One or More Errors in 67% of the IV Infusions: Insights from a Study of IV Medication Administration

Presented by:
Marla Husch
IV Pump FMEA: Failure Modes and Recommendations

**Failure Modes**

- Error in programming (RPN = 900)
- Error in initial set-up and handling of pump (RPN = 800)
- Inadequate patient assessment (RPN = 700)

**Recommendations**

- Develop policy and procedure for pump use
- Universal orientation through the academy
- Annual nursing competencies for utilizing pumps
- Surveillance to better understand trends
- Purchase smart infusion devices
- Apply FMEA process to equipment prior to purchase
Goals of a Point of Prevalence Day to Validate the FMEA Team’s Assessment of Risks

• Determine the actual frequency and potential severity of discrepancies associated with infusion pump orders, medications, labels, and programming, which may reflect errors, at Northwestern Memorial Hospital, on a first shift of a high-volume day among virtually all inpatients.

• Determine the potential impact of smart pumps on IV administration errors
Hypotheses

• The actual number of errors exceeds the number reported through incident reports

• IV pump errors are high-risk

• Programming errors occur frequently and have the potential to cause harm

• Smart pump technology will mitigate most IV administration errors associated with IV pumps
Methodology

• Observational approach

• Data collection criteria:
  – First shift (0800 - 1700) on a high volume day
  – All IV pumps in use on inpatient care units
  – Exceptions include: Operating room’s, Emergency Department, Postpartum, Labor and Delivery, and Recovery
Methodology

• Bedside:
  – Documented the medication, rate displayed on the infusion pump, and rate documented on the fluid/medication label

• Medical Record:
  – Compared the information documented at bedside to what was prescribed in the medical record
  – Documented discrepancies and evaluated associated potential harm, using the NCC MERP scale

• Retrospective
  – Potential impact of smart pump technology without an interface with other systems
  – Three investigators (two nurses and a pharmacist) rated all rate deviation errors as to whether or not smart pump technology would have prevented the error (yes or no)
Error types

- Rate deviation
- Incorrect IV medication
- Delay of rate change or medication change
- No rate documented on label
- Incorrect rate documented on label
- Unauthorized medication
- Patient Identification error
Results

- Total census: 669 patients
- Total # patients eligible: 486
- Total # patients with pump(s): 286
- Total number of medications observed: 426
Results: Discrepancies

- Medications observed = 426
- Observations with *no discrepancy* = 145 (34%)
- Observations with 1 or more discrepancies = 281 (66%)

- 0.92 Discrepancies per observation
- 1.3 discrepancies per patient with an IV pump
Results: Types of Discrepancies

n = 426

- Unauthorized medication: 16%
- Incorrect rate on label: 4%
- Patient identification error: 13%
- Incorrect IV medication: 3%
- Delay of therapy: 1%
- No rate on label: 46%
- Rate deviation: 9%
### Results: Harm

#### Number, frequency and potential severity of each type of error

<table>
<thead>
<tr>
<th>Type of error</th>
<th>Total (n=389)</th>
<th>Frequency per medication observations (n=426)</th>
<th>NCC MERP severity rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>No rate on label</td>
<td>195</td>
<td>46%</td>
<td>195</td>
</tr>
<tr>
<td>Unauthorized medication</td>
<td>68</td>
<td>16%</td>
<td>65</td>
</tr>
<tr>
<td>Patient identification error</td>
<td>55</td>
<td>13%</td>
<td>55</td>
</tr>
<tr>
<td>Rate deviation</td>
<td>37</td>
<td>9%</td>
<td>29</td>
</tr>
<tr>
<td>Incorrect rate on label</td>
<td>16</td>
<td>4%</td>
<td>16</td>
</tr>
<tr>
<td>Incorrect medication</td>
<td>14</td>
<td>3%</td>
<td>11</td>
</tr>
<tr>
<td>Delay of rate or medication change</td>
<td>4</td>
<td>1%</td>
<td>2</td>
</tr>
<tr>
<td>Total (%) n=389</td>
<td></td>
<td>373 (96)</td>
<td>8</td>
</tr>
</tbody>
</table>

Note: * Percents in this column do not add to 100 because some medications had more than one error.
## Error examples

<table>
<thead>
<tr>
<th>Medication and dose infusing via IV pump</th>
<th>Medical record order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heparin 200units/hour (2mL/hour)</td>
<td>Heparin 1300units/hour (13mL/hour)</td>
</tr>
<tr>
<td>Dopamine 800mg/250mL @ 2 mcg/kg/hour</td>
<td>Dopamine 200mg/250mL @ 2mcg/kg/hour</td>
</tr>
<tr>
<td>0.9 normal saline @ 20mL/hour</td>
<td>0.9 normal saline @ 250mL/hour</td>
</tr>
</tbody>
</table>
Conclusions

• The actual number of discrepancies associated with IV infusion devices exceeds the number reported through incident reports
  — 7 more errors were observed in one day than were reported through incident reports in two years

• IV medication errors associated with infusion pumps occur frequently, have the potential to cause harm and are epidemiologically diverse
  — 16 (4%) of the discrepancies identified had the potential to cause harm

• The extent and nature of these errors remains mostly unknown due to the lack of research

Conclusions

• Rate deviation errors occur and have the potential to cause harm. Pumps equipped with software that checks programmed doses against preset limits specific to a drug and clinical location can decrease the likelihood of a small number of these medication errors.
  – 37 (9%) of the 426 observed medications were programming discrepancies and 8 (21%) had the potential to cause harm

• Smart pumps with dose error reduction systems will have limited impact on patient safety unless they are fully integrated with information systems such as electronic medical record (EMR), computerized prescriber order entry (CPOE), bar-coded medication administration (BCMA), and the pharmacy information system (PIS)
  – 97.3% of rate deviation errors were rated unlikely to be prevented by smart pump technology and only 0.003% of errors overall would have been prevented by smart pump technology without an interface to other systems

Were the conclusions correct?
### Side-by-side comparison of results from 3 point-prevalence studies

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Infusions Observed</td>
<td>426</td>
<td>461</td>
<td>450</td>
</tr>
<tr>
<td>Total Patients</td>
<td>286</td>
<td>294</td>
<td>266</td>
</tr>
<tr>
<td>Rate deviation error</td>
<td>37</td>
<td>42</td>
<td>33</td>
</tr>
<tr>
<td>Unauthorized error</td>
<td>68</td>
<td>32</td>
<td>62</td>
</tr>
<tr>
<td>Patient Identification error</td>
<td>55</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Incorrect medication error</td>
<td>14</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Delay of rate or medication change</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Harm D</td>
<td>8</td>
<td>na</td>
<td>13</td>
</tr>
<tr>
<td>Harm E</td>
<td>5</td>
<td>na</td>
<td>3</td>
</tr>
<tr>
<td>Harm F</td>
<td>1</td>
<td>na</td>
<td>0</td>
</tr>
</tbody>
</table>