

**A CLINICAL PRACTICE CHANGE; ENHANCING THE EFFICACY OF PEDIATRIC  
EARLY WARNING SYSTEMS**

by

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### Abstract

With a lack of adherence to documentation, assessment, and utilization of the Pediatric Early Warning System (PEWS) by pediatric staff nurses, there was a significant gap between clinical deterioration recognition and escalation of care. The objective of this project was to enforce the consistent use of practice regarding the application of the PEWS. This project aimed to enhance understanding of the PEWS and improve the response time of registered nurses to pediatric clinical deterioration. Guided by internationally accepted recommendations, clinical practice changes were made regarding the education, usage, and recording of PEWS scores. Education was provided to nurses regarding the proper utilization of PEWS and a PEWS watch list and monitoring checklist were implemented as supportive tools. There was a significant increase in the ability of nurses to utilize the PEWS in recognizing clinical deterioration and providing early interventions. Recognition time of clinical deterioration decreased from an average of 4.75 hours to less than 1 hour with an increase in rapid response alerts and a decrease in emergency Pediatric Intensive Care Unit (PICU) transfers. This project concluded that when properly educated on the utilization and provided supportive tools, nurses reported high confidence levels in identifying clinical deterioration and communicating the need for escalation of care.

*Key words: pediatric early warning system, pediatric early warning signs, identifying deterioration*

### A Clinical Practice Change; Enhancing the Efficacy of Pediatric Early Warning Systems

This project aimed to improve patient safety and quality care through comprehensive education and the implementation and consistent use of a clinical practice change regarding the application of the Pediatric Early Warning System (PEWS) in units serving the pediatric population at a hospital in South Texas. The health care organization where this project took place is a 530-bed hospital that serves pediatric patients on four different units; general pediatrics, pediatric hematology/oncology, pediatric intensive care unit (PICU), and the pediatric observation unit. All four units serving the pediatric population were included in this project along with 77 pediatric nurses of varying educational backgrounds. Results showed an enhancement in the pediatric nurses' knowledge and utilization of the PEWS and improvement in response time to clinical deterioration leading to a decrease in emergency interventions and improved patient outcomes.

The project team, consisting of the project leader, pediatric director, pediatric educator, and pediatric clinical coordinator identified the need for improved PEWS application and documentation due to continued poor clinical deterioration recognition by pediatric nurses. In conducting a literature search, guidelines provided by The Australian Commission on Safety and Quality Health Care (2008), outlined interventions necessary to reinforce the usefulness of early warning systems and ensure proper utilization. The project team acknowledged that recognition and response to clinical deterioration could be challenging and therefore utilized the National Consensus Statement as strategies to successfully implement a strong recognition and response system. These strategies are copyrighted by The Australian Commission on Safety and Quality Health Care, but all materials are freely available.

The specific project interventions were chosen due to the need of the pediatric leadership team to not only reinforce the PEWS but to ensure proper understanding and utilization of the system by all nurses caring for the pediatric population. Literature shows that participation in intense education and training, as well as an evidence-based practice change project, increases knowledge, nurse competency, and confidence, and improves patient safety and outcomes. The Australian Commission on Safety and Quality in Healthcare (2008), states that education and training increase the ability of nurses to expertly recognize and manage patients with an impending critical illness. By using the guide and accompanying tools, the project team was confident in assessing the current practice, identifying areas for improvement, and developing and implementing successful solutions.

### **Problem Description**

As per Girotra (2013), cardiac arrest occurs in 2%-6% of intensive care pediatric patients. However, cardiac or respiratory arrest typically does not occur on a general pediatric unit due to the lower acuity of the patient population. Nationally, there is not an identified standardized benchmark due to a lack of a national pediatric cardiac arrest registry (Girotra, 2013). Current regulations are not standardized as there is no obligation to report adverse events to a national registry. The project site recognized the rate of pediatric cardiac and respiratory events on a general pediatric unit as a safety patient issue and committed to the immediate recognition of clinical deterioration and the need for higher acuity care. Due to the increase in poor patient outcomes as evidenced by emergent PICU transfers from the general pediatric unit, there was an identified need to create a standardized and objective assessment process to assist nurses in recognizing and responding to early clinical deterioration.

In response to the identified need, the project site introduced the PEWS to provide an effective approach to the identification of pediatric patients at risk for clinical deterioration and prevent detrimental health outcomes. However, the organization had been unsuccessful in seeing the desired outcome of decreased emergent PICU transfers. Pediatric nurses at the project site did not exhibit adequate knowledge or competency in the utilization of the PEWS. There was an indifference in the importance of proper PEWS score documentation by pediatric nurses. Non-adherence to the PEWS was evident by the number of unplanned PICU transfers as well as the lack of documentation of the PEWS scores and intervention data. Pre PEWS introduction data showed an average of 4.75 hours between the first clinical sign of deterioration as determined by the PEWS algorithm and the call for rapid response. This data and the subjectivity of assessment, led to the need for a change in clinical practice of PEWS utilization.

It was the goal of the project to improve the timeliness and efficiency of clinical deterioration recognition and intervention. According to The Australian Commission on Safety and Quality in Healthcare (2008), there needs to be a written timeframe in which a response is required. The goal for response to clinical deterioration and access to higher acuity care is less than 1 hour. The desired state of the organization was to have improved utilization of the PEWS as well as improvement in the recognition of patient clinical deterioration by pediatric nurses. The clinical practice change supported organizational goals by enabling pediatric nurses to appropriately utilize the PEWS with guidance and led to a better understanding of implementation in practice. The goal of training supported the correct and appropriate use of the PEWS. One of the main factors that contributes to the failure of clinical deterioration recognition is that pediatric registered nurses are not aware of the changes that are indicative of clinical deterioration (Australian Commission on Safety and Quality in Healthcare, 2008). An early

warning system, when used correctly, provides a more objective view by providing a numerical score to specific assessment findings that are strongly linked to deterioration (Kaul et al., 2014). Through this project, the gap between the introduction of the PEWS and the actual application to practice was bridged. Nursing practice was improved via the proper utilization of the PEWS and enhanced care excellence for pediatric patients.

