturbances.

Reduce rate of administration in cardiovascular disease.

Side effects associated with histamine release: skin flushing, hypotension, tachycardia, bronchospasm, and very rarely, anaphylactic reactions

**Incompatibilities** Phenobarbital sodium and parenteral lipid solution.

**Special handling precautions**

Store the injection in a fridge

Atracurium degrades at room temperature, change syringe every 24 hours

\*In some instances it may be appropriate to use 250mg in 25mL strength syringes

but as this is over the concentration recommended in the BNFC it should be reserved

for **severely fluid restricted patients only.** The maximum dose by continuous infusion is 3mg/kg/hour. This must be given on consultant advice only.

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# Atropine sulphate

**Form:** 1mL ampoules for injection containing600microgram/mL atropine

 Sulphate

**Indication:** To treat bradycardia, after premedication for elective/semi-elective

 intubation, with fentanyl and suxamethonium. Atropine is an

 anticholinergic, and can prevent vagal induced/drug induced bradycardia.

 Use pre-emptively if there is a strong suspicion that a baby may become

 bradycardic.

**Preparation:** Dilute 1mL of atropine sulphate to a total volume of 10mL with sodium

 chloride 0.9% or glucose 5%, to give a concentration of 60 microgram/mL.

Use this solution to give the required dose.

**Dose:** 20micrograms/kg

**How to prescribe:** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart as a stat

dose. Document the dose of atropine, rounded to the nearest **6micrograms**. Do not use a decimal point.

**Use the table below to calculate an appropriate dose volume of atropine sulphate**

|  |  |  |
| --- | --- | --- |
| Weight (kg) | Rounded Dose (microgram) | Dose volume (mL) of 60microgram/mL solution |
| <0.6 | 12 | 0.2 |
| 0.6 to <1 | 18 | 0.3 |
| 1 to <1.3 | 24 | 0.4 |
| 1.3 to <1.5 | 30 | 0.5 |
| 1.5 to <2 | 42 | 0.7 |
| 2 to <3 | 60 | 1 |
| 3 to <4 | 78 | 1.3 |

Note figures in table are rounded up so doses are slightly more than 20microgram/kg.

**Administration:** Give by IV injection before sedation/analgesia and paralytic medicines.

**Route of** Give via a central venous access device if one is in place, otherwise use

**Administration:** a large peripheral vein to give the injection and flush with sodium chloride 0.9%.

**Note/Side Effects:** The injection has a low pH and can potentially cause venous irritation.

 Atropine can also cause ventricular fibrillation, dilatation of pupils,

 tachycardia and flushing of skin. Paradoxical bradycardia may occur if

 given by slow IV injection.

Neonates require higher microgram/kg doses as they are more resistant to atropine.

**Incompatibilities** Do not give through the same line as a running infusion. If this is

 unavoidable, stop the infusion, flush the line, give the atropine, flush the

 line again and then restart the infusion. This applies to all infusions except

 inotropes and insulin, where atropine should be given down a separate line.

**Further information:** see [Premedication for Elective/Semi-elective Intubation in Neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/).

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# Benzylpenicillin

**Form** Vials containing 600mg benzylpenicillin.

**Reconstitution** Dissolve the powder in 5.6mL water for injection, to give a stock solution containing 100mg/mL or 10mg in 0.1mL. The reconstituted product should be used immediately.

**Use** First line antibiotic for early neonatal sepsis and treatment or prevention of neonatal group B streptococcus. Higher doses used for meningitis and meningococcal disease.

**Dose** 25mg/kg/dose every 12 hours.

Change to every 8 hours based on clinical judgement eg if baby appears very ill.

For low risk term babies on post-natal wards use banded doses of antibiotic:

|  |  |  |
| --- | --- | --- |
| Birth weight | Dose of benzylpenicillin | Comment |
| < 2kg  | 50mg | For 1.2kg baby, this is 42mg/kg/dose. For 1.9kg baby, this is 26mg/kg/dose. |
| ≥ 2kg and <3kg | 80mg | For 2kg baby, this is 40mg/kg/dose. For 2.9kg baby, this is 28mg/kg/dose. |
| ≥ 3kg and <4kg | 110mg | For 3kg baby, this is 40mg/kg/doseFor 3.9kg baby, this is 33mg/kg/dose |
| ≥ 4kg  | 150mg | For 4kg baby, this is 38mg/kg/doseFor 5kg baby, this is 28mg/kg/dose |

**Diluent** Dilute in sodium chloride 0.9% or glucose 5% only if benzylpenicillin is to be given by intravenous infusion.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of benzylpenicillin. Round the dose up to the nearest 10mg. Do not use a decimal point. Indicate administration times by circling the appropriate times on the prescription chart.

ALWAYS prescribe to be given at 1100 and 2300.

|  |  |
| --- | --- |
| **First dose of antibiotic given** | **Next dose to be given** |
| Between 0500 and 1700 | 2300 then 12hourly |
| Between 1700 and 0500 | 1100 then 12hourly |

Follow this regime so there is a fixed time to “give” babies their antibiotics.

**Route of Administration** Peripheral vein by intravenous bolus injection over 3-5 minutes or intravenous infusion over 30 minutes.

**Note**  A 50mg/kg/dose contains 0.14mmol/kg of sodium.

**Caution/side-effects** May rarely cause CNS toxicity including convulsions, especially with high doses or in severe renal impairment.

**Incompatibilities** Amphotericin and flucloxacillin.

**Further information**: see [sepsis in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

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# Caffeine citrate

**Form** Ampoules contain 20mg caffeine citrate in 1mL (Peyona® brand). Note other brands contain different concentrations of caffeine citrate.

**Reconstitution** Already in solution. Dilute further before administration.

**Use** Licensed for the treatment of idiopathic apnoea in preterm neonates. Can also be used to improve trigger ventilation, or assist extubation in ventilated infants.

**Dose** By intravenous (IV) infusion:

Loading dose: 20 mg/kg over 30 minutes,

Maintenance dose: 5 mg/kg over 10 minutes once daily starting the following day.

Orally:

Loading dose: 20 mg/kg,

Maintenance dose: 5 mg/kg once daily starting the following day.

If no response is observed with the maintenance dose of caffeine citrate, consider re-loading and assess over a 24 hour period. If the baby responds to a further loading dose, increase the maintenance dose to 10 mg/kg caffeine citrate.

**Diluent** If required dilute using sodium chloride 0.9% or glucose 5%.

**Method** Can be used with or without dilution.

Dilution required if loading dose is less than 12mg or maintenance dose less than 4mg.

Draw 1mL of diluent into a 10mL syringe.

Using a filter needle, withdraw 1mL of caffeine citrate injection (20mg) from the ampoule and add to the 10mL syringe. Mix well.

Further dilute, using the same diluent, to a final volume of 4mL.

The solution now contains 5mg/mL.

\*Opening the ampoule of caffeine injection may introduce glass particles into the solution. Therefore, to prevent administration of these particles, the caffeine solution MUST be filtered before use.

**How to prescribe Always state the dose in terms of caffeine citrate.**

Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the loading dose of caffeine, rounded to the nearest 0.5mg in the Once Only Prescriptions section.

Document the maintenance dose in the Regular Prescriptions section.

Indicate the times of administration by circling the appropriate times on the prescription chart.

Prescribe the maintenance dose as “Each day at 1100h”, even if loading dose given at night time.

If loading dose given between 1100 and midnight, commence the maintenance dose the next morning at 1100.

If loading dose given after midnight and before 1100, give no further doses that day and commence maintenance dose the following day at 1100.

**Route of administration** Give by intravenous (IV) infusion over 30minutes or slow intravenous (IV) injection over 10 minutes.

**Note** The MHRA and BNF for Children safe practice notice states:

When prescribing, ALWAYS state dose in terms of caffeine citrate.

Caffeine citrate 2mg = caffeine base 1mg.

Serious apnoea is uncommon in babies with post-conceptional age greater than 33weeks. Treatment can usually be stopped at 34weeks.

Caffeine has a long elimination half-life, of around 100hours; hence clinical effect will persist for some days after stopping treatment.

Sodium content (Peyona®) 1.95mg/mL or 0.085mmol in 1mL.

pH (Peyona®) 4.7 undiluted.

**Caution** When given intravenously, use a slow IV infusion/injection rather than an

 IV bolus injection: bolus IV administration may cause sudden changes in

 blood pressure.

**Side effects** Hypertension, tachycardia, hypoglycaemia, hyperglycaemia, fluid and

 electrolyte imbalance. Irritability and restlessness on withdrawal.

**Incompatibilities** Aciclovir and furosemide. For incompatible drugs or those with no

 compatibility information use a separate line or, for short infusions, flush

 well between drugs.

**Sampling** Caffeine concentrations do not need to be sampled routinely. Only test if

 you suspect possible toxicity.

**Further information**: see [caffeine citrate for apnoea of prematurity](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

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# Calcium gluconate

**Form** 10% solution which contains 100mg/mL equivalent to 1g/10mL calcium gluconate. Each mL contains 0.225mmol of Ca2+

**Reconstitution** Already in solution

**Use** To control symptomatic neonatal hypocalcaemia

**Dose** Acute hypocalcaemia- urgent correction: Give 0.5mL/kg diluted with to at least 5 times the volume with a suitable diluent as a single dose by slow intravenous injection over 5-10 minutes.

Acute hypocalcaemia- maintenance: Give 2.3mL/kg diluted with to at least 5 times the volume with a suitable diluent over 24 hours, by intravenous infusion, adjusted according to response.

**Diluent** Mix with sodium chloride 0.9% or glucose 5%.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

For urgent correction document the dose of calcium gluconate, rounded to the nearest 0.1mL in the once only section.

For maintenance, calculate the volume of calcium gluconate 100mg/mL, rounded to the nearest 0.1mL and document the final volume of a suitable diluent, in the intravenous infusion section.

**For example**: For a 1.6kg neonate

Drug: *Calcium gluconate 100mg/mL*

Dose: *3.7mL*

Diluent: *sodium chloride 0.9%*

Total volume: *to a final volume of 20mL*

~~Maximum~~ infusion rate: *0.9mL/hour.*

Dose range: *not applicable.*

Other instructions: *to deliver 2.3mL/kg/day*

**Route of Administration** Dilute and give via a peripheral line using a solution of 20mg/mL or less. Flush the line before and after injection with water for injection or sodium chloride 0.9%.

Can be given undiluted via a central line. Concentrations greater than 20mg/mL must be given via a central line.

Do not give sub-cutaneously or intramuscularly due to risk of tissue necrosis.

**Note** Use oral route if appropriate due to risk of extravasation. Serum calcium should be monitored closely (target range is 2.25-2.75mmol/L).

Store at room temperature. Do not use if a precipitate is seen.

A bigger dose is recommended in the Neonatal Formulary, in line with US practice, but the unit follows dosing advice from the BNF for Children 2013-2014.

**Caution/side effects** Extravasation can cause severe permanent tissue damage.

**Incompatibilities:** Do not add calcium to any solution containing bicarbonate, sulphate or phosphate. Do not let any fluid containing calcium come into contact with any other IV administered drug. An insoluble salt precipitates out on contact with ceftriaxone.

**Reference**

Neonatal Formulary, 7th Edition, BMJ Books, Blackwell Publishing 2015

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# Cefotaxime

**Form** Vials containing 500mg cefotaxime.

**Reconstitution** Dissolve the powder in 2.3mL water for injection, to give a stock solution containing 200mg/mL or 20mg in 0.1mL. The reconstituted product should be used immediately.

**Use** Bactericidal cephalosporin for management of neonatal meningitis and meningococcal disease.

**Dose** 50mg/kg/dose every 12 hours if child < 7 days.

50mg/kg/dose every 8 hours if child ≥ 7 days and < than 21days.

50mg/kg/dose every 6 to 8hours if ≥ 21days but < 28days.

**Diluent** Dilute in sodium chloride 0.9% or glucose 5% only if cefotaxime is to be given by intravenous infusion.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of cefotaxime, rounded up to the nearest 20mg. Do not use a decimal point. Indicate the times of administration by circling the appropriate times on the prescription chart.

**Route of Administration** Can be administered via a peripheral vein by intravenous bolus injection over 3-5 minutes or intermittent intravenous infusion over 30 minutes.

**Note** A 50mg/kg/dose contains 0.1mmol/kg of sodium.

Ready to use syringes are available on request from Pharmacy Aseptic Unit (ext 2832)

**Caution/side effects** See BNF for Children.

**Incompatibilities** Fluconazole, gentamicin and vancomycin hydrochloride.

**Further information**: see [sepsis in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

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**Ceftazidime**

**Form** Vials containing 500mg ceftazidime.

**Reconstitution** Dissolve the powder in 4.5mL water for injection, to give a stock solution containing 100mg/mL.

All vials are supplied under reduced pressure. Carbon dioxide is released when water is added and a clear solution will be obtained in about 3-4 minutes. The reconstituted product should be used immediately.

**Use** Bactericidal cephalosporin for the management of a wide range of gram-positive and gram-negative infections.

**Dose** 50mg/kg/dose every 24 hours if child < 7 days

 50mg/kg/dose every 12 hours if child ≥ 7 and < 21days

50mg/kg/dose every 8hours if ≥ 21days

**Diluent** Dilute in sodium chloride 0.9% or glucose 5% only if ceftazidime is to be given by intravenous infusion.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of ceftazidime, rounded up to the nearest 10mg. Do not use a decimal point. Indicate the times of administration by circling the appropriate times on the prescription chart.

**Route of Administration** Can be administered via a peripheral vein by intravenous bolus injection over 3-5 minutes or intermittent intravenous infusion over 30 minutes.

**Note** Ready to use syringes are available on request from Pharmacy

 Aseptic Unit (ext 2832)

**Caution/side effects** See BNF for Children.

**Incompatibilities** Clarithromycin, erythromycin, fluconazole, gentamicin, midazolam

 hydrochloride, phenytoin sodium and vancomycin hydrochloride.

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# Ciprofloxacin

**Form** 100mg/50mL or 200mg/100mL equivalent to 2mg/mL ciprofloxacin.

**Reconstitution** Already in solution. No need for further dilution.

**Use** Quinolone antibiotic used for *Pseudomonas* infection.

**Dose** 10mg/kg every 12 hours by intermittent intravenous infusion over 60 minutes.

If necessary the dose may be infused over 30 minutes.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

Document the dose of ciprofloxacin, rounded up to the nearest 1mg.

Indicate the times of administration by circling the appropriate times on the prescription chart.

ALWAYS prescribe to be given at 1100 and 2300.

|  |  |
| --- | --- |
| **First dose of antibiotic given** | **Next dose to be given** |
| Between 0500 and 1700 | 2300 then 12hourly |
| Between 1700 and 0500 | 1100 then 12hourly |

Follow this regime so there is a fixed time to “give” babies their antibiotics.

**Route of**

**Administration** Can be administered via a peripheral or central line.

**Note**

A 10mg/kg dose contains 0.76mmol/kg of sodium.

Bottles must be discarded promptly after they have been opened.

Ciprofloxacin may increase the half-life of caffeine.

**Caution/** Can cause seizures.

**Side effects**

**Incompatibilities** Amoxicillin, amphotericin, co-amoxiclav, ceftazidime, furosemide, heparin

 sodium, hydrocortisone sodium succinate, magnesium sulphate,

 phenytoin sodium, phosphate and sodium bicarbonate.

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# Clarithromycin

**Form** Vials containing 500mg of clarithromycin.

**Reconstitution** Reconstitute and dilute further before use.

**Use** Used usually following discussion with the clinical microbiologist.

**Dose** 7.5mg/kg twice daily.

**Method** Add 9.6mL of water for injection, to 500mg vial to get solution containing 50mg/mL. Take 1mL (50mg) of this solution, and dilute to 25mL with sodium chloride 0.9% to obtain a solution containing 2mg/mL.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

 Document the dose of clarithromycin in sodium chloride 0.9% solution, rounded up to the nearest 0.2mg.

ALWAYS prescribe to be given at 1100 and 2300.

|  |  |
| --- | --- |
| **First dose of antibiotic given** | **Next dose to be given** |
| Between 0500 and 1700 | 2300 then 12hourly |
| Between 1700 and 0500 | 1100 then 12hourly |

Follow this regime so there is a fixed time to “give” babies their antibiotics.

**Route of**

**Administration** Administer as an intravenous infusion over 60minutes via the largest vein possible. Flush slowly after administration.

**Note**

**Caution/side effects** Use with caution in neonates with predisposition to QT interval

 prolongation (including electrolyte disturbance and concomitant use

 of drugs that prolong QT interval). May cause gastrointestinal disturbance and hepatotoxicity.

**Incompatibilities:** Furosemide, heparin sodium, parenteral nutrition and phenytoin

 sodium. If there is no specific information for specific drugs, do not

 assume compatibility. For incompatible drugs or those with no

 compatibility information use a separate line or, for short infusions,

 flush well between drugs.

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# Co-Amoxiclav

**Form** Vial containing 600mg co-amoxiclav, consisting of 500mg amoxicillin and 100mg clavulanic acid.

Vial containing 1.2g co-amoxiclav, consisting of 1g amoxicillin and 200mg clavulanic acid.

**Reconstitution** Dissolve the 600mg powder in 9.5mL water for injection to give a stock solution containing 60mg/mL.

Dissolve the 1.2g powder in 19mL water for injection to give a stock solution containing 60mg/mL.

**Use** Amoxicillin is a broad-spectrum penicillin. Clavulanic acid has no significant antibacterial activity, but inhibits penicillinase and extends antibacterial spectrum.

**Dose** 30mg/kg/dose every 12 hours if child < 3months

**Diluent** Dilute to 5 times the volume if necessary in sodium chloride 0.9% only if co-amoxiclav is to be given by intravenous infusion.

**Route of Administration** Administer via peripheral vein by intravenous bolus injection over 3-4 minutes or intermittent intravenous infusion over 30 minutes. Use only freshly prepared solution.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of co-amoxiclav. Round the dose up to the nearest 6mg. Do not use a decimal point. Indicate the times of administration by circling the appropriate times on the prescription chart.

ALWAYS prescribe to be given at 1100 and 2300.

|  |  |
| --- | --- |
| **First dose of antibiotic given** | **Next dose to be given** |
| Between 0500 and 1700 | 2300 then 12hourly |
| Between 1700 and 0500 | 1100 then 12hourly |

Follow this regime so there is a fixed time to “give” babies their antibiotics.

**Note** Ensure line is adequately flushed with 0.9% sodium chloride between doses.

**Caution/side effects** Cholestatic jaundice. May cause convulsions, particularly with high

 dose or in renal impairment.

