A18/B18: Triggers to Measure Harm: Automated Review

IHI National Forum  December 8, 2015

Fran Griffin, RRT, MPA
David Classen, MD, MS
Chris Baker, RN, PhD
Joann Sanders, MD
Loran Hauck, MD

Objectives

Following this session, participants will be able to

- Identify how EHRs can be used to automate a trigger review process
- Implement strategies to mitigate patient harm using triggers in EHRs
Disclosures

- Fran Griffin, Chris Baker and Joann Sanders have nothing to disclose.
- David Classen is an employee and employee owner of Pascal Metrics, a Patient Safety Organization that offers services in this area.

Global Trigger Tool:
A method for measuring Adverse Events - From Paper to Electronic

Fran Griffin, RRT, MPA
Fran Griffin & Associates, LLC
Faculty, The Institute for Healthcare Improvement

David Classen, MD, MA
University of Utah and Pascal Metrics
New (Harm) vs. Old (Errors)

- Concentrates less on people more on systems
- Looks at all unintended results
- Makes measurement easier
- Concentrates on harm and those errors that cause harm
- Errors are the focus of discussion and solutions
- Tends to focus only on those results felt to be related to error, ignores other events
- Requires judgment
- Human found responsible for most of the errors

Background of IHI Trigger Tools

- Computerized triggers for ADE identification and concurrent intervention
  Classen (1990, 1994)
- Adverse Drug Event Trigger Tool
  Resar, Federico, Griffin, Haraden (1999)
- ICU Adverse Event Trigger Tool
  Resar, Simmonds, Haraden (2002)
- Surgical Trigger Tool
  Griffin, Classen (2004)
- Global Trigger Tool (GTT) testing and spread to US and international hospitals
10-X More Preventable Harm Since IOM’99

By David C. Classen, Roger Rosar, Frances Griffin, Frank Federico, Terri Frankel, Nancy Kimmel, John L. Whittington, Alisa Frankel, Andrew Segovia, and Brent C. James

‘Global Trigger Tool’ Shows That Adverse Events in Hospitals May Be Ten Times Greater Than Previously Measured

Department of Health and Human Services
OFFICE OF INSPECTOR GENERAL
ADVERSE EVENTS IN HOSPITALS: NATIONAL INCIDENCE AMONG MEDICARE BENEFICIARIES

1/3 Patients have AEs; 1/6 require extended care; >>200K lives >>$750B/year

Journey to No Preventable Risk: The Baylor Health Care System Patient Safety Experience

Donald Kennerly, MD, PhD,1
Kathleen M. Richter, MS, MFA, ELS,1
Vicki Good, MSN, RN, CCNS, CNP,1
Jan Compton, RN, BSN, MSHA, CPHQ,1
and David J. Ballard, MD, PhD, MSPH, FACP1

11/23/2015

Trigger methodologies uncover 10- to 100-fold more adverse events than incumbent systems

Exhibit 4
Adverse Event Detection, by Severity Level and Hospital

<table>
<thead>
<tr>
<th>SEVERITY LEVEL</th>
<th>IHI Global Trigger Tool</th>
<th>AHRQ Patient Safety Indicators</th>
<th>Hospital Voluntary Reporting System</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>204</td>
<td>23</td>
<td>0</td>
</tr>
<tr>
<td>F</td>
<td>124</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>G</td>
<td>8</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>H</td>
<td>14</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>354</td>
<td>35</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HOSPITAL</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital A</td>
<td>161</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Hospital B</td>
<td>92</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Hospital C</td>
<td>101</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td><strong>354</strong></td>
<td><strong>35</strong></td>
<td><strong>4</strong></td>
</tr>
</tbody>
</table>

Source: Classen et al, Health Affairs 2011
Recommendation 1 (continued)

b. The Office of the National Coordinator for Health IT (ONC) should expand its funding of processes that promote safety that should be followed in the development of health IT products, including standardized testing procedures to be used by manufacturers and health care organizations to assess the safety of health IT products.

c. ONC and AHRQ should work with health IT vendors and health care organizations to promote post-deployment safety testing of EHRs for high prevalence, high impact EHR-related patient safety risks.

d. Health care accrediting organizations should adopt criteria relating to EHR safety.

e. AHRQ should fund the development of new methods for measuring the impact of health IT on safety using data from EHRs.
FIRST TRIGGER BASED AE DETECTION
YES IT WAS AN E-TRIGGER

TABLE 2. Possible Adverse Drug Event Report
For August 12, 1989 (Past 24 Hours)

