2022 HQI Annual Conference



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Using Advanced Analytics to Improve Patient Safety Event Report Analysis

Raj Ratwani, PhD



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Conflict of Interest Disclosure

Raj Ratwani, PhD, reported no relevant financial relationships or relationships he has with ineligible companies of any amount during the past 24 months.





Raj Ratwani, PhD Vice President of Scientific Affairs MedStar Health Research Institute

Dr. Ratwani has spent 10 years developing methods to improve the analysis and use of patient safety event reports and other safety data. This work has included development of algorithms, analysis of workflows, and interviews with reporters and analysts. Dr. Ratwani's work has been funded by the Agency for Health Research and Quality, including numerous grants totaling over \$5m.



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Disclosures

- Research funded by:
 - Agency for Healthcare Research and Quality
 - National Institutes of Health
 - National Science Foundation
 - Pennsylvania Patient Safety Authority



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Agenda

- 1. Intro to Human Factors
- 2. Safety Report Data & User Needs
- 3. Visualization and Analytics



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National Center for Human Factors in Healthcare

We focus on <u>studying human capabilities</u> and <u>designing</u> technology, systems, and processes to meet these capabilities for <u>safety</u>, <u>efficiency</u>, & <u>quality</u>

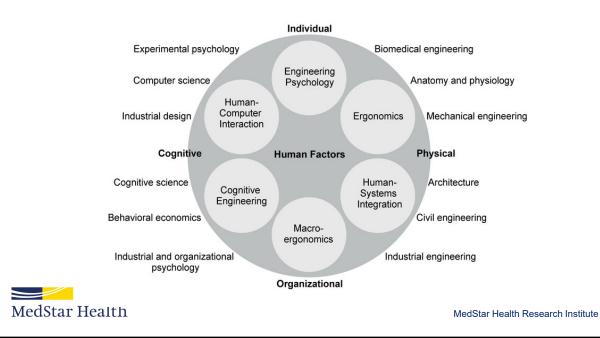
Multidisciplinary approach:

- Human factors
- Medicine
- Engineering
- Computer Science
- Psychology





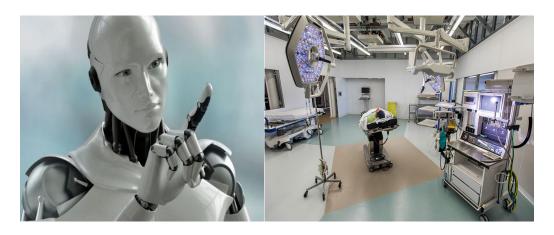
Human Factors



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The Central Tenet of Human Factors

"We don't redesign humans; we redesign the system within which humans work."



Data, Data, Everywhere ...

- Health care facilities collect thousands of patient safety event reports
- Patient safety organizations collect tens of thousands
- Federal databases contain millions
- Recent study shows +10 million reports in publicly available database





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And Not A Safety Thought to Think!

- Challenges:
 - Different/changing taxonomies
 - Insights are in free-text, but too many reports to read
 - Can't "see" patterns in the data
- Current state:
 - Spreadsheets for tracking
 - Memory based processes

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ORIGINAL ARTICLES

Usability and Accessibility of Publicly Available Patient Safety Databases

Sheehan, Julia G. BS'; Howe, Jessica L. MA'; Fong, Allan MS'; Krevat, Seth A. MD''; Ratwani, Raj M. PhD''. Author Information ⊚

Journal of Patient Safety: September 2022 - Volume 18 - Issue 6 - p 565-569

ORIGINAL STUDIES

Making Patient Safety Event Data Actionable: Understanding Patient Safety Analyst Needs

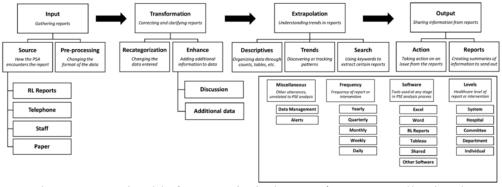
Puthumana, Joseph Stephen BA'; Fong, Allan MS'; Blumenthal, Joseph BA'; Ratwani, Raj M. PhD''¹ Author Information⊚

Journal of Patient Safety: September 2021 - Volume 17 - Issue 6 - p e509-e51 doi: 10.1097/PTS.0000000000000400

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Patient Safety Officer Needs

- 21 patient safety analysts
 - 11 hospitals from 3 health care systems
- Semi-structured interviews



Puthumana, J. S., Fong, A., Blumenthal, J., & Ratwani, R. M. (2017). Making Patient Safety Event Data Actionable: Understanding Patient Safety Analyst Needs. Journal of patient safety.

