RESEARCH ARTICLE

Using Quality Improvement to Introduce and Standardize the National Early Warning Score (NEWS) for Adult Inpatients at a Children’s Hospital

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ABSTRACT

INTRODUCTION: The population of adults with childhood-onset chronic illness is growing across children’s hospitals and constitutes a high risk population. National Early Warning Score (NEWS) is among the most recently validated adult early warning scores (EWSs) for early recognition of and response to clinical deterioration. Our aim was to implement and standardize NEWS scoring in 80% of patients age 21 and older admitted to a children’s hospital.

METHODS: Our intervention was tested on a single unit of our children’s hospital. The primary process measure was the percentage of NEWS documented within 1 hour of routine nursing assessments, and was tracked using a run chart. Improvement activities focused on effective training, key stakeholder buy-in, increased awareness, real-time mitigation of failures, accountability for adherence, and action-oriented response. We also tracked the distribution of NEWS values and medical emergency team calls.

RESULTS: The percentage of NEWS documented with routine nursing assessments for patients age 21 and over increased from 0% to 90% within 15 weeks and remained at 77% or greater for 17 weeks. Our distribution of NEWS values was similar to previously reported NEWS distribution.

CONCLUSIONS: A nurse-driven adult early warning system for inpatients age 21 and older at a children’s hospital can be achieved through a standardized EWS assessment process, incorporation into the electronic health record, and charge nurse and key stakeholder oversight. Furthermore, implementation of an adult EWS being used at a pediatric institution and our distribution of NEWS values were comparable to distribution published from adult hospitals.

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Dr Conway-Habes conceptualized and designed the study, carried out the initial analysis, and compiled the initial manuscript; Drs B. Herbst, L. Herbst, and Kinnear assisted with the design of the study, drafted parts of the manuscript, and reviewed and revised the manuscript; Ms Horewitz designed and carried out the patient census collection process and revised the manuscript; Ms Timmons designed the data collection instruments, coordinated and performed data collection, and revised the manuscript; Ms Falgout designed the nursing materials, coordinated the execution of our process on inpatient unit, and reviewed the manuscript; Drs Vossmeyer and O’Toole assisted with the conceptualization of the study design, supervised the study, and critically reviewed the manuscript; and all authors approved the final manuscript as submitted.

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The population of adults with congenital and childhood-onset chronic illness is increasing as survival rates improve with advances in the care of once-terminal diseases. Many of these patients continue to receive care from pediatric providers well into adulthood, contributing to the growing number of adults hospitalized at children’s hospitals. Although these individuals account for a small fraction of admissions at children’s hospitals, they constitute a high risk population. Patients over 21 years old admitted to PICUs have greater odds of mortality than adolescent patients, even when adjusting for the increased number of chronic conditions seen in older patients. There are currently no reports in the literature of how children’s hospitals recognize and treat early deterioration in adult patients.

At Cincinnati Children’s Hospital Medical Center (CCHMC), many pediatric subspecialists continue to care for patients into adulthood due to the specialized nature of their congenital and childhood-onset conditions. CCHMC also offers adults additional specialized programs for which there are few or no adult-trained providers or programs in the community such as an adult Living Organ Donor Program and Maternal-Fetal Care Center. In response to the number of adults seeking inpatient care at CCHMC, in 2014 the Division of Hospital Medicine created the Hospital Medicine Adult Care (HMAC) consult service staffed by physicians dually trained in Internal Medicine and Pediatrics. As care of adult patients at CCHMC became more frequent, many staff members reported discomfort caring for adult patients and expressed concern over recognizing deterioration in these patients. Failure to recognize and treat clinical deterioration remains a source of serious preventable harm for hospitalized patients, and may make adult inpatients at children’s hospitals an even higher risk population.

Early warning scores (EWSs) are bedside tools that use physiologic parameters to identify trends and predict patients at risk for decompensation. The Pediatric Early Warning Score (PEWS) has been used in our institution since 2007, but it is not validated in adults. The National Early Warning Score (NEWS) is among the most recent and validated adult EWS. However, there is no data of any EWS use in adults admitted to children’s hospitals. The overall aim of this improvement project was to enhance the safety of adult inpatients at CCHMC by increasing early recognition of clinical deterioration. The project’s specific aim was to implement and standardize NEWS in patients 21 years and older on a single unit. Our goal was to have NEWS assessments performed and documented with routine nursing assessments 80% of the time. We present an option for institutions without robust clinical information technology infrastructure as our project used an electronic health record (EHR) and did not include an expensive electronic surveillance system.

