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## High Risk Medication Alert Project - Change Management Case Study

*Learning from the experience of others to assist your project.....*

From Royal Adelaide Hospital, South Australia  
August 2003



### QUESTIONS

Why was potassium chloride (KCL) selected for the “change initiative”?  
Who “drove” the initiative and how were clinicians and managers involved?  
What data was used - overseas data, local data?

The Royal Adelaide Hospital (RAH) as an organisation is committed to promoting quality and safety in clinical practice. This is evidenced by strong executive support that facilitates a broad range of projects and ongoing system-wide improvement initiatives.

In recognition of the significant safety issues associated with medication use, a multidisciplinary working group was formed in early 2002 to drive the organisation’s work in this area. The Medication Quality and Safety Working Group, consists of individuals with an interest in improving medication safety from disciplines of Pharmacy, Nursing and Medicine and importantly includes both management and ‘coal face workers’. The Working Group reports to the Hospital’s Drug Committee and Clinical Practice Unit.

In its short life to date the group has utilised ongoing review of medication incident data from a variety of sources to drive its activities which focus on coordinating system change to improve medication use processes and hence outcomes.

### **Why KCl ? It’s a ‘no-brainer’!**

Sentinel events in the acute care setting arising from the use of intravenous potassium chloride (KCl) are well recognised in the international literature and a number of risk reduction strategies have been successfully implemented in the US and UK. Whilst reports of a similar nature are not easily found in Australian data, there are a number of near miss reports and the opportunity for error, given our medication use processes, is high. Several illustrative case reports are available from the Victorian Coroner’s database.

### QUESTIONS

How was the team put together?  
Who was on the team?  
What was the importance of “driving the project” and giving it credibility?

The KCl project was conducted under the auspices of the Medication Quality and Safety Group described above, and was lead by the Pharmacy Department with assistance from the ward-based nursing representatives.

The project was underpinned by a philosophy of ensuring stakeholder ownership via a collaborative and knowledge sharing approach and was focused on ensuring the system changes were managed to avoid the introduction of new or different risks.

The size of the hospital and the varied and widespread usage of KCl were some of the factors that added complexity to the process.

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### QUESTIONS

**What were the project aims and how were they communicated?**

**What education strategies and tools were developed?**

The project aims were to:

- raise awareness of the potential for inadvertent inappropriate KCl administration and the associated risks.
- to determine the feasibility of removing ampoules of KCl from patient care areas and for utilising pre-mixed infusions.

#### **Firstly, existing policies for KCl storage were reviewed.**

For many years KCl ampoules had been stored in the same ward stock cupboards as the small volume diluents such as sodium chloride ampoules. In addition to this, ampoules of KCl were often transferred by ward staff and stored along side these products in the areas utilised for medication preparation.

A new policy of storing KCl in the locked ward stock cupboards along with scheduled medications was introduced and bright warning labels regarding the need for dilution prior to use were prominently displayed. Nursing staff were educated on the reasons for the change in storage and agreed that stocks would no longer to be routinely stored in the medication preparation rooms. Storage within the Pharmacy Department was modified in the same way.

#### **Feasibility of using standard pre-mixed KCl infusions**

The Pharmacy Department undertook a review of the product range, presentation and cost of pre-mixes available. At the time, a small range was available and the costs were not significant.

A student project was undertaken to establish the pattern of use of KCl infusions across the hospital.

The relevant findings were:

- the most common doses ordered were 2 gram (44.3%), 1 gram (19.1%) and 3 gram (15.2%) per 1000 mL
- glucose 4%/sodium chloride 0.18% and sodium chloride 0.9% were the diluents used in 80% of cases
- wide range of doses ordered (0.5-20 gram) with higher doses predominantly ordered in specialised areas (eg haematology)

In summary, the majority of infusions ordered would be covered by the available pre-mixed solutions. However, a number of important issues were identified:

- doses are ordered in grams of KCl whilst the pre-mixes are labelled as millimoles and %
- access to higher doses and higher concentrations required in some units
- ease of ordering and dose preparation in millimoles would be facilitated by changing to 10 mmol/10 mL ampoules (rather than the 1 gram or 13.4 mmol/10 mL product in use)

#### **Recommendations**

The findings were presented to the Working Group and the Drug Committee with following recommendations:

- that two standard pre-mixes be made available – 30 mmol KCl in 1000 mL glucose 4%/sodium chloride 0.18% and 1000 mL sodium chloride 0.9%
- that KCl infusions be ordered millimoles

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This recommendation was based on the labelling of the pre-mixes and the fact that reporting of biochemistry results was based on millimoles. In addition an e-mail survey of local and interstate hospitals was undertaken and it was found that a majority of hospitals were using millimoles as their standard units for KCl.