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Current Analysis Shortcomings

- User needs analysis:
 - Graphs are static...cannot easily manipulate data to see trends
 - Have to read reports and code them, but coding keeps changing
 - Each question requires more coding
- Desire for improved tools to support safety analysis



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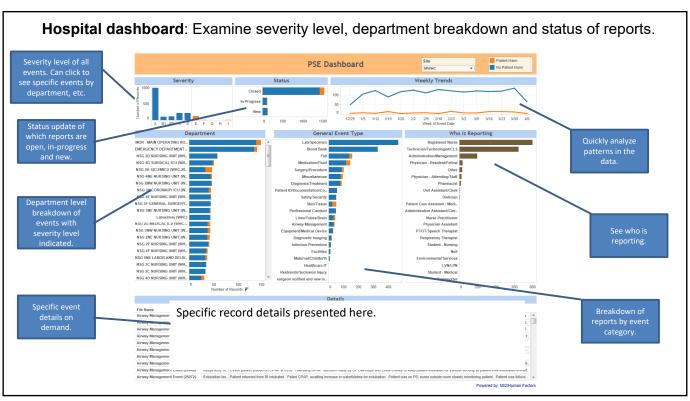
Analytics to Meet User Needs

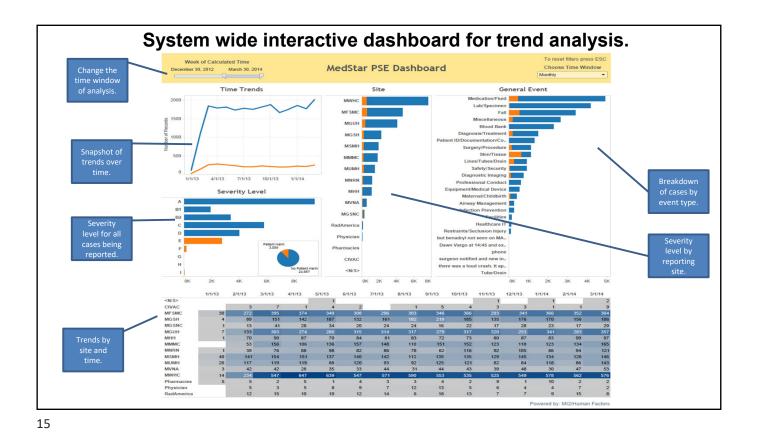
- Our principles:
 - Let the user see and interact with the data
 - · Dashboards and details on demand
 - Use natural language processing to identify patterns and trends in free text
 - Focus on free text analysis says taxonomies keep changing
 - Human is the decision-maker



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Machine Learning & Natural Language Processing 101

- Uses statistical patterns in sentences to group reports based on similarities
- Modeling
 - Unsupervised: no "categories" or "labels given to the computer
 - Given a database of reports, what clusters emerge?
 - · Easy to develop; results are of mixed value
 - Supervised: categories provided to the computer
 - Given the data given to the computer, what category does this new report belong to?
 - Harder to develop; results show promise



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Natural Language Processing

"... patient had MRI ordered. Pt needed premedication. Pt called for at 1100. At 1130 nurse said she needed to call MD to get meds. At 1145 nurse called to say pt was given meds and would be sent up. At 1225 nurse called to ask why we hadn't gotten the pt. When asked if she called transport, she said no. I told her that transport needs to be called or they won't come. At 1245 transport called us back to let us know the pt was on the way. Pt was on the MRI table in the scanner. Before we could start, she started yelling and tried to get out of the scanner. It was difficult to get her back on the stretcher to continue the scan. We made several attempts to reach her nurse and decided to send her back downstairs without the MRI. Called the charge nurse to have her let her nurse know since we couldn't reach her. We were later told that the family was very angry saying that the delay caused the medicine to wear off..."

Imaging

Communication

Med

Family



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Not So Fast!