**METHODS**

**Human Subject Protection**

Our project was undertaken in accordance with institutional review board policy on systems improvement work and did not require formal institutional review board review.

**Setting**

CCHMC is a freestanding, academic children’s hospital that serves as a quaternary medical center. The average daily census for patients 21 years and older at CCHMC is 15 (range of 5–26), and these patients are admitted to multiple different units based upon their medical conditions. We selected a 26-bed medical/surgical unit that cares for a larger percentage of patients 21 and older with a diversity of medical and surgical conditions and an engaged leadership team.

**Planning the Intervention**

The project was championed by HMAC physicians who chose the NEWS system on the basis of its superior ability to discriminate adult patients at risk for cardiac arrest, unanticipated ICU admission, or death within 24 hours when compared with 33 other EWS. NEWS physiologic parameters and action algorithm were adapted from the Royal College of Physicians Report (Table 1, Fig 1).

We assembled a multidisciplinary team including a bedside nurse, nurse educator, clinical research coordinator, project manager, and multiple HMAC attending physicians. Though there is no clear cutoff for what constitutes an “adult,” we chose 21 years and older on the basis of our institution’s previously established Adult Medical Emergency Team (MET) threshold. Our team constructed a flowsheet for scoring NEWS in the EHR that functioned similarly to our previously adapted PEWS flowsheet. The NEWS flowsheet displayed the most recent vital signs and required manual assignment of each physiologic parameter by using a dropdown menu. The total NEWS was automatically calculated.

Completion of a failure mode and effects analysis allowed our improvement team to develop a list of key drivers that guided interventions for rapid adoption of NEWS. Improvement activities focused on 4 key drivers: effective training, key stakeholder buy-in from physicians and nurses, accountability and real-time mitigation of failures, and an action-oriented response to NEWS assessment. Frequent, small tests of change according to the

<table>
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<th>1</th>
<th>2</th>
<th>3</th>
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<tr>
<td>Level of alertness</td>
<td>A</td>
<td>—</td>
<td>—</td>
<td>V, P, or U</td>
</tr>
<tr>
<td>Pulse/heart rate</td>
<td>51–90</td>
<td>41–50 or 91–110</td>
<td>111–130</td>
<td>&lt;41 or &gt;130</td>
</tr>
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<td>Respiratory rate</td>
<td>12–20</td>
<td>9–11</td>
<td>21–24</td>
<td>&lt;9 or &gt;24</td>
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<tr>
<td>Oxygen saturation</td>
<td>&gt;95</td>
<td>94–95</td>
<td>92–93</td>
<td>&lt;92</td>
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<tr>
<td>Any supplemental oxygen</td>
<td>No</td>
<td>—</td>
<td>Yes</td>
<td>—</td>
</tr>
<tr>
<td>Temperature</td>
<td>35.1–38.0</td>
<td>35.1–38.0 or 38.1–39.0</td>
<td>&gt;39.0</td>
<td>&lt;35.1</td>
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<tr>
<td>Systolic blood pressure</td>
<td>111–219</td>
<td>101–110</td>
<td>91–100</td>
<td>&lt;91 or &gt;219</td>
</tr>
</tbody>
</table>

Algorithm
NEWS
for Adults 21+ Years

Patient admitted to unit
Patient assessed by RN
NEWS score assigned

NEWS score 0-2

Yes
Reassess and rescore at next assessment time, repeat process with next scoring

No

NEWS score totaling 3 (with no individual 3)

