MEDINFO 23
8 – 12 JULY 2023 | SYDNEY, AUSTRALIA

Learning from Non-Routine Events and Teamwork in Intensive Care Units: Challenges and Opportunities

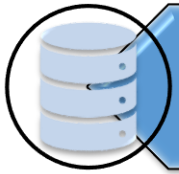
UTHealth Houston
McWilliams School of Biomedical Informatics

Yang Gong[1] & You Chen[2]

[1] The University of Texas Health Science Center at Houston
[2] Vanderbilt University

#gygyng

Objectives

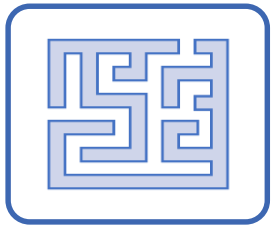


Introduce Non-Routine Events (NREs) in the context of time-dependent tasks and teamwork

Describe the NRE concept, context, and consequence (3Cs), an upstream interventional area for patient safety research

Discuss opportunities and challenges of employing electronic health records and network analysis to learn from the 3Cs of NREs

Introduction



Concept of Non-routine events (NREs)

- any aspect of care perceived by clinicians as **deviations from optimal care**
- latent and frequent safety threats, when left unchecked, can result in unintended consequences, including unsafe conditions or near misses.
- may allow clinicians to neutralize potential failures
- Upstream research in patient safety event (PSE) studies

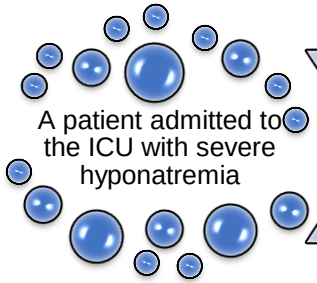
NREs should be investigated and understood

- **Contexts**: interactions between humans, technologies, and care settings that are associated with the causes, processes, or consequences of NREs
- **Consequences**: unsafe conditions, near misses, incidents w/ or w/o harm to patients

Introduction

High-performance teams are more resilient to NREs	• Team structure and familiarity between teammates associated with NRE awareness
Root cause analysis for PSEs may not be effective and efficient for NREs	• Context of teamwork • Time-dependent tasks
NREs offer substantial evidence	• for an upstream interventional area to analyze PSEs • have not been well explored

A case of NRE



sodium 109mEq/L, normal range 135mEq/l

a nephrology consultant reviewed the lab results and asked an intensivist to administer hypertonic saline (3% sodium) immediately

- to recheck the sodium level in one hour.
- did not specify how much hypertonic saline should be administered.

2 hours later, patient's confusion not improved. Sodium risen to 130mEq/dL, a rapid increase that put the patient at risk of severe neurologic complications.

- a 500 mL hypertonic saline had nearly finished infusing.
- The infusion was stopped immediately, and the patient was administered medications to correct the rapid increase of the sodium level.

Fortunately, the patient's sodium stabilized and his mental status gradually improved.

