45th Biennial Convention (16-20 November 2019)

Applying Predictive Analytics at the Bedside to Reduce Mortality and Facilitate Transitions of Care

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Background: Patients who develop sepsis are at high risk of mortality; therefore, recognizing early signs and symptoms is essential to saving lives (Rothman, Levy, Dellinger, Jones, Fogerty, Voelker, et al, 2017). The call for significant reduction in hospital mortality by the Institute for Healthcare Improvement motivated hospitals to adopt early warning systems and rapid response teams (RRTs). A RRT consists of first responders focused on early interventions to mitigate cardiac arrest (Wengerter, Pei, Asuzu, & Davis, 2018). The electronic medical record contains enormous amounts of data and information stored in multiple areas of the record, making it challenging to see changes in condition over time, especially over multiple shifts (Rothman, Rothman, & Beals, 2013). Previous early warning systems in place at the facility were limited in their ability to highlight the most relevant information for nurses and providers.

Method: Using a plan do study act (PDSA) model, this organization implemented a predictive analytics tool to improve patient outcomes during hospitalization. Quality leadership identified the Rothman Index (RI) as the most appropriate tool to support early identification of clinical decline. In addition to early recognition of deterioration, the RI can be utilized to evaluate patients for transition to a higher or lower level of care or to initiate palliative care discussions (Henderson, McCloskey, Walter, Rimar, Bai, & Moritz, 2017). Historical graphs dating back to July 2016 provide clinicians insight into a patient's health over time, particularly valuable when managing multiple chronic conditions.

The RI is a score generated through evaluation of 26 components including vital signs, lab results and nursing assessments. The integral part nursing assessment plays in generation of a score is what makes the RI unique. Physical assessment changes identified by the nurse often signal patient decline before lab results or vital signs begin to change (Daouk, Fakih, & Faruqi, 2017). Each score is displayed as a data point on a graph, creating a trend line over time. Every time new results are entered into the electronic record, a new score is generated and displays. Clinicians review the graphs on large monitors in each acute care, critical care and rehabilitation unit within the facility. The graph is also embedded in the electronic medical record for use on desktop and mobile computers. By clicking on a data point, a clinician can further evaluate the changes leading to an alteration in score. Based on the score and overall decline, the patient's graph may appear in a warning lane. Warning lanes alert clinicians to changes in the patient's condition and, when acted on in a timely manner, prevent failure to rescue.

Nurses are encouraged to review the RI trend during handoff and half way through the shift. Downward trends and sudden drops in the RI score are to be evaluated and communicated to the charge nurse or provider as necessary. A diagrammatic work flow

aids in decision making related to the RI. Providers are encouraged to review the trend during the rounding process and before transferring a patient out of intensive or intermediate care. If the patient's trend is not stable, providers may hold the transfer and adjust the plan of care. Similarly, clinicians can use the RI to make decisions about discharge. The RI allows for real-time clinical assessment of appropriateness before discharge, reducing readmission rates (Banoff, Milner, Rimar, Greer & Canavan, 2016). Creating a committee for implementation was imperative; the team included providers, nurses, quality and informatics. Once the team determined essentials for execution, a timeline was created and approved by senior leadership. Nursing and provider work groups developed process flow charts, educational materials, and communication for their respective disciplines. Shortly after implementation, the work groups combined to further collaborate on identifying and resolving issues related to assessment, documentation and communication.

Education for staff began in October 2017 with a go-live on October 30, 2017, in the Intensive Care, Cardiac Intensive Care, Intermediate Care and Post-Anesthesia Care Units. A core team of super users were stationed on the pilot units, providing real time education and support. After evaluating the implementation plan for the pilot units, the approach to nursing education via group classes was modified to one-on-one training. A rolling implementation through the acute care and rehabilitation units occurred from January through February 2018. Nursing informatics, clinical nurse specialists, and direct care nurse super users provided support throughout implementation.