The survey results were provided to the respondents and to promote a standard within the South Australian metropolitan area we encouraged those hospitals using grams to consider a change to millimoles.

### **Pilot of pre-mixes and new policy for dosage units**

One medical ward was selected for a pilot of pre-mixes and the new policy for dosage units. This ward was chosen predominantly due to the fact that the Clinical Nurse Consultant was a member of the Working Group and a very good clinical champion.

A pharmacist provided education sessions to multiple groups of nursing staff and medical staff. Sessions covered the rationale for the new policies and products; the conversion of grams to millimoles; how to order KCl on the existing medication charts and how to prepare infusions utilising the available ampoules and pre-mixes.

Wall charts and laminated pocket cards were developed to support the process (see appendices).

### **QUESTIONS**

**What barriers were encountered?**

**There was “nothing suitable” to replace concentrated potassium with....**

**There were post implementation problem with....**

A number of challenges were encountered including the sheer number of staff to be educated and ensuring the educational tools were meaningful and presented in appropriate language. Agreement from medical staff on standardising the ordering of KCl infusions prior to introduction of pre-mixes was also necessary.

The risk of nursing staff adding the total dose ordered to the pre-mix was also discussed and carefully addressed in the education sessions and was not been a problem during the pilot. Practical issues encountered included the existing wording on the IV fluid therapy chart and the storage of the pre-mixes within limited space available in the ward areas.

The labelling of the pre-mixes makes them easily distinguishable from other fluids by the pink outer wrapping and the red labelling is a positive. However the fact that the main label on the bags is in % of potassium and chloride has caused some confusion for nursing and pharmacy staff. In addition, the pre-mix in sodium chloride is labelled as 'hypertonic' (a very prominent label). This was picked up by nursing staff in the second ward of the pilot. They are very concerned about this wording despite the fact that we discussed with them that making up their own bags will produce the same product. This is being followed up with the manufacturer and may need further discussion with the Therapeutic Goods Administration (TGA).

A strong emphasis on risk management and reference to case reports was a key factor in gaining ownership and commitment to the process.

As KCl is familiar and perceived as a 'boring' medication in the hospital setting, a number of senior clinicians initially were not interested by the topic however were surprised by the rate of error reported and subsequently quite supportive.

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### QUESTIONS

**How were (or will) the barriers overcome?**

**Using standard pre-mixes – what was the approach?**

Overcoming staff education issues and ensuring the educational tools were meaningful and presented in appropriate language was achieved by the involvement of nursing and medical staff in their preparation. This was a key factor in successful communication of the information.

Agreement from medical staff on standardising the ordering of KCl infusions prior to introduction of pre-mixes was also necessary. It was agreed that the total dose of KCl and the infusion fluid to be used should be specified rather than simply 'KCl pre-mix'.

This was promoted on the basis that the dose required must be documented and that the pre-mixes are available in more than one fluid. In addition, a greater range of pre-mixes may be considered at a later date if required.

The labelling of the pre-mixes, especially the fact that the main label on the bags is in % of potassium and chloride and may cause confusion, has been raised with the manufacturer and the Therapeutic Goods Administration (TGA). However, this is an ongoing concern.

### QUESTIONS

**What were the short term wins?**

The pilot was successful in the first ward and was expanded into an adjacent medical ward.

### QUESTIONS

**What next?**

**What is still to be done, and what is the plan to do it?. (e.g. theatre, coronary care....)**

A more rapid roll out commencing in the medical and surgical wards is now planned. Clinical pharmacists providing education sessions for their areas will facilitate this.

The main unresolved issue is the inability to completely remove the KCl ampoules from ward areas. In the US, 24-hour pharmacy services provide patient specific infusions and in the UK there is a greater range of pre-mixes available.

One option is to introduce the requirement for non-standard doses to be prepared by pharmacy staff during working hours with access to limited emergency stock in a central location after hours. This option has the disadvantages of access and time delays which tend to encourage hoarding in unlabelled locations. It may be workable for specific areas using high doses on an infrequent basis.