### **Available Knowledge**

Early recognition can make life-saving differences. Having a system in place that guides nurses in assessing, stabilizing, and assisting in the care of pediatric patients is essential to improve health outcomes. An exhaustive literature review was completed to support the project intervention. Several terms were used to complete the search for research regarding the need and proper utilization of a pediatric early warning system. The following words were used individually and in combination with each other to yield results: *early warning system*, *early warning scores*, *pediatrics*, *pediatric early warning system*, *pediatric early warning signs*, *identifying deterioration*, and *PEWS*. Inclusion criteria in this search included full text, English language, and publish date being no earlier than 2009. Inclusion criteria also included age groups limited to all infant and all children. Children includes: Infant (<1 year), toddler (1-3 years), preschoolers (4-5 years), school Age (6-12 years), and adolescent (13-21 years). Peer reviewed articles were also chosen as an inclusion criteria. A variety of sites were used to conduct this research. For databases, the project leader used Cumulative Index to Nursing and Allied Health Literature (CINAHL) as well as PubMed Central. These two databases provided a wealth of information. Besides databases, websites were visited to review practice guidelines on early warning systems. Two websites that were used in the gathering of research were Institute for

Healthcare Improvement and the National Guideline Clearing House. Lastly, Google Scholar was used as a way to obtain scholarly articles not found in the databases.

### **Ranking of evidence.**

The initial search generated 72 studies regarding the utilization of PEWS. Duplications were recognized and removed from the grading process, this left 51 studies. Abstracts were reviewed on 51 manuscripts and the initial screening of articles was completed. If the manuscript was appropriate for inclusion it underwent a grading process. The grading process included 36 manuscripts. The Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) system was used to rank the evidence and strength of articles. The GRADE system provided the researcher a systematic way to determine judgments regarding the quality of evidence and recommendations (Guyatt et al., 2008). The GRADE system focuses on two main aspects; quality of evidence and strength of recommendation (Guyatt et al., 2008). Quality of evidence speaks to how confident one can be that the effect the article speaks to is correct, and strength of recommendation relates to the confidence one can have regarding the recommendation doing more good than harm (Guyatt et al., 2008). The first step of ranking the quality of evidence required assigning high grades to randomized controlled trials and low grades to observational studies (Goldet & Howick, 2013). In step two, these initial grades were either upgraded or downgraded depending on factors such as: inconsistency, indirectness of evidence, large effects, and bias publication or removal. Inconsistency, indirectness of evidence, and publication bias downgraded the project leader's initial ranking while large effects and bias removal upgraded initial rankings (Goldet & Howick, 2013). Finally, a final grade of quality of evidence was assigned for all the important outcomes of the project. After determining the quality of evidence, the strength in recommendation was analyzed. This was necessary to

determine the balance between the desirable and undesirable outcomes. In determining if there was enough evidence to support the recommendation, a strong or weak assignment to the articles' recommendations was determined. In completing the grading process, the project leader determined 21 from the original 36 articles included in the grading process would be included in the synthesis of research.

### **Recognition failure.**

Previous studies of the PEWS showed staff fails to recognize deterioration, communicate appropriately, and respond to critically ill patients (Ennis, 2014). Henderson (2012), states that health care professionals fail to identify deterioration in the pediatric population due to lack of training, experience, and supervision. Two-thirds of childhood deaths could be prevented if only early recognition and clinical responses to critically declining patients could be improved (McCabe, Duncan, & Heward, 2009). According to Solevag, Eggen, Schroder, and Nakstad (2013), signs of deterioration in a pediatric patient are detectable several hours before an actual life-threatening event however, trends go unrecognized due to the airway, breathing, circulation, disability, exposure (ABCDE) approach going unutilized. It is known that early recognition of clinical deterioration in the pediatric patient is difficult due to the varying parameters of age related vital signs and therefore, an objective assessment tool is needed to guide in the assessment, recognition, and stabilizing of pediatric patients (Fuijkschot et al., 2014).

### **Vital sign parameters.**

Also leading to failure to recognize, is the inconsistent and contradictory parameters of vital signs. As per Christofidis, Hill, Horswill, and Watson (2014), early warning systems may be more effective without individual vital sign scoring. Van Kuiken (2016), states that there is a



lack of understanding regarding the frequency of assessment and how to use behavioral and physiological indicators, rather than focus strictly on vital signs, to recognize deterioration. With these documented reasons for recognition failure of clinical deterioration, Adshead, and Thomson (2009), state that importance and urgent need for the development and implementation of PEWS in acute care settings. As per Morris and Davies (2010), early warning systems improve observation strategies and focus on clinical signs that are directly linked to clinical deterioration. Deree (2016), discusses the importance of nurses being able to not only recognize clinical changes in pediatric patients but also respond to those changes. It is this recognition and response by nurses that help improve patient outcomes. It is essential that nurses understand the proper utilization of the PEWS and how it helps to identify deterioration by focusing on specific clinical signs, communicate appropriately, and respond to critically ill pediatric patients.

### **Pediatric early warning system algorithms.**

Evidence shows that with the proper understanding and use of a PEWS, nurses can use algorithms to recognize and respond to clinical deterioration in patients. In analyzing the articles, it was noted that all 21 studies of the PEWS algorithms included the respiratory, cardiovascular, and neurological systems and followed the ABCDE algorithm; airway (presence of retractions, nasal flaring, grunting, and apnea), breathing (oxygen needs, respiratory rate, and effort), circulation (blood pressure, skin color, and capillary refill time), and disability (level of consciousness, feeding history, and behavior). Of the 21 articles, four articles provided details of the algorithm put in place along with the PEWS (Ennis, 2014; Henderson, 2012; Page, Blaber, & Snowden, 2008; Sefton et al., 2014). Having a straightforward algorithm of intervention leads to increased nurse empowerment and sound judgment (McCabe et al., 2009). The algorithm divided the PEWS scores by 0, 1-2, 3-4, and >5. For scores of 1-2 the charge nurses would be notified

and assessment frequency increased. Scores of 3-4 called for a physician review within thirty minutes of the PEWS being triggered (Naddy, 2012). A score greater than 5 triggered a physician response within 15 minutes. However, it was noted by de Oliveira Freitas, de Camargo, Nascimento, Sales Portela, and Monaghan (2016), that algorithms must be tested for validity and sensitivity and there is no consensus in the literature regarding the score necessary for intervention. Each organization must evaluate the tool chosen as their algorithm and ensure it suits their needs and reality.

