National Paediatric and Neonatal Standardised Infusion Smart-Pump Project

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Overview

• Background
• Project progress to date
• Future Plans
66% treated outside of Dublin
Medication Errors

70%

27%

1. IV doses administered via infusion pumps associated with an error
2. Infusion errors associated with syringe pumps

10-fold / 100-fold errors (1/3rd - infusion pump programming)

≥1 error handwritten ‘Rule of Six’ infusions

PICU/NICU: Highest Rates

Potential adverse drug events - Paeds vs Adults

x 3
IV Doses in NICU¹
31% < 1/10th vial
4.8% < 1/100th vial

66% Doses in PICU are off-label / unlicensed

From Prescription to Patient

Midazolam
1 microgram/kg/min

3.2 kg

- Neat = 0.0384 ml/hr
- Aim for 1 ml/hr

Midazolam (Hypnovel®)
5 mg/ml (2 ml amp)
Individualised Weight Based Infusions

‘Rule of 6’
6 x body weight (mg) in 100 ml:
1mL/hr = 1mcg/kg/min

3.2kg

Doctor’s Calculation

Statement of Rate Dose Range

Nurse Calculation
Preparation of Syringe

Calculation for Programming of Pump

Traditional Pump

Programming of Pump
74 incidents (April 2008 – November 2010)

Multiple 10-fold errors

- 10mgs /kg prescribed instead of 1mg /kg (Prescribing)
- Pump set at 0.5mls/hr instead of 0.05mls/hr (Pump)
- 600mcg drawn up instead of 60mcg (Syringe Preparation)
“Up to May 31 2010, 23 cases of accidental overdose with Perfalgan have been reported worldwide in children younger than 1 year, one of which was fatal.

Themes:
- Human error relating to setting up infusion pumps
- 10 times dose calculation errors in both the prescription and administration of intravenous paracetamol.
Standardize and identify medications effectively, as well as the processes for drug administration.

- Limit the number of concentrations and dose strengths of high alert medications to the minimum needed to provide safe care.

2004 – ‘standardisation of infusion devices’
2007 ‘Smart’ infusion pumps”
2007 – Ready-to-Use Solutions

Best Practice 8:
Administer high-alert intravenous (IV) medication infusions via a programmable infusion pump utilizing dose error-reduction software.

- All high alert medications in all hospital settings, both inpatient and outpatient.
- Dose error reduction software on all pumps (i.e. smart-pumps).
- If smart pumps not already in use in all areas, ensure capital equipment budget includes the purchase of this technology as soon as possible.
Individualised Weight Based Infusions

Doctor’s Calculation

Nurse Calculation Preparation of Syringe

Calculation for Programming of Pump

Traditional Pump

3.2kg

Standard Concentration Infusions

Doctor’s Calculation

Statement of Rate Dose Range

Nurse Calculation Preparation of Syringe

Calculation for Programming of Pump

Programming of Pump

Smart-Pump Technology

Standardised
No Calculation

Step Removed
No Calculation

Standardised
Measurable volumes

Step Removed
No Calculation
### Sample OLCHC SCI Table

**STANDARD CONCENTRATION DRUG LIBRARY**  
**PICU - SHORT VERSION** (See i-drive for full version)

<table>
<thead>
<tr>
<th>Drug</th>
<th>Weight</th>
<th>Standard Concentration (Normal Strength)</th>
<th>Std Concentration Fluid Restricted (High Strength)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adrenaline</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>≤2.5kg</td>
<td>1mg/50mL</td>
<td>3mg/50mL</td>
</tr>
<tr>
<td></td>
<td>&gt;2.5 - ≤5kg</td>
<td>1mg/50mL</td>
<td>3mg/50mL</td>
</tr>
<tr>
<td></td>
<td>&gt;5 - ≤10kg</td>
<td>3mg/50mL</td>
<td>6mg/50mL</td>
</tr>
<tr>
<td></td>
<td>&gt;10 - ≤20kg</td>
<td>6mg/50mL</td>
<td>12mg/50mL</td>
</tr>
<tr>
<td></td>
<td>&gt;20kg</td>
<td>6mg/50mL</td>
<td>12mg/50mL</td>
</tr>
<tr>
<td><strong>Heparin</strong> (Prophylaxis)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>≤2.5kg</td>
<td>2,500units/50mL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;2.5 - ≤5kg</td>
<td>2,500units/50mL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;5 - ≤10kg</td>
<td>5,000units/50mL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;10 - ≤20kg</td>
<td>10,000units/50mL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;20kg</td>
<td>10,000units/50mL</td>
<td></td>
</tr>
<tr>
<td><strong>Midazolam</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>≤2.5kg</td>
<td>10mg/50mL</td>
<td>25mg/50mL</td>
</tr>
<tr>
<td></td>
<td>&gt;2.5 - ≤5kg</td>
<td>25mg/50mL</td>
<td>50mg/50mL</td>
</tr>
<tr>
<td></td>
<td>&gt;5 - ≤10kg</td>
<td>50mg/50mL</td>
<td>50mg/50mL</td>
</tr>
<tr>
<td></td>
<td>&gt;10 - ≤20kg</td>
<td>50mg/50mL</td>
<td>100mg/50mL</td>
</tr>
<tr>
<td></td>
<td>&gt;20kg</td>
<td>100mg/50mL</td>
<td>250mg/50mL (Neat)</td>
</tr>
</tbody>
</table>
Smart Pump Technology
Safety Parameters

