Converting Infusion Rates from microg/kg/min to mL/h

If you need to infuse a medication (specified as an additive on the Intravenous Fluid Treatment Chart) at a given rate in microg/kg/min or mg/kg/min you will need to perform a calculation to covert this to a rate in mL/h to set on the infusion pump or syringe driver. The calculation will depend on a number of factors including the patient’s weight and the concentration of the additive in the IV fluid.

In order to simplify these calculations they are best performed in a series of steps as the examples below will illustrate.

As a convenient summary, the key formulae that need to be used have been provided below as a reference.

Converting a rate per kg/min to a rate per min:

Rate in mg/min = Rate in mg/kg/min x Patient’s weight

Rate in microg/min = Rate in microg/kg/min x Patient’s weight

Calculating the concentration of the additive in the IV Fluid:

Concentration of additive in the IV Fluid = Quantity of additive / Volume of IV fluid

Calculating the Infusion Rate in mL/h when you know the Infusion Rate in mg/h (or microg/h) and the concentration of the additive in the IV Fluid:

Infusion Rate in mL/h = Infusion Rate (mg/h) / Concentration of additive (mg/mL)

Infusion Rate in mL/h = Infusion Rate (microg/h) / Concentration of additive (microg/mL)

Concentration of additive: refers to the concentration of the additive in the IV Fluid

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Example

Mr Jaden Davis (Date of Birth: 15/1/72) has been admitted with cardiogenic shock following an extension of his AMI. He weighs 89 kg. Considering the order shown, what rate of infusion should be set on the volumetric pump in mL/h (rounded to the closest whole number) to deliver this order?

Overview of the Intravenous Fluid Treatment chart:

- The IV fluid order is valid as all of the required boxes have been filled in and the order is legible.
- The infusion rate ordered is 2.5 microg/kg/min of dobutamine 250 mg in 500 mL of 5% glucose.
- The patient’s weight is 89 kg (this information is provided in the case notes which have not been shown above).

Step 1

Identify the required rate of administration of the infusion in microg/kg/min and convert this to a rate in microg/min by multiplying it by the patient’s weight.

Rate (microg/min) = Rate (microg/kg/min) x Patient’s weight (kg)

= 2.5 microg/kg/min x 89 kg

= 222.5 microg/min
Step 2

Since you are required to calculate a final rate in mL per hour, you need to change the unit of measurement from minutes to hours. This can be achieved by multiplying by 60 min/h:

Rate (microg/h) = Rate (microg/min) x 60 (min/h)

= 222.5 microg/min x 60 min/h

= 13,350 microg/h

Step 3

Now calculate the concentration of the additive (250 mg of dobutamine) in the IV fluid (500 mL of 5% glucose). This can be found using:

Concentration of additive in the IV Fluid = \( \frac{\text{Quantity of additive}}{\text{Volume of IV fluid}} \)

= \( \frac{250 \text{ mg}}{500 \text{ mL}} \)

= 0.5 mg/mL

In the step above (step 2) the infusion rate is expressed in units of microg/h. The concentration found in this step has units of mg/mL. The two units of mass need to be the same before the calculation can be performed in the next step. As such, the units of mg/mL should be changed to units of microg/mL. You can do this by multiplying by 1000 microg/mg:

Concentration of additive in IV fluid = 0.5 mg/mL x 1000 microg/mg

= 500 microg/mL

The concentration of the dobutamine in the IV solution is 500 microg/mL. This means that for every 1 mL of IV fluid infused, the patient will receive 500 microg of dobutamine.
Step 4

You can now calculate the infusion rate in mL/h using the formula shown below.

The key point to look for is to ensure that corresponding units for mass are identical before inserting numbers into the formula. For example, you cannot mix units of micrograms and mg in the same formula - they MUST all be micrograms OR all mg.

\[
\text{Infusion Rate in mL/h} = \frac{\text{Infusion Rate (microg/h)}}{\text{Concentration of additive (microg/mL)}}
\]

\[
\text{Infusion Rate in mL/h} = \frac{13350 \text{ microg/h}}{500 \text{ microg/mL}}
\]

\[
\text{Infusion Rate in mL/h} = 26.7
\]

You are asked to round to the closest whole number. Therefore the final answer is 27 mL/h.

Example

Alexandra Jones (Date of Birth: 30/11/68) is to be commenced on an amiodarone infusion for her ventricular dysrhythmias as per the order shown below. Her weight is 78 kg. Rounded to 1 decimal place, what rate should be set in mL/h on the syringe driver to deliver this order correctly?
Overview of the Intravenous Fluid Treatment chart:

- The IV fluid order is valid as all of the required boxes have been filled in and the order is legible.
- The infusion rate ordered is 0.4 mg/kg/h of amiodarone 600 mg in 50 mL of 5% dextrose.
- The patient’s weight is 78 kg (this information is provided in the case notes which have not been shown above).

