Calculation skills

Paediatric Nursing
The journal for nurses caring for children and young people

RCN Publishing Company

Written by:
Meriel Hutton RGN, BA, CertEd, PhD, Senior Associate Dean (Undergraduate Studies, Nursing and Midwifery), School of Health, University of Wolverhampton
Email: meriel.hutton@wlv.ac.uk
and
Helen Gardner RGN, RSCN, BSc (Hons), MA, Senior Lecturer, Faculty of Health and Community Care, University of Central England
Email: Helen.Gardner@uce.ac.uk

Contents

Paediatric Nursing
The journal for nurses caring for children and young people

Paediatric Nursing
The Heights, 59-65 Lowlands Road, Harrow, Middlesex HA1 3AE

To subscribe call 08457726 100
www.paediatricnursing.co.uk

PNEG CAL
Cover picture by Corbis

Safe and effective administration of medicines to children requires a combination of professional competence, best available evidence and partnership (DH 2004) with each medicine administration event being viewed in the context of the total care of the child, young person and family (Watt 2003). Calculations are one part of this complex area of practice but there is evidence to suggest that one in six medication errors is due to dose miscalculation (Hutton 2003). The complex calculations often required for children's dosages make the risk of miscalculation greater than for adults, although the number of errors occurring is about the same (DH 2004). However, because they are less able to compensate physiologically, the potential for harm increases threefold in children (Woodrow 1998, DH 2004).

The need for complex calculations is due in part to the lack of licensed medicines in suitable formulations for children; children's dosages are calculated by weight or surface area on the basis of adult dosages. Paediatric formularies are available (for example, RCPCH 2003) and these should be consulted for dosages based on the weight of the child (Lapham and Agar 2003).

Practitioners administering medicines must be aware of their own accountability within a framework of legislation and professional regulation and guidance, specifically the Nursing and Midwifery Council (NMC) *Code of Conduct* (NMC 2002), *Guidelines for the Administration of Medicines* (NMC 2004a) and *Guidelines for Records and Record Keeping* (NMC 2004b).

About this guide

This guide is for all nurses working with neonates, children and young people to support their learning and revision of calculation skills. It does not cover every type of calculation but aims to provide guidance and practical exercises for commonly encountered problems. The guide starts with straightforward calculations and progresses to more complex ones, such as those needed by nurses working in paediatric intensive care. Examples used include medication based on body weight; although paediatric drug dosages may sometimes be based on surface area, these calculations are not covered here. Other examples include reconstitution of medicines for which policies may differ between organisations. Nurses should adhere to local policies where they exist.

Mathematics used in children's nursing is mainly arithmetic, used for fluid calculations, measurement and conversions between units. Nurses need to understand the metric system and the relationship between units. As parents are often more conversant with imperial units (pounds and ounces, feet and inches), the nurse should be able to convert from one system of units to the other, either by using conversion charts or, in the absence of a conversion chart, by calculating from first principles.

The guide is divided into sections covering the different kinds of calculations you may meet. There are worked examples to illustrate the different concepts and a short section of practice problems at the end of each section for you to complete. Answers are provided at the end of the guide. If you get the answers correct, carry on to the next section. If your answers are wrong, go back to the worked example and follow it through step by step before trying the practice problems again (*see notice below).

Section 1
The basics

1.1 Common sense and estimation

The golden rule of any calculation that you have to carry out is to have some idea of what a sensible answer should be. This is much easier with experience, but 'common-sense' knowledge can soon be developed if you are reflective in your own practice. As well as 'common sense knowing', the nurse needs to develop estimation skills, particularly where calculations involve decimals or several stages of computation. It is also sensible to check any calculation by working it backwards or using a different method. In the case of medication calculations, it is not safe to assume that the prescription is correct and another check should be based on the recommended dose range in the paediatric formulary in local use.

1.2 Mental arithmetic and easy calculations

Some calculations required in children's nursing are so straightforward that mental arithmetic is all that you may need. There are two common ways of calculating using mental arithmetic. Look at the following example:

A child is prescribed 5mg of a drug that is available in liquid form as 2mg per ml.