### **Response time frame.**

The literature referenced specific time frames of response and as per The Australian Commission on Safety and Quality in Healthcare (2008), there needs to be a written timeframe in which a response is required. The goal for response to clinical deterioration and access to higher acuity care is less than 1 hour. Several publications reported an increased chance of deterioration among patients with a higher PEWS score (Gold, Mihalov, & Cohen, 2014; Kaul et al., 2014; McCabe et al., 2009; Naddy, 2012; Tucker et al., 2009). Noting this correlation allowed nurses and other clinical staff to be better prepared with clinical interventions and have faster response times (Kaul et al., 2014). According to Massey, Chaboyer, and Anderson (2017), the importance of nurses' ability to recognize and respond quickly to deterioration cannot be undervalued. With an appropriate response time to clinical deterioration, adverse events can be reduced.

Publications also reported a decrease in PICU length of stay for patients who received escalation of care in a shorter time frame (Kaul et al., 2014). This stands to reason that less interventions were needed for critical patients due to early interventions provided by the PEWS algorithm and a quick response to deterioration.

**Continued areas of research.**

While it is agreed upon that earlier identification of clinical deterioration allows for an easier rescue, there is limited evidence on the effectiveness for using the PEWS (Sefton et al., 2014). According to de Oliveira Freitas et al., (2016), due to the development of a variety of PEWS with the same purpose, a need for comparing validity and reliability has developed. While all ‘track and trigger’ systems have the same common goal of assisting in earlier recognition of clinical deterioration, the variety of PEWS has led to differences in the frequency, type, and recording of observations (McCallum, Duffy, Hastie, Ness, & Price, 2013). The streamlining of PEWS assessment frequency and response guidelines will need to be completed for successful PEWS implementation (Oliver, Powell, Edwards, & Mason, 2010). Parshuram et al. (2011), continues that further evaluation of the effect on the PEWS regarding clinical end outcomes is needed. Also, there is a suggestion that PEWS needs to be combined with clinical judgment to create a better system for recognition and should not be discounted (Bonafide et al., 2013).

**Rationale**

Prior to determining a framework for this project, a needs assessment was performed by the project team. Using the needs chain model, the project team identified three areas of improvement that were required to reach the ultimate identified goal of improving nurses’ ability to utilize the PEWS properly to identify clinical deterioration in the pediatric patient; performance, instrumental, and organizational. Using Lewin’s Change Theory Model, the project team was able to repeal the current practice and decrease the resistance towards change as well as implement the required clinical change and move towards a new state of comfort (White & Dudley-Brown, 2012). Lewin’s Change Theory Model was chosen as a framework for this project due to its ability to assist in altering a traditional approach (unfreezing), refining proper

behaviors (change) and reinforcing change as a new normal of organizational structure (refreezing) (Manchester et al., 2014). The project team identified the problem of pediatric nurses disregarding the importance of the PEWS and not utilizing it correctly due to a knowledge deficit and in effect, having poor patient outcomes. The need for educational intervention was evident through the incomplete PEWS documentation as well as the rate of unplanned and emergent PICU transfers. To unfreeze this practice, the leadership team provided educational training sessions to educate nurses on the proper utilization of the PEWS. The project team felt education was a critical component of unfreezing the current practice because when nurses gain a strong understanding of the importance and use of the PEWS, there is a stronger adherence to the change. The leadership team supported the implementation and consistent use of a new clinical practice regarding the application of the PEWS. This clinical practice change reinforced the standard practice in the application of the PEWS. This change was necessary in enforcing the proper utilization and documentation of PEWS scores by nurses. Through education and administrative support, the project team moved towards a new normal of using the PEWS appropriately to help aid in identification of deterioration and track scores according to best practices. Lewin's Change Theory Model supported the project assumption that a change in practice and movement towards improved PEWS utilization would improve the response time of nurses to patient clinical deterioration and lead to a decrease in emergent PICU transfers improving patient safety and outcomes.

### **Specific Aims**

While the PEWS had been introduced to staff nurses, it was evident that it was not being utilized to its fullest potential and patient safety was still at risk due to the continued failure of clinical deterioration recognition. There was a need for improved utilization of the PEWS by

nurses. This project provided enhanced educational opportunities to pediatric nurses and enforced proper application of the PEWS. As the standard of practice, the purpose of this project was to improve the care provided to the pediatric population. In completing this project, the project team improved the utilization of the PEWS and enhanced nurses' understanding on the purpose and benefits of the PEWS which led to improved clinical deterioration recognition and response. This project also provided the project site with a pediatric leadership team to continue with the education and improvement of the PEWs. These factors will continue to help the project site enhance pediatric care and prevent hospital deaths due to poor clinical monitoring (University of York, n.d.).

## **Methods**

### **Context**

The project took place at a 530-bed hospital in South Texas. Four different units that care for the pediatric population were included in this project; general pediatrics, pediatric hematology/oncology, pediatric intensive care unit, and the pediatric observation unit. This project included 77 nurses of varying educational backgrounds; 54 Bachelor of Science Nurses (BSN), 22 Associated Degree Nurses (ADN), and 1 Licensed Vocational Nurse (LVN). The participants consisted of both full time and per diem staff as well as both day and night shift. As all four units are considered sister units, there is one director, one clinical coordinator, and one clinical educator for all units. This aspect helped increase collaboration and buy-in from participants of the project and created a strong leadership team for the project leader to collaborate with.

The project site's administration team supported this project as it reflected the mission, values, and goals of the organization. Providing comprehensive educational training sessions

cemented best clinical practices and enabled the project site to follow the national standards of care as there was an improvement in patient safety established. The administration team of the project site is an advocate for nurses' professional development and education and the promotion of patient safety (Doctor's Hospital at Renaissance, 2016). With this culture established, the project leader did not have any difficulty in receiving support in implementing the project. Early warning systems have proven to be a dependable assessment tool that allow nurses the ability to recognize vital signs, and other subtle changes, that predict cardiac arrest and negative health outcomes (Race, 2015). Through education and practice change, proper utilization of the PEWS was established to prevent hospital deaths due to poor clinical monitoring (University of York, n.d.). This project helped pediatric nurses better understand the benefit of the PEWS and how it is an integral part in their assessment and clinical decision making. By providing educational training sessions, the project team improved nurses' knowledge regarding the utilization of the PEWS. The implementation of the PEWS scores monitoring checklist (Appendix A) and watch list (Appendix B) helped nurses apply the PEWS appropriately and aided in the response time of patient clinical deterioration. With improved knowledge and proper application of the PEWS, nurses are able to provide quality care that enhances the outcomes of pediatric patients.