- ER, extended release, emergency room
- OR, operating room, or
- Patient, pt, physical therapist
- Hour, hr, heart rate
- Context is critical

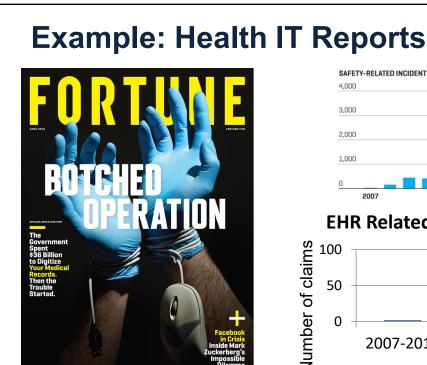


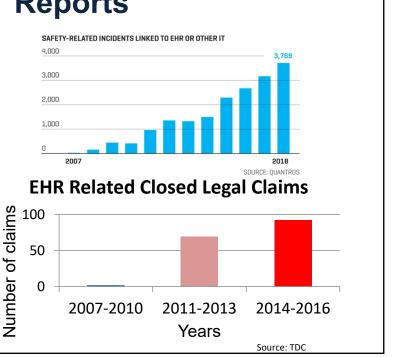


Safety Report Machine Learning Algorithms Miscellaneous **Profile** HIT Medication Recategorize reports Identify if multiple categories Identify health Identify medication entered with a match an event to identify information names any report and category into an technology related map to drug libraries. unique patterns. appropriately events given a freematching category. text description. MedStar Health MedStar Health Research Institute

Report Profiles Topics Apply supervised and unsupervised approaches to identify reports with multiple factors. Fall Medication HIT Text "side effects of Report 0.9 0 medication" Report "patient fell 0.9 0 0 from bed" 2 "patient fell 0.7 0.3 Report 0 while on new 3 medication" MedStar Health MedStar Health Research Institute

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Difficulty Identifying Health IT Issues

- Identifying health information technology (health IT) related reports is challenging:
 - Rarely specific event type categories for health IT
 - Reporters don't always recognize IT contributions
- How can we better detect health IT reports?



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Identifying Health IT Events

- Using natural language processing to identify health IT related events from free text descriptions
 - 1.7m reports
 - Develop a simple model that can be easily applied to determine which safety events may be health IT related
- A health IT hazard is a characteristic of any health IT application or its interactions with any other health care system (e.g. the people, equipment and workspaces) that increases the risk that care processes will be compromised and patients harmed. (Walker)



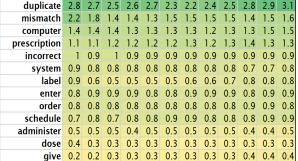
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Model Development Process

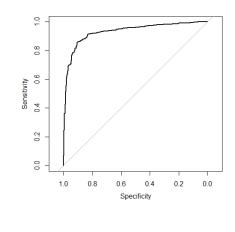
- Manually coded ~ 5,000 reports
 - 2,435 Likely and 2,852 Unlikely





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Model Performance



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303 Likely (L)
982 Unlikely (U)
95 Need more info

Exclude "Need more information"

Predicted U
True L 263 (87%) 40 (13%)
True U 122 (12%) 860 (88%)

Specificity: 0.88 AUC: 0.93 Sensitivity (Recall): 0.87 Precision: 0.68

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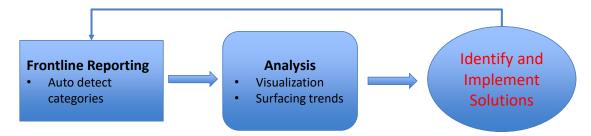
Model Application

- Applied the model to a database of reports (regardless of event type category)
- Identified 16x more health IT reports than traditional classification methods
- Enables identification of more health IT contributing factors



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The Future of Reporting and Analysis



Opportunities

- Reduce reporting burden
 - Automatically categorize free text
- Ease analysis challenges
 - Surface patterns and trends
- Semi-automate tracking of intervention effectiveness

Limitations

- Interface design
- Updating models
- Demonstrating value
- Solution development

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Current Efforts

- Developing a prototype application to support report analysis:
 - Intuitive search
 - Visualization
 - Algorithms
- Actively seeking sites to pilot test the tool
 - No data sharing required



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Questions



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Thank you.

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It's how we treat people.