Estimate first – do you need more or less than the available dosage?

Method 1

Look for relationships between the numbers involved.
You may recognise that 5 is $2\frac{1}{2}$ times 2.
So, if there are 2mg in 1ml, there will be 5mg in $2\frac{1}{2}$ x 1ml.
Required amount = 2.5ml.

Method 2

If you know what volume of the liquid contains 1mg of the drug, then you can multiply it by 5 to calculate the volume containing 5mg.
2mg per ml indicates that 1mg would be found in $\frac{1}{2}$ml or 0.5ml.
If 1mg = 0·5ml, then 5mg = 0.5 x 5 = 2.5.
Required amount is 2.5ml.

1.3 Using a calculator

Some calculations needed in paediatric nursing require more than mental arithmetic skills. It is recommended that you use a calculator for the more complex arithmetic required for some of

*** NOTICE**
Disclaimer: Although examples are based on recommendations of the *RCPCH Pocket Medicines for Children* (RCPCH 2003), these are included for calculation practice only and no responsibility is taken by the authors of this guide for accuracy of dosages.

the computations within this guide. Note that estimation of what is a sensible answer is very important whichever way you choose to do the calculations. The calculator can respond only to what is entered by the user and errors can occur. So, for it to be a useful tool, the nurse needs to know how that particular calculator works. Read the instructions that accompany the calculator and practice using it with simple calculations to which you know the answer.

1.4 Using a formula

There is no single right way to calculate drug dosages, as seen above, but there is one formula, in the form of an equation, that always works. The formula is worth learning, but will be easier to remember if you know how it was constructed.

Example 1

A child is prescribed 100mg fluconazole, which is supplied as capsules, each containing 50mg. The nurse must work out how many capsules to give. Two 50mg capsules would provide 100mg of drug – easy! Let's look at how you got that answer:

The dose prescribed, or *what you want*, was 100mg.

The dose per available capsule, or *what you've got*, was 50mg.

To get two capsules, you divided 100 by 50.

$$\text{Dose} = \frac{\textit{what you want}}{\textit{what you've got}} = \frac{100}{50} = 2 \text{ capsules.}$$

Let's see if the formula will work for a different prescription.

Example 2

A toddler is prescribed flucloxacillin 250mg. This drug is available in syrup form, 125mg in 5ml. How much should you give?

First estimate a sensible dose. If 5ml contains 125mg, then you'll need more than 5ml for a dose of 250mg. In fact you can probably see that 125 is half of 250 and so a dose of 10ml is required. Would using the formula give this answer?

$$\frac{\textit{what you want}}{\textit{what you've got}} = \frac{250}{125}$$

The answer is 2. Is this right? Two 'whats'?

It can't be 2mls because we have estimated that it should be more than 5mls.

Remember that each 125mg dose of what we have, is contained in 5ml and so the answer is two lots of 5ml, in other words, 10ml. So, to get the correct answer, we also need to multiply by the measure that the available drug is in.

Let's add this to the formula to make it work for this type of prescription.

$$\text{Dose} = \frac{\textit{what you want}}{\textit{what you've got}} \times \textit{what's it's in}$$

Check by substituting the values we have above. The answer is 10ml, which is what we had already decided.

1.1 Practice exercises

Use the formula to work out the volume you would give for the following:

1. A child is prescribed oral chloral hydrate 250mg. The drug is available as an elixir containing 200mg in 5ml.
2. Prescription is oral phenobarbital (phenobarbitone) 45mg. It is available as 15mg in 5ml.
3. Metronidazole comes as 100mg in 20ml. The child is prescribed 75mg IV.
4. Oral paracetamol 80mg is prescribed. It is available as a syrup with 120mg in 5ml.
5. Baby is to have 25 microgram digoxin IV. It is available as 500 microgram in 2ml.

In Example 1, the formula worked because the dose available was per capsule. In other words, '*what it's in*' was 1 (capsule).

