

# Implementing an IV potassium policy

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*Removing concentrated potassium ampoules from general hospital wards is a requirement of the safety alert issued by the NPSA last summer. This article sets out some practical considerations in achieving this at an acute 1,400 bed teaching trust, and discusses other aspects of the potassium policy now in place at the trust that go beyond the NPSA recommendations*

In the autumn of 2001, the risk management committee at the Royal Liverpool and Broadgreen University Hospitals NHS Trust resolved to address the risks and hazards associated with the presence in clinical areas of concentrated potassium ampoules. This decision pre-dated the NPSA (National Patient Safety Agency) safety alert on the use, storage and handling of potassium chloride concentrate and other strong potassium solutions, but was in line with the risk-management principles set out in documents such as "Organisation with a memory"<sup>1</sup> and "A spoonful of sugar".<sup>2</sup> The aim was to reduce the risks of inappropriate administration of concentrated potassium, but maintain therapeutic flexibility.

A project group was formed, consisting of the following people:

- Trust risk manager
- Chair of the trust's drugs and therapeutic committee
- Consultant cardiologist
- Consultant anaesthetist
- Consultant clinical chemist
- Deputy director of pharmacy

## FIRST STEPS

Before formulating a policy, the project group needed to know the number and type of ampoules then currently used at the trust, and the practicalities of using alternatives.

An audit revealed that all wards had significant stocks of potassium ampoules which

were in regular use, and that approximately 4000 ampoules of strong potassium chloride injection had been issued to wards and theatres in the previous 12 months. This suggested a trust-wide use of 10 ampoules per day. It was clear from this that the range of measures introduced by the trust in previous years to reduce the use of potassium ampoules (such as procuring manufactured specials for "Alberti-GLIK" regimens and the intensive care unit since 1996 and 1998 respectively) were not sufficient. Discussions were held with a range of senior medical and surgical clinicians (other than those in the project group) to identify how and why the various methods by which hypokalaemia could be corrected (i.e. oral potassium, pre-mixed solutions and ampoules for admixing) were used within the trust. Appropriate formulations for infusions to replace ampoule usage, and their availability, were also discussed.

The investigations identified that a range of licensed, pre-mixed potassium chloride infusions (0.15 per cent, 0.2 per cent and 0.3 per cent in both 0.9 per cent sodium chloride and 5 per cent glucose) were regularly used for the prevention and treatment of hypokalaemia. Where higher concentrations of potassium were needed, ampoules of strong potassium chloride injection 15 per cent were added to these infusions on wards to produce solutions of up to around 80mmol/L, which were generally infused peripherally. In areas such as the intensive care unit and the coronary care unit, even more concentrated infusions were made up, which were administered via a central line.

In the theatres, potassium ampoules were also in regular use, being added to 500ml glucose infusions to prepare 20mmol/L solutions on demand. Ampoules were also

added to the pre-mixed bags to enhance their potassium content to 20mmol/L.

There were also issues around the use of potassium acid phosphate injection 13.6 per cent for IV adjustment of serum phosphate. Infusions were admixed in wards and theatres by both anaesthetists and clinical chemists in a range of concentrations.

The use of infusion pumps was also raised as an issue. The project group identified that there were no clear guidelines on using the pumps for potassium solutions, and so pump use was inconsistent and significantly less than ideal.

Literature searches identified some guidance on the appropriate concentrations of potassium in infusions, and the appropriate administration rates. However, the advice was not always consistent. The British National Formulary (BNF), for example, recommends that the IV route be reserved for severe hypokalaemia (not defined) when sufficient potassium cannot be given by the oral route and quotes concentrations of 40mmol/L.<sup>3</sup> US references quote maximum concentrations for peripheral administration of 80–100mmol/L, with concentrations for use with central lines being twice that figure.<sup>4,5,6</sup> Only two documents were available from UK sources,<sup>7,8</sup> in contrast to the US where many hospitals publish potassium policies/guidelines on their web sites.