### **Interventions**

Interventions for this project included education and a clinical practice change. This project was a pilot study involving a pre and post test survey design. The interventions of the project were guided by internationally accepted recommendations by The Australian Commission on Safety and Quality Health Care in collaboration with the pediatric administrative team including; pediatric director, pediatric educator, and pediatric clinical coordinator. Current

practices needing improvement were identified, and a needs assessment was performed before implementation.

The education portion of this project took place on the four units identified and allowed the project leader to reinforce the utilization of the PEWS and introduce the clinical practice change. Staff nurses from the PICU, pediatric oncology/hematology, pediatric observation, and general pediatric units partook in the education. This population included registered nurses as well as licensed vocational nurses. While the project leader was the only project team member present at the educational sessions, the entire project team collaborated on the objectives and material used during the educational sessions. A full description of the education initiative can be seen in Appendix C.

The original plan for education called for the project leader to visit each unit during the change of shift to allow for more nurses to participate in the education at one time and facilitate a more robust discussion. However, it was soon discovered that change of shift was too busy a time to allow for full collaboration and participation from staff. Due to this, the project leader visited each unit numerous times during a 1.5 week period to ensure all shifts and nurses were able to obtain the education. Times of visitations included 2100 and 0400 for the night shift and 1300 for the day shift. Before participating in the education, nurses were asked to complete surveys identifying their perceived knowledge on the utilization of the PEWS. Post implementation, the same surveys were administered to help the project leader determine knowledge growth and confidence level on the utilization of the PEWS, this survey can be seen in Appendix D. This survey was developed by Kaul et.al. (2014), and a content validity assessment was performed.

The educational information was displayed on the unit's bulletin boards and consisted of "Tips from the Real World,"(Appendix E) a tool kit provided by the Australian Commission on Safety and Quality Healthcare (2008), as well as the PEWS scoring sheet (Appendix F), algorithm for action (Appendix G), PEWS watch list, and the monitoring checklist .The PEWS scoring sheet and algorithm for action detail the current clinical signs of deterioration to assess and actions to follow when scoring. The PEWS watch list and monitoring checklist were implemented for this project. The PEWS watch list called for patients with a score of three or greater to be monitored and assessed within specific time frames. The monitoring checklist was a tool implemented by the project team to help nurse' track trends of clinical deterioration. Also, to enhance retention of knowledge, Badge Buddies (Appendix H) were distributed to all pediatric staff nurses which included vital sign parameters as well as the PEWS scoring which allowed necessary information to be at nurses' fingertips during implementation.

After the education was completed, the clinical practice change was implemented, and data was collected for four weeks by the project leader. The clinical practice change required the use of the PEWS watch list and monitoring checklist. Signs detailing the use of the newly implemented watch list were displayed in various parts of the unit such as locker room, bathroom, medication room, and break room to remind staff of the intervention continuously. The monitoring checklist was made available to nurses on the first day of implementation and folders were left at each nursing station.

Any patient with a score of three or greater on the PEWS was placed on the watch list with their room number being written in red on the assignment board. Once a patient was identified as a watch list patient reassessment was required every 30 minutes as well as completion of the monitoring checklist. The monitoring checklist involved the assessment of the



following areas; level of consciousness, temperature, respiratory, systolic blood pressure, capillary refill, respiratory rate, and accessory muscles. The color coding system of the monitoring checklist enabled nurses to track and visualize any patient trends that could lead to clinical deterioration. Once a trend was noted, nurses could appropriately intervene and document interventions in the provided location. The monitoring checklist identified patient specific abnormalities rather than parameter abnormalities. The monitoring checklist would be used from the time a patient was placed on the watch list until escalation of care or until the patient's score decreased and the patient was removed from the watch list. The monitoring checklist was not used as part of the patient's chart but was submitted to the director of pediatrics at the end of each shift.

### **Study of the Interventions**

To measure improved nursing knowledge regarding the utilization of the PEWS and its ability to improve recognition of clinical deterioration, the Nursing Education Survey, used with permission from Kaul et al. (2014), was administered to pediatric staff nurses before education and implementation and administered a second time four weeks after intervention implementation. Licensure of usage was permitted by John Wiley and Sons for text extract (Appendix D). The survey included questions regarding nurses' confidence level in identifying and responding to clinical deterioration. These questions were answered using a Likert scale. Also, the survey included open-ended feedback from nurses regarding their opinion on the usefulness of the PEWS. Lastly, participants were requested to complete clinical scenarios (Appendix J) and were asked to provide a score for the described patient using the PEWS. This allowed for practice using the new tools before implementation. In addition to survey analysis, the project

team analyzed the monitoring checklists, specifically noting the average time between clinical deterioration identification of a patient and first intervention.

### **Measures**

The measures chosen for data analysis as part of the pilot study included increased nursing knowledge regarding PEWS application and improved response time to clinical deterioration of pediatric patients. These measures were analyzed using a pre test and post test survey design.

*Increased nursing knowledge regarding PEWS application-* pre and post intervention educational surveys identifying perceived knowledge and confidence regarding PEWS utilization and ability to identify and respond to clinical deterioration were completed by all participants. 144 total surveys (72 pre and 72 post) were completed and Mann-Whitney U-Tests were applied to specific survey question results to determine significant differences among responses. The following survey questions were used in the analysis: how confident are you in your ability to recognize individual aspects of a patient's assessment that serve as an early red flag for a patient's deterioration? When you recognize that a patient is clinically deteriorating how confident are you in knowing what steps to take to escalate the need of care? How confident are you in your ability to communicate your concerns about a patient's deteriorating status with the medical provider? These questions were asked using a Likert scale measuring nurses' confidence on a scale of one (not at all) to five (extremely confident). This survey was developed by Kaul et.al. (2014), and a content validity assessment was performed by two masters prepared nurses who are experts on incorporating PEWS into practice and with research and clinical education. These experts were asked to rate each item included in the survey and rate for relevance and content validity. The items on the survey received a content validity score of  $\geq .80$  (Kaul et al.,

2014). The scale level content validity index was measured at .98 by rating survey item relevance (Kaul et al., 2014).

*Improved response time to clinical deterioration of pediatric patients*- time between clinical deterioration onset and first intervention as well as specific patient outcomes post intervention were tracked by the project team using completed monitoring checklists. The average time between clinical deterioration and identification and first intervention was then compared to the average time pre-intervention (4.75 hours).