**Incompatibilities** Do not mix co-amoxiclav with gentamicin in same syringe or giving

 set because gentamicin may become less activce. Midazolam

 hydrochloride.

**Further information**: see [sepsis in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

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# Colistin

**Form** Vials containing 1million units of colistin.

**Reconstitution:** Dissolve the contents of a 1 million-unit vial in 5mL water for injection to give a stock solution containing 200,000units/mL. Roll the vial gently between hands to dissolve the powder. Do not shake the vial as froth will occur.

**Use** Colistin is a polymyxin antibiotic that is active against gram negative organisms. Use of colistin is restricted and must be approved by a consultant before use, usually following discussion with the clinical microbiologist.

**Dose** 25,000units/kg every 8 hours.

**Diluent** Dilute to a final concentration of 20,000units/mL in sodium chloride 0.9% or glucose 5%. Take 1mL of stock solution containing 200,000units/mL of colistin and mix with a suitable diluent to a final volume of 10mL.

**Route of Administration** Administer via a peripheral cannula or central line by intermittent intravenous infusion over 30 minutes. Use only freshly prepared solution.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of colistin rounded to the nearest 2,000units. Indicate the times of administration by circling the appropriate times on the prescription chart.

**Note** Ensure line is adequately flushed with water for injection or 0.9% sodium chloride intravenous infusion between doses.

 Colistin is also known as colistimethate sodium or colistin sulphomethate sodium or Colomycin®.

 1mg of colistin is 12,500units.

**Caution/side effects** Monitor renal function. Neuro and nephrotoxicity possible.

May cause rash.

**Incompatibilities** Erythromycin and hydrocortisone sodium succinate.

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# Dexamethasone

**Form** Vials containing 3.3mg/mL dexamethasone (equivalent to 4mg/mL of dexamethasone phosphate).

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**Reconstitution** Already in solution. Dilute further before use.

**Use** Chronic lung disease.

Treatment or prevention of post-extubation stridor.

**Dose** Chronic lung disease based on DART regime. Use 40microgram/mL solution.

Give this using a 40microgram/mL solution

75 microgram/kg twice daily for 3 days; then

50 microgram/kg twice daily for 3 days; then

25 microgram/kg twice daily for 2 days; then

10 microgram/kg twice daily for 2 days.

Post-extubation stridor. Use 412.5microgram/mL solution

200microgram/kg by intravenous injection or oral every 8hours for 3doses only. The first dose should be given at least 4 hours prior to extubation.

**Diluent** Dilute in sodium chloride 0.9% or glucose 5%

**Method** 1. Withdraw 1mL of dexamethasone 3.3mg/mL solution and dilute to a final volume of 8mL in a 10mL syringe with diluent of choice (this makes a solution of 412.5microgram/mL).

1. Withdraw 1mL of 412.5microgram/mL solution (from step 1) and make up to 10mL in a 10mL syringe using the same diluent as used above (this makes a solution of approximately 40microgram/mL).
2. Withdraw the required dose from 40microgram/mL solution (from step 2) into an appropriate syringe ensuring a minimum of 1mL overage is added.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

 Document the dose of dexamethasone in sodium chloride 0.9% solution or glucose 5%, rounded to the nearest 4micrograms. Indicate the times of administration by circling the appropriate times on the prescription chart. State the route of administration (IV bolus or IV infusion).

**Route of**

**Administration** Administer via a central or peripheral line either as a slow bolus over 3-5 minutes or as an infusion over 15-20 minutes.

**Note**

**Caution** Infection (bacterial/fungal). Gastrointestinal bleeding/perforation. Renal

 disease. Indomethacin (increases risk of bleeding),

 phenytoin/phenobarbital (decreased corticosteroid effect)

**Side effects** Hypocalcaemia, myocardial hypertrophy, hyperglycaemia, hypertension,

 nephrocalcinosis, gastrointestinal haemorrhage, poor growth, suppressed

 immunity, leucocytosis, hypokalaemia, suppression of HPA axis,

 neutrophilia, hypernatraemia.

**Incompatibilities** Ciprofloxacin, midazolam hydrochloride and vancomycin hydrochloride. If

 there is no specific information for specific drugs, do not assume

 compatibility. For incompatible drugs or those with no compatibility

 information use a separate line or, for short infusions, flush well between

 drugs.

Ready to use syringes, containing 40microgram/mL of dexamethasone, with 5mL in a 10mL syringe, which are stable for 7days in the fridge, are available on request from Pharmacy Aseptic Unit (Ext 2832).

**References:**

Neonatal Formulary, 7th Edition, BMJ Books, Blackwell Publishing 2015

Medusa, Injectable Medicines Guide

**Further information**: see [corticosteroid use in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

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# DOBUTamine Hydrochloride

**Form** 250mg/20mL (12.5mg/mL) dobutamine hydrochloride.

**Reconstitution** Already in solution. Further dilute before administration.

**Use** Systemic hypotension.
Dobutamine increases cardiac output in babies with poor ventricular function. It may be combined with dopamine to maintain adequate blood pressure. See notes.

**Dose** 5 to 20 microgram/kg/minute by continuous intravenous infusion. Measure clinical response as judged by heart rate, blood pressure and urine output.

**Diluent** Dilute in 0.9% sodium chloride or 5% glucose.
Prepare a fresh solution every 24 hours

**Solution for infusion** Choice of concentration will depend on the baby’s weight.

(SINGLE strength will be rarely needed)

<1kg use DOUBLE strength.

≥1kg use DOUBLE or QUAD strength

Draw up dobutamine hydrochloride (12.5mg/mL) into a syringe:

SINGLE 2.4mL (30mg) (final concentration 0.6 mg/mL)

DOUBLE 4.8mL (60mg) (final concentration 1.2 mg/mL)

QUAD 9.6mL (120mg) (final concentration 2.4 mg/mL)

Dilute to 50mL with one of the above diluents and use the table below to calculate the maximum infusion rate. Round this up to the nearest 0.5mL/hour.

|  |  |
| --- | --- |
| **Dose** **(microgram / kg / minute)** | **Maximum infusion Rate (mL / kg / hour)**Multiply this number by the weight and then round up to the next 0.5mL increment |
|  | SINGLE | DOUBLE | QUAD |
| 20 | 2 | 1 | 0.5 |

See next page for dosing table.

More concentrated infusions can be used. Discuss with pharmacist.

**How to prescribe**

Document the volume of dobutamine hydrochloride to be added to 50mL of solution. Name the diluent. State the dose range required and corresponding infusion rate. State whether this is SINGLE, DOUBLE or QUAD strength solution and specify the concentration.

**For example**: For a 0.9kg baby.

Drug: *DOBUTamine*

Dose: *(60mg*

Diluent: *Glucose 5%*

Total volume: *to a final volume of 50mL*

Maximum infusion rate: *1 mL/hour*

Dose range: *0 to 20microgram/kg/minute*

Other instructions: *This is a double strength solution containing 1.2mg/mL*

**Route of administration** Preferred route is via central venous line. Can be administered via

 a peripheral line. If on concurrent dopamine the dobutamine

 hydrochloride may be infused via a Y-connector into the same

 central line. Use umbilical arterial catheter if no other alternative

 access available.

**Note**

Dobutamine has a short half-life (approximately 2 minutes) in adults. No information exists for neonates.

Dobutamine has inotropic and chronotropic actions. Dopamine is more effective at increasing blood pressure because of its peripheral vasoconstriction.

Solutions containing dobutamine hydrochloride may turn pink due to oxidation of the drug. The colour may intensify with time. There is no significant loss of potency during the recommended storage period. Solutions that have turned pink may still be used,provided they were made less than 24hours previously.

**Caution/side effects** Ectopic beats, tachyarrythmias

**Incompatibilities** Incompatible with alkaline solutions such as sodium bicarbonate.

Do not mix with lipids or with diluents containing sodium metabisulphite or ethanol. There are reports suggesting that heparin is compatible with dobutamine hydrochloride when mixed in 0.9% sodium chloride. Precipitation may occur when the two drugs are mixed in a glucose solution.

**Further information**: see [hypotension in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

Ready to use syringes, containing 1.2mg/mL (double strength) DOBUTamine in glucose 5% are available on request from Pharmacy Aseptic Unit (Ext 2832) and can be kept as ward stock

Use this table to give a rough estimate of the required infusion rate. You can use this to check the infusion rate is appropriate.

|  |  |
| --- | --- |
| **Dose Required****(microgram / kg / minute)** | **Infusion Rate (mL / kg / hour)****NB – you must multiply this number by the weight** |
|  | SINGLE | DOUBLE | QUAD |
| 5 | 0.5 | 0.25 | 0.125 |
| 10 | 1 | 0.5 | 0.25 |
| 15 | 1.5 | 0.75 | 0.375 |
| 20 | 2 | 1 | 0.5 |

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# DOPamine Hydrochloride

**Form** 200mg/5mL (40mg/mL) dopamine hydrochloride.

**Reconstitution** Already in solution. Further dilute before administration.

**Use** Dopamine hydrochloride raises blood pressure by dose dependent effects

on vascular tone. See notes below.

Treatment should be combined with, or replaced by, dobutamine

hydrochloride if low cardiac output is the primary problem.

**Dose** 2.5 to 20 microgram/kg/minute.

**Diluent** Dilute in 0.9% sodium chloride or 5% glucose or 10% glucose.

Prepare a fresh solution every 24 hours

**Solution for Infusion** Choice of concentration will depend on the baby’s weight.

(SINGLE strength will be rarely needed)

<1kg use DOUBLE strength.

≥1kg use DOUBLE or QUAD strength

Draw up dopamine hydrochloride (40mg/mL) into a syringe:

SINGLE 0.75mL (30mg) (final concentration 0.6 mg/mL)

DOUBLE 1.5mL (60mg) (final concentration 1.2 mg/mL)

QUAD 3mL (120mg) (final concentration 2.4 mg/mL)

Dilute to 50mL with one of the above diluents and use the table below to calculate the maximum infusion rate. Round this up to the nearest 0.5mL/hour.

|  |  |
| --- | --- |
| **Dose** **(microgram / kg / minute)** | **Maximum Infusion Rate (mL /kg / hour)**Multiply this number by the weight and then round up to the next 0.5mL increment |
|  | SINGLE | DOUBLE | QUAD |
| 20 | 2 | 1 | 0.5 |

See next page for dosing table.

More concentrated infusions can be used. Discuss with pharmacist.

**How to prescribe**

State whether this is SINGLE, DOUBLE or QUAD strength solution.

Document the volume of dopamine hydrochloride to be added to 50mL of solution. Name the diluent. State the maximum infusion rate and dose range. State whether this is SINGLE, DOUBLE or QUAD strength solution and specify the concentration.

**For example**: For a 1.52kg baby.

Drug: *DOPamine DOUBLE strength*

Dose: *60mg*

Diluent: *Glucose 5%*

Total volume: *to a final volume of 50mL*

Maximum infusion rate: *2 mL/hour*

Dose range: 0 *to 20microgram/kg/minute*

Other instructions: *This is a double strength solution containing 1.2mg/mL*

**Route of administration** Preferred route is via central venous line. Can be

 administered via a peripheral line. If on concurrent dopamine

 the dobutamine hydrochloride may be infused via a

Y-connector into the same central line.

Use umbilical arterial catheter if no other alternative access

available.

**Note**

In adults there is a dose-dependent effect on the different types of receptor. At low doses (1 to 5microgram/kg/minute) dopaminergic effects (vasodilatation of renal, mesenteric, coronary and cerebral circulations) predominate. At 5 to 15microgram/kg/minute the principal effect is direct cardiac inotropy. At doses over 15microgram/kg/minute dopamine has predominantly α adrenergic vasoconstrictor effects. Whether this is also true in neonates is unclear.

Caution should be used with doses greater than 6microgram/kg/minute where there is co-existing hypertension in the neonatal period.

Discoloured solutions should NOT be used. In alkaline solutions dopamine hydrochloride is degraded to coloured materials forming a pink to violet colour. Formation of a yellow or brown discolouration of the solution indicates decomposition.

**Caution/side effects** Ectopic beats, tachyarrythmia, peripheral vasoconstriction.

Extravasation can cause dangerous ischaemia. Therefore avoid infusing high doses of dopamine hydrochloride except through a long intravenous line threaded into a major vein. Ischaemia can be managed by infiltration of the affected area with 5mg phentolamine mesylate in 5mL 0.9% sodium chloride using a fine needle.

**Incompatibilities** Incompatible with alkaline solutions such as sodium bicarbonate.

**Further information**: see [hypotension in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

Use this table to give a rough estimate of the required infusion rate. You can use this to check the infusion rate is appropriate

|  |  |
| --- | --- |
| **Dose Required****(microgram / kg / minute)** | **Infusion Rate (mL /kg / hour)****NB – you must multiply this number by the weight** |
|  | SINGLE | DOUBLE | QUAD |
| 2.5 | 0.25 | 0.125 | 0.0625 |
| 5 | 0.5 | 0.25 | 0.125 |
| 10 | 1 | 0.5 | 0.25 |
| 15 | 1.5 | 0.75 | 0.375 |
| 20 | 2 | 1 | 0.5 |

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# Fentanyl citrate

**Form** Ready to use pre-filled syringe dispensed from Aseptic Unit containing fentanyl citrate 5microgram/mL in 5mL of sodium chloride 0.9% solution.

**Reconstitution** Already in solution.

**Use** Opioid analgesic to be used in neonates only in accordance with, “Premedication for elective/semi‐elective intubation clinical guideline.” Fentanyl and suxamethonium will arrest breathing and appropriate ventilatory support must be provided.

**Dose** 5microgram/kg by intravenous (IV) injection over 30 to 60seconds.

**Dose volume of fentanyl citrate 5microgram/mL**.

|  |  |  |
| --- | --- | --- |
| **Weight (kg)** | **Rounded Dose (microgram)** | **Dose volume (mL)** |
| 0.4 | 2 | 0.4 |
| 0.6 | 3 | 0.6 |
| 0.8 | 4 | 0.8 |
| 1 | 5 | 1 |
| 1.25 | 6 | 1.2 |
| 1.5 | 7.5 | 1.5 |
| 2 | 10 | 2 |
| 3 | 15 | 3 |
| 4 | 20 | 4 |

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart in the once only prescriptions section.

 Document the dose of fentanyl, rounded to the nearest 0.5microgram.

**Route of Administration** Can be administered via a peripheral line

**Incompatibilities** Fentanyl can be added (terminally) to a line containing midazolam or standard TPN (including lipid).

**Stability** Stable for 60days after manufacture in Pharmacy Aseptic Unit.

**Note** Fentanyl is a controlled drug and its use must be in accordance with the Trust’s Controlled Drug Policy. Administration can sometimes cause muscle rigidity and seizure-like activity which is more likely after rapid administration. Has peak effect within 5minutes of administration with effects lasting 30 to 60minutes.

**Antidote** Bradycardia after excess fentanyl may respond to atropine. Muscle rigidity will respond to a muscle relaxant, such as suxamethonium. Naloxone hydrochloride is an effective fentanyl antidote. The dose of naloxone hydrochloride is 10microgram/kg and if no response give 100microgram/kg by IV bolus injection.

**Ordering** Complete **requisition** in **CD order book** and bring book to pharmacy.

**If fentanyl citrate 5microgram/mL syringes are not available fentanyl must be prepared as detailed below:**

**Method** Obtain a single ampoule of100microgram/2mL equivalent to 50microgram/mL fentanyl (as citrate). Withdraw 1mL of sodium chloride 0.9% into a 10mL syringe. Inject 1mL of fentanyl injection into the syringe and mix. Further dilute to final volume of 10mL. The solution now contains 5microgram/mL. Withdraw an appropriate volume of this solution and inject slowly over 30 to 60 second.

**Caution/** May sometimes cause muscle rigidity and seizure-like activity.

**Side effects**

**Incompatibilities** Phenobarbital sodium and phenytoin sodium.

**Further information**: see [pre-medication for elective/semi-elective intubation in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/)

 clinical guideline.

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# Flucloxacillin

**Form** Vials containing 250mg flucloxacillin.

**Reconstitution** Dissolve the 250mg powder in 4.8mL water for injection to give a stock solution containing 50mg/mL.

**Use** Flucloxacillin is a broad-spectrum penicillin.

**Dose** 25mg/kg/dose every 12 hours if child < 7 days.

 25mg/kg/dose every 8 hours if child ≥ 7 days and < 21days

 25mg/kg/dose every 6 hours if child ≥ 21 days and < 28days

Double dose can be used in severe infection.

**Diluent** Dilute to 5 times the volume if necessary in sodium chloride 0.9% only if flucloxacillin is to be given by intravenous infusion.

**Route of** Administer via a peripheral vein by intravenous bolus injection over

**Administration** 3-4minutes. Can also be administered by intermittent intravenous infusion over 30 minutes. Use only freshly prepared solution.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of flucloxacillin, rounded up to the nearest 5mg. Do not use a decimal point. Indicate the times of administration by circling the appropriate times on the prescription chart.

**Note** Do not mix flucloxacillin with gentamicin in the same syringe or giving set because loss of activity of the gentamicin may occur. Please ensure line is adequately flushed with water for injection or sodium chloride 0.9% between doses.

**Caution/side** Cholestatic jaundice. May cause convulsions, particularly with high dose

**effects** or in renal impairment.

**Incompatibilities** Clarithromycin and midazolam hydrochloride.

**Further information**: see [sepsis in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

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# Fluconazole

**Form** 50mg/25mL equivalent to 2mg/mL fluconazole

**Reconstitution** Already in solution.

**Use** Invasive candidal and cryptococcal infections

**Dose Prophylaxis:**

Neonates < 2 weeks: **6**mg/kg every Monday and Thursday.

Neonates 2 - 4 weeks: **6**mg/kg every Monday, Thursday and Saturday.

**Treatment:**

Neonates < 2 weeks: **12**mg/kg every Monday and Thursday.

Neonates 2 - 4 weeks: **12**mg/kg every Monday, Thursday and Saturday.

Child > 1month: **12**mg/kg once daily.

Extend the interval after TWO doses if renal function is poor.

**Diluent** Does not require further dilution.

**Method** Give by intravenous infusion over 10 to 30minutes.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of Fluconazole, rounded up to the nearest 0.2mg. Indicate the times of administration by documenting the schedule as twice weekly on Monday and Thursday, three times weekly on Monday, Thursday and Saturday or every 24hours. Circle the appropriate schedule time, usually 1100h, on the prescription chart.