Section 2
Metric units, conversion between units and percentages

2.1 Metric units

The metric system is based on unit measures such as gram and litre. The prefixes added to the base unit mean the same, whatever the type of measurement. Thus, a kilometre is 1000 metre just as a kilogram indicates 1000 gram. (See Table 1 for a fuller range of metric units.)

As you can see in Table 1, the relationship between most of the units used in nursing is in multiples of 1000. In children's nursing, drugs may be prescribed in gram, milligram, microgram or even nanogram. The abbreviations for these last three units look very similar and so it is recommended good practice that anything other than milligram (mg) is written out in full. In some places you may see microgram written mcg, but be aware of local policies on this. This abbreviation will be used in this guide.

Table 1: Common units of metric measurement and their relationship to the base unit

Kilo (base x 1000)	Base unit	Milli (base÷1000)	Micro (base÷1,000,000)	Nano (base÷1,000,000,000)
Kilogram (kg)	Gram (g)	Milligram (mg)	Microgram (μg or mcg)	Nanogram (ng)
Kilometre (km)	Metre (m)	Millimetre (mm)	Micrometer or micron (μm)	
	Litre (l)	Millilitre (ml)		

2.1 Practice exercises

Test your working knowledge of decimal units by trying the following:

1. 0.05g = how many milligram?
2. 0.25 microgram = how many nanogram?
3. 0.025 litre = how many millilitre
4. 1575 microgram = how many milligram?
5. 750 milligram = how many gram?

2.2 Practice exercises

A drug is available as 1mg in 20ml:

1. How many microgram per ml?
2. What volume contains 10 microgram?
3. How many nanogram per ml?
4. What volume contains 500 nanogram?
5. How many nanogram in 0.25ml?

2.2 Conversion between units

Because children come in a wide range of sizes, drug doses differ considerably between patients. You need to be confident in recognising units and in changing from one to another.

Example 3

A baby is prescribed 750mcg of a drug that is available in liquid form as 1mg in 20ml. Before working out the amount needed, you need to recognise that the units involved are different. To apply the formula, you need to know how many micrograms there are in 20ml.

This one is easy, 1mg = 1000mcg.

And so there are 1000mcg in 20ml and you can apply the formula to work out the amount required substituting this value.

The calculation becomes: $\frac{750}{1000} \times \frac{20}{1} = 15$ml.

2.3 Conversion between metric and imperial units

Children's medicines are nearly always prescribed using a dose per kilogram basis. To check whether what you are giving is a safe dose, you need to know the weight of the child, at least approximately. Many clinics have weight conversion charts to which you can refer, but there may be an occasion when you will have to rely on your own resources and convert the weight from imperial to metric or vice versa. How do you do it?

The easiest conversion factor to remember is that 1kg is 2.2 pounds. You will also need to remember that 14 pounds make a stone and there are 16 ounces in a pound.

Example 4

Converting weight from imperial to metric

According to the parents, a child weighs 1 stone 8lb, what is this as metric measure?

Step 1: Change the weight into pounds by multiplying the stones by 14.
1 stone 8lb = (1 x 14) + 8 pounds = 22 pounds.

Step 2: Convert the pounds into kg by dividing by 2.2.

The child weighs (22 ÷ 2.2) kg = 10kg.

Example 5
Converting weight from metric to imperial
A baby weighs 3.6kg but parents want to know what this is as imperial measure.

Step 1: Change the kilogram into pounds.
1kg = 2.2lb, so multiply by 2.2.
3.6kg = 2.2 x 3.6lb = 7.92lb.

This is approximately 8lb, but to be more exact…

Step 2: Convert 0.92lb to ounces.
1lb = 16oz, so 0.92lb = 0.92 x 16oz = 14.7oz.

Step 3: Conclusion: The baby weighs 7lb 15oz (to the nearest ounce).