One advantage of raising the awareness of the potential risks is that it has encouraged good checking practices amongst the nursing staff.

Future technologies such as electronic prescribing with decision support and bar coding of drugs prior to administration to the patient would seem to have significant advantages in reducing a range of risks in the medication use process.

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**ACKNOWLEDGEMENTS**



ROYAL ADELAIDE HOSPITAL

Royal Adelaide Hospital is kindly acknowledged for sharing their learning experiences via the notes provided in this Change Management Case Study.

The notes were kindly prepared by:

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August 2003

**Appendix 1 – Example Flyer for Nursing Staff on the New Policy  
at Royal Adelaide Hospital**

*This page was given to nursing staff and the following page was laminated (A4)  
and placed in the medication preparation areas and ward stock areas.*

Pharmacy Department  
Medication Quality & Safety Working Party

Trial in Ward S8 – Commencing Tuesday 2nd September 2003

**IV Potassium Chloride - New Policy & Procedures for Ordering & Dose Preparation**

- Injection of **concentrated potassium chloride causes death.**
  - There are many case reports in the medical literature where potassium chloride (KCl) has been accidentally administered undiluted either directly or after being used as a diluent for administering antibiotics and other bolus injections resulting in cardiac problems and ultimately demise of the patient.
- To **reduce the risk** associated with concentrated KCl, the RAH is adopting new policy and procedure for ordering and preparation of intravenous KCl.
- To promote safe use of KCl **some new products** will be available.

**New Policy**

- Potassium chloride concentrate will be stored in the locked imprest cupboard ONLY
- Ward stocks of potassium chloride concentrate ampoules will be minimised
- Doses of IV Potassium chloride should be ordered in millimoles
  - Ordering doses in either grams or ml/litre will be phased out

**New Products**

**1. Potassium Chloride Pre-mix Infusions**

Two infusions stocked in IV imprest:

- 30mmol in 0.9% sodium chloride, 1 litre
- 30mmol in 4% glucose/0.18% sodium chloride, 1 litre (4% and a 1/5)
  - Both solutions come in a pink outer bag and have red labelling

*Note: 30mmol is equivalent to 2.2g of potassium chloride.*

**2. Potassium chloride concentrate ampoules**

Now stocked in special imprest cupboard as:

- 10mmol/10ml potassium chloride ampoules
- new ampoules are plastic with orange labelling
  - this will replace the 1g (13.4mmol) in 10ml ampoule

*Note: 10mmol is equivalent to 750mg (0.75g) of potassium chloride.*

## HOW TO ORDER & PREPARE POTASSIUM CHLORIDE INFUSIONS

Instructions for ordering and preparing the most common doses of IV potassium chloride (KCl) are provided below.

KCl Dose ordered	Equivalent to:	Preparation of KCl infusion
10mmol	750mg	Add 10ml of KCl 10mmol/10ml <sup>(1)</sup> to 1 litre bag of : <ul style="list-style-type: none"> <li>• 0.9% sodium chloride</li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>• 4% dextrose/0.18% sodium chloride</li> </ul>
15mmol	1.1g	Add 15ml of KCl 10mmol/10ml <sup>(1)</sup> to 1 litre bag of : <ul style="list-style-type: none"> <li>• 0.9% sodium chloride</li> </ul> <p><b>OR</b></p> <p>4% dextrose/0.18% sodium chloride</p>
30mmol	2.2g	Use pre-mix KCl bag <sup>(2)</sup> - no addition required.
40mmol	3.0g	Add 10ml of KCl 10mmol/10ml to premix KCl bag <sup>(2)</sup>
55mmol	4.1g	Add 25ml of KCl 10mmol/10ml to premix KCl bag <sup>(2)</sup>
80mmol	6.0g	Add 50ml of KCl 10mmol/10ml to premix KCl bag <sup>(2)</sup>

(1) *potassium chloride concentrate 10mmol in 10ml (orange printing on ampoule)*  
*One ampoule = 10mmol*

(2) *Premix KCl 30mmol is available in 0.9% sodium chloride or 4% dextrose/0.18% sodium chloride in 1litre bags (pink wrapper/red printing on bag).*

*Note: careful and thorough mixing is required after adding concentrate to the premix solution.*

**For more information** on what dose of potassium chloride (KCl) to use, infusion rate & compatibility information refer to:

- the Australian Injectable Drugs Handbook
  - your clinical pharmacist
- OR
- RAH Medicines Information Centre (ext 25546).