**Route of** Can be administered via a peripheral intravenous line.

**Administration**

**Incompatibilities** No known incompatibilities. Can increase half-life of midazolam.

**Note** Monitor liver function before commencing treatment and weekly thereafter to assess for signs of damage.

A 6mg/kg dose contains 0.46mmol/kg of sodium.

Ready to use syringes, which are stable for 5days at room temperature, are available on request from Pharmacy Aseptic Unit (Ext 2832).

**Caution/side effects** Monitor liver function with high doses or extended courses.

**Incompatibilities** Amphotericin,calcium gluconate, cefotaxime, ceftazidime and furosemide.

**Further information**: see [fungal infection in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

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# Foscarnet

**Form** Ready to use pre-filled syringe dispensed from Pharmacy Aseptic Unit containing a concentration 24mg/mL. More dilute solution is available for peripheral administration.

**Reconstitution** Do not dilute further.

**Use** Treatment of neonatal cytomegalovirus, following discussion with the clinical microbiologist.

**Dose** 60mg/kg every 8hours for 14 to 21days, then reduce dose to 90 to 120mg/kg once daily. Seek advice from microbiology and pharmacy about the maintenance dose.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

 Document the dose of foscarnet, rounded to the nearest 2.4mg.

**Route of**

**Administration** Administer as an intravenous infusion over 60minutes via a central line or largest vein possible. Flush slowly after administration, with sodium chloride 0.9% or glucose 5% solution. If giving peripherally it must be diluted to 12mg per mL with glucose 5% or sodium chloride 0.9%.

**Note**

**Caution/side effects:**

Impaired renal function may occur: monitor serum creatinine and maintain adequate hydration. If concerned about renal function pre-hydrate at 125mL/m2/hour for 1 hour with 0.9% sodium chloride. Continue hydration during foscarnet infusion and for 1 hour afterwards.

Foscarnet can chelate bivalent ions such as calcium: use may be associated with an acute decrease of ionised serum calcium, which may not be reflected in total serum calcium levels. Electrolytes especially magnesium and calcium, should be assessed prior to and during therapy.
Foscarnet has local irritating properties: when excreted in high concentrations in urine it may induce genital irritation or ulcerations.
Can cause phlebitis at injection site especially following infusion of undiluted solution.

**Incompatibilities** Aciclovir, amphotericin, calcium containing solution, dobutamine hydrochloride, ganciclovir, magnesium containing solutions, midazolam hydrochloride and vancomycin hydrochloride.

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# Furosemide

**Form** 50mg/5mL equivalent to 10mg/mL furosemide.

**Reconstitution** Already in solution.

**Use** Rapid acting diuretic.

**Dose** Corrected gestational age < 31weeks: 1mg/kg every 24hours.

Corrected gestational age ≥ 31weeks: 1mg/kg every 12hours.

**Method** Slow intravenous bolus injection over 10minutes.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of furosemide, rounded to the nearest 0.1mg. Indicate the times of administration by circling the appropriate times on the prescription chart.

**Route of**

**Administration** Can be administered via a peripheral or central line.

**Incompatibilities** Infusion pH is 8-9.3 – precipitation can occur when furosemide is mixed with any intravenous fluids with pH <5.6 (such as glucose or glucose with sodium chloride mixtures). It should thus always be separated by a 0.5mL ‘bolus’ of sodium chloride 0.9% injection.

**Note** Half-life may be 24hours in very preterm babies with progressive drug accumulation with repeated doses. Hence the different dosage regimen for post-menstrual age.

**Caution/** Risk of ototoxicity at infusion rates greater than 4mg/minute.

**Side effects** Hypotension, hypokalaemia (monitor potassium), nephrocalcinosis may

 occur following long-term use.

**Incompatibilities** Ciprofloxacin, clarithromycin, dobutamine hydrochloride, dopamine

 hydrochloride, fluconazole, gentamicin, midazolam hydrochloride and

 morphine sulphate.

**References:**

Neonatal Formulary 7th Edition 2015, BMJ Publishing Group

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# Ganciclovir

**Form** Ready to use pre-filled syringe dispensed from Pharmacy Aseptic Unit containing a concentration 5mg/mL.

**Reconstitution** Do not dilute further.

**Use** Treatment of neonatal cytomegalovirus, following discussion with the clinical microbiologist.

**Dose** 6mg/kg twice daily.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

 Document the dose of ganciclovir in sodium chloride 0.9% or glucose 5% solution, rounded to the nearest 0.2mg.

**Route of**

**Administration** Administer as an intravenous infusion over 60minutes via the largest vein possible. Flush slowly after administration, with the same diluent as used to prepare the ganciclovir solution.

**Note**

**Caution/** Maintain hydration during intravenous use due to risk of crystalluria and

**side effects** renal tubular damage. May cause neutropenia and thrombocytopaenia in

 over 10% of cases. Treatment needs to be suspended, or dose reduced, if

 neutrophil count falls below 0.75 x109/L. May cause dyspnoea,

 arrhythmias and hypotension.

**Incompatibilities** Drug company advise ganciclovir is not mixed with any other medicine.

**Special handling precautions** Handle as for cytotoxics: for more info see [Cytotoxic Medicines Policy](http://www.whnt.nhs.uk/document_uploads/Trust_Wide_Policies_Procedures/45e%20-%20Cytotoxic%20Medicines%20Policy%20-2012-06%20v2.pdf). Wear gloves when handling. The use of polyethylene or latex gloves is recommended to avoid exposure in case of leakage. If the solution contacts skin or mucosa, immediately wash thoroughly with soap and water. Rinse eyes for at least 15 minutes with sterile water, or plain water if sterile water is unavailable. Avoid inhalation.

Syringes must be stored in the fridge. Discard the solution if visible

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# Gentamicin

**Form** Vials containing 10mg/mL gentamicin.

**Use** Gentamicin is an aminoglycoside antibiotic with good effect against many Gram negative and some Gram positive organisms.

**Dose** See table below.

|  |  |
| --- | --- |
| **Location** | **Dose and blood sampling** |
| **Neonatal unit** | Give stat dose of 5mg/kg/dose and measure two timed post-dose concentrations. If gentamicin recently stopped, within last 48hours, please contact pharmacy for dosing advice.**Always review the first gentamicin concentration** and **if less than 2mg/L you may need to give another loading dose.** Always take 1st sample 2 hours post and if:  |
|  | Gentamicin given between 0601 and 1800h  | Take 2nd sample with routine bloods in morning so it can be reviewed before 1200h.  |
| Gentamicin given between 1801 and 0000h  | Take 2nd sample at midday so it can be reviewed before 1700h.  |
| Gentamicin given between 0001 and 0600h  | Discuss with pharmacist in morning who will advise when to take 2nd sample based on clinical acuity, gestational age etc. |
| **Post-natal ward** | Give stat 5mg/kg/dose and follow NICE guidance. If cultures are negative 36hours after the sample was taken, and there is no clinical suspicion of infection, antibiotics can be stopped. Check cultures at 36hours and if antibiotics are to continue, measure a pre-dose trough concentration immediately before giving the second dose (The second dose should be given 36hours after the initial dose.) Do not delay this dose until blood concentration reported. Adjust dose and frequency based on clinical pharmacokinetic review of pre-dose trough concentration, for further doses if required. |

Once concentrations reported contact pharmacy for further dosing advice.

**Route of**

**Administration** Give by intravenous bolus injection by peripheral cannula or central line over approximately 5 minutes. Ensure line is adequately flushed with 0.9% sodium chloride between doses.

**Method** Dilute in 0.9% sodium chloride, glucose 5% or glucose 10% only if given by intravenous infusion. This is necessary only if dose greater than 7mg/kg.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

Document the stat dose of gentamicin in the “**once only”** section.

Round the dose up to the nearest 1mg. Do not use a decimal point.

Once an individualised dose has been calculated prescribe this and indicate times of administration by circling the appropriate times on the prescription chart and blocking out unused times.

Do not prescribe doses for administration at midnight.

**Therapeutic Drug Monitoring**

**Record time** and **site of blood sampling,** using 24hour clock, on the therapeutic drug monitoring sheet.

**Record time of administration** of each dose of gentamicin, using 24hour clock. Document the start and finish time on the prescription chart.

Measure concentrations as detailed in dose section above.

**Review the first gentamicin concentration** and **if less than 2mg/L you may need to give another loading dose.**

The pharmacist will review reported concentrations and sample time, and advise on further dosing, based on the elimination rate constant and distribution volume. They will advise when to measure further concentrations depending on clinical condition, history and estimate of the clinical pharmacokinetic parameters.

**Steady state** Peak concentration 2 hours after end of injection.

**Sampling time** Trough concentration immediately before next dose.

**Target Range** Peak concentration 8-12mg/L.

 Trough concentration <2mg/L, ideally less than 1mg/L.

**Note** If gentamicin is given more than 1hour from the due time a clinical incident form must be completed.

**Caution/side effects** The main side-effects are dose-related therefore take care with dose calculations frequency. Administration of gentamicin and ototoxic diuretics such as furosemide should be separated by as long a period as practicable**.**

**Incompatibilities** Aciclovir, co-amoxiclav, flucloxacillin, furosemide, heparin sodium, indometacin, meropenem and Tazocin®.

**Further information**: see [*Sepsis in neonates*](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

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# Glucagon

**Form** Vial containing glucagon 1mg (as hydrochloride) powder. Plus pre-filled syringe containing 1.1mL water for injections for reconstitution.

**Reconstitution** Inject 1.1mL water for injections into the contents of the vial of glucagon to
 obtain a reconstituted solution containing glucagon 1mg in 1mL. Shake
 the vial gently until the powder is completely dissolved and the solution is
 clear. Withdraw the solution back into the syringe. Do not use the
 reconstituted solution if it is not clear. Further dilute before administration.

**Use** Hypoglycaemia. The use of this drug must be discussed with the registrar or consultant on call.

**Dose:**  1 to 18 microgram/kg/hour

Start at 5 microgram/kg/hour and adjust according to response.

**Diluent** Dilute in glucose 5%. Prepare a new solution every 24 hours.

Dilute 1mg to 20mL with glucose 5%. The solution now contains 50microgram/mL. Use the table below to calculate infusion rate.

|  |  |
| --- | --- |
| **Dose Required****(microgram / kg / hour)** | **Infusion Rate (mL / kg / hour)****NB – you must multiply this number by the weight** |
| 1 | 0.02 |
| 2 | 0.04 |
| 5 | 0.1 |
| 7 | 0.14 |
| 10 | 0.2 |
| 12 | 0.24 |
| 15 | 0.3 |
| 18 | 0.36 |

**How to prescribe**

Document the dose of Glucagon to be added to 20mL of glucose 5% solution. State the dose range required and maximum infusion rate.

**For example**: For a 1.8kg baby

Drug: *Glucagon*

Dose: *1mg*

Diluent: *Glucose 5%*

Total volume: *to a final volume of 20mL*

Maximum infusion rate: *0.7 mL/hour*

Dose range: *0 to 18 microgram/kg/hour*

Other instructions: *Solution contains 50microgram/mL. Start infusion at 5microgram/kg/hour, which is 0.18mL/hour and adjust according to blood sugars*

**Route of** Continuous infusion preferably via a central line to avoid
**administration** potential venous irritation as the preparation has a low pH. If central line
 not available, assess the benefits and risks of peripheral administration for
 the individual patient (e.g timeliness of therapy, clinical status of patient). If
 given peripherally, choose a large vein and monitor the injection site
 closely using a recognised infusion phlebitis scoring tool.

**Monitoring** Close monitoring of blood glucose is essential. Check blood glucose every 30-60 minutes after starting infusion or dose change until rate of infusion and blood sugar is stable within the target range. Then at least every 4 hours. Check blood glucose 60minutes after stopping glucagon treatment.

**Caution/** Vomiting, hypokalaemia, hypocalcaemia and hyper or

**side effects** hypoglycaemia (monitor blood glucose).

**Compatibilities** Sodium chloride 0.9%, glucose 5%

**Incompatibilities**  Do not add to infusion fluids containing calcium; precipitation may occur.

**Storage** Glucagon packs must be stored in the fridge.

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# Glucose Infusions – calculating and making up

**To make the following strength glucose bags:**

**(Note the strength of glucose solution produced is an approximate)**

|  |  |  |
| --- | --- | --- |
| 7.5% | **🡪** | Remove **30mL** from a 500mL bag of **5%** glucose.Add **30mL** of **50%** glucose. |
| 12.5% | **🡪** | Remove **30mL** from a 500mL bag of **10%** glucose.Add **30mL** of **50%** glucose. |
| 15% | **🡪** | Remove **60mL** from a 500mL bag of **10%** glucose.Add **60mL** of **50%** glucose. |
| 20% | **🡪** | Remove **125mL** from a 500mL bag of **10%** glucose.Add **125mL** of **50%** glucose. |

**How to prescribe**

Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

**For example**:

Drug: Glucose 50%

Dose: *30mL*

Diluent: *Glucose 10%*

Total volume: *to a final volume of 500mL*

Maximum infusion rate: *10 mL/hour*

Dose range: *give as part of total fluids of 150mL/kg/day*

Other information: *This gives approximately a 12.5% glucose solution*

**During Pharmacy opening hours**

Ready to use infusion bags are available on request from Pharmacy Aseptic Unit (ext 2832).

In this case, document the concentration of glucose solution and the infusion rate.

Eg for a 1.5kg baby, receiving 150mL/kg/day, prescribe 12.5% glucose solution to run at 9.4mL/h. Ready-made 500mL bags of 20% glucose are kept as stock in the pharmacy aseptic unit and can be supplied from pharmacy,

**Out of hours**

The infusion bag should be made on the ward. Document the volumes to be removed and replaced (as in the table above), the final concentration of the glucose solution, as an approximate, and the infusion rate.

Eg for a 1.5kg baby, receiving 150mL/kg/day, document 30mL 50% glucose added to 470mL of 10% glucose to produce 12.5% glucose solution to run at 9.4mL/h.

**Further Information**

* See below for the explanation as to why these are approximate concentrations.
* Additional information is available from Pharmacy Department, Arrowe Park Hospital.

**Explanation**

The above figures are **approximate** due to an **overage** in all manufactured bags. Overage is designed to ensure that each bag contains the designated volume plus enough fluid to prime a giving set.

The manufacturer’s target fill volume for a 500mL Baxter Viaflo® infusion bag is 530mL. The product licence limits allow a 500mL bag to contain between 520mL and 540mL.

Based on the product licence limits, and using the above methods, the concentration of glucose produced will vary between the following range:

|  |  |  |  |
| --- | --- | --- | --- |
| **Target Glucose****Strength %w/v** | **Actual Glucose Strength %w/v** |  |  |
| **500mL Bag** | **520mL Bag** | **540mL Bag** |
| *7.5% w/v* | 7.7 | 7.6 | 7.5 |
| *12.5 % w/v* | 12.4 | 12.3 | 12.2 |
| *15% w/v* | 14.8 | 14.6 | 14.4 |
| *20% w/v* | 20 | 19.6 | 19.3 |

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#

# Heparin sodium

**Form** Ready to use pre-filled syringe dispensed from Aseptic Unit containing Heparin sodium 50units in sodium chloride 0.45% in 50mL syringe.

**Reconstitution** Already in solution.

**Use** To maintain vascular access and catheter patency.

**Dose** 0.5 to 1mL/hour (equivalent to 0.5 to 1unit/hour).

**Diluent** Already in 0.45% sodium chloride.
(Can also be made in 0.9% sodium chloride.)

**Solution** Already diluted to 1 unit/mL.

**How to prescribe**

Document the volume of heparin sodium (1000units/mL) and the name and volume of the diluent. Document the infusion rate. Document the need to use prepared infusion. Specify which line is being kept patent.

**For example:**

Drug: *Heparin sodium*

Dose: *50units*

Diluent: *Sodium chloride 0.45%*

Total volume: *to a total volume of 50mL*

Maximum infusion rate: *0.5mL/hour*

Dose: *0.5 unit/hour*

Other instructions: *Use ready prepared infusion only. To keep umbilical arterial catheter patent*

**Route of administration:** Continuous infusion via a central or peripheral arterial or venous line.

**Note**

Administer as continuous infusion as soon as possible after the line is inserted.

Heparin sodium infusions are prepared in pharmacy using the following method:

Use 1000units in 1mL heparin sodium. Draw up 50units (0.05mL) of this solution. Dilute to 50mL with 0.45% sodium chloride (can also use 0.9%). Final concentration 1 unit/mL.

**Caution/side effects** Use of this infusion will add to sodium load.

**Incompatibilities** Amphotericin, ciprofloxacin, clarithromycin, dobutamine hydrochloride, gentamicin, phenytoin sodium and vancomycin hydrochloride.

**Note Ordering**

Heparin sodium syringes are a stock medicine. To obtain further supply please order on Cerner by selecting **Communicate**, using the **NNU stock meds request,** and sending the message to **Aseptic Stock Requests** stating how many batches of 10syringes are required.

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# Human Albumin Solution

**Form** 5% solution: 100mL, 250mL or 500mL in glass bottle

20% solution: 100mL in glass bottle.

**Reconstitution:** Pre-prepared solution.

**Use:** Volume expansion – **5%** **solution**

Volume expansion with hypoalbuminaemia – **20%** **solution**

Use of 20% solution is restricted and must be approved by a consultant before use.

**Dose:** Hypovolaemia: **10 to 20mL/kg** of **5% solution** given over 30 minutes.

Hypovolaemia with hypoalbuminaemia: **5mL/kg** of **20% solution** given over 2 to 4 hours. This must be approved by a consultant. Diuretic cover with furosemide 1mg/kg may be given.

**How to prescribe:**

Prescribe on the blood products section of the WUTH Neonatal Intensive Care Unit Prescription Chart.

The batch number for each bottle **must** be recorded. There is a peel off sticker with the batch number on each bottle. This can be stuck onto the appropriate space on the prescription. If the sticker is not available the batch number must be written on the prescription chart.

HAS or plasma albumin are not appropriate abbreviations and must not be used.

All prescriptions should be written as “*Human albumin solution 5%,”* or, “*Human albumin solution 20%.*”

For example; for a 1.2kg baby with hypovolaemia:

*Human albumin solution 5%, 12mL over 30 minutes.*

**Route of Administration**

Administer intravenously via a peripheral or central vein, there are no special requirements for the giving set. The solution must not be filtered.

**Note**

Each 5mL dose contains 0.6mmol of sodium and small amounts of potassium.

