Implementing Smart Pump Technology with a Fixed Concentrations Drug Library Across a Paediatric Hospital

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Background

- Dose error reduction systems (DERS) via use of smart pump technology are aimed at preventing under or overdoses and require consideration of medication practices across divergent clinical areas.
- Successful smart pump implementation requires project management, where team roles are well defined to ensure all goals are delivered. This includes defining pre-implementation practice to aid configuration of settings to allow clinicians to titrate according to the patients needs, training of staff in DERS and ongoing monitoring of compliance with use.

Method

- A project team comprised of medical, nursing, pharmacy and education team staff, with a non-clinical project manager was established.
- Baseline data were collected across a number of clinical specialities, at different time periods to determine pre-implementation drug delivery practices and patient needs. Data included weight, infusion concentrations, minimum and maximum rates, bolus dosing needed and volume given per 24 hours. The mode of these data were converted to a maximum of three concentrations and compared to the Intensive Care Society (ICS) recommended infusion strengths, any prefilled syringes prepared in NHS special manufacturing units and closest whole vial/ampoule amounts for ease of preparation. These were then inputted into a Excel calculator to check titratability for varying weights (figure 1).
- A principle of using minimum concentration options was employed, to reduce risk of drug/concentration selection error.
- Tables displaying proposed concentrations, soft and hard maximum/minimum and bolus settings were sent to key stakeholders across the hospital for agreement, prior to finalising drug library (DL) settings. This was to ensure current clinical practices would not be compromised.
- Drug monographs and prescribing documents were redesigned to include the agreed DL settings (figures 2 and 3). An extensive multimodal education programme, delivering online teaching alongside face-to-face support was rolled out and DL use was launched following 80% staff training.
- Audit data collection of DL compliance commenced 3 months post launch.

Drug name	Morphine 5mg in 50ml	
Min weight	1.0 kg	
Max weight	10.0 kg	
Bottom dose normal range	4 microgram/kg/hour	
Highest dose normal range	50 microgram/kg/hour	
Concentration		
	Dose in microgram/kg/hour	rate in ml/kg/hour
Lowest dose& rate	4	0.04
Normal start dose & rate	20	0.20
Safe upper limit&rate	50	0.50
Absolute upper limit&rate	100.0	1.00
Fluid rate at normal starting dose for minimum weight	0.2 ml/hour	
Fluid rate at normal starting dose for MAXIMUM weight	2 ml/hour	
Fluid rate at safe upper limit for minimum weight	0.5 ml/hour	
Fluid rate at safe upper limit for MAXIMUM weight	5 ml/hour	
Fluid rate at Absolute minimum weight	1 ml/hour	
Fluid rate at absoulte MAXIMUM weight	10 ml/hour	
To be bolused	YES	
Bolus dose/kg	50 microgram	
Bolus volume/kg	0.5 ml	
Resticted to critical care areas- circle	YES	NO

Figure 1: Excel calculator used to check if proposed concentrations provided the ability to deliver current clinical practice

Pump programming

Fentanyl*500/50= fentanyl 500microgram in 50ml

Fentanyl**2500/50= fentanyl 2500microgram in 50ml

Short Code	Default starting dose	Soft Minimum	Soft Maximum	Hard Maximum
Fentanyl*500/50	0.5microgram/kg/hr	0.2microgram/kg/hr	3microgram/kg/hr	10microgram/kg/hr
Fentanyl**2500/50				

Bolus dose default dose using hands on and free: 1microgram/kg

Figure 2: DL settings added to injectable monographs

ADRENALINE	mg	Diluents	IV CENTRAL
Standard Fixed Concentration: under 5kg: 1mg in 50ml; 5kg - 20kg: 4mg in 50ml; over 20kg: 8mg in 50ml	in 50 ml	G5W/G10W NS, 1/2NS	Extravasation Risk HIGH/VERY HIGH
	Emergency peripheral strength = 1mg in 50ml Only use in an emergency only until central access available		
..... ml/hr = 0.1microgram/kg/min	*Start infusion at .....microgram/kg/min*		
Prescribers Name (print): Prescribers Signature:	GMC/Reg No.	Date	Pharm
May be mixed at the terminal y-site with drugs listed on IV monograph			
Withdraw 1ml at end of infusion, or flush with 1ml sodium chloride 0.9% at same rate			
Date/ time prepared			
Nurse 1 sign			
Nurse 2 sign			
Pump programmed by			
Pump program checked by			

Figure 3: Example of prescribing document changes

Results

- General ward areas were found to need a separate DL profile to ensure safety, with a more limited DL, lower maximum dosing limits and no bolus capabilities.
- Theatres and ICU DLs were combined into 1 profile following clinician agreement on dosing limits and bolus capabilities.
- Only three drugs required a maximum of three different concentrations to account for the vast majority of clinical practices and patient weights: adrenaline, noradrenaline and morphine.

Learning Points

- Use of a multidisciplinary project team aided the roll out across the Children's Hospital
- Ensuring stakeholders were engaged in the choice of DL settings, especially the bolus function in theatres where practices differ from ward areas, was key to acceptance of using the DERS
- The multimodal education programme allowed for different staff groups to select best teaching and refreshers options, for areas where infusions are less frequently used

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