### Analysis

Differences in the responses to the survey questions pre and post intervention were measured using descriptive statistics from the ordinal data provided by the surveys. It is important to note that response rate was the same both pre and post survey however, completing the nursing education survey was not mandatory. Pre and post surveys were not matched to any participant nor were units analyzed against each other. The project team performed the Mann-Whitney U-Tests on surveys from units separately to identify if education was successful in each unit individually. In total 144 surveys were completed. The following table displays surveys completed per unit.

Table 1				
<i>Surveys Completed Per Unit</i>				
	General Pediatrics	PICU	Pediatric Observational	Pediatric Onco/Hem
PRE	23	18	17	14
POST	23	18	17	14

The average confidence levels (values) pre intervention, and average confidence levels (values) post intervention was attached to a ranking. The sum of ranks was then determined for both pre and post intervention values. The Ustatistic (rank sum) was calculated and compared to the Critical Values for the Mann Whitney U-Test (Appendix K) to determine significance. Mann-Whitney U-Tests allowed the project leader to examine the difference in the distribution of the answers and determine if the provided education significantly enhanced nurses' perceived knowledge of utilization of the PEWS in identifying clinical deterioration.

Analysis of improved response time to clinical deterioration of the pediatric patient was completed through quantitative measurements. Interval data regarding clinical recognition time was collected retrospectively via electronic medical chart audits. During implementation, the project leader tracked completion of the monitoring checklist for all watch list patients and identified time between clinical deterioration onset and time of first intervention. The average time was then compared to pre-intervention data to identify any improvement in recognition time and response of nurses to clinical deterioration.

### **Ethical Considerations**

The Institutional Review Board of Capella University determined that this project did not meet the federal regulation's definition of Human Subjects Research and therefore, IRB oversight was not needed. The Ethics Board at the project site approved the project. Ethical issues and practices were considered throughout the entirety of the project, and confidentiality of data was maintained. Personal identification of nurses and patients part of this project was unknown to the project team.

### **Results**

Over the course of 1.5 weeks, participants partook in educational sessions that provided them with information and resources on the utilization of the PEWS and the proposed clinical practice change. The education proved significant for two of the four units. The general pediatric unit and the pediatric hematology/oncology unit showed enhanced knowledge regarding the utilization of the PEWS. (general pediatrics:  $U=138$ ,  $n1=n2=23$ ,  $P<0.05$  two tailed and pediatric oncology/hematology:  $U=37.5$   $n1=n2=14$ ,  $P<0.05$  two tailed).

Table 2				
<i>Significance of Education</i>				
	General Pediatrics	PICU	Pediatric Observation	Pediatric Onc/Hem
<i>U</i>	138	195	166.6	37.5
<i>n1=n2</i>	23	18	17	14
<i>P</i>	<0.05	<0.05	<0.05	<0.05
<i>UCrit</i>	175	99	87	55

In the 4 weeks of implementation and using the PEWS watch list and monitoring checklist, 47 patients qualified for the PEWS watch list. Of these 47 patients, monitoring checklists were completed on 45. Of the 45 patients with completed checklists 32, or 71%, of identified PEWS watch list patients received early intervention and did not require escalation of care. Thirteen, or 29% of patients, required escalation of care and were transferred to the PICU. One patient who was flagged as a watch list patient but did not have a monitoring checklist completed is considered a failure to rescue. The recognition time on this patient was 3.25 hours

and required PICU admission. A second patient requiring escalation of care was not recognized as a PEWS watch list patient and is considered a second failure to rescue during the implementation period. It is recommended that further research regarding the efficacy of PEWS include analyzing specific differences between day and night shift that affect utilization such as; experience of nurses, unit staffing, nurse to patient ratios, and available resources. Also, further research of this study could analyze the reason for differences in PEWS utilization and knowledge enhancement among the different participating units as well as the affect that varying demographic characters had on project results.

Table 3			
<i>Care Needed</i>			
Total Qualifying Patients: 47			
<u>Checklist Completed</u>	<u>Intervention</u>	<u>Escalation</u>	<u>Failure</u>
45	32 (71%)	13 (29%)	2 (0.04%)

**Discussion**

**Summary**

During the four week intervention period, rapid response calls increased by 44% as compared to the previous four weeks with emergency PICU transfers decreasing by 24%. Before implementation, the average time between recognition and intervention was 4.75 hours. Post implementation the average time was less than one hour.

Table 4
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<i>Recognition Time</i>		
	<u>Pre</u>	<u>Post</u>
<i>Hours</i>	<i>4.75 hrs.</i>	<i>&lt;1 hr.</i>

Nurses reported that with the use of the monitoring checklist they felt more comfortable in calling rapid responses when needed because the clinical deterioration, or clinical trends, were evident. These findings confirm that the intervention resulted in the proper use of the PEWS and monitoring checklist and improved response time of pediatric nurses to clinical deterioration of the pediatric patient.

Education on the proper utilization of the PEWS was a critical part of this intervention and directly related to the improvement in clinical recognition. The data concluded that the education resulted in significant improvement in the understanding of the utilization of the PEWS in two of the four units where the project was conducted.

### **Interpretation**

The project proved to have a substantial effect on the recognition and response to clinical deterioration. Identifying at risk patients for clinical deterioration early on with the use of the watch list established a routine of reassessment. With the use of the monitoring checklist, clinical trends were easily identifiable. It was important for nurses to identify abnormal assessment findings that were patient specific rather than following set parameters. For example, nurses were able to identify that a patient's systolic blood pressure was trending downwards. Before implementation, vital signs were required every four hours, if this patient was not identified as a watch list patient this trend would have gone unnoticed. While still being within normal

parameters for the patient's age, nurses were aware of this trend and monitored this patient closely. Early intervention to the decreasing systolic blood pressure resulted in the patient being stabilized early and not requiring PICU admission.

These findings correlate to current research; an early warning system provides a more objective view by providing a numerical score to specific assessment findings that are strongly linked to deterioration (Kaul et al., 2014). As per Tallon, Kendall and Newall (2015), the development of "track and trigger" observation tools, such as the monitoring checklist, allow for health care providers to monitor and recognize varying clinical developments that may signal the need for intervention or an escalation of care. When caring for the pediatric population, a PEWS score has the ability to assist health care providers in recognizing children at risk for clinical deterioration (Murray et al., 2015). If utilized correctly, a PEWS can provide a more objective view by providing a numerical score to specific assessment findings that are strongly linked to deterioration (Kaul et al., 2014).