2.3 Practice exercises

Use the conversion factors given to complete these, giving your answers correct to 1 decimal place:

1. 9lb 4oz	=	___ kg	
2. 4.78kg	=	___ lb	___ oz
3. 3 stone	=	___ kg	
4. 28.3kg	=	___ st	___ lb
5. 1 stone 5lb	=	___ kg	

(2.2lb = 1kg, 14lb = 1 stone, 16oz = 1lb)

2.4 Percentages (%)

Solutions used in nursing are sometimes prepared as percentage solutions. Think of 5% glucose, a common intravenous solution. In most cases, the % is simply a descriptive label indicating, in this case, that there are 5 parts of glucose per 100 parts of water. 'Per cent' literally means 'per 100'.

Some drugs, particularly local anaesthetics, come in different percentage solutions. As they are usually prescribed in either milligram per kilogram or microgram per kilogram, the nurse needs to recognise what the % label means.

Take 1% lidocaine (lignocaine) as an example. How many mg per ml? 1% means 1 in 100.

By convention 1ml is equivalent to 1g, and so, 1% lidocaine means 1g in 100ml.

This means 1000mg = 100ml.

1ml of 1% lidocaine will therefore contain $\frac{1000}{100}$ mg of lidocaine.

1% lidocaine is equivalent to 10mg per ml.

2.4 Practice exercises

Complete the following table for lidocaine preparations:

Lidocaine	Mg per ml	Microgram per ml
0.1%		
0.2%		
0.5%		
1%	10mg/ml	
2%		
5%		

Section 3
Fluid calculations

As pumps are normally used to deliver IV fluids to children, IV rate calculations are not covered in this guide. However, correct calculation of fluid balance is particularly vital in sick babies and children. Feeds have to be entered into the equation and all fluid measured, including drug volumes. The type of calculation that the nurse may need to make is to work out what volume of maintenance feed can be given within the total fluid allowance. This allows the dietitian to make up the content appropriately. The calculation may involve percentages, addition and subtraction.

Example 6

An Infant weighing 12kg is prescribed 75% of maintenance fluids over 24 hours. How much of the hourly intake should be feed?

According to local policy, 100% maintenance for a 12kg child is 45ml/hour.

So what is 75% of 45ml/hr?

First do a rough estimate

75% = 3/4 so the amount must be less than 45 (the whole amount) but more than 22 (approx half).

$$75\% = \frac{75}{100} : \frac{75}{100} \times \frac{45}{1} = \frac{135}{4} = 33.75.$$

So the child should be receiving a total of 33·75ml per hour.

But when you look at the prescription sheet, you see that continuous infusions of various drugs amount to 5ml/hour and antibiotics add another 15ml every six hours. So what is the amount of feed that can be given per hour?

First calculate the total volume of prescribed drugs per hour.

IV infusions = 5ml /hour PLUS antibiotics = 15ml in 6 hours = 15 ÷ 6ml/hr = 2.5ml/hr.

Total volume of infusions/drugs per hour is 7.5ml.

Hourly fluid allowance	33.75
	− 7.5
Therefore child can be given feed of:	26.25ml/hr

3.1 Practice exercises

A baby of 3kg (prescribed 100% maintenance 12ml/hr) is receiving 3.5ml/hr via IV infusion and 10.8ml of drugs 6 hourly. What volume of feed should be given hourly?

A 5kg baby is prescribed 50% maintenance fluids (100% = 20ml/hr). A total volume of 4.2ml/hour is being given via IV infusion and 10ml by bolus 4 hourly. What volume of feed should be given hourly?

Section 4
Drug calculations

This section gives worked examples and practice exercises covering a variety of drug calculations required by children's nurses starting with the more straightforward and progressing to more complex calculations such as those needed for paediatric intensive care nursing.

All drug calculations can be carried out using the following 4 steps:

Step 1: Use the recommended dose range to check that the prescribed amount is sensible, remembering to take into account the size of the child, route prescribed and frequency of the dose.

Step 2: Check that the drug is available in the same units as the prescription and work out an approximate amount.