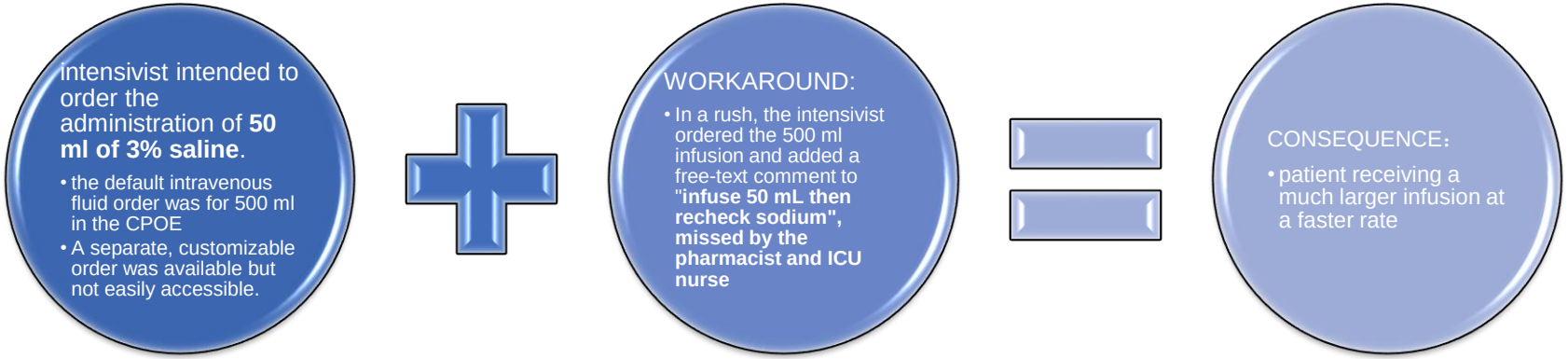
NRE

Health IT is designed to enhance safety and quality and is indispensable for patient safety

- Miscommunication mediated by Health IT; Partial, incomplete, inaccurate information
- Introducing new human-human and human-technology interactions

Workaround/deviations under time pressure – signaling upstream, stoppable PSE

- 80% PSE in neonate's gastrostomy tube placement involved NRE



3C

Concept:
Non-Routine Events
NRE

- deviation from the expected course of treatment that can result in unsafe conditions, near misses, or incidents.

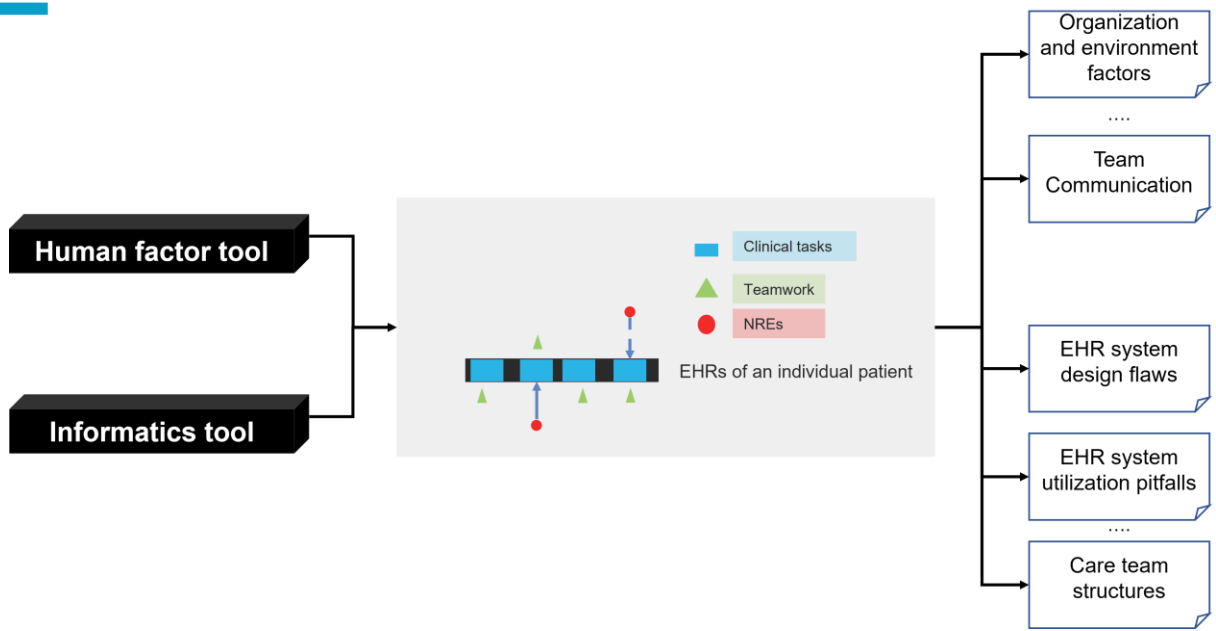
Context:
The patient was administered hypertonic saline in an amount greater than what was prescribed due to a workaround in the EHRs order entry system.