<table>
<thead>
<tr>
<th>Date</th>
<th>Patient Received:</th>
<th>Doc:</th>
<th>Admit Diag:</th>
<th>Prev. Dosh:</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/11/89</td>
<td>Diphenhydramine</td>
<td>0776 Smith, Ralph</td>
<td>Bowel Obstruction</td>
<td>06/01/1989</td>
</tr>
<tr>
<td>Pat: 01110</td>
<td>Jones, David</td>
<td>76 M</td>
<td>Enhanced Reporting</td>
<td>06/20/1989</td>
</tr>
<tr>
<td>Admit:</td>
<td></td>
<td>EB21 MR#: 40001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Drugs</td>
<td>90 (12%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discontinued Drugs</td>
<td>641 (88%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/10/89</td>
<td>Meperidine 75 mg,</td>
<td>08/10/89 17:27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/11/89</td>
<td>IV q6h prn</td>
<td>Furosemide 20 mg,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/11/89</td>
<td>0:27</td>
<td>Inj, IV q12h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/11/89</td>
<td>Digoxin 0.25 mg,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/10/89</td>
<td>Tab, PO once daily</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/10/89</td>
<td>Morphine 6 mg,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/10/89</td>
<td>Inj, IV stat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/10/89</td>
<td>Furosemide 80 mg,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/11/89</td>
<td>Inj, IV q12h</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/11/89</td>
<td>Cefotaxime 2 g,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/11/89</td>
<td>Inj, IV q12h</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Example of a daily adverse drug event report. The signal was diphenhydramine, the offending drug was cefotaxime which caused a rash, and was stopped at the time the diphenhydramine was ordered.

ADVERSE DRUG EVENTS:
REPORTING AT LDS HOSPITAL

<table>
<thead>
<tr>
<th></th>
<th>Computerized Surveillance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>Automated Detection</td>
</tr>
<tr>
<td></td>
<td>Enhanced Reporting</td>
</tr>
<tr>
<td>9</td>
<td>641 (88%)</td>
</tr>
<tr>
<td></td>
<td>90 (12%)</td>
</tr>
</tbody>
</table>

* Total - 731

- Traditional: incident reports
- Enhanced: staff asked to report adverse events
- Automated: screened for triggers
- Results: Computer-based monitoring yielded 8-fold increase over aggressive voluntary reporting

Classen, JAMA 1992:267:1922
AUTOMATED HARM PEDIATRIC TRIGGER COLLABORATIVE

Children’s Hospital Association and PSO
Sponsors Pediatric Trigger tool development in three settings
(Dr. Paul Sharek, lead/senior author on each, Dr. David Classen)
• Neonatal ICU
• General Pediatric Inpatient
• Pediatric ICU

United States
Known use of Madera Children’s Hospital use of a Pediatric Trigger manual chart review
(Dr. Samuel Lehman, developer)
Known use of Automated Pediatric Triggers in Several Children’s Hospitals Neonatal ICU
• Children’s National (Dr. David Stockwell, Developer)
• Cincinnati Children’s Hospital (Drs. Steven Muething and Eric Kirkendall, developers)
• Colorado Children’s Hospital (Drs. Dan Hyman and Eric Tham, Developers)
• Cook Childrens (Dr Joann Sanders)

International
Canadian Paediatric Trigger Tool list developed (Dr. Anne Matlow, lead author)
Known use of Great Ormand Street’s use of a Paediatric Trigger manual chart review
(Dr. Peter Lachman, developer)

Recognizing Hypoglycemia in Children Through Automated Adverse-Event Detection

AUTHORS: Mindy J. Glickman, MD, PhD*; Brian R. Jacobs, MD, PhD*; Hima Vinodhas, RN; and David C. Stockwell, MD
Department of Pediatrics, Children’s National Medical Center, Washington, DC

WHAT’S KNOWN ON THIS SUBJECT: Automated adverse-event detection using triggers derived from the electronic health record is an efficient method of identifying adverse events, including hypoglycemia. However, there has been limited investigation using this system to detect adverse events in hospitalized children.

WHAT THIS STUDY ADDS: Hypoglycemia is common in hospitalized children, particularly neonates and those receiving insulin therapy. An electronic health record–driven automated adverse-event detection system was effective in identifying hypoglycemia in this population and will augment the safety programs of organizations that have adopted the electronic health record.
Kaiser Permanente Experience with Automating the IHI Global Trigger Tool Using the EPIC EHR System

presented at AHRQ 2010 Annual Meeting
September 29, 2010

Dot Snow, MPH and David Classen MD MS
National Patient Safety
Kaiser Permanente Foundation Health Plan

Real-time Patient Safety & Improvement

Enabling healthcare systems at each level of care to anticipate and avoid/ameliorate patient harm and related cost
Partnering with Pascal Metrics to Accelerate our Journey to Meaningful Use