While being an overall success, this project also shed light on clinical issues that had not otherwise been noted. Two patients failed to be recognized by nurses as at risk for clinical deterioration and needing escalation of care. Despite the tools implemented, the clinical deterioration of these patients went unnoticed. These outcomes resulted in the project team taking a closer look at these two events. In one event the patient was identified as a watch list patient, but the monitoring checklist was not completed due to the nurse delegating the completion of the form to an unlicensed assistive personnel (UAP). For future replication of this project, it is critical that monitoring checklists are completed by the primary nurse. Once a patient is identified as at risk for clinical deterioration the assessment and vital signs of that patient cannot be delegated.



Other areas of improvement identified included charting fatigue, empowerment of nurses to advocate for their patients, and teamwork. The nurses that were part of the two failure to rescue events reported failing to live document. Even though they reported being concerned about a patient's condition, their charting did not reflect it. Both of these events occurred on the night shift, and there has been a reported decrease in teamwork and nurses being uncertain of who to ask for help. More education is needed for night shift nurses on the utilization of the PEWS and escalation of care.

### **Limitations**

Originally this project called for implementation to one unit, the general pediatric unit. However, due to a lower census in the summer months resulting in severe project limitations, the project was implemented on all units providing care to the pediatric patient. The multi-unit implementation allowed for greater generalization of findings as it represents pediatric patients with varying clinical issues as well as nurses with varying educational and experience backgrounds. Factors that could affect validity included nurses with previous, superior PEWS knowledge were not excluded from the project.

### **Conclusions**

This project has found that with enhanced education regarding proper utilization of the PEWS and the implementation and consistent use of a practice change, patient outcomes can be improved. Using the tools provided staff nurses were able to identify and respond to clinical deterioration quickly. The findings of this project have implications for the hospital administration given that patient safety can be greatly improved with the use of the watch list and monitoring checklist. Furthermore, this project has identified other areas of improvement needed for enhanced patient outcomes. These interventions can be further implemented in the units

responsible for the admission and the triage of pediatric patients to ensure proper care is provided. The PEWS and support tools introduced in this project can make life-saving differences among the pediatric population and can enhance nurses' confidence and ability in identifying and responding to clinical deterioration quickly and efficiently.

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Appendix A

Monitoring Checklist

(Australian Commission on Safety and Quality in Healthcare, 2008).

Date: \_\_\_\_\_ Age: \_\_\_\_\_ Time "Watch" Started: \_\_\_\_\_ Time "Watch" End or RRT: \_\_\_\_\_

TIME									
		<b>Neurology</b>							
Level of Consciousness	Awake & Alert or Baseline								
	Consolable								
	Inconsolable								
	Lethargic, confused, decrease response to pain								
		<b>Cardiovascular</b>							
Temperature	>101°F								
	99.6 – 100.9°F								
	97.6-99.5°F								
	96.5-97.5°F								
	<96.5°F								
Pulse	Tachy/>30 above BL								
	>20 above BL								
	Baseline/WNL for age								
	Brady								
Systolic Blood Pressure	SBP > 120								
	SBP > 90/Baseline								
	Minimum for age (5 <sup>th</sup> Percentile)								
	SBP <70+2x age (neonate <60)								
Cap Refill	5 secs								
	4 secs								
	3 secs								
	Brisk/1-2 secs								
		<b>Respiratory</b>							
Respiratory Rate	>20 above baseline								
	>10 above baseline								
	Baseline/WNL for age								
	Below Baseline								
Accessory muscle	Grunting or Stridor								
	Retractions								

Data: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Action: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Response: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



Appendix B

PEWS Watch List



**PEWS WATCH**  
**LIST**

- For all patients scoring a total of **3** on the PEWS
- Room number to be written in **RED** on the white-board
- All staff are responsible for the monitoring of these patients
- PEWS monitoring checklist to be completed on these patients and all patients requiring a Rapid Response

Appendix C  
Education Initiative

Objectives:

- Understand the utilization of the Pediatric Early Warning System
- Identify clinical signs of pediatric clinical deterioration
- Understand the utilization of the monitoring checklist
- Verblize understanding of the PEWS watch list

Part 1: Tips from the Real World

- A bulletin board will be created on each unit outlining the tips from the real world. This information will be displayed for staff nurses to familiarize themselves with the usage and benefits of early warning systems.
- The bulletin board will also include the current PEWS scoring and algorithm as well as information regarding the intervention (PEWS watch list and monitoring check list).
  - This information will be available one week prior to educational sessions for review.

Part 2: Educational Sessions

- Educational sessions will be provided for 1.5 weeks (6/14/17-6/25/17) at varying times for both day shift and night shift staff nurses (2100, 0400, 1300).
- Units to receive education will include PICU, general pediatrics, pediatric observation, and pediatric oncology/hematology.
- Educational sessions will consist of the following:
  - Nursing Education Survey (pre)

- Diadactic instruction regarding the PEWS, PEWS watchlist, and monitoring checklist
  - Within small groups, each participant will receive a copy of the PEWS scoring and algorithm, and monitoring checklist. The project leader will explain the implementation of the PEWS watchlist and direct participants to where the signs are posted. The project leader will hold a small discussion on the role the PEWS has played and how the intervention is aimed to enhance clinical deterioration recognition in the pediatric patient. Time will be left for question and answer from participants.
- Distribution and explanation on the usage of Badge Buddies.
- Scenario completion utilizing PEWS. Participants will be requested to use the PEWS scoring sheet and complete a monitoring checklist on a pre-determined scenario by the project team. This will allow participants to practice the new tools before participation.

### Part 3: Clinical Practice Change Intervention

- The PEWS watchlist and monitoring checklist will go live 6/26/17. The project period will last 4 weeks and end of 7/24/17.
- Monitoring checklists will be provided at each nursing station starting on the go live date.
- As per the watchlist, any patient scoring a 3 or greater will require a monitoring checklist.
- Pediatric director will collect monitoring checklists at each shift. Checklists are not part of patient's chart.

- Following the 4 week implementation period, post nursing education surveys will be distributed to participants. Post surveys will be completed at the schedule staff meeting on 8/17/17 to ensure completion.

