Simulation to Assess and Improve EHR Safety

Dr. Jeffrey A. Gold, MD

10/18/17
Disclosures

- No Commercial Conflicts of Interest
- Research Funding from AHRQ, AAMC/Donaghue Foundation
Patient Safety and EHRs

- Cognitive overload with excessive data
  - >2000 data pt/day

- Facilitates selective data gathering and processing
  - Associated 3-fold increase in patient morbidity
  - Delayed and Missed diagnosis are top patient safety threat

- Significant impacts on efficiency
  - Dramatic rise in number of professional groups which enter and view patient data

- Facilitates increased test ordering

- New data on new med mal threats from all of the above
Barriers to Safe and Effective EHR Use

- Little user interface design science focused on data management
- Large amount of data per patient
  - Can you see the forest through the trees?
- Need for standardization of patient care coupled with uniqueness of each individual/environment
- Training cases are simple, data poor, specialty/environment agnostic and don’t test cognitive processing
- Alert Fatigue (ICU pt 150-200 EHR alerts/day) (kizzier 2015)
- Data fragmentation/over-customization
- Cognitive errors – knowing what’s important
Simulation

- Allows for controlled investigation of the EHR-provider-patient relationship
- Provides a valuable means for deliberate practice and training
  - Demonstrated effectiveness across wide range of procedures and delivery pathways
- Goal is for activities to be patient NOT provider centered
- Requires the ideal degree of fidelity to reproduce clinical complexity, cognitive load and workflow
- Should be designed to “stress” the system
Testing and Evaluation Paradigm

Domain #2 - Provider Satisfaction (SUS)

Minimum Threshold

Domain #3 Usability
Efficiency, Fragmentation, Gaze

Inferiority Non-Inferiority Superiority

Domain #1 - Efficacy

© 2014 AAMC. May not be reproduced without permission.
Development of EHR Simulation - Residents First

- 5 day real life ICU stay created in EPIC simulation environment
  - Cloned from Production Q3 months to maintain realism and customization
- Every data point created and entered by hand in relative real time (no way to download data into system)
- Patient “cloned” forward to day of testing so can be used in real time (temporally “In-Step”)
- Case contains clinical decompensation with purposely designed patient safety issues
  - Vitals trends, medication misdosing, lack of best practices
Use of Case in Actual Work Flow

- Done In Situ with ICU residents
  - Ensures all subjects familiar with ICU workflow and best practices
  - Recapitualtes other socio-technical factors (noise, lights)

- Trainees given written history, relevant clinical info for last 5 days, Bld Cx results and PE

- Trainees given 10 min to gather data in EPIC
  - Integrate Eye and Screen Tracking for detailed usability

- Subjects told to present case as if presenting on rounds

- Subjects could be tested again, at least 1 week later
  - Repeat testing with different case-random order
Simulation to Improves Effective EHR Use

Stephenson et al BMC Med Ed 2014
Simulation Trained Novices Outperform Experts

Stephenson et al. BMC Med Ed 2014

© 2014 AAMC. May not be reproduced without permission.
Patient Centric Simulation-Same Case, Multiple Professions

Sakata et al J IP Care 2015

© 2014 AAMC. May not be reproduced without permission.
ICU Rounding Simulation-Team Based Simulation

Case 1 - Safety Issues Identified
- Unnecessary Famotidine
- No DVT Prophylaxis
- Lack of Nutrition x 5 days
- Positive Blood Culture
- Elevated Eosinophils
- Elevated Protein Gap
- Increasing Serum Bicarb
- Acute Kidney Injury
- Tachycardia
- Decreased Respiratory Rate
- Worsening Hypoxia
- Many Centrally Acting Meds
- Multiple Opiates
- CAM

Case 2 - Safety Issues Identified
- Port Removal Considered
- Inappropriate Heparin
- Steno in Sputum
- Cipro & TF interaction
- TRALI Considered
- INR Elevation
- Hypercalcemia
- QT Prolongation
- Dexmedetomidine ADE
- Digoxin ADE
- Bradycardia
- High Tidal Volume
- Elevated Plateau Pressure
- Severe ARDS

<25% with primary diagnosis in differential
Impact of Selective Data Gathering on Clinical Decision Making

Case 1

Case 2

© 2014 AAMC. May not be reproduced without permission.
EHR and Video Based Simulation to Assess Note Creation

A. Subjective

Physical Exam

Assessment and Plan

Pranaat et al JMIIR Med Inf 2017

© 2014 AAMC. May not be reproduced without permission.
Other Results

- >35% of available data misrepresented on ICU Rounds
- EHR generated rounding tool is greatest source of errors
- Used EHR based simulation to understand structure and content of Progress note
- Used EHR based simulation to “diagnose and treat” struggling learners
- Evaluating ability off simulation to improve implementation of new EHR workflow
Summary

- EHRs can have negative consequences on efficiency, efficacy and subsequently patient safety

- Simulation is a powerful tool to allow for systematic evaluation of design and improve training

- Simulation hinges upon both high-fidelity cases which reproduce the environment, EHR activity and the latent safety and efficiency issues associated with use