- The order entry system had a workaround, a separate and customizable order entry was available but not used
- The ICU setting is a typical interplay of humans, technologies, and setting
- The care team's preparedness, composition, and dynamics regarding interactions between human-computer and human-human.
- complement a holistic view of the NRE.

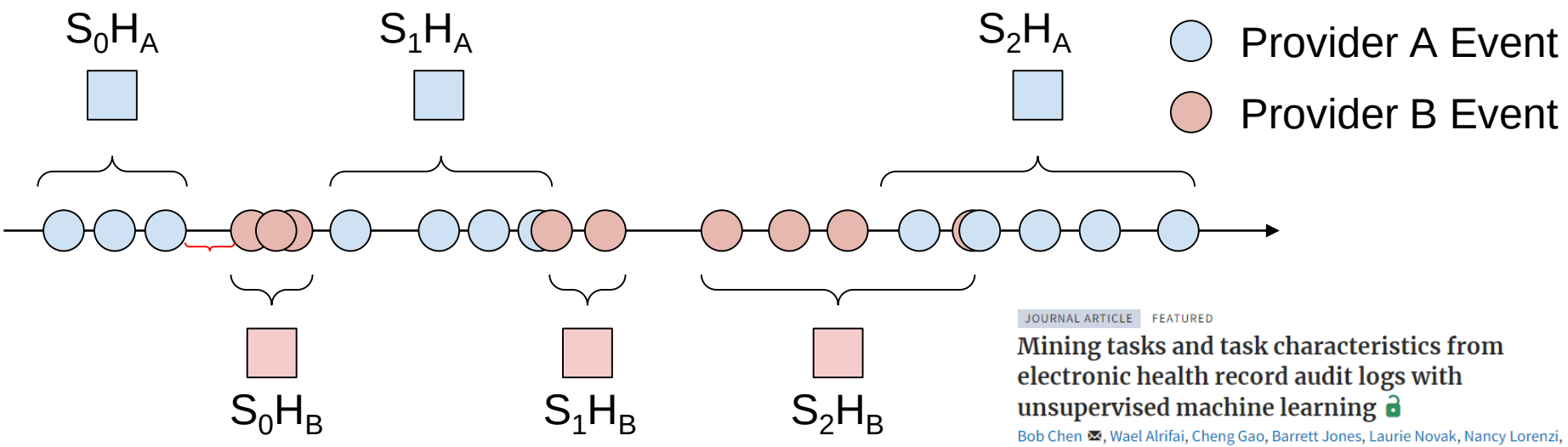
Consequence:
Patient affected, not harmful, or had minimal impact on the patient because of timely intervention.

- Learn from NREs to improve the safety and quality of care provided to patients and to identify and address any underlying system or process issues that may contribute to the occurrence of such events.
- Focusing on the upstream event progress of NREs could provide an excellent opportunity to mitigate potential risks.

Informatics and human factor tools



Context: learning tasks from EHRs



JOURNAL ARTICLE FEATURED

Mining tasks and task characteristics from electronic health record audit logs with unsupervised machine learning

Bob Chen, Wael Alrifai, Cheng Gao, Barrett Jones, Laurie Novak, Nancy Lorenzi, Daniel France, Bradley Malin, You Chen

Journal of the American Medical Informatics Association, Volume 28, Issue 6, June 2021, Pages 1168–1177, https://doi.org/10.1093/jamia/ocaa338
Published: 12 February 2021 **Article history**

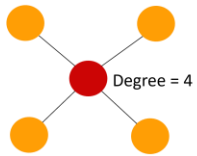
Context: learning team structures

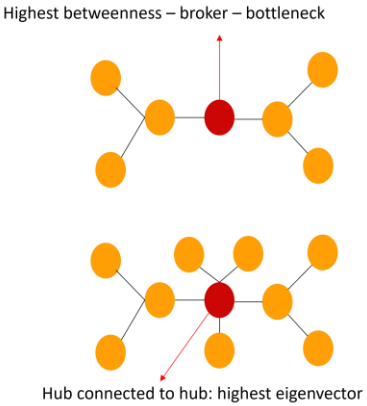
Stud Health Technol Inform. Author manuscript; available in PMC 2022 Jun 21.
Published in final edited form as:
Stud Health Technol Inform. 2022 Jun 6; 290: 359–363.
doi: 10.3233/SHTI220096

