# How should intravenous (IV) potassium chloride be administered in adults?

Prepared by UK Medicines Information ([UKMi](http://www.ukmi.nhs.uk/ukmi/about/default.asp?pageRef=1)) pharmacists for NHS healthcare professionals

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## Background

Research in UK and elsewhere has identified a risk to patients from errors occurring during intravenous administration of potassium solutions (1). To reduce the risk of accidental overdose of intravenous potassium arising from the use of potassium chloride concentrate solutions, the storage and handling of potassium chloride concentrate solutions are controlled (1). These concentrated solutions are restricted to pharmacy departments and those critical care areas where concentrated solutions are needed for urgent use.

Potassium chloride concentrate solutions or strong potassium solutions can be defined as (1):

* Solutions of potassium chloride of 10% or more (i.e. 1 gram potassium in 10ml)
* Solutions of potassium hydrogen phosphate and potassium dihydrogen phosphate
in ampoules and vials.

Wherever possible commercially available ready to use diluted solutions should now be prescribed and used (1).

Hypokalaemia (potassium <3.5mmol/L) can occur due to increased loss, transcellular shift or decreased intake of potassium and sometimes by magnesium depletion (2,3). Mild hypokalaemia (3.0-3.5mmol/L) is often asymptomatic. Severe hypokalaemia usually refers to a serum potassium of <2.5mmol/L and can result in muscle necrosis and cardiac arrhythmias (2,4). Clinical management of hypokalaemia is usually by potassium replacement (2,4).

## Answer

Potassium administration via the intravenous route should only be used when the oral or enteral route is not available or will not achieve the required increase of serum potassium within a clinically acceptable time.

**Salt**

Potassium chloride is the salt most commonly used for potassium replacement as it is effective at treating the most likely causes of hypokalaemia (5).

**Dosage**

As a general rule, a reduction of serum potassium by 0.3mmol/L suggests a total body deficit of 100mmol (2-4,6). For patients with mild to moderate hypokalaemia who cannot receive treatment via the oral or enteral route, an initial intravenous dose of 20-40mmol/L should be given. For those with severe/symptomatic hypokalaemia, 40mmol/L is given and a second or third dose may be required (7). A recommended maximum dose is 2-3mmol/kg of potassium in 24 hours (5). This may not need to be replaced over the next 24 hours and indeed this may be inappropriate given the likely infusion volume required for larger patients. The rate of potassium loss should also be considered.

Patients with impaired renal function will require more intensive monitoring when prescribing potassium. In these patients, more caution is required with subsequent doses (8).

**Infusion fluid**

As glucose may reduce serum potassium concentrations, during initial replacement it may be preferable to use premixed infusions that are glucose-free (9).

Table 1 shows examples of the strengths of the ready prepared potassium solutions which are available. The infusion fluids in which they are prepared are also listed. This list is not exhaustive.

**Table 1. Examples of available ready prepared potassium solutions (10)**

|  |  |  |
| --- | --- | --- |
| **Strength of potassium chloride** | **Number of mmol potassium** | **Infusion fluids** |
| Potassium chloride 0.15%w/v | 20mmol in 1 litre bag10mmol in 500ml bag | Sodium chloride 0.9% w/vGlucose 5% w/vGlucose 4% w/v with sodium chloride  0.18% w/v Glucose 5% w/v with sodium chloride  0.45% w/v |
| Potassium chloride 0.2%w/v | 27mmol in 1 litre bag13.3mmol in 500ml bag | Sodium chloride 0.9% w/vGlucose 5% w/vGlucose 4% w/v with sodium chloride  0.18% w/v  |
| Potassium chloride 0.3% w/v | 40mmol in 1 litre bag20mmol in 500ml bag | Sodium chloride 0.9% w/vGlucose 5% w/vGlucose 4% w/v with sodium chloride  0.18% w/v |

Ready-mixed infusion solutions should be used where possible. In exceptional circumstances where there is a requirement for potassium solution in a dilution which is not commercially available, potassium chloride concentrate as ampoules containing 1.5 grams (20mmol potassium) in 10ml may be thoroughly mixed with 500ml of sodium chloride 0.9% intravenous infusion and given slowly over two to three hours with specialist advice and electrocardiography (ECG) monitoring in difficult cases (10). It is essential that the bag is squeezed and inverted at least ten times (11) prior to administration as incomplete mixing can lead to the administration of high bolus doses of potassium, which can cause cardiac arrest.