**Caution/side effects:** Human albumin solution is a blood product, hence there is a chance of hypersensitivity reaction. Human albumin solution acts as a volume expander: hypervolaemia may occur and increased oncotic pressures and fluid shifts, especially with the 20% solution. Infusion must be stopped if hypervolaemia occurs (hypertension, dyspnoea, raised venous pressure, pulmonary oedema)

**Incompatibilities** Should not be mixed with other medicinal products. Mixing with water for injection may cause haemolysis. Flush with 0.9% sodium chloride or 5% glucose.

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# Hydrocortisone Sodium Succinate

**Form** 100mg vials hydrocortisone (as the sodium succinate powder)

**Reconstitution** Reconstitute with 2mL water for injection to create a solution of 50mg/mL. Further dilute before administration.

**Use** Hypotension resistant to inotropic treatment and volume replacement.

**Dose** Initially 2.5mg/kg (repeat if necessary after 4hours), then 2.5mg/kg every 6hours for 48hours or until blood pressure recovers. Then gradually reduce the dose over at least 48hours.

**Diluent** Dilute with sodium chloride 0.9% or glucose 5%.

**Method** Withdraw 5mL of diluent into a 10mL syringe. Inject 2mL of the reconstituted hydrocortisone sodium succinate injection into the syringe and mix. Further dilute to final volume of 10mL. The solution now contains 10mg/mL. Withdraw an appropriate volume of this solution and inject slowly over 2 to 5 minutes. Alternatively the dose may be further diluted and administered by intravenous infusion over 20 to 30minutes.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of hydrocortisone sodium succinate, rounded to the nearest 1mg. Indicate the times of administration by circling the appropriate times on the prescription chart.

**Route of** Can be administered via a peripheral or a central intravenous line.

**Administration**

**Incompatibilities** Nil

**Note** Try to withdraw treatment within 2 to 4 days because steroid use increases risk of fungal infection and gut perforation, especially if used concomitantly with indometacin.

If dose is less than 1mg discuss with the neonatal pharmacist as a more dilute solution will be necessary to allow the dose to be measured

**Caution/side effects** See BNF for Children.

**Incompatibilities** Ciprofloxacin, midazolam hydrochloride and phenytoin sodium.

**Further information**: see [Hypotension in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

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# Ibuprofen

**Form** Vials containing 10mg in 2mL ibuprofen.

**Reconstitution** Already in solution. Dilute further before administration

**Use** Closure of patent ductus arteriosus.

**Dose** 10mg/kg as single dose followed by 2 doses of 5mg/kg, given at 24 hour intervals. A treatment course therefore consists of 3 doses.

**Diluent** Dilute in sodium chloride 0.9% or glucose 5%.

**Method** Dilute the required dose of ibuprofen to 3mL with one of the diluents above.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of ibuprofen, rounded to the nearest 0.5mg. Document each of the 3 doses of ibuprofen in the stat section and make sure the date and time of administration is clearly recorded.

**Route of administration** Give by slow intravenous (IV) injection over 15 minutes.

**Note**

If the ductus arteriosusdoes not close 48 hours after the last injection or if it re-opens, a second course of 3 doses, as above, may be given.

If anuria or manifest oliguria occurs after the first or second dose, the next dose should be withheld until urine output returns to normal levels.

**Caution/side effects:** See BNF for Children.

**Incompatibilities** No data available.

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# Immunoglobulin

|  |  |
| --- | --- |
| **Form** | WUTH stock Flebogamma DIF ® solution which contains 50mg/mL or 5g of immunoglobulin in 100mL (5%w/v). The following data applies only to Flebogamma DIF ® solution produced by Grifols UK Limited. |
| **Reconstitution** | Already in solution.  |
| **Use**  | Treatment of haemolytic disease of the newborn.  |
| **Dose** | 500mg/kg as a single infusion, or 10mL/kg of a 5% solution over approximately 4hours. |

**Method of administration**

Flebogamma DIF ® solution is administered intravenously.

Children’s ward have experience of how to give immunoglobulin and can provide support.

The infusion should be commenced at an initial rate of 0.01 - 0.02 mL/kg/minute for 30 minutes. If well tolerated, the rate of administration may be gradually increased to 0.04mL/kg/minute up to a maximum of 0.1mL/kg/minute, for the remainder of the infusion (see table below).

**Suggested infusion rates specified in mL/hour**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Time | 0 to 30minutes | 30 to 60minutes | 60 to 90minutes | From 90minutes until complete |
| Weight |  |  |  |  |
| 1-1.9kg | 0.6 | 1.2 | 2 | 4 |
| 2-2.9kg | 1.2 | 2.4 | 4.8 | 8 |
| 3-3.9kg | 1.8 | 3.6 | 7.2 | 15 |
| 4kg plus | 2.4 | 4.8 | 9.6 | 20 |

Locate patient weight in table and read off infusion rate in mL/hour for the period 0 to 30 minutes, 30 to 60 minutes, 60 to 90 minutes and from 90 minutes until complete.

Record the batch number of each vial of immunoglobulin given. Do this using the peelable label from each bottle and attach to the prescription sheet.

**How to prescribe infusion**

Prescribe on the intravenous infusions section.

Document total dose of immunoglobulin to be infused in both grams and volume in mL. All infusion rates and duration of each infusion rate must be stated.

**For example**: For a 1.8kg baby.

Drug: *Immunoglobulin 5% solution (as Flebogamma)*

Dose: *0.9g*

Diluent: *not applicable*

Total volume: *give total volume of 18mL*

Maximum infusion rate: *4mL/hour*

Other instructions: *Infuse 0.6mL/hour for 30minutes, then 1.2mL/hour for 30minutes, then 2mL/hour for 30minutes then 4mL/hour until complete*

**Route of Administration:** Can be administered via a peripheral line.

**Note**

Immunoglobulin must be used in accord with [WUTH Intravenous Immunoglobulin Policy and Procedure.](http://www.wuth.nhs.uk/media/386157/045l-Intravenous-Immunoglobulin-Policy-and-Procedure-2013-09-v2.pdf)

***Note*** that this is a “red” indication, and so no approval is needed.

Requests for supply should be made via the ward or on-call pharmacist.

The consultant or registrar must complete the WUTH electronic IVIG request form.

This is available on the intranet home page under medicines formulary, Immunoglobulin request form or via the following link: <https://nsecure.wirral.nhs.uk/clinical/Default.aspx>

Due to the absence of any anti-microbial preservatives, administration must begin immediately after piercing the cap.

The SPC for this product states that it is contraindicated in patients under 2 years and in patients with hereditary fructose intolerance because of the sorbitol content. The contraindication in 0-2 years is because infants *may* have undiagnosed fructose intolerance. The Consultant Pharmacist and Paediatricians at WUTH have agreed to use Flebogamma DIF first line for children and neonates. For indications such as haemolytic disease of the new born which is life threatening, the benefit of treatment outweighs this risk.

**Caution/side effects** Patients should be monitored during and after an infusion of immunoglobulin. If a mild reaction occurs, such as flushing, reduce infusion rate and gradually bring back to half of the rate at which the reaction occurred. Mild reactions usually occur within the first 30minutes of infusion, if at all.

Severe adverse reactions include anaphylactic shock, aseptic meningitis and renal toxicity.

**Incompatibilities** Immunoglobulin is incompatible with all other medicinal products and must not be mixed.

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# Indometacin

**Form** Ready to use pre-filled syringe dispensed from Aseptic Unit containing Indometacin 500micrograms in 5mL of sodium chloride 0.9% solution in a 10mL syringe.

**Use** Closure of patent ductus arteriosus.

**Dose** 100microgram/kg/dose once daily for 6 doses.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of indometacin, rounded to the nearest 10 microgram. Do not use a decimal point. Indicate the times of administration by circling the appropriate times on the prescription chart. Take great care with the dose calculation.

**Route of administration** Prime the giving set with indometacin solution before starting the dose. Give by intravenous infusion over 20 to 30 minutes. Disconnect the giving set and flush the infusion port with 1mL of sodium chloride 0.9% solution infused over 30minutes.

**Note**

Dose calculation. Ten-fold overdoses are easy to make. Calculate the dose by multiplying the baby’s weight in kg x 100microgram to give a dose in microgram.

Ready to use syringes are available on request from Pharmacy Aseptic Unit (Ext 2832).The infusion is prepared from a 50mg/2mL solution hence these will only be available Monday to Friday. If treatment is clinically urgent out of hours obtain a vial of 50mg powder for injection from Pharmacy, where it is kept within the Aseptic Unit, and prepare a dose as outlined below:

**Method** 1. Add 2mL of water for injection to a vial of indometacin 50mg. This makes a solution of 25mg/mL.

2. Withdraw 0.5mL of indometacin 25mg/mL solution and dilute to a final volume of 10mL in a 10mL syringe with sodium chloride 0.9%. This makes a solution of 1.25mg/mL.

3. Withdraw 0.8mL of 1.25mg/mL solution (from step 2) and make up to 10mL in a 10mL syringe with sodium chloride 0.9%. This makes a solution of 100microgram/mL.

4. Administer the prescribed dose as outlined above.

**Caution/side effects** Rapid administration causes a significant decrease in mesenteric artery and cerebral blood flow that may contribute to development of necrotizing enterocolitis or cerebral ischemia.

**Incompatibilities** Amphotericin, calcium gluconate, dobutamine hydrochloride, dopamine hydrochloride, gentamicin, glucose and parenteral nutrition.

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# Insulin

**Form** 100unit/mL Human Actrapid ® insulin

**Reconstitution** Already in solution. Further dilute before administration.

**Use** Hyperglycaemia or hyperkalaemia. The use of this drug must be discussed with the registrar or consultant on call.

**Dose:**  0 to 0.5 unit/kg/hour

For **hyperglycaemia** start at 0.05 unit/kg/hour.

For **hyperkalaemia** start at 0.3 unit/kg/hour

(NB. For hyperkalaemia, ensure that sufficient glucose is given, such as glucose 10% at 5mL/kg/hour. This is always in addition to the current maintenance fluid).

**Diluent** Dilute in sodium chloride 0.9% for treatment of hyperglycaemia. Dilute in glucose 10% for treatment of hyperkalaemia. Dilute in 5% glucose if needed. Prepare a new solution every 24 hours.

**Solution for infusion** Choice of concentration will depend on the baby’s weight.

<1kg use SINGLE or DOUBLE strength

≥1kg use DOUBLE or QUAD strength

Draw up insulin (100units/mL) into an **insulin syringe**:

SINGLE 10units (final concentration 0.2 unit/mL)

DOUBLE 25units (final concentration 0.5 unit/mL)

QUAD 50units (final concentration 1 unit/mL)

Dilute to 50mL with one of the diluents and use the table below to calculate infusion rate.

Add the insulin to the diluent volume and invert syringe several times to ensure even mixing of insulin. See notes below.

|  |  |
| --- | --- |
| **Dose Required****(unit / kg / hour)** | **Infusion Rate (mL / kg / hour)****NB – you must multiply this number by the weight** |
|  | **SINGLE** | **DOUBLE** | **QUAD** |
| 0.05 | 0.25 | 0.1 | 0.05 |
| 0.1 | 0.5 | 0.2 | 0.1 |
| 0.15 | 0.75 | 0.3 | 0.15 |
| 0.2 | 1 | 0.4 | 0.2 |
| 0.25 | 1.25 | 0.5 | 0.25 |
| 0.3 | 1.5 | 0.6 | 0.3 |
| 0.35 | 1.75 | 0.7 | 0.35 |
| 0.4 | 2 | 0.8 | 0.4 |
| 0.5 | 2.5 | 1 | 0.5 |

**How to prescribe**

Document the number of units of Human Actrapid ® insulin to be added to 50mL of solution. Name the diluent on the prescription chart. State the dose range required and corresponding infusion rate. State whether this is SINGLE, DOUBLE or QUAD strength solution and specify the concentration.

Do **not** use the abbreviation U to denote units.

**For example**: For a 1.5kg baby

Drug: *Human Actrapid Insulin (100unit/mL)*

Dose: *25units*

Diluent: *Sodium chloride 0.9%*

Total volume: *to a final volume of 50mL*

Maximum infusion rate: *1.5 mL/hour*

Dose range: *0 to 0.5 unit/kg/hour*

Other instructions: *This is a double strength solution containing 0.5unit/mL*

**Route of** Continuous infusion via a central or peripheral venous line.
**administration** **Do not** administer a bolusinfusion via this line.

**Monitoring** Close monitoring of blood glucose is essential to minimise risk of hypoglycaemia. Check blood glucose every 30-60 minutes after starting infusion or dose change until rate of infusion and blood sugar is stable within the target range. Then at least every 4 hours. Check blood glucose 60minutes after stopping insulin treatment.

|  |  |
| --- | --- |
| **Blood Glucose** | **Insulin infusion rate** |
| >10mmol/L | Increase infusion by 0.05units/kg/hour(If blood glucose is falling rapidly (> 4 mmol/hour), consider maintaining or even decreasing the rate, even if blood glucose remains elevated) |
| 7 – 10mmol/L  | Maintain current infusion rate |
| <7mmol/L  | Stop infusion |
| 3 – 3.9mmol/L | Consider giving 2.5mL/kg bolus of glucose 10% |
| <3mmol/L orrapid fall in blood glucose | Give 2.5mL/kg bolus of glucose 10% |

Some infants may require a half strength insulin infusion, when 0.05units/kg/hour is too much, but hyperglycaemia recurs when insulin is stopped.

Monitor serum potassium (insulin may cause hypokalaemia).

**Note**

There are conflicting reports of insulin adsorption to infusion sets and filters with a lack of universal agreement on management. Add the insulin to the diluent volume and invert syringe several times to ensure even mixing of insulin.

On priming the infusion line expel the first 20mL of solution. **Do not filter or use an octopus attachment**. Attach the infusion as close to the infusion site as possible.

If administering via an umbilical venous catheter attach infusion at the 3-way tap. Remember from the 3-way tap to the end of the catheter there is a 0.5mL dead space. At low infusion rates it may take several hours for the infusion to reach the infant and lead to an inappropriate escalation of dose rate due to an apparent lack of response. In such cases accurate priming of the administration system is vital.

**Caution/side effects** Hypoglycaemia, hypokalaemia

**Compatibilities** Insulin can be added terminally to a line containing PN with intralipid or containing dobutamine hydrochloride, heparin sodium, midazolam, milrinone or morphine sulphate.

**Incompatibilities**  Dopamine hydrochloride.

**Storage** Store vial in fridge. Open vial can be used for 3 months. Record date vial opened.

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# Intralipid 20% with Solivito and Vitlipid N emulsion

**Form** Ready to use pre-filled syringe dispensed from Aseptic Unit containing Intralipid 20% with Solivito and Vitlipid N emulsion

**Reconstitution** Already in solution.

**Use** Lipid component of parenteral nutrition.

**Dose** Gradually increase infusion rate as detailed below.

|  |  |  |
| --- | --- | --- |
| Day of TPN | Dose (mL/kg/day) | Calories/day (kCal/kg/day) |
| 1  | 5 | 10 |
| 2 | 10 | 20 |
| 3 | 15 | 30 |
| 4 and greater | 17.5 | 35  |

To calculate hourly infusion rate multiply the dose (mL/kg/day) by weight (kg) and divide by 24.

NB: If patient septic, do not give more than 5mL/kg/day. Monitor triglyceride levels in serum.

**Method** Administer via Syringe Driver by continuous intravenous infusion.

**How to prescribe** Prescribe on WUTH Neonatal Intensive Care Unit Prescription Chart.

Document maximum infusion rate in mL/hour and dose range in mL/kg/day.

Document the need to use ready prepared infusions.

**For example For a 0.63kg neonate**

Drug: *Solivito in 2mL Vitlipid N emulsion*

Dose: *not applicable*

Diluent: *Intralipid 20%*

Total volume: *to a final volume of 32mL*

Maximum infusion rate: *0.5mL/hour*

Dose range: *0 to 17.5mL/kg/day*

Other instructions: *Use ready prepared infusions only.*

**Note**

Each syringe contains 30mL of Intralipid 20% with 2mL of Vitlipid N emulsion and 20% of a vial of Solivito.

**Ordering**

Intralipid 20% syringes with Solivito and Vitlipid N emulsion are a stock medicine. To obtain further supply please order on Cerner by selecting **Communicate**, using the **NNU stock meds request,** and sending the message to **Aseptic Stock Requests** stating how many batches of 10syringes are required.

**Caution/side effects** See BNF for Children.

**Incompatibilities** NNF-7 suggests compatible with insulin, heparin, vancomycin, noradrenaline. Should never be co-infused with any other drug.

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# Levetiracetam

**Form** 100 mg/mL concentrate solution for infusion.

Each 5 mL vial contains 500 mg of levetiracetam.

**Reconstitution** Already in solution

**Use** Seizures. Use of levetiracetam must be approved by a consultant.

**Dose** 20mg/kg every 12 hours1

**Diluent** Dilute insodium chloride 0.9% or glucose 5% to a concentration of 20mg/mL using the method outlined below.1

**Method** Draw up 2mL of sodium chloride 0.9% or glucose 5% into a syringe. Into the same syringe draw up 1mL of 500mg/5mL levetiracetam injection. Ensure the solution is thoroughly mixed by gentle movement of the plunger. Make up to a final volume of 5mL with sodium chloride 0.9%. Again mix the solution. The prepared solution has a concentration of 20mg/mL.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

Document the initial dose in the Parenteral Drugs-Once Only Prescriptions section. Round the dose to the nearest 2mg. Document the maintenance dose in the Regular Prescriptions section. Indicate the times of administration by circling the appropriate times on the prescription chart.

**Route of** Give by intravenous infusion over 15minutes. Can be administered via a **Administration** peripheral line.

**Note** Intravenous levetiracetam is not licensed for use in neonates but is used

off-label. Each 5 mL vial contains 19 mg (0.8 mmol) of sodium.

**Caution/** May cause nasopharyngitis, headache. Can also cause blood

**side effects** disorders, uncommonly; thrombocytopenia, leukopenia, rarely;

 pancytopenia neutropenia, agranulocytosis.

**Incompatibilities** No data available.

Reference

1. Abend NS et al. Levetiracetam for Treatment of Neonatal Seizures. [***J Child Neurol.* 2011; 26: 465–470**](http://www.ncbi.nlm.nih.gov/entrez/eutils/elink.fcgi?dbfrom=pubmed&retmode=ref&cmd=prlinks&id=21233461) available at: [**http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3082578/**](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3082578/) accessed 14/01/14.