PMCID: PMC9213069
NIHMSID: NIHMS1817266
PMID: 35673035

Perioperative Care Structures and Non-Routine Events: Network Analysis

You Chen,[a] Mhd Wael Alrifai,[a] Yang Gong,[b] Rhodes Evan,[a] Jason Slagle,[a] Bradley Malin,[a] and Daniel France[a]





Discussion & Future Directions

- Studies on NRE present opportunities and challenges
- Typical ICU setting to identify NRE cases
  - Defined duration to understand the context
  - Human interactions at the individual and team level, and human-technology
- Limited generalizability due to
  - a variety of team structures and strategies
  - Patient's status and time-dependent tasks
  - NRE reflected in EHR could be fractional
- Potential data capture approach
  - Computer vision (silhouette)
  - Audiovisual data on human-human interaction
  - Log files on human-technology interaction

References

1. Alberto EC, Jagannath S, McCusker ME, Keller S, Marsic I, Sarcevic A, O'Connell KJ, Burd RS. Classification strategies for non-routine events occurring in high-risk patient care settings: A scoping review. J Eval Clin Pract. 2021 Apr;27(2):464-471.
2. Chen Y, Gong Y. Teamwork and Patient Safety in Intensive Care Units: Challenges and Opportunities. Stud Health Technol Inform. 2022 Jun 6;290:469.
3. France DJ, Schremp E, Rhodes EB, Slagle J, Moroz S, Grubb PH, Hatch LD, Shotwell M, Lorinc A, Robinson J, Crankshaw M. A pilot study to determine the incidence, type, and severity of non-routine events in neonates undergoing gastrostomy tube placement. J Pediatr Surg. 2022 Jul 1;57(7):1342-8.
4. Chen Y, Alrifai MW, Gong Y, Evan R, Slagle J, Malin B, France D. Perioperative Care Structures and Non-Routine Events: Network Analysis. Stud Health Technol Inform. 2022 Jun 6;290:359.
5. Chang A, Schyve PM, Croteau RJ, O'Leary DS, Loeb JM. The JCAHO patient safety event taxonomy: a standardized terminology and classification schema for near misses and adverse events. International Journal for Quality in Health Care. 2005 Apr 1;17(2):95-105.
6. Webman R, Fritzeen J, Yang J, et al. Classification and team response to non-routine events occurring during pediatric trauma resuscitation. J Trauma Acute Care Surg. 2016;81(4):666–673.
7. Incomplete Orders for Hypertonic Saline to Treat Hyponatremia, Cases & commentaries, PSNet, 2020, Jan
8. King J, Patel V, Jamoom EW, Furukawa MF. Clinical benefits of electronic health record use: national findings. Health Information Technology. 2014;49(1 Pt 2):392–404.
9. Chen B, Alrifai W, Gao C, Jones B, Novak L, Lorenzi N, France D, Malin B, Chen Y. Mining tasks and task characteristics from electronic health record audit logs with unsupervised machine learning. J Am Med Inform Assoc. 2021 Jun 12;28(6):1168-77.
10. Li P, Chen B, Rhodes E, Slagle J, Alrifai MW, France D, Chen Y. Measuring Collaboration Through Concurrent Electronic Health Record Usage: Network Analysis Study. JMIR Med Inform. 2021 Sep 3;9(9):e28998.
11. Schraagen JM, Schouten T, Smit M, et al. A prospective study of paediatric cardiac surgical microsystems: assessing the relationships between non-routine events, teamwork and patient outcomes. BMJ Qual Saf. 2011;20:599–603.
12. Mannering H, Yan C, Gong Y, Alrifai MW, France D, Chen Y. Assessing neonatal intensive care unit structures and outcomes before and during the covid-19 pandemic: Network analysis study. J Med Internet Res. 2021 Oct 20;23(10):e27261.