2017

TeamSTEPPS Training and Vital Signs Chart to Improve Situational Monitoring for Clinical Deterioration

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Submitted in partial fulfillment of the requirements for the degree of Doctor of Nursing Practice

At Eastern Kentucky University

By

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Lexington, KY

2017

Abstract

Failure to monitor early warning signs of patient deterioration can result in cardiopulmonary arrests and patient death. Implementation of team building programs emphasizing vital sign data, with consistent monitoring and trending have demonstrated positive outcomes in multiple health care environments. This project implemented TeamSTEPPS© education for 23 registered nurse (RN) residents in an acute care medical center. Specific aims included: (a) increased knowledge of team communication techniques; (b) improved attitudes towards vital sign monitoring, especially respiratory rate assessment; and (c) improved attitudes towards early rapid response system activation. The education program included support tools, behavioral-modeling, simulation exercises based on de-identified patient data and debriefing. Paired *t*-tests evaluated the impact of the intervention on total TeamSTEPPS Teamwork Attitudes Questionnaire (T-TAQ) and V-Scale scores. There were statistically significant increases in T-TAQ and V-Scale scores post intervention (1.78 p =.04 and 1.87 p = .04 respectively). Eta square calculation indicated a large effect size for T-TAQ and V-Scale measures. The TeamSTEPPS simulation-enhanced curriculum was successful in improving RN residents' attitudes toward teamwork, and vital signs monitoring and surveillance practices.

Keywords: clinical deterioration, early warning scores (EWS), Modified Early Warning Score (MEWS), failure-to-rescue, V-Scale, TeamSTEPPS©, Teamwork Attitudes Questionnaire, Situation Awareness, Situation Monitoring, Quality Improvement (QI)

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Acknowledgements

This project would not be possible without the vision, expertise, and guidance of my DNP Project Committee: Dr. Donna Corley (chair) and Dr. Mary Clements. Sincere gratitude is extended to Saint Joseph Hospital in Lexington, Kentucky for support of this project. Heartfelt appreciation is also extended to my mentor, Chris Slaughter, for her unwavering dedication to patient safety. Lastly, I would like to express a personal note of gratitude to my husband, Mark, for his love and encouragement on this journey.

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Introduction

In the United States, 98,000 hospitalized patients die annually due to cardiopulmonary arrest (Swartz, 2013). It is estimated that most hospital arrests are avoidable if due to a delay in the detection and responsiveness to patients' early signs of clinical deterioration (Schein, Hazday, Pena, Ruben, & Sprung, 1990; Orfanos, 2004; Schmid, Hoffman, Happ, Wolf, & DeVita, 2007; Fuhrmann, Lippert, Perner, & Ostergaard, 2008; Thompson et al., 2008; Liaw, Scherpbier, Klainin-Yobas, & Rethans, 2011; DeMeester, Bogaert, Clarke, & Bossert, 2012; Ludikhuize, Smorenburg, DeRooij, & DeJonge, 2012; Swartz, 2013). The seminal study by Schein et al. (1990) reported that 84% of patients had clinical documentation of deterioration or new complaints within 8 hours prior to arrest, and 70% had either deterioration of respiratory or mental function. Early activation of rapid response teams (RRT) is associated with decreased mortality, while delays are associated with increased morbidity and mortality (Jones, Skinner, High, & Reiter-Palmon, 2013). Functional patient outcomes after in-hospital cardiopulmonary resuscitation (CPR) have declined resulting in increased length of stay, neurologic compromise, tube feedings, and mechanical ventilation (Ozekcin, Tuite, Willner, & Hravnak, 2015).