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# Magnesium Sulphate

**Form** 5mL ampoules of 50% (containing 2.5g or 10mmol of Magnesium)

**Reconstitution** Already in solution. Further dilute before administration.

**Use** Neonatal hypomagnesaemia, serum magnesium less than 0.6mmol/L and late neonatal hypocalcaemia, corrected serum calcium less than 1.7mmol/L.

**Dose** 100mg/kg of magnesium sulphate as a single dose by iv infusion over at least 10 minutes repeated 12hours later. For hypomagnesaemia further doses can be given as necessary.

**Diluent** Dilute in glucose 5%, glucose 10% or sodium chloride 0.9%. Prepare a fresh solution every 24 hours.

**Solution for Infusion**

Draw up 2mL of magnesium sulphate 50% injection and dilute to 10mL with glucose 5%, to give a 10% solution (100mg/mL). Using this 10% solution, give 1mL/kg by intravenous infusion **for each kg** the infant weighs over at least 10 minutes.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart in the once only section. Document the dose and volume of magnesium sulphate (50% solution) to be added to 10mL of solution. Name the diluent on the prescription chart. State the dose required and corresponding infusion rate if appropriate.

*e.g: for a 1.4kg baby with Hypomagnesaemia*

*Magnesium sulphate (50%) injection, 2mL diluted to a final volume of 10mL with glucose 5%. Infuse 1.4mL equal to 140mg over 10minutes.*

**Route of administration**  Can be administered via a peripheral line.

**Note**

**Caution/side effects** Monitor blood pressure, respiratory rate, urinary output and for signs of overdose included vomiting, weakness, flushing, drowsiness.

**Incompatibilities** Ciprofloxacin and sodium bicarbonate.

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# Meropenem

**Form** Vials containing 500mg meropenem.

**Reconstitution** Dissolve the 500mg powder in 9.6mL water for injection to give a stock solution containing 50mg/mL.

**Use** Meropenem is a carbapenem beta-lactam antibiotic. Due to risk of developing carbapenem resistance, use of meropenem is restricted and must be approved by a consultant before use, usually following discussion with the clinical microbiologist.

**Dose** 40mg/kg/dose every 12 hours if child < 7 days.

40mg/kg/dose every 8 hours if child ≥ 7days.

**Diluent** Dilute to a final concentration of 1 – 20mg/mL if necessary in sodium chloride 0.9%. Meropenem is also compatible with 5% and 10% glucose.

**Route of Administration** Administer via a peripheral cannula or central line by intravenous bolus injection over approximately 5 minutes. Can also be administered by intermittent intravenous infusion over 30 minutes. Use only freshly prepared solution.

**Method** Further dilution is required only if meropenem is to be given by intravenous infusion.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of meropenem, rounded up to the nearest 10mg. Do not use a decimal point. Indicate the times of administration by circling the appropriate times on the prescription chart.

**Note** Do not mix meropenem with gentamicin in the same syringe or giving set because loss of activity of the aminoglycoside may occur.

Please ensure line is adequately flushed with water for injection or 0.9% sodium chloride intravenous infusion between doses.

The powder for injection contains 3.4mmol of sodium per gram.

The displacement value for Meronem ® 500mg is 0.44mL.

**Caution/side effects** Nil.

**Incompatibilities** Aciclovir, amphotericin and calcium gluconate.

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# Metronidazole

**Form** Each 100mL infusion contains 500mg metronidazole with a concentration of 5mg/mL

**Use** Metronidazole is an antibiotic with good activity against anaerobic bacteria and protozoa.

**Dose** Give 15mg/kg as a single loading dose then continue maintenance dose as per table:

|  |  |  |
| --- | --- | --- |
| **Corrected gestational age** | **Maintenance dose** | **When to start maintenance dose** |
| Less than 26weeks | 7.5mg/kg daily | 24hours after loading dose |
| 26-34weeks | 7.5mg/kg 12hourly | 12hours after loading dose |
| Greater than 34weeks | 7.5mg/kg 8hourly | 8hours after loading dose |

**Route of Administration** Administer via a peripheral cannula or central line by intermittent intravenous infusion over approximately 20 to 30 minutes.

**Method** Further dilution is not required.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the loading dose in the Parenteral Drugs-Once only prescription section. Round the dose up to the nearest 1mg. Document the maintenance dose in the Regular Prescriptions section. Do not use a decimal point. Indicate the times of administration by circling the appropriate times on the prescription chart.

**Diluent** Metronidazole is compatible with 5% and 10% glucose.

**Note** Please ensure line is adequately flushed with water for injection or 0.9% sodium chloride between doses.

A 7.5mg/kg dose contains 0.2mmol/kg of sodium.

**Caution/side effects** Nil.

**Incompatibilities** No data available.

**Further information**: see [necrotising enterocolitis (NEC)](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

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# Midazolam Hydrochloride

**Form**10mg/2mL midazolam hydrochloride – note there are two strengths of injection. Use the correct solution.

**Use** Sedative and for refractory seizures

**Dose Sedation
Maintenance** dose = **30-60microgram/kg/hour.**

 When used as sedative there is no need for a loading dose.

Dose as sedative should be reviewed after 24hours. Consider halving the dose to prevent accumulation in neonates with corrected gestational age less than 33weeks. Maximum recommended treatment duration 4 days. Longer courses must be approved by the duty consultant.

**Seizures**
**Loading** Dose = **90microgram/kg**Give by intravenous bolus injection over 3-5minutes

 **Maintenance** Dose= **60-300microgram/kg/hour**

Dose may be increased by 60microgram/kg/hour every 15minutes to achieve seizure control. Monitor for accumulation and use the lowest effective dose.

**Diluent** Dilute in sodium chloride 0.9%, glucose 5% or glucose 10% injection

**Solution for infusion:** Choice of concentration will depend on the baby’s weight.

(SINGLE strength will rarely be needed)

<1kg use DOUBLE strength

≥1kg use QUAD strength

To prepare an infusion follow the instructions below:

SINGLE 100microgram/mL

To prepare a 100microgram/mL solution, add 0.5mL of midazolam hydrochloride (5mg/mL) to a syringe, dilute to 25mL with an appropriate diluent.

DOUBLE 200microgram/mL

To prepare a 200microgram/mL solution, add 1mL of midazolam hydrochloride (5mg/mL) to a syringe, dilute to 25mL with an appropriate diluent.

QUAD 400microgram/mL

To prepare a 400microgram/mL solution, add 2mL of midazolam hydrochloride (5mg/mL) to a syringe, dilute to 25mL with an appropriate diluent.

To calculate a maximum infusion rate use the table overleaf and round this up to the nearest 0.5mL/hour.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Dose (microgram/kg/hour)** | **Maximum Infusion Rate (mL / kg / hour)** | **Maximum Infusion Rate** **(mL / kg / hour)** | **Maximum Infusion Rate** **(mL / kg / hour)** | **Indication** |
|  | Single | Double | Quad |  |
| 60 | 0.6 | 0.3 | 0.15 | Sedative or anticonvulsant |
| 300 | 3 | 1.5 | 0.75 | Anticonvulsant |

Multiply the number above by the weight and then round up to the next 0.5mL increment.

See next page for dosing table.

**How to prescribe**

Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of MIDAZOLAM HYDROCHLORIDE to be added to 25mL of solution.

Name the diluent on the prescription chart.

State the maximum infusion rate and dose range required.

State whether this is SINGLE, DOUBLE or QUAD strength solution and specify the concentration.

**For example**: For sedation in a 1.5kg baby.

Drug: *Midazolam hydrochloride*

Dose: 5*mg*

Diluent: Glucose *10%*

Total volume: *to a final volume of 25mL*

Maximum infusion rate: *0.5 mL/hour*

Dose range: *0 to 60microgram/kg/hour*

Other instructions: *This is DOUBLE strength solution containing 200microgram/mL*

**Route of**

**administration** Can be administered via a peripheral line.

**Stability** Stable for 24 hours if made up on ward.If made up in pharmacy (Aseptic Unit), it has a longer expiry date, but still needs to be changed every 24 hours. Stock syringes containing 200micrgram/mL in glucose 5% are available from pharmacy.

**Ordering** Midazolam is a controlled drug.

All requests for supply must be made in a controlled drug requisition book.

 When ordering syringes you must state:

|  |  |
| --- | --- |
| ▪ | concentration of midazolam in each syringe (100, 200 or 400microgram/mL)  |
| ▪ | diluent (sodium chloride 0.9%, glucose 5% or glucose 10%) |
| ▪ | babies name, hospital number, NHS number and consultant. |

See next page……..

 All **orders for midazolam syringes, except 200microgram/mL in glucose 5%, must be countersigned** by the **ward pharmacist** before sending the requisition book and blue bag to pharmacy.

 All supplies of midazolam, both injection and syringes for infusion, must be documented in the controlled drugs register.

**Please Note** Doses of 60microgram/kg/hour can be used for up to 4 days with apparent safety in the ventilated new-born baby, but rate of infusion **must** be halved after 24 hours in babies <33 weeks post-conceptional age to prevent drug accumulation (see below).

**Caution/side effects** Long term use may be associated with drug accumulation and the development of a severe encephalopathic illness in infants with drowsiness, dystonic posturing and choreoathetosis developing one or two days after treatment is stopped and persisting for a week or more.

**Reversal of overdose** High dose therapy may cause respiratory depression and hypotension. Flumazenil can be used for the reversal of sedative effects of benzodiazepines. It must be available in all areas where midazolam is used in case of excessive sedation. If flumazenil is used a Trust Patient Safety Incident form must be completed.

**Flumazenil dose**

By intravenous injection, 10 microgram/kg over 15 seconds, repeated at 60 second intervals if required.

Flumazenil has a shorter duration of action than midazolam. It can be given by intravenous infusion if drowsiness recurs after injection.

**Incompatibilities** Ceftazidime, cefuroxime, co-amoxiclav, dexamethasone sodium phosphate, dobutamine hydrochloride, flucloxacillin, foscarnet, furosemide, hydrocortisone sodium succinate and sodium bicarbonate.

Use this table to give a rough estimate of the required infusion rate. You can use this to check the infusion rate is appropriate.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Dose Required (microgram/kg/hour)** | **Infusion Rate (mL / kg / hour)****NB – you must multiply this number by the weight** | **Infusion Rate** **(mL / kg / hour)****NB – you must multiply this number by the weight** | **Infusion Rate** **(mL / kg / hour)****NB – you must multiply this number by the weight** | **Indication** |
|  | Single | Double | Quad |  |
| 30 | 0.3 | 0.15 | 0.07 | Sedative or anticonvulsant |
| 60 | 0.6 | 0.3 | 0.15 | Sedative or anticonvulsant |
| 120 | 1.2 | 0.6 | 0.3 | Anticonvulsant |
| 180 | 1.8 | 0.9 | 0.45 | Anticonvulsant |
| 240 | 2.4 | 1.2 | 0.6 | Anticonvulsant |
| 300 | 3 | 1.5 | 0.75 | Anticonvulsant |

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# Milrinone

**Form** Vial containing 10mg in 10mL milrinone.

**Reconstitution** Already in solution. Further dilute before administration.

**Use** Severe refractory hypotension, on consultant request only.

**Dose** Preterm neonates (under 30 weeks) give loading infusion of 0.75microgram/kg/minute for 3hours then a maintenance infusion of 0.2microgram/kg/minute.

Consider omitting the loading dose in extreme prematurity as hypotension may occur when starting milrinone.

Adjust dose according to response to 0.1 to 0.75microgram/kg/minute.

Those older than 30weeks give loading infusion of 1.25microgram/kg/minute for 1hour then a maintenance infusion of 0.5 to 0.75microgram/kg/minute

**Diluent** Draw up 5mL of 10mg/10mL solution. This will give (5mg). Add to 45mL of the required diluent, namely glucose 5% or sodium chloride 0.9%. This will give a solution of 5mg in 50mL.

**Route of Administration** Preferably via a central line by intravenous infusion.

**How to prescribe** Prescribe initial dose in once only section. Prescribe continuous infusion on a Neonatal Intensive Care Unit Prescription Chart in the Intravenous Infusion section.

Document the amount (in mg) of milrinone to be made up to 50mL with the diluent. Name the diluent on the prescription sheet. Use the table below to calculate the maximum infusion rate. Round this up to the nearest 0.2mL increment.

|  |  |
| --- | --- |
| **Dose Required****(microgam/kg/minute)** | **Maximum Infusion Rate (mL / kg / hour)**Multiply this number by the weight and then round up to the nearest 0.2mL increment |
| 0.75 | 0.45 |

**For example:** For a 0.9kg baby.

Drug: *Milrinone*

Dose: *5mg in 5mL*

Diluent: *Glucose 5%*

Total volume: *to a final volume of 50mL*

Maximum infusion rate:  *0.6 mL/hour*

Dose range: *0 to 0.75microgram/kg/minute*

Other instructions: *This creates a 100microgram/mL solution*

**Note**

Do not flush the milrinone line. On discontinuation of the milrinone infusion or if

the milrinone line is required for any other infusion, run 0.5mL/hour of sodium chloride 0.9% for 3 hours to clear the line.

**Cautions/side effects** See BNF for Children and Neonatal Formulary

**Compatibilities:** Adrenaline, amiodarone, dobutamine, dopamine, heparin, insulin,

lorazepam, midazolam, morphine, noradrenaline, potassium, propofol,

vancomycin

**Incompatibilities:** Furosemide, bumetanide, sodium bicarbonate

**Further information**: see [hypotension in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

Use this table to give a rough estimate of the required infusion rate. You can use this to check the infusion rate is appropriate.

|  |  |
| --- | --- |
| **Dose Required****(microgram/kg/minute)** | **Infusion Rate (mL / kg / hour)****NB – you must multiply this number by the weight**  |
| 0.1 | 0.06 |
| 0.2 | 0.12 |
| 0.25 | 0.15 |
| 0.3 | 0.18 |
| 0.4 | 0.24 |
| 0.5 | 0.3 |
| 0.6 | 0.36 |
| 0.75 | 0.45 |

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# Morphine Sulphate

**Form**Morphine sulphate in 25mL of glucose 5%, syringe for intravenous infusion containing 40, 100 or 200microgram/mL

Syringes are manufactured by pharmacy Aseptic Unit. Order via the ward CD book.

**Reconstitution** Already in solution.

**Use**Sedation during intubation/ventilation, analgesia

**Dose** Loading Dose 100 microgram/kg

 Maintenance Dose 10-40 microgram/kg/hour

Give loading dose by intravenous bolus infusion over 5 to 10 minutes.

Then commence infusion at a rate of 10 to 40 microgram/kg/hour.

**Diluent** Already in 5% glucose.
(Can also be made in 10% glucose or 0.9% sodium chloride.)

**Solution for infusion:** Choice of concentration will depend on the baby’s weight.

(SINGLE strength will be rarely needed)

<1kg use DOUBLE strength

≥1kg use DOUBLE or QUAD strength

SINGLE 40microgram/mL

DOUBLE 100microgram/mL

QUAD 200microgram/mL

Use the table below to calculate the maximum infusion rate. Round this up to the nearest 0.5mL/hour.

|  |  |
| --- | --- |
| **Dose** **(microgram / kg / hour)** | **Maximum Infusion Rate (mL / kg / hour)**Multiply this number by the weight and then round up to the next 0.5mL increment |
|  | SINGLE | DOUBLE | QUAD |
| 40 | 1 | 0.4 | 0.2 |

See next page for dosing table.

**How to prescribe infusion:**

Document the strength of morphine sulphate infusion and the diluent. State the dose range required and corresponding infusion rate.

State whether this is SINGLE, DOUBLE or QUAD strength solution and specify the concentration.

**For example**: For a 1.5kg baby.

Drug: *Morphine sulphate*

Dose: *100 microgram/mL*

Diluent: *Glucose 5%*

Total volume: *to a final volume of 25mL*

Maximum infusion rate: *1 mL/hour*

Dose range: *0 to 40microgram/kg/hour*

Other instructions: *This is double strength solution containing 100microgram/mL*

**Route of**

**Administration:** Can be administered via a peripheral line.

**Note**

**Caution** Prior to stopping the infusion you may wish to halve the infusion rate for a

 few hours. Tolerance may develop during long-term treatment.

**Side effects** Common side effects include nausea and vomiting, constipation, dry mouth and biliary spasm. Larger doses produce muscle rigidity, hypotension and respiratory depression.

**Incompatibilities** Aciclovir, furosemide, phenytoin sodium and sodium bicarbonate.

**Reversal** The antidote naloxone should be given if there is coma or bradypnoea. Caffeine citrate may be administered prior to extubation in preterm infants.

Use this table to give a rough estimate of the required infusion rate. You can use this to check the infusion rate is appropriate.

|  |  |
| --- | --- |
| **Dose Required****(microgram / kg / hour)** | **Infusion Rate (mL / kg / hour)****NB – you must multiply this number by the weight** |
|  | SINGLE | DOUBLE | QUAD |
| 10 | 0.25 | 0.1 | 0.05 |
| 20 | 0.5 | 0.2 | 0.1 |
| 30 | 0.75 | 0.3 | 0.15 |
| 40 | 1 | 0.4 | 0.2 |
| **Bolus** – 100 microgram/kg | 2.5 | 1 | 0.5 |

**How to convert intravenous to oral morphine**

Calculate the dose of intravenous morphine currently given every 4hours then consider the following:

As bioavailability is less than 1, the equivalent oral dose will need to be greater than the dose given intravenously to have a similar effect.

If the plan is to keep the analgesic or sedative effect similar, but switch to the oral route, then give 30% more than they are currently getting intravenously, every 4 hours. The dose can then be titrated up or down to achieve appropriate sedation/analgesia.

If the plan is to switch to oral morphine **and** reduce the analgesia or sedation, give the same dose of morphine orally every 4hours. The oral dose can then be titrated up or down to achieve appropriate sedation/analgesia.

There is little evidence to guide conversion of intravenous to oral morphine in neonates. Babies should be monitored closely for the first 24hours after switching from to oral morphine to assess the appropriateness of the dose.

Stop the morphine infusion immediately after giving the first oral dose of morphine.

**Worked example:**

A 1.5kg neonate has received a continuous intravenous infusion of morphine 100microgram/mL, running at 0.15mL/hour for 3 days.

They are thus receiving 15microgram per hour = 60microgram every 4hours

If you want to keep the analgesia or sedation similar, but switch to oral, the prescribed dose should be 60microgram plus 30% (18microgram).

The starting dose should be 78microgram.

It however comes in a 200microgram/mL solution.

Round the dose to 80microgram to make the volume measurable.