**Infusion concentration and rate**

The infusion site should be checked on a regular basis for signs of redness and inflammation. Extreme care must be taken to avoid extravasation. For intravenous administration via a peripheral line, the concentration of potassium should not exceed 40mmol/L (12), as higher strengths can cause phlebitis and pain. Administration should be via a volumetric infusion pump (11). However, other guide have suggested that concentrations exceeding 40mmol/L can be given peripherally in emergency situations, through a large vein, but this must be guided by a consultant using appropriate monitoring (13). Administration via the central route avoids the pain and phlebitis associated with peripheral administration (5). Concentrations greater than 40mmol/L should be given via a central venous catheter, using a suitable infusion pump (13). However it has been commented that high concentrations of potassium given centrally may carry a greater risk of cardiac toxicity if the infusion is carried directly to the heart (5).

In practice, the rate of administration should not normally exceed 10mmol/hour and no more than 20mmol/hour in emergencies.Administration rates above 20mmol/hour require cardiac monitoring (11,13). Administration of potassium at rates faster than recommended may cause cardiac toxicity, including arrhythmias and cardiac arrest (13).

Electrolytes should be monitored. Repeated measurements of serum potassium are necessary to determine whether further infusions are required, and to avoid the development of hyperkalaemia; this is especially liable to occur in renal impairment (14). All patients with hypokalaemia should have a magnesium level checked because of the strong correlation between hypomagnesaemia and hypokalaemia (2). If the patient is acidotic, correct the potassium first to prevent an alkali-induced shift of potassium into the cells (15).

Once the hypokalaemia is no longer severe, the rate of intravenous potassium repletion should be reduced or changed to oral therapy. Patients should be treated until the serum potassium concentration is persistently above 3.0 to 3.5 mmol/L and symptoms or signs attributable to hypokalaemia have resolved (16).

## Summary

* Potassium administration via the intravenous route should only be used when the oral or enteral route is not available or will not achieve the required increase of serum potassium within a clinically acceptable time.
* Wherever possible commercially available ready to use diluted solutions should be prescribed and used.
* During initial replacement it may be preferable to use premixed infusions that are glucose-free.
* Administration should be via a volumetric infusion pump.
* The concentration of potassium for intravenous administration via a peripheral line should not exceed 40mmol/L, as higher strengths can cause phlebitis and pain.
* The infusion site should be checked regularly for redness and inflammation.
* Higher concentrations have been given in severe cases of hypokalaemia but should be given via the central venous route and require infusion pump control.
* The rate of administration should not normally exceed 10mmol/hour.
* Administration rates above 20mmol/hour require cardiac monitoring.
* Electrolytes should be monitored to determine the need for further infusions and to avoid hyperkalaemia.
* Treatment of hypokalaemia may require both potassium and magnesium repletion.

LimitationsYour pharmacy department will be able to inform you of which ready prepared potassium solutions are kept within your hospital. Trust guidelines on the storage and administration of potassium may differ from the information provided in this Q&A and should be consulted. This Q&A provides advice on the preparation and administration of potassium chloride only and does not include other available potassium salts. Contact your pharmacy department for further advice on these other preparations. This Q&A is for adult patients only.

### References

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### 2020 Search strategy

1. Embase (potassium chloride and hypokalemia )
2. Pubmed (potassium chloride and hypokalemia)
3. Micromedex (potassium chloride)
4. BNF (intravenous potassium)
5. SPS (potassium chloride)
6. NICE Evidence (potassium chloride)
7. eMC (potassium chloride)
8. Injectable Medicines Guide
9. Injectable Drugs Guide
10. MiDatabank (potassium chloride or potassium salts AND administration-intravenous)