Step 3: Use your chosen method for calculating (see section 1) or apply the formula:

$$\frac{\textit{what you want}}{\textit{what you've got}} \times \textit{what it's in} = \text{dose.}$$

Step 4: Check this answer against the approximation from step 2.

4.1 Straightforward prescriptions

Example 8 (page 11)

Step 1: Recommended dose for one to five years is 2.5mg, which is the prescribed amount.

Step 2: 2mg in 5ml is the same units as prescription and 2.5mg will be just over 5ml.

Step 3: Use your chosen method for calculating (see section 1) or substitute the known values in the formula:

$$\frac{2.5}{2} \times \frac{5}{1} = \frac{12.5}{2} \text{ ml} = 6.25\text{ml.}$$

Example 8

Age	Drug	Amount	Route	Frequency
18 months	Diazepam	2.5mg	Oral	Single dose (pre-med)

Preparation: oral liquid 2mg in 5ml

Recommended dose for 1 to 5 years is 2.5mg

Step 4: This is near the estimated amount from step 2.

Step 5: Conclusion: 6.25ml of diazepam is a safe amount to give orally for pre-medication.

4.1 Practice exercises

Following steps 1 to 4, calculate the amount to be given for each dose of the following and decide whether it is safe to give:

1

Age	Drug	Amount	Route	Frequency
13 years	Amoxicillin	1g	Oral	Twice daily

Preparation: Capsules containing 500mg

Recommended dose for *H.pylori* in 12 to 18 years is 1g, twice daily (bd)

2

Age	Drug	Amount	Route	Frequency
3 years	Chlorphenamine	1mg	Oral	3 times/day

Preparation: Oral liquid 2mg in 5ml

Recommended dose range for 2 to 5 years is 1-2mg, three times a day (tds)

3

Age	Drug	Amount	Route	Frequency
8 years	Cotrimoxazole	480mg	Oral	Twice daily

Preparation: Paediatric suspension 240mg in 5ml

Recommended dose range for 6 to 12 years is 480mg, twice daily (bd)

Example 9 (see 4.2, page 13)

Age	Weight	Drug	Amount	Route	Frequency
5 years	19kg	Digoxin	95 microgram	Oral	Daily

Preparation: oral elixir containing 50 microgram per ml

Recommended dose is 5 microgram per kg by either oral of IV route, daily

4.2 Practice exercises (see 4.2, page 13)

Following steps 1 to 4, calculate the amount to be given for each dose of the following and check by calculating the recommended range:

1

Age	Weight	Drug	Amount	Route	Frequency
4 months	6.5kg	Furosemide	7.5 mg	IV	Twice daily

Preparation: Ampoules containing 20mg in 2ml

Recommended dose range age 1 month to 2 years is 1 – 2mg/kg bd

2

Age	Weight	Drug	Amount	Route	Frequency
18 months	11kg	Sodium valporate	140mg	Oral	Twice daily

Preparation: Liquid containing 200mg in 5ml

Recommended dose range 1 month to 12 years is 12.5 – 15mg/kg bd

3

Age	Weight	Drug	Amount	Route	Frequency
2 years	13·5kg	Alfacalcidol	400 nanogram	Oral	Daily

Preparation: Oral suspension 2 microgram per ml

Recommended dose range for 2 to 12 years is 15 – 30 nanogram/kg, Daily

4

Age	Weight	Drug	Amount	Route	Frequency
2 months	4·5kg	Ranitidine	4·5mg	IV	3 times daily

Preparation: Ampoules 50mg in 2ml

Recommended dose range for 1 month to 18 years is 1mg/kg, 2 – 4 times daily

4.2 Dosage by body weight

(Example 9, page 12)

Step 1: Recommended daily dose of digoxin is 5 microgram per kg by either oral or intravenous route.

For a 19kg child, this would be 5 x 19mcg daily.

5 x 19 = 95mcg.

This is exactly the amount prescribed and so it is safe to give.

Step 2: Units are the same for prescription and preparation.

50mcg in 1ml would equate to 100mcg in 2ml.