The baby should be prescribed morphine 80microgam orally every 4hours.

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# Noradrenaline (Norepinephrine)

**Form** 8mL vial of 1 in 1000 noradrenaline (containing 16mg of noradrenaline tartrate equivalent to 8mg noradrenaline base) and 20mL vial (containing 40mg of noradrenaline tartrate equivalent to 20mg noradrenaline base)

**Reconstitution** Already in solution. Further dilute before administration

**Use** Refractory hypotension, after discussion with consultant.

**Note, hypotension should be treated first with dopamine and/or dobutamine.**

**Dose** 0.2 to 1 microgram noradrenaline base/kg/minute

**Diluent** Dilute in glucose 5% or sodium chloride 0.9%. Once the solution is prepared, use immediately. Prepare a fresh solution every 24hours,

**Solution for infusion** Choice of concentration will depend on baby’s weight.

<1kg use SINGLE or DOUBLE strength

≥1kg use DOUBLE or QUAD strength

Draw up noradrenaline 1:1000 (1mg/mL) into a syringe:

* SINGLE 1.5mL (1.5mg noradrenaline base) final concentration 30microgram/mL
* DOUBLE 3mL (3mg noradrenaline base) final concentration 60microgram/mL
* QUAD 6mL (6mg noradrenaline base) final concentration 120microgram/mL

Dilute to 50mL with one of the above diluents. Use the table below to calculate maximum infusion rate. Round this up to the nearest 0.5mL/hour.

|  |  |
| --- | --- |
| **Dose (microgram/kg/minute)** | **Maximum infusion rate (mL/kg/hour)**Multiply this number by the weight and then round up to the next 0.5mL increment |
|  | SINGLE | DOUBLE | QUAD |
| 1 | 2 | 1 | 0.5 |

See next page for dosing table.

**How to prescribe**

Prescribe on a WUTH Neonatal Intensive Care Unit Prescription chart.

Document the volume of noradrenaline to be added to 50mL of solution. Name the diluent. State the maximum infusion rate and dose range required.

State whether this is SINGLE, DOUBLE or QUAD strength solution and specify the concentration.

**For example** for a 0.9kg baby

Drug: *Noradrenaline 1 in 1000*

Dose: *3mg in 3mL*

Diluent: *Glucose 5%*

Total volume: *to a final volume of 50mL*

Maximum infusion rate: *1 mL/hour*

Dose range: *0 to 1 microgram/kg/minute*

Other instructions: *This is a DOUBLE strength solution containing 60microgram/mL*

**Administration** via a central line only (risk of extravasation and tissue necrosis if administered through a peripheral line)

**Note**

* Withdraw gradually to avoid a profound drop in blood pressure
* Do not flush the central venous catheter. Once the infusion has stopped, disconnect the administration set, aspirate the cannula contents and flush with sodium chloride 0.9%
* Discard the solution if discoloured.
* Always record dose in terms of noradrenaline base

**Caution**

profound hypoxia/hypercarbia

* must be used with appropriate blood volume replacement

**Side effects**

Tachycardia, bradycardia, arrhythmias, palpitations, urine retention, arterial hypotension, tissue hypoxia, dyspnoea, respiratory insufficiency, local irritation at injection site

**Compatibilities**

Atracurium, dopamine, dobutamine, calcium containing solutions, heparin, hydrocortisone, midazolam, morphine, pancuronium

**Incompatibilities**

Furosemide, insulin, sodium bicarbonate, phenytoin

**Further information**: see [hypotension in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

Use this table to give a rough estimate of the required infusion rate. You can use this to check the infusion rate is appropriate.

|  |  |
| --- | --- |
| **Dose required (microgram/kg/minute)** | **Infusion rate (mL/kg/hour)****NB – you must multiply this number by the weight** |
|  | SINGLE | DOUBLE | QUAD |
| 0.2 | 0.4 | 0.2 | 0.1 |
| 0.3 | 0.6 | 0.3 | 0.15 |
| 0.4 | 0.8 | 0.4 | 0.2 |
| 0.5 | 1 | 0.5 | 0.25 |
| 0.6 | 1.2 | 0.6 | 0.3 |
| 0.7 | 1.4 | 0.7 | 0.35 |
| 0.8 | 1.6 | 0.8 | 0.4 |
| 0.9 | 1.8 | 0.9 | 0.45 |
| 1 | 2 | 1 | 0.5 |

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# Omeprazole

**Form** Vial containing 40mg omeprazole.

**Reconstitution** Dissolve the 40mg powder in 10mL of sodium chloride 0.9% to give a stock solution containing approximately 4mg/mL.

**Use** Omeprazole inhibits the proton pump and stops gastric acid production.

**Dose** 500microgram/kg/dose once daily increased to a maximum dose of 2mg/kg/dose once daily.

**Diluent** Reconstitute with 10mL of sodium chloride 0.9% as follows.

Withdraw 10mL of sodium chloride 0.9% in a syringe.

 Add approximately 5mL of sodium chloride 0.9% to the vial with freeze dried omeprazole.

 Withdraw as much air as possible from the vial back into the syringe. This will make it easier to add the remaining solution.

 Add the remaining solution into the vial, make sure the syringe is empty.

 Rotate and shake the vial to ensure all the freeze-dried omeprazole has dissolved. This gives a solution of approximately 4mg/mL.

 Withdraw the required dose and give undiluted over 3-4minutes

**Route of Administration** Administer via peripheral or central vein by intravenous bolus injection over 3-4 minutes. Use only freshly prepared solution.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of omeprazole. Round the dose to the nearest 0.4mg. Indicate the times of administration by circling the appropriate times on the prescription chart.

ALWAYS prescribe to be given at 1100.

**Note**

Ensure line is adequately flushed with 0.9% sodium chloride between doses.

**Caution** See BNF for Children

**Side effects** See BNF for Children

**Incompatibilities** Midazolam hydrochloride.

**Further information**:

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# Pancuronium bromide

**Form** 4mg in 2mL ampoules containing 2mg/mL of pancuronium bromide

**Reconstitution** Already in solution. Dilute further before use.

**Use** Non-depolarising neuromuscular blocking drug given for sustained paralysis in babies. Only to be used with adequate sedation.

**Dose** 80microgram/kg by slow intravenous injection, repeated every 4-6hours as necessary.

**Method:** Withdraw 0.5mL of 2mg/mL solution and mix with 0.5mL of sodium chloride 0.9% solution to obtain a preparation containing 100micrograms in 0.1mL. Inject slowly over 20seconds.

**How to prescribe:** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart in the as required section.

 Document the dose of pancuronium bromide, rounded to the nearest 20microgram.

**Route of**

**Administration:** Can be administered via a peripheral line

**Dose volume of pancuronium bromide 100microgram in 0.1mL**.

|  |  |  |
| --- | --- | --- |
| **Weight (kg)** | **Rounded Dose (micrograms)** | **Dose volume (mL)** |
| 0.4 - 0.6 | 40 | 0.04 |
| 0.7 - 0.8 | 60 | 0.06 |
| 0.9 - 1.1 | 80 | 0.08 |
| 1.2 - 1.3 | 100 | 0.1 |
| 1.4 - 1.6 | 120 | 0.12 |
| 1.7 - 1.8 | 140 | 0.14 |
| 1.9 - 2.1 | 160 | 0.16 |
| 2.2 - 2.3 | 180 | 0.18 |
| 2.4 - 2.6 | 200 | 0.2 |
| 2.7 - 2.8 | 220 | 0.22 |
| 2.9 - 3.1 | 240 | 0.24 |
| 3.1 - 3.3 | 260 | 0.26 |
| 3.4 - 3.6 | 280 | 0.28 |
| 3.7 - 3.8 | 300 | 0.3 |
| 3.9 - 4.1 | 320 | 0.32 |

**Note:** You will never need more than a single vial to administer the correct dose.

**Caution/side effects** Use of magnesium sulphate or gentamicin may enhance clinical effect.

**Incompatibilities** No data available.

**Reference** Neonatal Formulary 7th Edition, BMJ Books, Blackwell Publishing 2015

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# Paracetamol Infusion

**Form** 10mg/mL paracetamol solution for intravenous infusion. Available as 50mL vial.

**Reconstitution** Already in solution

**Use** Analgesic

**Dose** Give loading dose of 20mg/kg then the following maintenance dose.

* Pre-term babies (<32 weeks post-conceptional age) – 10mg/kg IV every 8 hours
* Pre-term babies (33 to <36 weeks post-conceptional age) – 7.5mg/kg IV every 8 hours
* Term babies – 10mg/kg IV every 6 hours

**Diluent** Can be given undiluted or diluted to a concentration of 1mg/mL in glucose 5% or sodium chloride 0.9%. Use within 1 hour of dilution.

**Method** Give by intravenous infusion over 15 minutes.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of paracetamol, rounded to the nearest 1mg. Indicate administration times by documenting the schedule as every 4 hours or every 6 hours or by circling the appropriate schedule time on the prescription chart.

**Route of**

**Administration:** Can be administered peripherally.

**Note:**

One supply of paracetamol infusion is labelled: *“Only for patients weighing more than 33kg”.* This solution is safe for neonates, as long as the prescribed dose is as detailed above.

**Caution/side effects** Caution in cases of poor nutrition, severe disease and renal disease. Very high doses may cause liver failure. Overdose with paracetamol is particularly dangerous as it may cause hepatic damage which is not apparent for 4 to 6 days.

**Incompatibilities** Paracetamol should not be mixed with other medicinal products.

**Reference:**

Neonatal Formulary, 7th Edition, BMJ Books, Blackwell Publishing 2015

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# Phenobarbital Sodium

**Form:** 30mg/mL or 60mg/mL phenobarbital sodium

**Reconstitution:** Already in solution

**Use:** Seizures

**Dose:** Loading dose 20mg/kg. If no response in 15minutes give further loading dose of 10mg/kg. If no response, give final loading dose of 10mg/kg.

Maintenance dose 2.5 – 5mg/kg once daily. When to start maintenance therapy will depend upon loading dose given and severity of seizures. Please discuss with lead clinician before commencing maintenance medication.

**Dilution:** If using 30mg/mL solution, draw up phenobarbital sodium into syringe and dilute to 10 times volume with water for injection. The diluted solution will now contain 3mg/mL.

 If using 60mg/mL solution, draw up phenobarbital sodium into syringe and dilute to 10 times volume with water for injection. The diluted solution will now contain 6mg/mL.

Ensure adequate mixing by gentle movements of the plunger

**How to prescribe:** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of phenobarbital sodium, rounded to the nearest 3mg. Do not use a decimal point. Indicate the times of administration by circling the appropriate times on the prescription chart.

**Method:** Give 20mg/kg by slow intravenous injection over 20 - 30 minutes at a maximum rate of 1mg/kg/minute. Give 10mg/kg by slow intravenous injection over 10minutes.

**Therapeutic Drug Monitoring**

**Record the exact time of blood sampling, using the 24hour clock, on the therapeutic drug monitoring sheet.**

**Record the time of administration of each dose of phenobarbital sodium, using the 24hour clock. Document the start and finish time on the prescription chart.**

**Sampling Time:**Immediately before next dose.

**Target Range:** 20 to 40mg/L. Note prolonged elimination half-life in neonates therefore serum concentrations may continue to rise for up to 4 weeks

**Note**

* Phenobarbital is a Schedule 3 Controlled Drug. Store in the CD cupboard. Order via the ward CD book.
* In fluid restricted neonates a concentration of 15mg/mL may be used at the rate of 1mg/kg/minute
* Loading dose of up to 40mg/kg exceeds the BNF for Children (1) recommendation but is supported by the Neonatal Formulary (2).

**Caution/side effects** Respiratory depression, shock, hypotension or laryngospasm may occur if administered too quickly. Avoid injection into the umbilical artery cannula in neonates. Phenobarbital is highly alkaline (pH10-11) and may cause severe extravasation injury, hence dilution is advisable. Use lower doses and monitor concentrations closely in liver and renal disease.

**Incompatibilities** Avoid mixing with parenteral nutrition solutions during administration.

**Further information**: see [neonatal seizures](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

**Reference**

Neonatal Formulary, 7th Edition, BMJ Books, Blackwell Publishing 2015

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# Phenytoin Sodium

**Form** 250mg/5mL phenytoin sodium.

**Reconstitution** Already in solution

**Use:**  Seizures

**Dose**  Loading Dose 20mg/kg

 Maintenance Dose 2.5mg/kg 12 hourly

**Method of**

**administration:** Give by slow intravenous injection at a rate no greater than 1mg/kg/minute or by intravenous infusion over 20-30 minutes**. Phenytoin sodium must be administered through an in-line filter (0.22 - 0.5 micron),** hence infuse the solution via a 3-way tap distal to the in-line IV filter.

To avoid local venous irritation before and after each injection or infusion of phenytoin sodium, infuse sterile sodium chloride 0.9% intravenous infusion through the same needle or catheter. Prime the administration line with sodium chloride 0.9% intravenous infusion then infuse the appropriate volume of phenytoin sodium. Care must be taken after giving phenytoin sodium to ensure that the sodium chloride flush is administered slowly otherwise the residual drug contained within the infusion device will be delivered as a bolus dose.

**Diluent:** Dilute in sodium chloride 0.9% to a concentration of 5mg/mL using the method outlined below.

**Solution for**

**infusion:** Draw up 5mL of sodium chloride 0.9% into a syringe. Into the same syringe draw up 1mL of 250mg/5mL phenytoin sodium injection. Ensure the solution is thoroughly mixed by gentle movement of the plunger. Make up to a final volume of 10mL with sodium chloride 0.9%. Again mix the solution. The prepared solution has a concentration of 5mg/mL.

Complete administration within 1 hour of preparation. Examine the infusion for particles or discolouration and discontinue if present.

**How to prescribe:** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the loading dose in the Parenteral Drugs-Once Only Prescriptions section. Round the dose to the nearest 1mg. Document the maintenance dose in the Regular Prescriptions section. Do not use a decimal point. Indicate the times of administration by circling the appropriate times on the prescription chart.

**Route of**

**Administration:** Infuse via a central line, but if not possible use the largest bore vein available.

**Therapeutic Drug Monitoring:**

**Record the exact time of blood sampling, using the 24hour clock, on the therapeutic drug monitoring sheet.**

**Record the time of administration of each dose of phenytoin sodium, using the 24hour clock. Document the start and finish time on the prescription chart.**

The target range for phenytoin in neonates is 6-14mg/L. A higher concentration range of 18 to 24mg/L may be requested by a consultant neurologist. Measure concentrations at least 2 hours after an intravenous loading dose, to confirm adequacy or otherwise. Also measure concentrations following a change in clinical status, for example, change in route of administration or formulation, maintenance dose and addition or deletion of drugs known to alter metabolism or absorption. Note it may take 14days to reach steady state. When receiving a maintenance dose, sample blood immediately before the next dose. This result will reflect the lowest concentration within the dosing cycle. If the concentration appears to be falling, following a concentration within the target range, consider whether another loading dose should be given or the maintenance dose should be increased or both. This should be discussed with the pharmacist covering neonates.

**Caution/side effects** May cause restlessness or drowsiness, vomiting, nystagmus and

 pupillary dilation.

**Incompatibilities** Do not mix with solutions containing glucose.

**Further information**: see [neonatal seizures](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

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# Phosphate

**Form:** Ready-made syringes containing 0.2mmol/mL of phosphate in 50mL of glucose 10% are available from pharmacy. The solution also contains 0.15mmol/mL of sodium and potassium.

**Use:** Hypophosphataemia less than 1.4mmol/L. Supplement and replacement of deficiency.

**Dose:** 0.5mL/kg/hour of a 0.2mmol/mL solution will deliver approximately 2mmol/kg/day. The right dose to correct hypophosphataemia is not precisely known: use the dosing table below to select an appropriate infusion rate. This does not need to be changed based on weight, but can be changed if the serum phosphate does not increase.

|  |  |
| --- | --- |
| **Weight band (kg)** | **Infusion rate (mL/hour)** |
| 0.4 - 0.59 | 0.2 |
| 0.6 - 0.89 | 0.3 |
| 0.9 - 1.09 | 0.4 |
| 1.1 - 1.39 | 0.5 |
| 1.4 - 1.69 | 0.6 |
| 1.7 - 1.89 | 0.7 |
| 1.9 - 2.09 | 0.8 |
| 2.1 - 2.39 | 0.9 |
| 2.4 - 2.69 | 1 |

**How to prescribe:** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the concentration of phosphate and infusion rate.

**For example**: For a 1.12kg baby.

Drug: *Phosphate*

Dose: *0.2mmol/mL*

Diluent: *Glucose 10%*

Total volume: *50mL*

~~Maximum~~ infusion rate: *0.5mL/h*

Dose range: *approximately 2mmol/kg/day*

Other instructions: *Use ready-prepared syringe only*

**Route of administration:** Give by intravenous infusion into a central line or the largest vein available over 24hours.

**Note**

Monitor serum phosphate concentrations and adjust/stop infusion accordingly. Measure potassium concentrations at least each day.

Due to the potassium concentration (ready-made syringes contain 150mmol/L), intravenous phosphate solutions are treated as a controlled drug at Wirral Hospitals.

Ready to use syringes, containing 0.2mmol/mL of phosphate in 50mL of glucose 10% are available on request from Pharmacy Aseptic Unit (Ext 2832).

**Ordering** Complete **requisition** in **CD order book** and bring book to pharmacy.

When ordering syringes you must state the concentration of phosphate in

each syringe (0.2mmol/mL) and diluent (glucose 10%).

**Caution** May cause tissue necrosis on extravasation. 0.5mL/kg/hour will also

 deliver 1.5mmol/kg/day of both sodium and potassium. This needs to be

 included in all calculations of sodium and potassium delivered.

 Hypocalcaemia and tetany may occur with rapid increases in plasma

 phosphate.

**Side effect** Hypotension, oedema, hypocalcaemia, acute renal failure, phlebitis.

**Incompatibilities** Calcium and magnesium containing solutions - may precipitate. Do not co-infuse with PN bag 2 or 3 which both contain calcium.

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# Piperacillin/Tazobactam

**Form** Vials containing 2g of piperacillin and 250mg of

 tazobactam.

**Reconstitution** Dissolve the 2.25g powder in 9.7mL water for injection to give a stock solution containing approximately 200mg/mL.

**Use** Piperacillin/Tazobactam is an antipseudomonal penicillin.

**Dose** 90mg/kg/dose every 8 hours. Note dose is expressed in terms of piperacillin and tazobactam combined.

**Route of** Administer via a peripheral vein by intravenous bolus injection

**Administration** over 3-5minutes. Can also be administered by intermittent intravenous infusion over 20-30 minutes. Use only freshly prepared solution.