Yes
Notify PCF and RN/PCCF assess patient

No

NEWS score 3

No
Notify PCF and RN/PCCF assess patient

Individual NEWS of 3 in any category

Yes

No

NEWS score 4

Notify PCF and RN/PCCF assess patient

RN/PCCF assesses and calls intern/APRN

Action taken

No

NEWS score 6

Yes
Notify PCF and RN/PCCF assess patient

No

NEWS score 6

Interventions: bedside to assess patient

Yes

No

Action taken

RN/PCCF calls intern/APRN, who notifies senior

Interventions: bedside to assess patient

Intern/APRN and senior respond and collaborate together

Plan collaborated with entire healthcare team

Action taken

Documentation is recorded in progress notes, repeat process with next scoring

FIGURE 1 Adapted NEWS algorithm at CCHMC. MRT, medical response team (ie, MET); PCF, patient care facilitator (ie, charge nurse); RN, registered nurse.
Plan-Do-Study-Act (PDSA) model were based on the key drivers to successfully implement and sustain documentation of NEWS.

**Planning the Study of the Intervention**

**Effective Knowledge and Training**

Sixty-seven nurses on the target unit completed mandatory education and training. This multimodal curriculum included the Royal College of Physicians’ online modules (https://tfnews.ocbmedia.com), brief assessments of skills by using our online customizable training (Mosby Clinical Skills; Elsevier, Inc, Atlanta, GA), and review at unit staff meetings. A summary of the project was discussed monthly at physician staff meetings and e-mailed monthly to rotating resident physicians.

**Increased Awareness and Buy-In From Key Stakeholders**

We implemented a series of visual reminders to increase nursing awareness of the project. Visual reminders were placed on patient doors, and Table 1 was attached to unit computer screens. We met with charge nurses, clinical managers, and unit nursing educators on a biweekly basis and shared our data, updates, and run chart through weekly unit e-mails.

Two weeks after implementation, we surveyed and shadowed nursing staff to identify the most frequent barriers to NEWS completion. The most commonly identified failure was lack of discussion regarding NEWS between nurses and charge nurses at shift handoffs. We made several adaptations including prompts for verbal exchange during charge nurse rounds and modified preformatted nursing handoff papers to include a NEWS column.

**Real-Time Mitigation of Failures and Accountability for Adherence**

To ensure timely mitigation of missing scores, the HMAC physician discussed NEWS with the unit charge nurse during twice-daily hospital-wide, multidisciplinary safety huddles and provided feedback if NEWS was not being regularly performed. After small tests of change, the process was adapted to a more formal report out during safety huddles by the HMAC attending on the number of eligible NEWS patients with scoring completion.

**Action-Oriented Response of NEWS Assessment**

In addition to focusing on implementation, we wanted to bring attention to the NEWS action-oriented algorithm. Based on parallels to our institution’s previously established PEWS processes, we established a Situational Awareness Bundle for NEWS. This included EHR documentation of a Situational Awareness concern for a NEWS of 5 or greater and charge nurse verbal report out during twice-daily safety huddles.

**Implementation of the Intervention**

We collected data between March 12th and October 22nd of 2015. All patients 21 and older on the target unit had NEWS performed. No baseline data were collected because NEWS was a novel process. The percentage of NEWS documented in the EHR with every 4-hour nursing assessments, completed within 1 hour of assessing the patient, served as the primary process measure of our improvement efforts. We tracked the distribution of NEWS values as an additional process measure to allow for basic comparison of NEWS values between an adult population in a children’s hospital and the original adult population in the validated study. Daily reports of the NEWS-eligible patient census and all NEWS scores recorded were extracted from the EHR. These were compared with structured chart review of nurse flowsheets and validated by our clinical research coordinator.

For purposes of this study, we wanted to describe any influence of the NEWS system on prompting MET calls and detect any changes in the frequency of MET calls during NEWS implementation. Every floor-to-ICU transfer at our institution is preceded by an MET, although METs can be activated for a variety of reasons including family concerns, watcher/clinician gut feeling, communication concerns, and/or presence of an elevated EWS. Although activation of the MET is the mechanism by which transfer...
must be initiated, it does not always result in transfer to the PICU. We retrospectively gathered MET data for patients 21 years and older from monthly reports of unit MET calls. We then performed structured chart review by 2 reviewers from the study team to identify the most recent NEWS at time of MET, if the patient was transferred to the PICU, and if NEWS was identified as a reason for MET activation. The reviewers used nurse documentation in the NEWS flowsheet regarding MET activation and/or the templated physician MET note, which lists indications for activation including “elevated EWS.” There were no disagreements between reviewers.