## Appendix D

## Nursing Education Survey

(Kaul et al., 2014)

You are being asked to participate in a survey research project entitled '*A Clinical Practice Change: Enhancing the Efficacy of Pediatric Early Warning Systems*' which is being conducted by Jaime Yang, a student at Capella University. This survey is anonymous. No one, including the researcher, will be able to associate your responses with your identity. Your participation is voluntary. You may choose not to take the survey, to stop responding at any time, or to skip any questions that you do not want to answer. You must be at least 18 years of age to participate in this study. Your completion of the survey serves as your voluntary agreement to participate in this research project and your certification that you are 18 or older. Please do not write your name or put any other identifying information on the survey/response sheet

- 1) I have been a nurse for (choose one).

0-1years	2-4 years	5-7 years	8-9 years	10+ years
----------	-----------	-----------	-----------	-----------

- 2) I have previous experience with Pediatric Warning Systems

- a. Yes
- b. No

- 3) How confident are you in your ability to recognize individual aspects of a patient's assessment that serve as an early red flag for a patient's deterioration?

Confidence level	1: Not at all	2	3	4	5: Extremely confident
------------------	---------------	---	---	---	------------------------

- 4) When you recognize that a patient is clinically deteriorating how confident are you in knowing what steps to take to escalate the need of care? (Next steps include what nursing

actions to take, what monitoring to add, how frequently to reassess the patient, and who to contact.)

Confidence level	1: Not at all	2	3	4	5: Extremely confident
------------------	---------------	---	---	---	------------------------

5) How confident are you in your ability to communicate your concerns about a patient’s deteriorating status with the medical provider?

Confidence level	1: Not at all	2	3	4	5: Extremely confident
------------------	---------------	---	---	---	------------------------

6) What are the most influential parameters in your nursing assessment that you use to determine a patient’s level of stability? (Select all that apply.)

- a. Heart rate
- b. Respiratory rate
- c. Oxygen requirement
- d. Oxygen saturation
- e. Blood pressure
- f. Sedation score
- g. Urine output
- h. Capillary refill time
- i. Parental concern
- j. Temperature
- k. Respiratory effort

1. Other: \_\_\_\_\_

7) How has PEWS helped you in your practice?

## Appendix E

## “Tips from the real world”

(The Australian Commission on Safety and Quality Health Care, 2008)

**FACT SHEET****Tips from the real world: a patient's story****A case from the real world: unrecognised deterioration**

This story is told by Polly (not her real name), who nearly died in hospital after a series of failures to recognise or respond to her clinical deterioration. Polly is a wife and a mum. She is an experienced critical care nurse who, at the time she became unwell, was working in education and toward a post graduate research degree. Polly developed excruciating and debilitating pain, and woke one night thinking that she had developed a life-threatening illness.

**FACT SHEET****Tips from the real world****Implementing and sustaining recognition and response systems: the nurse unit manager's perspective**

Aaron Jones, DipHealthScn, GradDipN, MClined  
Nurse Unit Manager  
Royal Prince Alfred Hospital

In this fact sheet, Aaron Jones shares his experiences as the Nurse Unit Manager (NUM) of a 30 bed surgical oncology ward in a large tertiary hospital. Prior to taking on this role, he was the Clinical Nurse Consultant who managed implementation of the hospital's three tiered clinical emergency response system. He has a background in intensive care and emergency nursing, with a Graduate Diploma in Critical Care Nursing and a Masters of Clinical Education.





**FACT SHEET****Tips from the real world****Recognising and responding to deterioration in a remote hospital****Doug Gilchrist**

General Manager and Director of Nursing  
Gove District Hospital, Northern Territory

**In this fact sheet Doug Gilchrist shares his experiences of implementing a recognition and response system in a remote hospital.**

Gove District Hospital serves East Arnhem district, which has a population of 16,000 people who are spread across 33,000 square kilometers. The hospital provides eight obstetrics beds and manages in excess of 200 births a year. There is also an emergency department, a 20 bed ward that admits adults and paediatrics, a medical imaging department and a pharmacist. The nearest tertiary hospital is at least six hours away (door to door). Doug implemented the COMPASS system (which was originally developed at the Canberra Hospital). This uses a modified early warning score (MEWS) to trigger escalation of care.



Appendix F

PEWS Scoring Sheet

<b><u>Behavior</u></b>	<ul style="list-style-type: none"> <li>• Playing</li> <li>• Alert</li> <li>• Appropriate</li> <li>• At baseline</li> </ul>	<ul style="list-style-type: none"> <li>• Sleep</li> <li>• Fussy but consolable</li> </ul>	<ul style="list-style-type: none"> <li>• Irritable/ Inconsolable</li> </ul>	<ul style="list-style-type: none"> <li>• Lethargic</li> <li>• Confused</li> <li>• Reduced response to pain</li> </ul>	
<b><u>Cardiovascular</u></b>	<ul style="list-style-type: none"> <li>• Pink</li> <li>• Capillary refill 1-2 seconds</li> </ul>	<ul style="list-style-type: none"> <li>• Pale</li> <li>• Capillary refill 3 seconds</li> </ul>	<ul style="list-style-type: none"> <li>• Grey</li> <li>• Capillary refill 4 seconds</li> <li>• Tachycardia of 20 above normal rate</li> </ul>	<ul style="list-style-type: none"> <li>• Grey</li> <li>• Mottled</li> <li>• Capillary refill 5 seconds or above</li> <li>• Tachycardia of 30 above normal rate or bradycardia.</li> </ul>	
<b><u>Respiratory</u></b>	<ul style="list-style-type: none"> <li>• Within normal parameters</li> <li>• No retractions</li> </ul>	<ul style="list-style-type: none"> <li>• Greater than 10 above normal parameters</li> <li>• Use of accessory muscles</li> <li>• 30+% FiO2</li> <li>• 3+ Liters/ minutes</li> </ul>	<ul style="list-style-type: none"> <li>• Greater than 20 above normal parameters</li> <li>• Retractions</li> <li>• 40+%FiO2</li> <li>• 6+ Liters/minutes</li> <li>• Trach &amp; ventilator dependent</li> </ul>	<ul style="list-style-type: none"> <li>• Below normal parameters with retractions</li> <li>• Grunting</li> <li>• 50% FiO2</li> <li>• 8+ Liters/ minutes</li> </ul>	



