## Motivation:
In hospitals, medication safety teams (pharmacists, nurses, and physicians) regularly review and analyze alert events to evaluate performance of drug infusions for each medication-care unit combination. Several analysis tools for performance measures and indicators have been developed:

- **Key Performance Indicators (KPIs) & Performance Scorecard**
- **IV Medication Harm Index**
- **IP Safety Score**

However, only some of them incorporate risk assessment.

- Most indicators utilize the actual alert frequency, but not associated risk.
- Low frequency medications with high safety risk might be ignored.

Need: consolidated risk factors and a new indicator to help medication safety teams quickly target the combinations of care units and high-risk medications.

## Objective:
Apply a matrix-based method to create a new indicator (Risk-based Infusion Score) using normalized alert risk scores.

## Methodology:
A Matrix-based Method

### Data Source:
- **Hospital A (January 2010 - July 2015)**
- **Infusion Type:** Continuous, Intermittent, and Fluid infusions
- **Measure:** Normalized alert risk scores (from 100, the highest, to 1, the lowest risk)

### Alert Risk Factor Metrics:
- F1 - F3 were assessed by 4 pharmacists and 1 nurse.
- Top 24 frequently checked drugs by IPI users.

### Relative Risk Levels

<table>
<thead>
<tr>
<th>Relative Risk Level</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Risk (Good)</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Moderate Risk (Bad)</td>
<td>Moderate</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Higher Risk (Very Bad)</td>
<td>High</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Relative Degree of Risk

<table>
<thead>
<tr>
<th>Relative Degree of Risk</th>
<th>Lower Risk (Good)</th>
<th>Moderate Risk (Bad)</th>
<th>Higher Risk (Very Bad)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1: Risk Level of Medication</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>F2: Level of Care Unit</td>
<td>General Care</td>
<td>Intermediate Care</td>
<td>Adult Intensive Care</td>
</tr>
<tr>
<td>F3: Detectability of Adverse Drug Events (ADEs)</td>
<td>Easy</td>
<td>Moderate</td>
<td>Hard</td>
</tr>
<tr>
<td>F4: Relative Deviation from Programming Values to Soft Limits (%)</td>
<td>Smaller (Upper Bound)</td>
<td>Larger Number (UB)</td>
<td>Smaller (Lower Bound)</td>
</tr>
</tbody>
</table>

## Results:

### Histogram of Risk Score by year in Adult ICU & Adult Med/Surg

<table>
<thead>
<tr>
<th>Year</th>
<th>Adult ICU</th>
<th>Adult Med/Surg</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>2011</td>
<td>2012</td>
</tr>
</tbody>
</table>

### Top 10 Drugs with High Risk Score

- **Drug Name**
  - Hydroxyzine
  - Insulin
  - Insulin
  - Insulin
  - Vancomycin

### Impact of IPI User Activity on Risk Score

- **Drug Name**
  - Hydroxyzine
  - Insulin
  - Insulin

## Future Work:
- Integrate our new indicator and expert knowledge to generate new ways to evaluate infusion performance as a decision support tool for medication safety teams.

## Acknowledgements:
The authors would like to thank Ping Huang, PhD (Research Scientist, RHE) and Dan Degnan, PharmD (Clinical Research Associate, RHE) for assisting with methods.

## Reference:

1. CareFusion (2016). Knowledge Portal for Infusion Technologies v2.10
3. Carlson et al. (2015). Development of an infusion pump safety score

* Questions? Comments? Please contact: su33@purdue.edu