**Method** Further dilution is required ONLY if given by intravenous infusion.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

Document the dose of Piperacillin/Tazobactam, rounded up to the nearest 20mg.

Do not use a decimal point.

Indicate the times of administration by circling the appropriate times on the prescription chart.

**Diluent** Dilute to a concentration of 15-90mg/mL with glucose 5% or sodium chloride 0.9% or to a concentration of 90mg/mL with water for injection.

**Note** Each 2.25g vial of Tazocin® contains 1.4mmol of sodium. Different brands of piperacillin/tazobactam have a displacement volume of either 1.6mL or 1.7mL. ALWAYS use the reconstitution outlined above which will give a concentration of approximately 200mg/mL.

**Caution/side effects** See BNF for Children.

**Incompatibilities** Aciclovir, amphotericin, dobutamine hydrochloride, ganciclovir, gentamicin and vancomycin hydrochloride. Please ensure line is adequately flushed with water for injection or sodium chloride 0.9% intravenous infusion between doses.

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#

# Potassium Chloride

**Form** Ready-made syringes containing potassium chloride 0.3mmol/mL in 50mL of glucose 10%, syringe for infusion.

**Reconstitution** Already in solution.

**Use** Potassium supplement.

**Dose** Individualised according to blood results.

Maintenance dose is 1mmol/kg/day.

Replacement dose for hypokalaemia is 2-4mmol/kg/day.

When calculating the additional potassium that is required, it is important to take account of the electrolytes administered in the TPN bag or concomitant infusions, such as phosphate.

**Infusion rate (mL/hour) to deliver additional potassium.**

**Infusion rates in the following table give approximate doses.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Weight (kg)** | **1mmol/kg/day** | **2mmol/kg/day** | **4mmol/kg/day** |
| 0.5 | 0.1 | 0.1 | 0.3 |
| 0.6 | 0.1 | 0.2 | 0.4 |
| 0.8 | 0.1 | 0.2 | 0.5 |
| 1 | 0.1 | 0.3 | 0.6 |
| 1.25 | 0.2 | 0.3 | 0.7 |
| 1.5 | 0.2 | 0.4 | 0.9 |
| 1.75 | 0.2 | 0.5 | 1 |
| 2 | 0.3 | 0.6 | 1.2 |
| 2.5 | 0.3 | 0.7 | 1.4 |
| 3 | 0.4 | 0.8 | 1.7 |
| 3.5 | 0.5 | 1 | 2 |
| 4 | 0.6 | 1.1 | 2.3 |

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

State the strength of potassium chloride (0.3mmol/mL) and the diluent.

Document a maximum infusion rate, based on whether you want a maintenance or replacement dose, and the approximate quantity of **extra** potassiumthat is required (mmol/kg/day).

**For example:** for a 0.8kg infant

Drug: *Potassium chloride*

Dose: *0.3mmol/mL*

Diluent: G*lucose 10% solution*

Total volume: *50mL*

Maximum infusion rate: *0.5mL/hour*

Dose range: *0 to approximately 4mmol/kg/day of potassium*

Other instructions: *Start with 1mmol/kg/day and adjust according to serum potassium concentrations*

**Route of**

**Administration** Administer via the largest vein possible.

**Ordering** Complete **requisition** in **CD order book** and bring book to

 pharmacy.

**Cautions / side effects** Serum potassium concentrations must be measured and reviewed

 at least once every 24hours for patients receiving maintenance

 therapy. Serum potassium concentrations should ideally be

 measured and reviewed at least every 8hours for patients being

 treated for hypokalaemia.

**Incompatibilities** Phenytoin sodium.

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# Prostaglandin E2 (Dinoprostone injection)

**Form** 750microgram/0.75mL equivalent to 1mg/mL dinoprostone.

**Reconstitution** Already in solution. Dilute further before administration.

**Use** Maintain patency of ductus arteriosus in babies with suspected or proven ductdependent cardiac anomalies.

**Dose unventilated infant** 5 to 10 nanogram/kg/minute
(equivalent to 0.3 to 0.6 microgram/kg/hour)

**ventilated infant** 5 to 100 nanogram/kg/minute
(equivalent to 0.3 to 6 microgram/kg/hour)

**Diluent** Dilute in glucose 5%, sodium chloride 0.9% or glucose 10%. Prepare a fresh solution every 24 hours.

**Solution for infusion:** Unlike other solutions, prostaglandin E2 is generally used as SINGLE concentration only.

(The CONCENTRATED solution is for use in babies receiving 50nanogram/kg/min or above. Use must be discussed with a consultant and / or cardiology – see notes below. Care must be taken when using this at handover, and when a baby is being transferred.)

**SINGLE strength solution** – Draw up 0.5mL (0.5mg) prostaglandin E2 (1mg/mL) into a syringe using a filter needle.

Add this to a 500mL bag of one of the above diluents - final concentration 1microgram/mL.

Calculate the infusion rate using the table below:

|  |  |
| --- | --- |
| **Dose Required****(nanogram/kg/minute)** | **Infusion Rate (mL / kg / hour)****NB – you must multiply this number by the weight** |
|  | SINGLE |
| 3 | 0.18 |
| 5 | 0.3 |
| 10 | 0.6 |
| 50 | 3 |
| 100 | 6 |

NOTE: 10 nanogram/kg/minute is equivalent to 0.6 microgram/kg/hour

**How to prescribe:**

Document the volume of dinoprostone 1mg/mL to be added to 500mL of solution. Name the diluent. State the dose range required and corresponding infusion rate. Note for this drug a maximum infusion rate is not appropriate. Please score out the word maximum and state the required infusion rate. Do not approximate or round up.

State that this is SINGLE strength solution and specify the concentration.

**For example**: For a 1.5kg baby.

Drug: *Dinoprostone*

Dose: *0.5mL of 1mg/mL solution*

Diluent: *Sodium chloride 0.9%*

Total volume: *500mL*

~~Maximum~~ infusion rate: *0 to 0.9 mL/hour*

Dose range: 0 *to 10 nanogram/kg/minute*

Other instructions: *This is a SINGLE strength solution containing 1microgram/mL*

**Route of administration:** Give as a continuous intravenous infusion.

**Note**

Prostaglandin E2 is rapidly inactivated in the lung and has a very short half life (less than a minute). No loading dose is needed.

**Caution/side effects** May cause profound respiratory depression or apnoea. Do not give an iv bolus.

**Incompatibilities:** Prostaglandin E2 should never be infused simultaneously through the same line as any other drug.

**CONCENTRATED** **solution** – should be used for doses of 50nanogram/kg/minute or above, or in specific circumstances after discussion with the consultant and / or cardiology (eg high dose needed or in fluid restricted infant).

Draw up 0.5mL (0.5mg) prostaglandin E2 (1mg/mL) into a syringe using a filter needle.

Dilute to 50mL with one of the above diluents - final concentration 10micrograms/mL.

Calculate the infusion rate using the table below:

|  |  |
| --- | --- |
| **Dose Required****(nanogram/kg/minute)** | **Infusion Rate (mL / kg / hour)****NB – you must multiply this number by the weight** |
|  | CONCENTRATED |
| 5 | 0.03 |
| 10 | 0.06 |
| 50 | 0.3 |
| 100 | 0.6 |

NOTE: 10 nanogram/kg/minute is equivalent to 0.6 microgram/kg/hour

**How to prescribe:**

Document the volume of dinoprostone 1mg/mL to be added to 49.5mL of solution. Name the diluent. State the dose range required and corresponding infusion rate. Note for this drug a maximum infusion rate is not appropriate. Please score out the word maximum and state the required infusion rate. Do not approximate or round up. State that this is CONCENTRATED solution and specify the concentration.

**For example**: For a 4.5kg baby.

Drug: *Dinoprostone CONCENTRATED strength*

Dose: *0.5mL of 1mg/mL solution*

Diluent: *Sodium chloride 0.9%*

Total volume: *to final volume of 50mL*

~~Maximum~~ infusion rate: *0.27 to 1.35 mL/hour*

Dose range: *10 to 50 nanogram/kg/minute*

Other instructions: *This is a CONCENTRATED solution containing 10microgram/mL*

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# Ranitidine Hydrochloride

**Form** 50mg/2mL equivalent to 25mg/mL ranitidine hydrochloride.

**Reconstitution** Already in solution. Further dilute before administration.

**Use** Inhibit gastric acid secretion

**Dose** 1mg/kg every 8 hours by slow intravenous injection or intermittent intravenous infusion.

**Diluent** Dilute in sodium chloride 0.9%, glucose 5% or glucose 10%.

**Method** Withdraw 5mL of diluent into a 10mL syringe. Inject 1mL of ranitidine injection into the syringe and mix. Further dilute to final volume of 10mL. The solution now contains 2.5mg/mL. Withdraw an appropriate volume of this solution and inject slowly over 2 to 5 minutes. Alternatively the dose may be further diluted and administered by intravenous infusion.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of ranitidine, rounded to the nearest 0.25mg. Indicate the times of administration by circling the appropriate times on the prescription chart.

**Route of**

**Administration** Can be administered via a peripheral line

**Incompatibilities** Ranitidine should never be infused simultaneously through the same line as dinoprostone (prostaglandin E2).

**Note**

Ready to use syringes containing 2.5mg/mL in sodium chloride 0.9% are available on request from Pharmacy Aseptic Unit (Ext 2832). When ordering you must state whether it is for iv bolus, which requires no overage, or iv infusion which requires excess in the syringe to allow priming the line.

**Caution/side effects** Rapid administration may cause cardiac arrhythmia.

**Incompatibilities** No data available.

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# Rifampicin

**Form** 600mg vial with water for injection

**Reconstitution** Reconstitute and dilute further before use.

**Use** Used synergistically with teicoplanin or vancomycin. Use of rifampicin is restricted and must be approved by a consultant before use, usually following discussion with the clinical microbiologist.

**Dose** 10mg/kg twice daily.

**Method** Add 9.5mL of water for injection, to 600mg vial to get solution containing 60mg/mL. Take 1mL (60mg) of this solution, and dilute to 10mL with glucose 5% or 10% to obtain a solution containing 6mg/mL. Use within 6hours. Infuse the prescribed dose slowly over 30minutes.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

 Document the dose of rifampicin in glucose 5% or 10% solution, rounded up to the nearest 0.6mg.

**Route of**

**Administration** Administer via the largest vein possible. Flush slowly after administration.

**Note** Rifampicin is an enzyme inducer and may increase clearance of other drugs: discuss possible drug interactions with pharmacist.

**Caution/** May cause hypotension and phlebitis. Tears, urine and secretions will be

**side effects** stained red. Inform parents of this before giving the first dose.

**Incompatibilities** Sodium bicarbonate.

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# Salbutamol

**Form** 5mL ampoules containing 500microgram/mL salbutamol.

**Use** Severe hyperkalaemia**.** Salbutamol is a synthetic sympathomimetic drug which acts on ß adrenergic receptors. Drug binding to liver and muscle adrenergic receptors increase cellular uptake of potassium through a cyclic GMP mediated system.

**Dose**  4 microgram/kg IV bolus.

 A further dose may be given after a minimum of 2 hours.

**Diluents** Dilute in sodium chloride 0.9%, glucose 5% or glucose 10%.

**Administration**  Initially dilute 0.4mL of salbutamol to a total volume of 20mL with a suitable diluent to give a solution with a concentration of 10 microgram/mL. Use this solution to draw up the required dose. Further dilute this amount to give an appropriate volume for intravenous administration (eg 2mL). Give as a slow intravenous bolus (or intravenous infusion) over 5 to 10 minutes.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart as a stat dose. Document the dose of salbutamol, rounded to the nearest 1microgram.

**Route of**

**Administration** Can be given through a peripheral intravenous cannula.

**Note**

**Side effects** Tachycardia

**Incompatibilities** Aminophylline.

**Other Information** Salbutamol in neonatal hyperkalaemic renal failure is not licensed, but is used off-label.

**Further information**: see [Hyperkalaemia in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/) clinical guideline.

**References :**

Neonatal Formulary, 7th Edition, BMJ Books, Blackwell Publishing 2015

Greenough A et al. Salbutamol infusion to treat neonatal hyperkalaemia. J Perinat Med 1992; 20:437-41

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# SMOFlipid 20% with Solivito and Vitlipid N emulsion

**Form** Ready-made syringes containing SMOFlipid 20% with Solivito and Vitlipid N emulsion

**Reconstitution** Already in solution.

**Use** Lipid component of total parenteral nutrition.

**Dose** Gradually increase infusion rate as detailed below.

|  |  |  |
| --- | --- | --- |
| Day of TPN | Dose (mL/kg/day) | Calories/day (kCal/kg/day) |
| 1 | 5 | 10 |
| 2 | 10 | 20 |
| 3 and greater | 15 | 30 |

To calculate hourly infusion rate multiply the dose (mL/kg/day) by weight (kg) and divide by 24.

NB: If patient septic, do not give more than 5mL/kg/day. Monitor triglyceride levels in serum.

**Method** Administer via Syringe Driver by continuous intravenous infusion.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

Document the infusion rate in mL/hour and the dose range in mL/kg/day.

Document the need to use ready prepared infusions.

**For example For a 0.74kg neonate**

Drug: *Solivito in 2mL Vitlipid N emulsion*

Dose: *not applicable*

Diluent: *SMOFlipid 20%*

Total volume: *to a final volume of 32mL*

Maximum infusion rate: *0.5mL/hour*

Dose range: *0 to 15mL/kg/day*

Other instructions: *Use ready prepared infusions only.*

**Note** Each syringe contains 30mL of SMOFlipid 20% with 2mL of Vitlipid

 N emulsion and 20% of a vial of Solivito.

**Ordering** SMOFlipid 20% syringes with Solivito and Vitlipid N emulsion must

 be requested from pharmacy on an individual patient basis.

**Caution/side effects** See BNF.

**Incompatibilities** NNF-7 suggests compatible with insulin, heparin, vancomycin,

 noradrenaline. Should never be co-infused with any other drug.

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# Sodium Bicarbonate

**Form** 4.2% solution which contains 0.5mmol of sodium bicarbonate per mL.

(Also available as 8.4% solution, which contains 1mmol/mL of sodium bicarbonate)

**Reconstitution** Already in solution.

**Indication** 1. To correct severe metabolic acidosis, including as a result of hyperkalaemia.

 2. During resuscitation.

**Dose** 1. Calculate a half correction by multiplying:

blood gas base deficit x weight (kg) x 0.3

This gives the volume in mL of 4.2% sodium bicarbonate.

If a full correction is required, double the figure.

Dose volumes greater than those stated overleaf MUST be confirmed with the duty consultant.

2. For resuscitation, or for emergency use, use 2-4mL/kg of 4.2% sodium bicarbonate intravenous infusion (1-2mmol/kg).

**Diluent** Further dilution not generally required. Can be diluted with glucose 5% if necessary.

**Method** 1. Give a half correction as an intravenous infusion over 30minutes.

Bicarbonate can work better when given over a longer time period.

To calculate the infusion rate for a continuous intravenous infusion, calculate the dose for a half correction and divide this by 6 to give the hourly rate. This rate should be reviewed with each blood gas.

Dose volumes greater than those outlined in table 1 overleaf must be confirmed with the duty consultant.

2. In resuscitation / emergency use inject at rate less than 0.5mmol/kg/minute ie less than 1mL/kg/minute when using the 4.2% solution.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

Document the concentration and volume of sodium bicarbonate intravenous infusion to be infused and state the infusion rate.

**Example** Infant weighs 0.72kg. Base deficit 11.

Replacement dose for a half correction is:

11 x 0.72 x 0.3 = 2.4mL

So prescribe, *”Sodium bicarbonate intravenous infusion 4.2%, infuse 2.4mL over 30 minutes.”*

If only the 8.4% solution is available you would need to give half the volume so prescribe, *”Sodium bicarbonate intravenous infusion 8.4%, infuse 1.2mL over 30 minutes.”*

**Or** For a continuous intravenous infusion, divide this volume by 6 to give an hourly rate, ie sodium bicarbonate intravenous infusion 4.2%, infused at 0.4mL/hour.

**Route of**

**Administration** Administer through an umbilical venous catheter or long line if possible, through a separate lumen. Can be administered via a peripheral line.

**Note**  Check a blood gas after the infusion is complete.

**Table 1. Doses greater than below MUST be confirmed with duty consultant.**

|  |  |  |
| --- | --- | --- |
| **Weight** | **Dose volume for half correction** | **Dose volume for full correction** |
| <1kg | 5mL | 10mL |
| 1-<2kg | 10mL | 20mL |
| 2-<3kg | 14mL | 28mL |
| 3-<4kg | 18mL | 36mL |
| 4-<5kg | 22mL | 44mL |

**Caution/side effects** If given via peripheral line observe closely for redness, swelling or blanching during infusion as tissue damage can be severe. Tissue extravasation can be managed with hyaluronidase. Use of a dilute preparation reduces the risk of serious tissue damage.

**Incompatibilities** Do not mix with other medicines due to the alkaline pH. Ensure that during resuscitation lines are flushed well between giving bicarbonate and adrenaline. Should be given via its own line. Incompatible with dobutamine hydrochloride, dopamine hydrochloride, morphine sulphate and solutions containing calcium, magnesium or phosphates such as TPN.

**Why do we calculate a half correction in mL rather than mmol?**

The mmol of bicarbonate required to correct acidosis is calculated by:

F x blood gas base deficit (mmol/L) x weight (kg).

F represents the extracellular fluid: weight ratio. This is 0.5-0.6 in premature neonates, 0.4 in neonates and 0.3 in infants and children. Only **half** the base deficit should be corrected initially by slow IV infusion and blood glucose, pH and electrolytes analysed before full correction.

The calculation of half and full correction used at Wirral gives the volume of sodium bicarbonate 4.2% in mL because we have already multiplied the F factor by 0.5, the mmol/mL of bicarbonate in 4.2% solution. We also use a fixed F value so all neonates get the same dose of bicarbonate and do not differentiate between premature and term neonates.

It is usual to only give a **half correction initially**, however after analysis of blood glucose, pH, and electrolytes a further half correction can be given.

Some sources state the maximum daily dose should not exceed 8mmol/kg due to a risk of hypernatraemia and rebound alkalosis.