1. Key in weight of Pt
2. Select SCI
3. Default rate offered
4. Press Go

1. Drug Library
2. Visual display
3. Integration
4. Bar-Coding
5. Data Capture/CQI data
ISMP Error Reduction Strategies

Forcing Functions and Constraints

Automation and Computerization

Standardization and Protocols

Checklists and Redundancies (double-check systems)

Rules and Policies

Education/Information

"Be More Careful"
Standardisation

65.3% US hospitals SCIs (for paed infusions)
88.1% use smart-pumps

60% paediatric/neonatal units use weight-based infusions
2/3rd do not use a smart-pump with SCIs
National Project Progress

2012

Implemented into PICU, OT, CHC (OLCHC)

> 175 Staff

Version 1

Original single-site paediatric drug library

UNI-DIRECTIONAL INTERFACE

Clinical Information Management System (Philips ICCA)
Electronic Standard Orders

Enter New Orders

Allergies: Status=None Known
Has Latex Allergy?=No

Weight (Admit): 3.210, Height (cm): 48.5 cm, Actual • BSA:

Mode: Direct Prescriber Entry

1. Medication Infusions
2. Adrenaline

3. Adrenaline 1 mg in 50 mL Glucose 5% w/v @ 0 to 0.1 microgrm/kg/min
   Adrenaline 3 mg in 50 mL Glucose 5% w/v @ 0 to 0.1 microgrm/kg/min

<table>
<thead>
<tr>
<th>Drug</th>
<th>Formulation</th>
<th>Amount Added</th>
<th>Min Dose/Wt/Time</th>
<th>Max Dose/Wt/Time</th>
<th>Use Wt Based Dosing</th>
<th>Concentration</th>
<th>Base Solution</th>
<th>Base Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adrenaline</td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adrenaline Injection
### Pump Interface

<table>
<thead>
<tr>
<th>Chloride u.v...</th>
<th>02/11/2016</th>
<th>05:00</th>
<th>06:00</th>
<th>07:00</th>
<th>08:00</th>
<th>09:00</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heparin for Injection 2500</td>
<td>Units/kg/hr</td>
<td>0</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Units in 50 mL Sodium Chloride 0.9...</td>
<td>Units/kg/hr</td>
<td>(9.1)</td>
<td>1.4</td>
<td>1.4</td>
<td>1.4</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>Volume Adm</td>
<td>1.4</td>
<td>0.3</td>
<td>1.4</td>
<td>1.4</td>
<td>1.4</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>Rate Adm (mL/hr)</td>
<td>0</td>
<td>1.44</td>
<td>1.44</td>
<td>1.44</td>
<td>1.44</td>
<td>1.44</td>
<td></td>
</tr>
<tr>
<td>Dose/Weight/Time</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Action</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Site</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cosign 1 (prep)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cosign 2 (prep)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-sign 1 (pump)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cosign 2 (pump)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bolus Volume</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bolus Dose</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Syringe Level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milrinone Injection 5 mg in 50 mL Glucose 5% w/v @ 0 microgram...</td>
<td>microgram/kg/min</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Noradrenaline Injection 1 mg in 50 mL Glucose 5% w/v @ 0 microgram...</td>
<td>microgram/kg/min</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Sildenafil Injection 10 mg in 50 mL Glucose 5% w/v @ 0.03 mg...</td>
<td>mg/kg/hr</td>
<td>0.03</td>
<td>0.03</td>
<td>0.03</td>
<td>0.03</td>
<td>0.03</td>
<td></td>
</tr>
</tbody>
</table>

**Order Details**

- **Assigned Pump symbol**
- **Volume infused in last hour (pump data)**
- **Rate infusing on the hour (pump data)**
- **Rate calculation by ICON (based on flowsheet Pt weight)**
PICU & Beyond

IPATS

PICU (OLCHC & Temple St)

IPATS

Non-specialist Transport Team (NSTT)