## POLICY FORMULATION

The accumulated data led to the formation of a policy (see panel 1, p349). It was agreed that there was a clinical need for a readily available pre-mixed infusion of a higher concentration than 40mmol/L for peripheral administration in both saline and glucose variants. However, licensed products

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## Panel 1: Policy statements on the use of IV potassium at Royal Liverpool and Broadgreen University Hospitals NHS Trust

1. Intravenous treatment of hypokalaemia must only be instigated when the oral/enteral route is unavailable or will not achieve the required elevation of serum potassium within a clinically acceptable time.
2. All prescribing of potassium must be expressed in terms of millimoles of potassium and must include the rate of infusion and duration of treatment. A treatment programme considering the patient's potassium needs for the following 24–48h should be prepared, with assistance from a clinical chemist.
3. All ampoules of potassium-containing solutions will be removed from use and will not be available to any clinical area under any circumstances.
4. Only the designated pre-prepared potassium-containing infusions must be used.
5. All potassium containing infusions must be administered via a suitable infusion pump to control the infusion rate and volume.
6. All patients being treated with intravenous potassium are to have at least once daily measurement of serum potassium until levels are shown to be satisfactory.

of this strength were not commercially available. Instead, manufactured specials were procured. Where particular pre-mixed specials would not be available for some time, interim measures were put in place, such as co-infusing a pre-mixed 10mmol “Alberti bag” with one containing 40mmol of potassium in 500ml of 0.9 per cent sodium chloride, the latter being infused at one quarter the rate of the Alberti bag.

It was also agreed to decrease the existing

range of licensed pre-mixed potassium infusions to reduce the risk of confusion. Agreement was reached on defining degrees of hypokalaemia and these were then indexed against the approved infusions as in Table 1 (p 350).

For the treatment of hypophosphataemia, agreement was reached on using a single formulation (20mmol potassium + 20mmol phosphate in 250ml water for injection). This was procured as a manufactured special

and enabled the removal of potassium acid phosphate injection ampoules from all clinical areas.

### IMPLEMENTATION PLAN

Following policy approval by the trust's risk management committee and drugs and therapeutics committee, the first phase of implementation, consisting of publicity and the promotion of good practice, took place in February 2002. The policy could not be fully implemented at this time because not enough stock of manufactured specials had yet been sourced.

Awareness sessions were held with medical and nursing staff during, for example, junior medical staff training sessions and “grand rounds”, and regular ward managers' meetings. Participants were told about the forthcoming new policy and about aspects of good practice that they should adopt in the meantime (such as using oral potassium supplementation where possible and making better use of the pre-mixed infusions then currently available, for example, the Alberti-GLIK regimen infusions).

Once sufficient stocks of the 40mmol potassium in 500ml infusions were received, phase two began and a date was set (30 June 2002) for the withdrawal of ampoules from clinical areas. A bulletin was circulated by a

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**Table 1: Treatment of hypokalaemia and hypophosphataemia with intravenous potassium infusions, where use of oral potassium is inappropriate**

<b>A. Treatment of hypokalaemia</b>		
<b>Serum potassium level (mmol/L)</b>	<b>Degree of hypokalaemia</b>	<b>Treatment</b>
3.5-5.0 (normal)	Prophylaxis against hypokalaemia	20mmol in 1L of 0.9 per cent sodium chloride or 5 per cent glucose infusion administered peripherally (or centrally) over at least 8h as part of a normal fluids regimen
3.0-3.4	Mild or non-urgent hypokalaemia	40mmol in 1L of 0.9 per cent sodium chloride or 5 per cent glucose infusion administered peripherally (or centrally) over at least 6-8h
less than 3.0	Severe or very urgent hypokalaemia	40mmol in 500ml 0.9 per cent sodium chloride or 5 per cent glucose infusion* administered peripherally (or centrally) over at least 4h, or 40mmol in 100ml 0.9 per cent sodium chloride infusion* administered in intensive treatment unit, post-operative critical care unit, high-dependency unit, or coronary care unit over at least 2h via a central line with continuous ECG monitoring of rate and rhythm
<b>B. Treatment of hypophosphataemia</b>		
20mmol potassium and 20mmol phosphate in 250ml water for injection* administered peripherally (or centrally) over at least 4 hours		
* unlicensed manufactured special		

variety of mechanisms (for example, e-mail, posters and flyers) to reach as many hospital staff as possible. The announcement by the NPSA that summer of its target to remove all potassium ampoules from general wards helped greatly in persuading staff as to the merits of the policy.