Chris Baker RN, PhD, MBA, FACHE
St. Mary’s Hospital
Madison, WI

100 Years of Care...and Counting
SSM Health

- Founded in 1872 by the Franciscan Sisters of Mary
- St. Louis based
- Operating facilities in 4 states/5 regions
- St. Mary’s Madison implemented Epic EHR in May 2008

Our Work with Pascal Metrics

- Relationship began early 2013
  - Risk Trigger Monitoring indicators for St. Mary’s identified
  - WIITTS worked with Pascal and St. Mary’s project managers to map data from Epic into Pascal harm detection algorithm
  - Pascal project manager worked with St. Mary’s clinical team to develop workflows
Our Work with Pascal Metrics

• Spring 2014  
  – Began reviewing triggers in a staging environment  
• June 2014  
  – Began using RTM in live environment

Daily Intervention Triggers

• Nephrotoxic medications & rising creatinine  
• Creatinine > 2x baseline  
• Pressure injury  
• INR > 6  
• Stool positive for c diff  
• In-hospital stroke  
• Narcan administration  
• Blood glucose < 50  
• Return to surgery  
• ICU re-admission  
• Transfer to ICU within 4-hours of admission  
• Sepsis indicator  
• Possible surgical site infection  
• Abnormal cranial imaging (NICU)  
• Decrease in Hgb of 25% or more within 24-hour period
Tracking/trending Triggers

• SCIP – prophylactic antibiotic administered within 1 hour from first incision
• 7, 14, 30 - day unplanned readmissions

Work Flow

• Flat file abstracted early AM and transmitted to Pascal Metrics
• Daily report returned by 10AM
• Triggers reviewed and triaged to Clinical Nurse Specialists, wound nurses, diabetes nurse educators and other clinical experts
• After clinical review case scored, validated, and closed for submission to reporting workbench
What we’ve learned from trigger review

- Opportunities
  - Physician documentation
  - Nursing knowledge
  - Acute kidney injury
  - Transfer to ICU within 4 hours of admission
- The vast majority of adverse events detected by RTM were not captured in our event reporting system

Pressure Injury

- Pressure Injury was found to be a frequent trigger
- Case review by Clinical Nurse Specialists and Wound Ostomy Nurses revealed that in most cases there was no pressure injury present
  - Moisture dermatitis was frequently identified by staff RNs as a Stage II pressure injury
  - Also misidentified as instances of pressure injury were bruises, skin tears, scabs from old abrasions, and macular-popular rashes
- This unexpected finding of a nursing knowledge deficit served as a call to action
Action Steps

• SOS (save our skin) Team formed with 1-2 skin champions from each nursing unit
  – Monthly educational offering by member of WOCN team
  – Unit skin champions joined the team that conducted quarterly pressure injury prevalence studies
• Pressure Injury assessment competency completed by all staff RNs
• Skin care materials developed by the SSM Health system were shared with each nursing unit
• St. Mary’s became a training site for Wound Treatment Associates, a training program developed by the Wound, Ostomy, Continence Nursing Society

Results to date

Pressure Injury Prevalence Stage II and Above
Standardized Score

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV</td>
<td>-0.36</td>
<td>-0.13</td>
<td>-0.01</td>
<td>0.11</td>
<td>0.12</td>
<td>0.12</td>
<td>-0.27</td>
<td>-0.27</td>
</tr>
<tr>
<td>More HIV</td>
<td>0.01</td>
<td>-0.02</td>
<td>-0.01</td>
<td>-0.02</td>
<td>-0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.00</td>
</tr>
</tbody>
</table>
Transfer to ICU within 4 Hours of Admission

• Most of these transfers:
  – Occurred with first hour of admission
  – Were received in transfer from one of our rural affiliates
  – Referring physician did not work through our Access Center, but made physician-to-physician call to Hospitalist of the Day

Action Steps

• Required all referring physicians to work through our Access Center
• Patient Access Nurse initiates 3-way call with referring & receiving physicians and stays on the call and asks probing questions as needed
• Patient Access Nurse completes bed placement process & provides pre-brief to receiving unit
Key Takeaways for St. Mary’s

- The most meaningful use of the EHR is to detect evolving/potential harm and prevent it
- A generative culture depends upon our ability to identify actual and potential harm points in our systems and mitigate them

Cook Children’s Health Care System

- Not-for-profit pediatric integrated health care system
  - Eight companies
- Over 6,000 employees
- Medical Center
  - 430 beds
  - Magnet designated since 2005
  - 107-bed Level IV NICU
  - Over 60 specialties & subspecialties
  - Over 180,000 ER/Urgent Care visits a year
Trigger Tool Project Goal

- Providing optimal, safe, efficient care means knowing the vulnerabilities that exist in a system.