NNTP

3 Dublin Hospitals

25% admissions (400 per year)

19 Maternity Sites

X 100
2015 Transfers by Source Region

- **LEINSTER**: TSCUH - 0, OLCHC - 0
- **MUNSTER**: TSCUH - 0, OLCHC - 0
- **DUBLIN**: TSCUH - 0, OLCHC - 0
- **CONNACHT**: TSCUH - 0, OLCHC - 0
- **ULSTER**: TSCUH - 0, OLCHC - 0
- **N. IRELAND**: TSCUH - 0, OLCHC - 0

At least 1 transfer from all 26 counties in 2015
Neonatal Standardisation

- National Audit
- Working Group
  Neonatal Advisory Group
  Clin Programme Paediatrics & Neonatology
- Library agreed
- Phased roll out (19 sites plus Neonatal Transport)
- Maternal and Neonatal Clinical Management System (MN-CMS)
- Pilot Sites (Coombe & Rotunda)
Awards
1. Best Hospital Project Award - Irish Healthcare Awards 2016
2. Excellence in Patient Safety Award - Hospital Professional Awards 2016
3. Finalist in HMI Leaders Awards 2016 - Commendation awarded
National Project Progress

2012
- Implemented into PICU, OT, CHC (OLCHC)

2014
- Upgrade and Implementation into TSCUH & Paediatric Transport

2015
- National Neonatal SCI Drug Library

2016
- B.Braun Drug Library Content Management System (OLCHC)
- Live in Coombe (6/16), Cork (11/16), Rotunda (partial)
- Draft National Paediatric Library

2017
- Live in Kerry (3/17), Rotunda (complete)
- On-going negotiations with HSE, CHG
- NTMP agree to fund 2 x 0.5WTE posts

2018
- 0.5 Pharmacist/Nurse in post (Jan 2018)
- Processes for external centres (Wt-based & SCI)
- WG Paed ED Library Ver 4 library
Smart-Pump Team

Eimear

Eimear McGrath
Clinical Nurse Facilitator – Informatics/Smart-Pumps
eimear.mcgrath@olchc.ie

Sharon

Sharon Sutton
Senior Pharmacist – Informatics/Smart-Pumps
sharon.sutton@olchc.ie
Each hospital has a specific site ID.

Interim Measure Only
Smart-Pump Drug Library Development

42 Drug Lines
- Version 1
  - Original single-site paediatric drug library (2012)

61 Drug Lines
- Version 2
  - Master cross-site paediatric drug library (2014)

117 Drug Lines
- Version 3
  - Master cross-site paediatric drug library (2017-18)

200 Drug Lines
- Version 4
  - National Paediatric SCI Drug Library

EXPAND 2019
- Neonatal SCI Drug Library
  - 15 Drug Lines

Non-Specialist Emergency Departments
- 2019+

Paediatric Tertiary Emergency Departments (NPH Urgent Care Centres)
- Jan/Feb 2019

Adult ICUs
- 2019+
Paediatric – Adult Interface

‘Adult’ Dose Caps
Non-Weight Based Dosing
Expand to Adults in the Adult Setting
Governance –
Pre Children’s Hospital Group (Jan 2019)

NAG, Clinical Programme: TOR and WG

OLCHC

Legally Binding Contract
Library will not be provided to any site without prior consent from OLCHC

Validation Process (Pharmacy Led)

Legally Binding Contract
Library will not be shared or altered without prior consent from OLCHC

Braun

Site by site arrangements for upload, training, costs

Other Sites
Potential Future Benefits of National Standardisation

• Centralised Service Level Agreement (SLA)
• Optimising ‘Smart’ capabilities of Existing Pumps
• Centralised Drug Library Uploads
• CIVAS/Pre-prepared infusions: Ready-To-Use (RTU) +/- or Ready-To-Administer (RTA)
• Closed Loop Medication Management
Drug Library Management – A Vision for the Future?

Drug File Manager – PICU OLCHC

Create, Manage & Download Multiple Drug Library Files

HSE Network

Hospital Network/WiFi

Manual Upload via USB

All Sites
Potential Risk & Barriers

- Resources (Human/Capital)
- Governance Structures
- Buy-in from Regional Hospitals
- Resistance to Change
- Drug Library Consensus
- Differing Practices
- Non-compliance
- Divergence
Summary

✓ A lot done – more to do
✓ Implementing Safer Infusion Practices at a National Level
✓ National and International Recommendations use of HIT
✓ Success of Multi-Disciplinary Collaboration
✓ Further Potential Benefits
Cormac Breatnach – Consultant Intensivist, OLCHC

........ AND many, many others!!
References for Medication Errors Slide