Green= 0-2 Score



Yellow=3 score



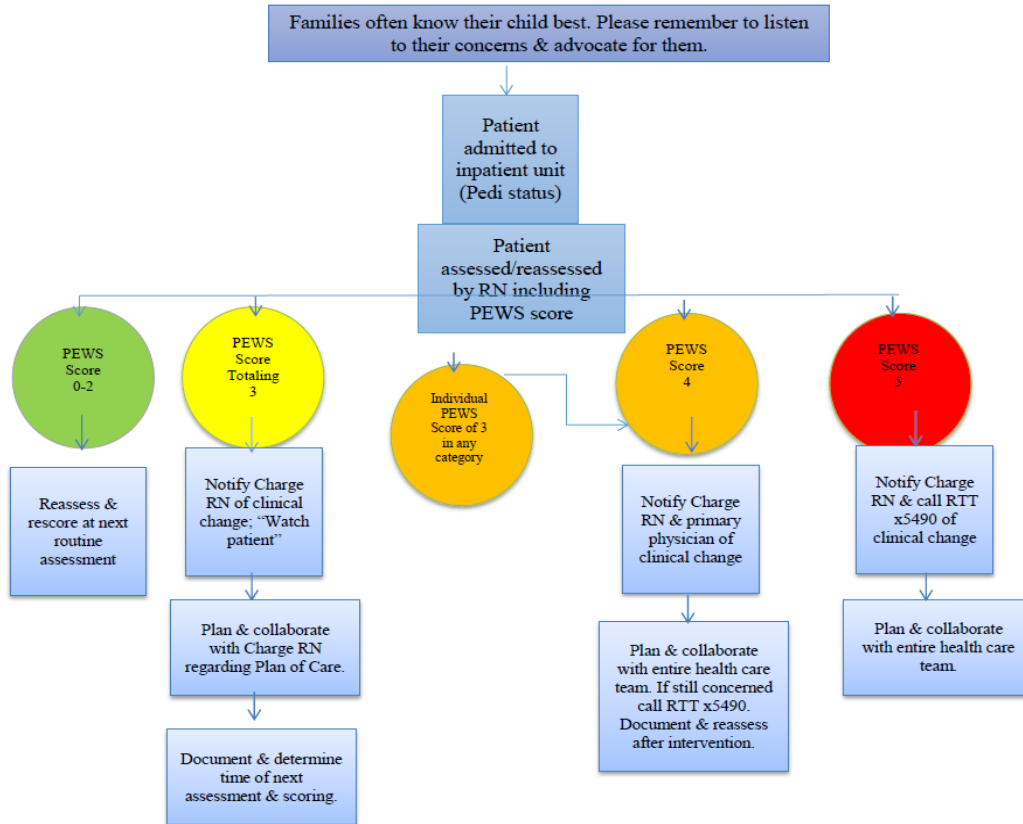
Orange = 4 score



Red = 5 or Greater Score

Appendix G

PEWS Algorithm for Action



Appendix H  
Badge Buddies



Appendix I  
Permission to Use

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## Appendix J

## Scenarios

The pediatric nurse assesses a 2-year old patient with pneumonia coming from the emergency room to the pediatric unit. The assessment reveals: a sedation score of 4 while held by parent, HR 166, BP 118/64, Temp 102.4 F, RR 66 with moderate subcostal and sub-sternal retractions with occasional grunting. The patient was given 150ml of 0/9% NaCl bolus in ER, the diaper is dry and the parents report the last diaper change was approximately 12 hours ago. Oxygen saturation is 92% on 1LPM via Nasal Cannula. The patient's hands and feet are slightly cool with a capillary refill time of less than 3 seconds. The parent verbalized that patient is usually more alert and playful.

The pediatric nurses assesses a 5 year old male patient admitted with a diagnoses of pneumonia. The assessment finds the patient alert, oriented, and extremely anxious. His color is pale, and his nail beds are dusky and cool to the touch; other findings are heart rate (HR) 136 beats/min, respiratory rate (RR) 36 breaths/ min regular and even, oral temperature 99.1 ° F (37.3 ° C), spo2 89% on room air, breath sounds decreased in lower lobes bilaterally and congested with inspiratory and expiratory wheezes, prolonged expirations, and a productive cough. As the nurse asks the mother questions, she notes that the patient's RR is increasing; he is sitting on the side of the bed, leaning slightly forward, and is having difficulty breathing.

The pediatric nurses assesses a 5 month old female patient. The assessment includes BP of 130/72, HR of 188, RR 83, and temperature of 101.1 F with a Spo2 of 88% on room air. The patient weighs 8 kg. Her parents state that she has had mild cold symptoms for a few days and has breastfed poorly over the last few days, with a decreased number of wet diapers. Further

assessment reveals the patient to be alert, fussy, anterior fontanel slightly depressed, bilateral wheezing heard on auscultation with mild intercostal retractions.

The pediatric nurses assesses a 28-day-old female admitted during the night with complaint of apneic episodes approximately 2/day with changing color to blue. Apneic episodes lasts 1-2 minutes, resolves with stimulation, chest rub, or gentle shaking. Apneic episodes not associated with vomiting/spit ups. The patient completely recovers to her baseline with stimulation. Baby always sleeps on her back, no family history of SIDS. The current episode started more than 1 week ago. The problem occurs intermittently. The problem has not changed since onset.

Nothing relieves the symptoms. Nothing aggravates the symptoms. Pertinent negatives include no fever, no stridor, and no intake of a foreign body. Upon assessment that nurse notes that the baby has continued to have longer episodes of apnea, still recovering completely between episodes.

The pediatric nurses assesses a 4 year old male admitted yesterday from ER with a 1 day history of a 100.1 fever, sore throat for 3 days and swelling in the right neck. His diagnosis is tonsillitis with retropharyngeal cellulitis. He was admitted to PICU for a question of airway compromise and transferred to the floor last evening. Mom reports a history of increasing difficulty eating and denies trauma to the neck. He has Clindamycin and Unasyn IV ordered. He has a weighted NGT in the right nare with orders for Pediasure every 6 hours but has been NPO since 2:00 AM for repeat CT scan this morning. He is very uncomfortable and has been medicated with IV morphine 3 mg several times during the night for pain in the throat and neck, last time 3 hours ago. Respiratory, while normal at first assessment, has now become increasingly labored with a rate of 44 breaths per minute and O2 saturation of 91% on room air.