**Methods of Evaluation and Analysis**

We used a run chart and established rules for identifying special cause variation to track our primary process measure. Run chart data were plotted in aggregates of 15 eligible data points (ie, 15 sequential possible assessments) to minimize variability in daily patient volume. The distribution of NEWS values was calculated as a percentage of all NEWS values over the study period. We used descriptive analysis from chart review of 2 independent reviewers to provide detail on the reasons for MET. The number of MET calls per patient day during the study period was compared with the same time period 1 year before by using Fisher’s exact test.

**RESULTS**

The target unit admitted 56 unique patients (84 separate admissions) over the 7-month study period, with the average age of 26.6 years (range, 21–49 years). Nurses documented 1411 NEWS scores out of 1980 opportunities (71%) during the entire study period. After interventions and PDSAs, 77% of NEWS scores were recorded (890 of 1154).

The median line for the percentage of NEWS documented for patients age 21 and over increased from 0% to 47% with completion of nursing education. Rapid cycle PDSAs increased the median to 90% within 15 weeks. For the remainder of the study period (17 weeks), the median continued to remain at 77% or higher (Fig 3).

The secondary process measure, the distribution of NEWS values, was compared with the distribution previously reported in the literature and was found to be similar (Fig 4). In total, 6.8% of NEWS values were 5 or higher, which should trigger an evaluation by either the advanced practice https://www.aappublications.org/news/
registered nurse or physician. Only 0.9% of NEWS values were 7 or higher, which should prompt both clinician evaluation and MET response.

Additionally, the number of unit MET events during our 224-day study period was compared with the same time period 1 year before. In the prestudy period in 2014, six MET events occurred over 311 patient days. In the study period in 2015, eight MET events occurred over 279 patient days. There was no statistically significant difference in MET event rates ($P = .453$) and no deaths during the study period. NEWS was elevated (defined as 5 or greater) in 6 of 8 METs during the study period, and all NEWS were performed less than 4 hours before.

Reviewers identified elevated NEWS as a reason for MET activation in 5 of 8 METs. There were 3 PICU transfers with 2 patients having elevated NEWS before transfer. In the other case, a known dialysis patient was transferred to the PICU for emergent hemodialysis due to severe hyperkalemia, and the NEWS was 3 at that time. Of note, the same patient accounted for 4 separate MET events over a prolonged 70-day admission with eventual discharge home.

There was 1 NEWS of 11, which was recorded on a separate patient at time of transfer from PICU to the floor. There was no MET called, but a note at the time of the elevated score clarified that doctors were called to bedside, a revised plan was made, and patient was established as a "watcher." The following NEWS value was 3.

**DISCUSSION**

Using improvement science and reliability methods, we implemented a successful process for a nurse-driven NEWS scoring system for adults on a single unit of our children’s hospital. Although we reached our prespecified goal for a 6-week period, our median remained very close to our goal at 77% for several months. Our findings indicate that quality improvement methods can help implement and standardize an adult EWS without an expensive electronic surveillance system. This is the first report and application of an adult EWS with established validity evidence for monitoring of adult patients at children’s hospitals.

During our study period, the distribution of NEWS values was comparable to the distribution of NEWS values described by Smith et al that used a large vital sign database of 198,755 observation sets from acute medical conditions. Our NEWS values of zero (30.9%) and 1 (22.0%) were nearly identical to the percentages reported by Smith et al. A score of 7 or more, which should prompt both clinician evaluation and MET response, accounted for 0.9% of NEWS and suggests that this threshold for MET should not be excessively triggered. Despite our adult patient population being younger and likely having different comorbidities than populations used to develop the NEWS scoring system, our distribution of NEWS values correlated well with the previously reported data.