In July 2018, the combined nursing and provider work group implemented a monthly case review to celebrate successes and discuss opportunities for improvement related to the RI. Showcasing "real world" stories reinforces the importance of accurate and timely documentation and the potential life-saving capabilities of the early warning system.

Results: The main goals of the project to reduce overall mortality and sepsis mortality were demonstrated by a downward trend in both areas from January to June 2018:

- Mortality Rate: 2.42% to **1.86%**
- Sepsis Mortality Rate: 25.49% to **16%**

Additionally, it was noted that Rapid Response Team calls trended upward from January to June 2018, demonstrating earlier identification and reaction to decline:

- January 2018 – 47 calls
- June 2018 – 65 calls (**38% increase**)

Comparing pre-implementation to post-implementation, the project has shown a reduction in unplanned ICU transfers, suggesting that use of the RI puts patients in appropriate beds from admission:

- July 2016 through September 2017: monthly average of 66 unplanned transfers to ICU
  - Rate = 4.8%
- October 2017 through June 2018: monthly average of 46 unplanned transfers to ICU
  - Rate = 3.2% (**32% decrease**)

Although early in the journey, improvements have been seen not only in the defined metrics for success, but in the various changes seen throughout the facility. Nurses take note of subtle changes in patient condition, and using information found embedded in the Rothman Index, communicate with providers sooner. For novice nurses, this tool

provides objective data to share with the provider. For experienced nurses, the tool provides support for their "gut" feeling of a patient's clinical deterioration.
Implications/Future State: In September 2018, proactive rounding by masters-prepared nurse leaders was implemented. This experienced team reviews patients showing acute decline, thus appearing in the "high" or "very high" warning lanes. Once identified, the nurse leader conducts a thorough assessment with the direct care nurse, reviews the documentation for accuracy, and facilitates a discussion with the provider. For patients admitted to acute care units, the timely escalation to critical care improves the patient's chance of survival (Sankey, McAvay, Siner, Barsky, & Chaudhry, 2016).

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Keywords:
Mortality, Predictive analytics and Transitions of Care

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Abstract Summary:

Recognizing early changes in a patient's condition is essential to saving lives. This large urban facility successfully reduced mortality, increased situational awareness, and supported appropriate transitions of care. Utilizing a validated predictive analytics tool, nurses and providers identify patient decline earlier and intervene to reduce cardiac arrest outside the ICU.

Content Outline:
1. Introduction
1. Significance of mortality in hospitals
1. Institute for Healthcare Improvement encouraged hospitals to adopt early warning systems and Rapid Response Team calls
2. Impact of the electronic medical record
1. Enormous amounts of data
2. Difficult to highlight most relevant information
3. Nursing assessments are often overlooked
2. Body
1. Description of the Rothman Index
1. 26 components with focus on nursing assessments
2. Trend lines show decline
3. Warning lanes identify acute or subtle decline
2. Implementation
1. Clinical and Provider Work Groups

1. Development of education for staff
2. Clinical integration: incorporating into daily work flow and escalation process
2. Pilot Units
1. Critical Care and Intermediate Care units
3. Post-Pilot Evaluation
1. Restructuring of education: one-on-one review
2. Rolling implementation
1. Implement on one floor per week
2. Leverage support resources
3. Results
1. Reduction in mortality
2. Decrease in unplanned transfers to the ICU
3. Increase in Rapid Response Team calls
4. Reduction in codes outside the ICU
4. Post-Implementation
1. Monthly collaborative nurse-provider meetings
1. Case reviews
2. Identified successes and missed opportunities
2. Initiated proactive rounding
1. Nurses review patients in warning lanes
2. Connect with the direct care nurse
3. Review assessment and documentation
4. Facilitate communication with provider

3. Revised work flow and escalation process
3. Conclusion
1. Predictive analytics at the bedside can be used to improve
1. Mortality rates
2. Rapid Response calls
3. Situational awareness
4. Nurse-provider communication

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