During the week preceding ampoule withdrawal, clinical areas which were known or suspected not to hold stocks of ampoules (for example, clinics) were checked and the absence of ampoules confirmed. Withdrawal of ampoules and the simultaneous supply of a small stock of the new infusions took place on 30 June as planned and included all wards and theatres at both hospitals (71 clinical areas in all). This process was completed in less than four hours by four teams of two pharmacy staff members. During the withdrawal process, a copy of the policy and a laminated A3 poster summarising the key points were placed near the potassium infusion storage areas.

### — PRACTICAL ASPECTS

As mentioned above, stepwise implementation was necessary because of difficulties in sourcing enough pre-mixed infusions to meet the needs of the trust.

The project group determined that approximately 600 bags of the 40mmol potassium in 500ml infusions were needed to place stock in all clinical areas of both hospitals in the trust. This equated to each general ward receiving four bags of the saline variant and two of the glucose variant, with theatres and intensive care areas receiving increased amounts. In addition, to ensure

maintenance of supply and avoid compromising patient care once the potassium ampoules were withdrawn, stock had been commissioned from two different special manufacturers.

The unlicensed manufactured specials needed to be readily available on each ward but it was necessary to document all issues to patients so that regulations regarding unlicensed products were met. This was managed by treating the unlicensed specials as controlled drugs, requiring entries for receipt and issue in a "potassium register", thereby creating the necessary audit trail from purchase to administration.

Having an increased number of potassium infusion bags on wards caused some problems in that they took up storage space and looked similar to other infusion products. The project group recommended that the potassium infusions were stored in a discrete area reserved for them. Where space allowed, some wards chose to keep them in their controlled drugs cupboards.

We considered it important to complete the withdrawal of ampoules and simultaneous supply of the new infusions in one event. A Sunday was chosen for the withdrawal since this had the benefit of being a relatively quiet day and on the following day (Monday) all of the pharmacy and medical resources would be available to deal with any problems that arose.

The policy requirement for all potassium infusions to be administered via a volumetric pump could not initially be met. An audit showed that the total number of pumps available at the trust was insufficient for the anticipated demand. In addition, a significant

proportion of the pumps were becoming obsolete. The risk management committee recommended a major investment in new pumps, and a large capital sum was agreed. A project group was formed to identify the type and number of pumps required and a local specification was drawn up which led into an accelerated competitive procurement. Due to the expressions of interest from manufacturers and likely time frame for completion, it was agreed not to await the arrival of new pumps before implementing the policy. An interim policy amendment reserved the use of pumps for infusions containing more than 40mmol/L potassium. The introduction of new pumps was completed by October 2002.

### — POST-IMPLEMENTATION

It was clear that this project would have a major impact on the trust and would need follow-up. For example, the trust's formulary and prescribing guidelines and medical staff handbook have been updated accordingly.

An audit was carried out by pharmacists three months post-implementation to determine levels of adherence to the policy. The results showed that there was a high degree of compliance with the policy. For example, no potassium ampoules of any type have been issued since the policy was implemented and the use of "Alberti bags" has increased from 170 to 570 bags per month. Pharmacists also found that all potassium infusions were being delivered through infusion pumps, as directed by the policy.

A questionnaire was also conducted to gauge the opinions of medical and nursing

staff about the policy implementation and identify areas for development. The results showed that staff were generally happy with the way that the policy had been implemented. For example, 93 per cent of the 53 staff questioned thought that the policy was clear about its aims and intentions, 92 per cent agreed that implementation of the policy had been either "moderately" or "very" successful (as opposed to "unsuccessful") and 87 per cent thought that the removal of ampoules of strong potassium chloride from their area had not had an adverse effect on their ability to treat patients. Improvements in the implementation process that staff suggested mainly related to maintaining continued publicity about the use of oral potassium and informing new medical staff about the policy.

## CONCLUSION

Although it pre-dated the NPSA safety alert, it is our understanding that the "potassium policy" adopted at the Royal Liverpool and Broadgreen Trust meets the NPSA's recommendations on the storage and use of strong potassium solutions. Indeed, in some aspects the policy goes further than the measures advocated by the NPSA. In particular, the removal of concentrated potassium ampoules from theatres, as well as wards, guarantees that inadvertent direct injection and improper admixture cannot occur. The requirement that all infusions be administered by volumetric pumps reduces the risks of over zealous infusion and "infusion free-flow". In our experience, therapeutic flexibility has not been adversely affected by these measures.

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