For 95mcg, your answer should be just under 2ml.

Step 3: Use your chosen method for calculating or apply the formula to give:

$$\frac{95}{50} \times \frac{1}{1} = \frac{95}{50} \text{ ml} = 1.9\text{ml}.$$

Amount to be administered is 1.9ml. Check against the approximation from step 2.
1.9ml is just under 2ml as predicted.

Step 4: Conclusion: 1.9ml of the digoxin elixir is a safe amount to give orally.

Now try practice exercise 4.2.

4.3 Reconstituted drugs

Some drugs are available only in powdered form and require reconstitution with a diluent before they can be administered as a liquid. The actual amount of powder adds volume which is called the displacement value. As this differs depending on the solubility of the drug concerned, there are usually local pharmacy guidelines available to guide the nurse in the reconstitution process. In the practice exercise below (4.3), the displacement value has been taken into account in the preparation.

4.4 Calculations involving time – continuous infusions

Children are often prescribed post-operative analgesia as a continuous infusion of diluted drug. In high dependency areas, children may be given continuous infusions of a variety of drugs and nutrients. In small sick babies, the total amount of fluid has to be carefully controlled, some of the drugs involved are extremely

4.3 Practice exercise

From the information below, calculate the dose to give and the recommended range in the same way as the practice examples in 4.2:

Age	Weight	Drug	Amount	Route	Frequency
$3^1/_2$ years	15kg	Cefuroxime	300mg	IV	tds

Preparation: Powder which when reconstituted with 1.8ml water for injection, gives a solution of 250mg in 2ml. (Displacement value 0.2ml)

Recommended dose range for 2 to 12 years is 10 – 30mg/kg tds

Example 10					
Age	**Weight**	**Drug**	**Amount**	**Route**	**Frequency**
Newborn (term)	3kg	Dobutamine	Solution made up as 90mg in total volume of 50ml	IV	1ml/hr
Preparation: 50mg per ml. Recommended diluent is 5% glucose for dilution to a concentration of not more than 5mg/ml Recommended dosage is 2 – 10 microgram/kg/min					

potent and so very small amounts are involved. Accurate calculation and safety checks are absolutely essential. The following examples are taken from PICU.

Example 10 (see box above)
This looks daunting, but follow the steps shown on page 10 with additional steps as shown below.

Step 1.1: First calculate how many micrograms are contained in 1ml of the solution made up as prescribed. NB the different units.

Start with the mg/mcg issue and SIMPLIFY first.

90mg in 50ml = 9mg in 5ml.

then MULTIPLY mg by 1000 to get microgram (mcg).

9mg in 5ml = 9000 mcg in 5 ml.

If 5ml contains 9000mcg, 1ml contains $\frac{9000}{5}$ mcg = 1800mcg.

Therefore the prescribed amount is 1800mcg per hour.

Step 1.2: But the recommended range is given for minutes.

The amount per minute will be the hourly amount divided by 60.

$\frac{1}{60}$ of 1800mcg = $\frac{1800}{60} = \frac{180}{6}$ = 30mcg.

So, the prescribed amount is 30mcg/minute.

Step 1.3: Is this sensible for a 3kg baby? What is the dose per kg?

30mcg/min is 30 ÷ 3 = 10mcg/kg/min.

The prescription is for 10mcg/kg/min, which is within the recommended range.

Step 2.1: Dobutamine is available in 5ml, ampoules containing 50mg per ml but must be diluted to a concentration of not more than 5mg/ml. The diluent is 5% glucose and the prescribed dilution is 90mg in a total volume of 50ml.

Check that the prescription is within the guidelines for strength of dilution.

90mg in 50ml = $\frac{90}{50}$ mg/ml = 1.8mg/ml.

This is below the recommended maximum of 5mg/ml.

Step 2.2: If dobutamine is available as 50mg/ml, then for a final solution of 90mg we will need less than 2ml of the concentrated drug.