A key insight during our implementation was the importance of oversight and sponsorship from the unit charge nurse. We found that bedside nurses had difficulty remembering to score NEWS when only a fraction of inpatients are adults. Many nurses went several weeks without caring for a NEWS-eligible patient, and a patient may have 3 to 4 different nurses on any given day. We found that charge nurses served as agents of continuity for multiple bedside nurses with regard to oversight and awareness of NEWS and were crucial to the process. Another example of the importance of charge nurse oversight was when the median line for our primary process measure dropped to 67% over a period of 10 days. NEWS was rarely scored for 3 of these 10 days, and the only pattern noted was variable performance between individual charge nurses. There were 3 charge nurses who accounted for all 8 shifts during this 3-day period of low NEWS scoring. Two out of 3 charge nurses were interviewed and reported not believing NEWS added value to preventing adult inpatient deterioration, thus providing evidence of how nursing buy-in was critical to the success of the project.

After this decline, 2 additional interventions were added. The bedside nurse began documenting NEWS equal to or greater than 5 in the situation awareness flowsheet, and charge nurses reported these high NEWS scores during hospital-wide safety huddles. Subsequently, the median increased to 77%.

**FIGURE 4** Distribution of NEWS values over study period.

<table>
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<tr>
<th>NEWS Value</th>
<th>Count of Score</th>
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<tbody>
<tr>
<td>0</td>
<td>436</td>
</tr>
<tr>
<td>1</td>
<td>311</td>
</tr>
<tr>
<td>2</td>
<td>281</td>
</tr>
<tr>
<td>3</td>
<td>170</td>
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<td>4</td>
<td>117</td>
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<td>5</td>
<td>51</td>
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<td>6</td>
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<td>3</td>
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<td>9</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>Grand Total</td>
<td>1411</td>
</tr>
</tbody>
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or above for 17 weeks. Although we were unable to determine causality on which drivers or interventions most affected change, these interventions contributed to the observed improvement and will be addressed in a future study as this project continues on other units of our children's hospital. Although there was still variability in our run chart (Fig 3), 77% of possible NEWS scores (890 of 1154) were recorded after interventions and PDSAs. We plan to work on accountability for adherence along with methods to improve communications for mitigations of failures to address the remaining variability.

Limitations
Our adult inpatient population is a small fraction of hospitalized patients, and a limitation of our study was the low number of NEWS-eligible patients on a single unit at a single institution. In the 56 patients studied, there was varying severity of illness and length of stay. Several patients were admitted for infusion therapy and discharged in less than 24 hours, whereas 1 patient was admitted over 70 days and accounted for 4 METs. Also, we were unable to show that the NEWS system prompted earlier interventions or was associated with improved patient outcomes. However, chart review of NEWS-eligible patients with METs suggested increased communication between nurses and physicians along with more frequent patient assessments, ordering of additional medications, and imaging when NEWS was elevated. We plan to study these factors, execution of the NEWS algorithm, and other patient-centered outcomes in a future study. Outcomes such as in-hospital cardiac arrest or death are rare in our hospital and were not studied as part of the scope of this project.

Although our flowsheet readily displayed recent vital signs, nursing needed to manually assign a value for each of the 6 physiologic components of NEWS. A potential error would be incorrect component scoring. A possible solution to ensure score accuracy and reduce human error would be use of an electronic physiologic surveillance system, which has been associated with reduced patient mortality. In addition, specially designed software can prompt nurses to record a complete set of vital signs at appropriate intervals, improve the accuracy and reliability for EWS, and incorporate notable laboratory values or other parameters into the scoring system. Our project required a moderate amount of manpower and did not include an expensive electronic surveillance system. We present an option for institutions without robust clinical information technology infrastructure.

CONCLUSIONS
We implemented a new process of a nurse-driven EWS for adults admitted at our children's hospital. NEWS was a novel process for a small population of hospitalized adults, and the percentage of nurse assessments with NEWS documented within 1 hour reached 77% or above for 17 weeks through use of charge nurse oversight, incorporation into system-wide safety huddles, and mitigation of failures. Although NEWS has not previously been applied to adults in a children's hospital, the distribution of NEWS values obtained during our study period is similar to the previously reported distribution from adult hospitals. Next steps include spreading NEWS to other units and studying outcomes such as detection of earlier interventions, emergent and unanticipated ICU transfer; cardiac arrest; and death.

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  [http://www.hosppeds.aappublications.org/cgi/collection/hospital_medicine_sub](http://www.hosppeds.aappublications.org/cgi/collection/hospital_medicine_sub)  
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