For more information regarding the new policy or products please contact:  
 Naomi Burgess  
 Deputy Director  
 Pharmacy Services Ext 24951

**Appendix 2 – Example Flyer for Medical Officers on the New Policy  
at Royal Adelaide Hospital**

*This flyer was given to medical staff initially at education sessions and then posted out.  
It was reduced to a pocket size and laminated for all medical staff as well.*

Pharmacy Department  
Promoting Safe Use of Medicines

**IV Potassium Chloride (KCl) - Trial Extended to Ward S8  
from Tuesday 2<sup>nd</sup> September 2003**

**New Policy**

- All doses of IV KCl to be ordered in millimoles (mmol)

**New Products**

- **KCl pre-mixed infusions** – available as 30mmol/1000ml in 0.9% sodium chloride or 4% glucose/0.18% sodium chloride.
- **KCl concentrate ampoules – available as** 10mmol/10ml KCl (replacing the 1g (13.4mmol)/10ml ampoule)

**How to write up the order:**

- Orders for IV KCl will be written on the infusion therapy record.

**Please indicate:**

- type of fluid eg sodium chloride 0.9% or glucose 4%/sodium chloride 0.18%
- the total amount of KCl in millimoles
- volume and duration of infusion
- PLEASE DO NOT JUST WRITE “PREMIX” – total dose & fluid must be specified.

KCl Dose in mmol	Equivalent to:
10	750mg
15	1.1g
30*	2.2g
40	3.0g
55	4.1g
80	6.0g

\*1000ml premix infusions available in this strength

Note: this policy has also been in place in Ward R8 since June 16<sup>th</sup> 2003.

## **Appendix 3 – Example list of topics covered at education sessions at Royal Adelaide Hospital**

*This memory prompt sheet was mainly used for the reference of the pharmacist presenter at the in-house education sessions.*

Pharmacy Department  
Medication Quality & Safety Working Party

### **Intravenous KCl trial – Commencing 2<sup>nd</sup> September in Ward S8**

#### **Background**

- Safety & Quality in Healthcare – a focus for RAH, nationally & internationally.
- Medication safety – a major component of incidents
- Australian data – 140,000 hospital admissions/year related to a medication incident or error
- RAH data – medication incidents comprise 20% of reported incidents

#### **KCl and error**

- Injection of conc KCl causes cardiac conduction problems including conduction block, asystole, ventricular fibrillation and ultimately death.
- Used in cases of capital punishment.
- Also causes pain and thrombophlebitis when infused at high concentrations.
- In USA, concentrated KCl is responsible for the highest number of fatal medication-related incidents
- Fatal incidents with conc KCl also reported in Canada and the UK
- A near miss reported in a Melbourne Hospital involving a dose of ceftriaxone reconstituted with conc KCl instead of WFI
- RAH – no errors of this nature reported so far

#### **Contributing factors**

- KCl ampoules often stored near or with water for injection and sodium chloride ampoules – similar appearance
- Insufficient mixing of IV bags can lead to pooling and hence “bolus” effects
- Multiple units used in ordering, monitoring, labelling and administration eg grams, millimoles, % and mEq.

#### **Approaches**

- National action plans in the UK & USA – remove all concentrated KCl from ward areas & restrict to critical care areas & pharmacy.

#### **RAH – first steps**

- Review of KCl usage
- Improve storage of KCl ampoules – separate from other small volume ampoules, reduce stock holdings, lock ward cupboards, warning labels
- Trial introduction of limited range of pre-mix solutions (NS & 4%/1/5)
- Use millimoles for all ordering and labelling
- Trialled for 2months in Ward R8 – now expanding to S8.

#### **What you need to do**

- Use oral K<sup>+</sup> replacement where possible
- When ordering IV KCl
- Write order in millimoles not grams
- note availability of 30mmol/L pre-mixes (equiv 2.2g KCL)
- ampoule strength now available – 10mmol/10ml (equiv 750mg)

#### **What we can to assist ?**

- pocket card on grams to millimoles conversion
- wall charts for preparation of infusions