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# Sodium Chloride

**Form** Ready-made syringes containing sodium chloride 0.3mmol/mL in 50mL of glucose 10%, syringe for infusion.

**Reconstitution** Already in solution.

**Use** Sodium supplement.

**Dose** Individualised according to blood results.

When calculating the additional sodium required it is important to take account of the electrolytes administered in the TPN bag (see electrolyte infusion guideline).

**Infusion rate (mL/hour) to deliver additional sodium. Infusion rates quoted in the following tables give approximate doses.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Weight (kg)** | **2mmol/kg/day** | **4mmol/kg/day** | **8mmol/kg/day** |
| 0.5 | 0.1 | 0.3 | 0.6 |
| 0.6 | 0.2 | 0.3 | 0.7 |
| 0.8 | 0.2 | 0.4 | 0.9 |
| 1 | 0.3 | 0.6 | 1.2 |
| 1.25 | 0.3 | 0.7 | 1.4 |
| 1.5 | 0.4 | 0.8 | 1.7 |
| 1.75 | 0.5 | 1 | 2 |
| 2 | 0.6 | 1.1 | 2.3 |
| 2.5 | 0.7 | 1.4 | 2.8 |
| 3 | 0.8 | 1.7 | 3.3 |
| 3.5 | 1 | 1.9 | 3.9 |
| 4 | 1.1 | 2.2 | 4.5 |

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart.

State the strength of sodium chloride (0.3mmol/mL) and the diluent.

Document a maximum infusion rate, based on whether you want a maintenance or replacement dose, and the approximate quantity of **extra** sodiumthat is required (mmol/kg/day).

**For example**: For a 1.5kg infant

Drug: *Sodium chloride*

Dose: *0.3mmol/mL*

Diluent: G*lucose 10% solution*

Total volume: *50mL*

Maximum infusion rate: *1.7mL/hour*

Dose range: *0 to approximately 8mmol/kg/day of sodium*

Other instructions: *Start with 2mmol/kg/day and adjust according to serum sodium concentrations*

**Route of**

**Administration** Administer via the largest vein possible.

**Note Ordering**

Sodium chloride syringes are a stock medicine. To obtain further supply please order on Cerner by selecting **Communicate**, using the **NNU stock meds request,** and sending the message to **Aseptic Stock Requests** stating how many syringes are required.

0.3mmol/mL sodium chloride is equivalent to a 1.8% w/v solution and is thus, *“Double-strength normal saline.”*

**Caution/** See BNF for Children.

**Side effects**

**Incompatibilities** Amphotericin.

**Oral sodium chloride**

**Sodium chloride 5mmol/mL oral solution** is used for supplementation. Start with 0.2mL/kg/dose four times each day, which gives 1mmol/kg/dose, and adjust according to serum sodium concentrations.

Prescribe the dose in mL and specify the preparation, on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the approximate quantity of sodium chloride required (mmol/kg/day) in the “Other information” section.

The table gives volume (mL) of **sodium chloride 5mmol/mL oral solution for each dose, four times each day** to give 2, 4 or 8mmol of sodium per kilogram per day.

|  |  |  |  |
| --- | --- | --- | --- |
| **Weight (kg)** | **2mmol/kg/day** | **4mmol/kg/day** | **8mmol/kg/day** |
| 0.5 | 0.05 | 0.1 | 0.2 |
| 0.6 | 0.06 | 0.12 | 0.24 |
| 0.8 | 0.08 | 0.16 | 0.32 |
| 1 | 0.1 | 0.2 | 0.4 |
| 1.25 | 0.13 | 0.26 | 0.5 |
| 1.5 | 0.15 | 0.3 | 0.6 |
| 1.75 | 0.18 | 0.36 | 0.7 |
| 2 | 0.2 | 0.4 | 0.8 |
| 2.5 | 0.25 | 0.5 | 1 |
| 3 | 0.3 | 0.6 | 1.2 |
| 3.5 | 0.35 | 0.7 | 1.4 |
| 4 | 0.4 | 0.8 | 1.6 |

***Prescribing Example for a 1.5kg baby:***

Drug: *Sodium chloride 5mmol/mL oral solution*

Dose: *0.3mL four times each day*

Route: *Oral*

Other instructions: *This will give approximately 4mmol/kg/day*

**Extra Information:**

* As a rough guide, the amount of additional sodium (in mmol) to be added to the patient’s current intake can be calculated via:

(138 – Serum Sodium) x 0.3 x Weight (kg)

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# Suxamethonium chloride

**Form** Ready-made syringes containing suxamethonium chloride 10mg in 2mL of sodium chloride 0.9% solution.

**Reconstitution** Already in solution. Further dilute before administration.

**Use** Depolarising neuromuscular blocking drug to be used in neonates only in accordance with, “Premedication for elective/semi‐elective intubation clinical guideline.” Provides short term muscle paralysis.

**Warning** Staff must **never** paralyse a baby unless they are confident that they can keep the airway open and hand-ventilate the baby.

**Dose** 2mg/kg by a rapid intravenous push.

Flush with 1mL of sodium chloride 0.9% over 1minute to ensure no muscle relaxant remains within the line.

**Dose volume of suxamethonium chloride 5mg/mL**.

|  |  |  |
| --- | --- | --- |
| **Weight (kg)** | **Rounded Dose (mg)** | **Dose volume (mL)** |
| 0.4 | 1 | 0.2 |
| 0.6 | 1 | 0.2 |
| 0.8 | 1.5 | 0.3 |
| 1 | 2 | 0.4 |
| 1.25 | 2.5 | 0.5 |
| 1.5 | 3 | 0.6 |
| 2 | 4 | 0.8 |
| 3 | 6 | 1.2 |
| 4 | 8 | 1.6 |

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart in the once only prescriptions section.

 Document dose of suxamethonium chloride, rounded to nearest 0.5mg.

**Route of** Can be administered via a peripheral line

**Administration**

**Note**

**Caution/** Suxamethonium produces a rapid and complete muscle paralysis within **side effect** 30 seconds after intravenous injection, which usually lasts only 3 to 6

minutes. Its action cannot be reversed. Suxamethonium may increase

plasma potassium concentrations. Suxamethonium must not be used if there is suspicion of muscular dystrophy, significant hyperkalaemia or a

family history of malignant hyperthermia.

**Incompatibilities** Phenobarbital sodium and sodium bicarbonate.

**If suxamethonium chloride syringes are not available suxamethonium must be prepared as detailed below:**

**Method** Obtain a single ampoule of 100mg/2mL suxamethonium chloride. Withdraw 5mL of sodium chloride 0.9% into a 10mL syringe.
Inject 1mL of suxamethonium chloride injection into the syringe and mix.
Further dilute to final volume of 10mL.
The solution now contains 5mg/mL.
Withdraw an appropriate volume of this solution and inject as a rapid intravenous push.

**Note Ordering**

Suxamethonium chloride syringes are a stock medicine. To obtain further supply please order on Cerner by selecting **Communicate**, using the **NNU stock meds request,** and sending the message to **Aseptic Stock Requests** stating how many syringes are required.

**Further information**: see [pre-medication for elective/semi-elective intubation in neonates](http://www.wuth.nhs.uk/staff/clinical/clinical-guidance/clinical-guidelines/)

clinical guideline.

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# Synacthen Test (Short)

**Form** Vial containing 250 microgram per 1mL of tetracosactide for

 intravenous (IV) injection

**Reconstitution** Dilute 1mL, containing 250 microgram, to a total of 5mL with
sodium chloride 0.9% to give a solution containing 50microgram/mL

**Use** Diagnostic test for investigation of adrenal reserve.

 Administration of tetracosactide should stimulate the adrenals to

 produce cortisol. Failure to respond suggests some degree of

 adrenal insufficiency.

**Dose** 36 microgram/kg in neonates. Round to nearest 10microgram

 250microgram for all babies >1 month

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription

 Chart as a stat dose. Round the dose to the nearest

 10microgram. Document on the line below the prescribed dose

 *“Measure blood samples immediately before and at 30 and*

 *60minutes after giving the dose.”*

**Route of** Give as a slow IV injection over 2-3 minutes via a peripheral

**administration** cannula.

**Blood samples** Sample immediately before the tetracosactide to measure

 baseline cortisol, then at 30 minutes post tetracosactide and at

 60 minutes post tetracosactide. Put in green capped bottles and send to

 Biochemistry at Arrowe Park Hospital. Label bloods as 0,

 30minutes and 60minutes and send with the patient details.

 **Note** Samples should be ordered as a single Synacthen Test (not

 separate cortisol levels). Results will be reported on Wirral

 Millennium.

**Caution/** Hypersensitivity reactions are rare but may occur, usually within 30
**Side effects** minutes of administration. Patients should be monitored during this time.

**Incompatibilities** None known

**Further** Protect from light. Store in a refrigerator (2-8oC). Steroids **information** interrupt cortisol levels. Hydrocortisone should be stopped 12

 hours before the test. Prednisolone and dexamethasone should

 be stopped 48 hours before the test.

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# Teicoplanin

**Form** Vials containing 200mg teicoplanin.

**Reconstitution** Reconstitute with water for injection provided in pack.

**Use** Antibiotic for coagulase negative staphylococcal infection

**Dose** 16mg/kg loading dose by intravenous infusion.

Followed by 8mg/kg/day by intravenous infusion the next day.

**Diluent** Sodium chloride 0.9%, glucose 5% or sodium chloride 0.18% and glucose 4%.

**Methods** Addthe entire content of the ampoule of water 3.2mL. Roll the vial gently between the hands until all the powder dissolves without foaming. Do not shake. If foam does develop let the vial stand for 15 minutes until the foam subsides. Remove approximately 2mL of air, and then add 2mL of 0.9% sodium chloride. The solution so prepared contains 40mg/mL of Teicoplanin. Add to an appropriate solution if necessary and administer by intravenous infusion over 30 minutes.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. Document the dose of teicoplanin, rounded up to the nearest 4mg. Document the instruction: “Infuse over 30minutes.” Indicate the times of administration by circling the appropriate times on the prescription chart.

**Route of Administration** Can be administered by a peripheral intravenous line.

**Note**

**Caution/side effects** Monitoring blood concentrations may be necessary in babies with

 overt, deep seated infection. Please discuss with a pharmacist

 before doing so.

**Incompatibilities** Ciprofloxacin

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# Trometamol also known as Tris(hydroxymethyl)aminomethane or THAM

**Form** Ampoule containing 5mL of 3.6% solution.

Administration of 1mL of 3.6% trometamol is equivalent to the administration of 0.5mmol bicarbonate

**Reconstitution** Already in solution.

**Use** To correct acidosis, only when sodium bicarbonate unsuitable e.g. when pCO2 or sodium levels are raised. Use on consultant request only.

**Dose** Half correction of acidosis = 0.3 x base deficit (mmol/L) x weight (kg)

It is usual to only give **half a correction initially**, however after analysis of blood glucose, pH, and electrolytes a further half correction can be given.

Full correction of acidosis = 0.6 x base deficit (mmol/L) x weight (kg)

Do not exceed a rate of 1mL/kg/minute of 3.6% trometamol (the equivalent of 0.5mmol/kg/minute of bicarbonate)

Do not exceed a total dose of 30mL/kg/24 hours of 3.6% trometamol.

**Diluent** Withdraw the required dose of 3.6% trometamol and give undiluted at a rate not exceeding 1mL/kg/minute (the equivalent of 0.5mmol/kg/minute of bicarbonate)

**Route of Administration** Concentrations of 3.6% or less can be administered peripherally or centrally. Any concentration greater than 3.6% must be administered via a **central** line.

**How to prescribe** Prescribe continuous infusion on a Neonatal Intensive Care Unit Prescription Chart in the Intravenous Infusion section.

Document the % concentration and required dose of trometamol, the volume to be infused and the infusion time.

**For example:** Infant weighs 0.9kg. Base deficit 10.

Replacement dose for a half correction is:

10 x 0.9 x 0.3 = 2.7mL

So prescribe, “Trometamol 3.6% intravenous infusion, infuse 2.7mL over 3hours.”

**Or** For a continuous intravenous infusion, divide this volume by 6 to give an hourly rate, ie trometamol 3.6% intravenous infusion, infused at 0.45mL/hour.”

**Note** If you are considering use of trometamol contact pharmacy as soon as possible. This is an unlicensed medicine and supply may have to be obtained from another hospital.

Check a blood gas after the infusion is complete.

**Side-effects**: respiratory depression; hypoglycaemia; hyperkalaemia in renal

impairment; liver necrosis reported following administration via

 umbilical vein in neonates.

There is no compatibility or incompatibility information for THAM - do not assume compatibility, use a separate line.

**Compatibilities:** There is no compatibility information

**Incompatibilities:** There is no incompatibility information

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# Vancomycin Hydrochloride

**Form** Ready-made syringes containing vancomycin 5mg/mL in sodium chloride 0.9% syringes and vials containing 500mg vancomycin hydrochloride.

**Reconstitution** Dissolve the powder in 10mL water for injection to prepare a stock solution of 50mg/mL. This must be further diluted before administration. A fresh stock solution should be prepared every 24 hours and stored in the fridge.

**Use** Antibiotic for systemic staphylococcal infection.

**Dose**  15mg/kg loading dose by intravenous infusion then:

 10mg/kg 12 hourly, if < 7 days by intravenous infusion,

 or

 10mg/kg 8 hourly, if > 7 days by intravenous infusion.

The regular maintenance dose of 10mg/kg should be commenced until the pharmacist reviews and interprets the two timed concentrations. For more detail see ‘Therapeutic Drug Monitoring’ below.

**Diluent** Sodium chloride 0.9%, glucose 5%, glucose 10%, or glucose 5% and sodium chloride 0.9%.

**Method** Withdraw 5mL of diluent into a 10mL syringe. Inject 1mL of vancomycin hydrochloride stock solution (50mg/mL) and mix. Further dilute to final volume of 10mL. The solution now contains 5mg/mL vancomycin hydrochloride. Withdraw an appropriate volume of this solution and infuse over 60 minutes using a syringe driver as described below. Care must be taken after giving vancomycin hydrochloride to ensure that a sodium chloride flush is administered slowly otherwise the residual drug contained within the infusion device will be delivered as bolus dose. For patients prescribed more than 10mg flush with 2mL of sodium chloride 0.9% infused over 60minutes. For patients prescribed less than 10mg flush with 1.5mL of sodium chloride 0.9% infused over 60minutes. Further advice on what volume and rate at which to infuse the sodium chloride flush over is available from the neonatal pharmacist.

**How to prescribe** Prescribe on a WUTH Neonatal Intensive Care Unit Prescription Chart. The first dose should be prescribed as a ‘stat’ dose. Document the dose of vancomycin hydrochloride, rounded up to the nearest 1mg. Do not use a decimal point. Subsequent doses should be calculated by a pharmacist following measurement and interpretation of serum concentrations. For continuation therapy indicate the times of administration by circling the appropriate times on the prescription chart. Document on all prescriptions, “Infuse over 60minutes.” A sodium chloride 0.9% flush must also be prescribed as detailed above.

**Route of**

**Administration**  Can be administered via a peripheral line. Give using a syringe driver.

**Therapeutic Drug Monitoring**

**Record the exact time of blood sampling, using the 24hour clock, on the therapeutic drug monitoring sheet.**

**Record the time of administration of each dose of vancomycin, using the 24hour clock. Document the start and finish time on the prescription chart.**

Blood samples must be sent in a red-topped bottle. Sample two timed concentrations of vancomycin after the first dose. Measure first concentration 2 hours after both vancomycin and the flush has been given. Measure second concentration immediately before the next dose ie 12 hours after commencement of the infusion if <7days and 8 hours after commencement of the infusion if >7days. Then give the maintenance dose and contact pharmacy for further advice once concentrations reported. Pharmacy will advise on dose and the need for measurement of further concentrations.

**Sampling Time** Peak concentration 2 hours after end of the flush.

 Trough concentration immediately before next dose.

**Target Range** Peak concentration 18-26mg/L

 Trough concentration 10-15mg/L.

**Record the exact times of blood sampling on the monitoring sheet.**

**Note** Vancomycin 5mg/mL in sodium chloride 0.9% syringes are a stock medicine. To obtain further supply please order on Cerner by selecting **Communicate**, using the **NNU stock meds request,** and sending the message to **Aseptic Stock Requests** stating how many batches of 9 syringes are required.

More concentrated solution may be prepared for fluid restricted babies on high doses.

**Caution/side effects** Rapid intravenous infusions cause erythema and pruritis, and may

cause a dangerous arrhythmia. Concentrated solutions cause

thrombophlebitis.

**Compatibilities** Vancomycin can be added (terminally) to a line containing PN with intralipid and mixed (terminally) with caffeine citrate, insulin, midazolam, milrinone or morphine sulphate or ≤ 1unit/mL heparin sodium.

**Incompatibilities** Cefotaxime, ceftazidime, and piperacillin/tazobactam.

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# Appendix 1

**Administration Guideline for Intravenous Infusion Fluid**

When a baby requires intravenous fluid administered via a syringe pump device, prior to commencing each infusion:

* Ensure prescription complies with WUTH Medicines Management (General) policy
* Draw up fluid in a clean, clear, designated area
* Follow Aseptic Non-touch Technique (ANTT) and Neonatal Unit Intravenous Guidelines
* Withdraw required volume from the intravenous bag using an appropriate sized syringe
* Discard intravenous fluid bag immediately
* Connect syringe to Alaris pump as per guideline and ensure it is correctly loaded before connecting the infusion to the baby
* Double check the infusion rate and total volume to be infused, where appropriate, with another registered nurse against the prescription

**During each infusion:**

* Double check the infusion rate and total volume to be infused, where appropriate, at each rate change and sign the administration section on the prescription chart
* Monitor the baby during the infusion and if the baby deteriorates consider the possibility of fluid overload, alongside other potential causes
* Close all clamps on intravenous administration sets before removing the administration set from the infusion pump, or switching the pump off

**At handover of care:**

* Double check the infusion rate and total volume to be infused, where appropriate, with the registered nurse taking over care and sign the administration section on the prescription chart
* Ensure that all discontinued infusions have been disconnected from the baby

For further information see overleaf the NPSA clinical briefing for healthcare professionals outlining how to prevent over infusion of intravenous fluids and medicines in neonates.

**Training needs analysis:**

* Alaris pump training - all staff undertake training and complete self assessment competencies.
* ANTT - all staff are trained in ANTT and annually updated.

Author J Morgan, J Cooper, N A Caldwell, February 24 2011

**Auditable standards:**

1. In all cases when using a syringe pump to infuse intravenous fluid to neonates a bag of fluid should not be connected to the syringe.
2. All nurses are trained and competent in use of Alaris pumps.