- Proactive adverse event identification provides opportunity to recognize, intervene, or mitigate harm.
  - understand risk
  - opportunities for improvement
The Journey

- **Step 1**
  - create the triggers
  - refine & reduce alert noise

- **Step 2**
  - evaluate effectiveness of triggers
  - validate use of trigger to reduce/identify harm
  - identify trends & opportunities for improvement

The Journey Continued

- Enter into PSO agreement with a third party vendor
- Utilized HL7 connection to send and receive data
- Expanded the triggers utilizing the CHA (Children’s Hospital Association) pediatric triggers
- And, then . . .
We Turned on the Fire Hose!

Exploring Triggers

- Started with 19 triggers
- Expanded to 41 triggers
- Reduced to 30 active triggers today
  - Medication administered (7)
  - Patient status (7)
  - Abnormal laboratory (5)
  - Elevated medication levels (11)
### Active Triggers

#### Medications Administered
- Digoxin immune fab (Digibind)
- Flumazenil (Romazicon)
- Naloxone (Narcan)
- Vitamin K after warfarin
- Anti Xa > 1.5 units/mL and heparin or low molecular weight heparin administered
- Protamine after heparin
- Potassium > 6 mmol/L and receiving supplementation

#### Abnormal Laboratory
- Bilirubin total > 25 mg/dL
- Glucose < 40 mg/dL
- Potassium <= 2 mmol/L
- Potassium >= 6.5 mmol/L
- Possible acute kidney injury (Cr)

#### Elevated Medication Level
- Amikacin > 20 mcg/mL
- CarBAMazepine > 20 mcg/mL
- CycloSPORINE > 500 ng/mL
- Gentamicin > 4 mcg/mL
- Oxcbazepine > 45 mcg/mL
- PHENobarbital > 40 mcg/mL
- Phenytoin > 30 mcg/mL
- Tacrolimus > 20 ng/mL
- Tobramycin > 4 mcg/mL
- Valproic acid > 170 mcg/mL
- Vancomycin > 25 mcg/mL

#### Patient Status
- ED admit - 48 hrs after hospital discharge
- Hospital admit - 48 hrs after ED discharge
- Hospital readmission within 7 days
- ICU readmission within 24 hours
- Radiology study for emboli or DVT
- Transfer to ICU
- Transfer to ICU within 4 hours of admission

#### Trigger Sensitivity

<table>
<thead>
<tr>
<th>Trigger Name</th>
<th>Triggers</th>
<th>Deviations</th>
<th>Sensitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium &gt;= 6.5 mmol/L</td>
<td>307</td>
<td>4</td>
<td>1.30%</td>
</tr>
<tr>
<td>Hospital readmit - 16 to 30 days</td>
<td>549</td>
<td>2</td>
<td>0.36%</td>
</tr>
<tr>
<td>Hospital readmit - 15 days</td>
<td>902</td>
<td>6</td>
<td>0.67%</td>
</tr>
<tr>
<td>Administration of Flumazenil</td>
<td>2</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Vitamin K after Warfarin</td>
<td>2</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>ICU Readmission within 24 hours</td>
<td>28</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Phentolamine Administration</td>
<td>6</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Phenytoin &gt; 30 mcg/mL</td>
<td>1</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Serum Sodium &lt; 125 mmol/L</td>
<td>210</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Serum Sodium &gt; 160 mmol/L</td>
<td>195</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Tacrolimus &gt; 20</td>
<td>8</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Tobramycin Trough &gt; 4</td>
<td>1</td>
<td>0</td>
<td>0.00%</td>
</tr>
</tbody>
</table>
Trigger Refinement

- Tested/refined 61 triggers

Chart Review

- Dedicated reviewer
  - September 2013 hired a well-respected critical care nurse with a strong knowledge base and interpersonal skills
- Findings are initially categorized
  - disease-state
  - known complication
  - deviation of care
Serious Safety Event Committee

- Multidisciplinary committee
  - Front-line nursing staff
  - Physicians
  - Risk management
  - Patient safety
  - Chief nursing officer
- Reviews the detailed trigger findings and applies a harm score according to Healthcare Performance Improvement Safety Event Classifications®

Jan. 2014 – Aug. 2015 Summary

- Triggers Reviewed: 12,572
- Adverse Events 1,379 (11%)
  - Non-preventable 1,170
  - Preventable adverse events 209
    - Serious Safety Events 17
Serious Safety Events

We Believe

- Electronic trigger tool together with a dedicated reviewer:
  - Identifies serious safety events caused by omission or commission
  - Broadens understanding of system weaknesses
  - Contributes to the quality care of patients
Quality Improvement

- Pediatric early warning system
  - review and update
  - share PEWS documentation with nurse managers
- Infiltration/extravasation detail data review
- Increased awareness of sepsis
- Discharge assessment
  - was not clear if patients were stable on discharge
  - first piloted on 6N
  - now done within 2 hours of discharge on all inpatient units

QUESTIONS??