Step 3: Substitute the known values in the formula to calculate the amount.

$$\frac{90}{50} \times \frac{1}{1} = \frac{90}{50} = 1.8\text{ml.}$$

Step 4: Check this answer against the approximation from step 2.2.

The final step is to calculate how much diluent is required for the final total volume.

Total volume = 50ml.

Concentrated drug = 1.8ml.

Volume of diluent required = 50-1.8ml = 48.2ml.

Step 5: Conclusion: 1.8ml dobutamine made up to 50ml with 48.2ml glucose 5% will give the correct solution to be infused at 1ml/hour.

4.4 Practice exercises

Calculate and check dilution and rates as in example 10 on page 14:

	Age	Weight	Drug	Amount	Route	Frequency
1	12 years	37kg	Midazolam	40mg in 40ml	IV	2ml/hr

Preparation: Ampoules 10mg in 2ml. Recommended diluent 5% glucose
Recommended dose range: 1 month to 18 years, 500 nanogram - 3.3mcg/kg/min

	Age	Weight	Drug	Amount	Route	Frequency
2	7 months	8kg	Morphine	8mg in 50ml glucose 5%	IV	0·5ml/hr

Preparation: 1ml ampoule 10mg/ml Recommended diluent 5% glucose
Recommended range birth to 18 years, 5-20mcg/kg/hr

Answers to practice exercises

Section 1.1

1 6·25ml
2 15ml
3 15ml
4 3.3ml
5 0.1ml

Section 2.1

1 50mg
2 250 nanogram
3 25ml
4 1.575 microgram
5 0.75g

Section 2.2

1 50 microgram
2 0.2ml
3 50,000 nanogram
4 0.01ml
5 12,500 nanogram

Section 2.3

1 4.2kg
2 10lb 8oz
3 19.1kg
4 4 stone 6lb
5 8.6kg

Section 2.4

Lidocaine	Mg/ml	Microgram/ml
0.1%	1	1000
0.2%	2	2000
0.5%	5	5000
1%	10	10,000
2%	20	
5%	50	

Section 3.1

1 6.7ml
2 3.3ml

Section 4.1

1 2 caps
2 2.5ml
3 10ml

Section 4.2

		Recommended range
1	0.75ml	6.5mg – 13mg bd = 0.65 – 1.3ml bd
2	3.5ml	137.5mg – 165mg bd = 3.4 – 4.1ml bd
3	0.2ml	202.5 – 405 nanogram daily = 0.1 – 0.2ml daily
4	0.18ml	4.5 mg tds = 0.18ml tds

Section 4.3

	Recommended range
2.4ml	150 – 450mg = 1.2 – 3.6ml

Section 4.4

1	Dilution	Rate
1.1	1000 microgram/ml	2000 microgram/hr
1.2		33.3 microgram/min
1.3		0.9 microgram/kg/min
2/3	8ml drug 32ml diluent (5% glucose)	
2		
1.1	160 microgram/ml	80 microgram/hr
2/3	0.8ml drug and 49.2ml diluent (5% glucose)	

References

Department of Health (2004) *National Service Framework for Children, Young People and Maternity Services*. London, DH.

Hutton M (2003) Calculations for new prescribers. *Nursing Standard.* 17, 25, 47-52.

Lapham R, Agar H (2003) *Drug Calculations for Nurses: A step-by-step approach* (2nd ed). London, Arnold.

Nursing and Midwifery Council (2002) *Code of Professional Conduct*. London, NMC.

Nursing and Midwifery Council (2004a) *Guidelines for the Administration of Medicines*. London, NMC.

Nursing and Midwifery Council (2004b) *Guidelines for Records and Record Keeping.* London, NMC.

Royal College of Paediatrics and Child Health and the Neonatal and Paediatrics Pharmacists Group (2003) *Pocket Medicines for Children* (2nd ed). London, RCPCH.

Watt S (2003) Safe administration of medicines to children: Part 1. *Paediatric Nursing*. 15, 4, 40-43.

Woodrow P (1998) Numeracy skills. *Nursing Standard*. 12, 30, 48-55.

NOTES