**Step 1**

Identify the rate of infusion in mg/kg/h and convert this to a rate in mg/h by multiplying it by the patient’s weight.

\[
\text{Rate (mg/h)} = \text{Rate (mg/kg/h)} \times \text{Patient’s weight (kg)}
\]

\[
= 0.4 \text{ mg/kg/h} \times 78 \text{ kg}
\]

\[
= 31.2 \text{ mg/h}
\]

This means that every 1 hour the patient is receiving 31.2 mg of amiodarone.

**Step 2**

Now calculate the concentration of the additive (600 mg of amiodarone) in the IV fluid (50 mL of 5% dextrose). This can be found using:

\[
\text{Concentration of additive in the IV Fluid} = \frac{\text{Quantity of additive}}{\text{Volume of IV fluid}}
\]

\[
= \frac{600 \text{ mg}}{50 \text{ mL}}
\]

\[
= 12 \text{ mg/mL}
\]

The units in step 1 and 2 are compatible (they are both mg) so you can proceed to Step 3.
Step 3

You can now calculate the infusion rate in mL/h using the formula shown below.

\[
\text{Infusion Rate in mL/h} = \frac{\text{Infusion Rate (mg/h)}}{\text{Concentration of additive (mg/mL)}}
\]

Infusion Rate in mL/h = \frac{31.2 \text{ mg/h}}{12 \text{ mg/mL}}

Infusion Rate in mL/h = 2.6

The syringe driver would be set to deliver an infusion rate of 2.6 mL/h.

Example

Mrs Emily Johnson (Date of Birth: 29/4/76) who weighs 63 kg has profound hypotension associated with septic shock. A noradrenaline infusion has been ordered. Calculate the rate of infusion in mL/h (rounded to 1 decimal place) that needs to be administered to deliver this order.
Overview of the Intravenous Fluid Treatment chart:

- The IV fluid order is valid as all of the required boxes have been filled in and the order is legible.
- The infusion rate ordered is 14 microg/min of noradrenaline 4 mg in 50 mL of 5% glucose.
- The patient’s weight is 63 kg (this information is provided in the case notes which have not been shown above).

**Step 1**

Identify the rate of administration of the infusion in microg/min and convert this to a rate per hour.

\[
\text{Rate (microg/h)} = \text{Rate (microg/min)} \times 60 \text{ (min/h)}
\]

\[
= 14 \text{ microg/min} \times 60 \text{ min/h}
\]

\[
= 840 \text{ microg/h}
\]

This means that every 1 hour the patient is receiving 840 microg of noradrenilne.

**Step 2**

Now calculate the concentration of the additive (4 mg of noradrenaline) in the IV fluid (50 mL of 5% glucose). This can be found using:

\[
\text{Concentration of additive in the IV Fluid} = \frac{\text{Quantity of additive}}{\text{Volume of IV fluid}}
\]

\[
= \frac{4 \text{ mg}}{50 \text{ mL}}
\]

\[
= 0.08 \text{ mg/mL}
\]

In the step above (step 1) the infusion rate is expressed in units of microg/h. The concentration found in this step has units of mg/mL. The two units of mass need to be the same before the calculation can be performed in the next step. As such, the units of mg/mL...
should be changed to units of microg/mL. You can do this by multiplying by 1000 microg/mg:

Concentration of additive in IV fluid = 0.08 mg/mL x 1000 microg/mg

= 80 microg/mL

The concentration of the noradrenaline in the IV solution is 80 microg/mL. This means that for every 1 mL of IV fluid infused, the patient will receive 80 microg of noradrenaline.

**Step 3**

You can now calculate the infusion rate in mL/h using the formula shown below.

The key point to look for is to ensure that *corresponding units of mass are identical* before inserting numbers into the formula. For example, you cannot mix units of micrograms and mg in the same formula - they MUST all be micrograms OR all mg.

\[
\text{Infusion Rate in mL/h} = \frac{\text{Infusion Rate (microg/h)}}{\text{Concentration of additive (microg/mL)}}
\]

\[
\text{Infusion Rate in mL/h} = \frac{840 \text{ microg/h}}{80 \text{ microg/mL}}
\]

\[
\text{Infusion Rate in mL/h} = 10.5
\]

The syringe driver would be set to a rate of 10.5 mL/h.