Problem description

In August 2014, an electronic medical record (EMR) was implemented which interrupted workflow for vital signs (VS) monitoring and documentation. The Modified Early Warning Scoring system (MEWS) was introduced to the medical-surgical and progressive care nurses during initial EMR training (Appendix A). The MEWS was to be documented by an RN at least once per 12-hour shift. During the first year of EMR transition, observations were made by

leaders that code blue events (cardiopulmonary arrests) seemed to be increasing on these units. From January 1, 2016 through March 2017, 62 adult code blue events occurred on four medical-surgical (n=18) and three progressive care units (n=44). A total of 28 codes occurred during the day shift, and 34 codes occurred during the night shift. Monthly RRT calls ranged from 75 to 160 and most were requests for assistance with patient transport and IV starts. Less than 5% of the 62 codes had a preemptive RRT call in the 24-hours prior to arrest. These findings led to a peer review process for all code blue data from these select units and formation of a quality improvement (QI) interdisciplinary team.

Available knowledge

Failure to rescue (FTR) is defined as, "the inability of clinicians to save a patient's life by timely diagnosis and treatment when a complication develops" (Gephart, McGrath, & Effken, 2011, p. 275). Multiple reasons are cited for nurses' failure to recognize and respond appropriately to signs of patient deterioration, including: (a) lack of knowledge and skills, (b) not monitoring VS routinely, (c) lack of confidence, (d) failure to seek assistance, (e) communication failures, and (f) confusion regarding role responsibilities (National Patient Safety Agency, 2007). Similarly, Moldenhauer and colleagues (2009) identified four barriers to early recognition and intervention: (a) failure to recognize signs of deterioration, (b) failure to communicate and escalate concerns effectively, (c) failure to physically assess the patient, and (d) failure to diagnose and treat appropriately.

Monitoring VS is risk-free, inexpensive, reproducible, and identifies deterioration in most patients. Mok, Wang, and Liaw (2015) conducted an exploratory study of VS monitoring practices and reported that VS measurements may not be performed predictably, accurately, or completely. Monitoring of VS is often delegated to non-licensed staff and they may not be

trained to interpret findings. In addition, nurses' abilities to assess deterioration are influenced by institutional support issues, available tracking tools, and effective teamwork (Tait, 2010).

Astroth and colleagues (2013) reported that unit culture may be more important in influencing nurse activation of RRT than evidence-based policies and interventions. Seasoned nurses were found to be less likely to feel the need for RRT support due to the belief that RRT primarily benefitted novice nurses. These attitudes limit the number of RRT calls and deprive newer nurses of positive role-modeling by RRT staff. The role of experience, expertise, and intuition in positively influencing clinical judgment has historically been perceived as highly significant in the decision-making skills of nurses (Benner, 1984). However, recent findings have demonstrated that experience and intuition are used less than previously thought and may not always positively impact clinical decisions of nurses (Traynor, Boland, & Buus, 2010).

Roberts and colleagues (2014) reported that identifying and addressing barriers to RRT escalation can improve safety culture and mortality rates outside of the ICU. Identified barriers were: (a) perceptions that nurses have the necessary skills and abilities to perform in critical situations; (b) challenges related to navigation of the intra-professional and inter-professional hierarchies; and (c) reluctance among sub-specialty physicians to transfer patients to the ICU for fear of inappropriate treatment. System failures identified, were: (a) delays in diagnosis and misdiagnosis; (b) incomplete treatment; (c) inadequate interpretation of clinical symptoms; (d) inexperienced staff; and (e) inappropriate patient placement.

Rationale

Nurses are at the patient's bedside for extended period of time, often 12-hour shifts. This continuous presence places nurses in a privileged position to recognize signs of deterioration and

take action. Because most patients begin to display signs 48 – 72 hours prior to an arrest, nurses are the key to situation monitoring and timely intervention (Subbe & Welch, 2013).

Situation Awareness Theory

There is increasing recognition that situation awareness (SA) has an impact on the decision-making of healthcare professionals working in complex and dynamic environments, with higher SA levels linked to improved clinical outcomes (Singh, Petersen, & Thomas, 2006). Situation Awareness Theory originated in the aviation industry in the 1970s and has used to better understand the causes of pilot decision error. The educational focus is not on technical skills, rather cognitive and interpersonal skills, such as: communication, situational awareness, problem-solving, participatory decision-making, leadership, assertiveness, and teamwork (Hazlehurst, McMullen, & Gorman, 2007; Yule, Flin, Maran, Rowley, Youngson, & Patterson-Brown, 2008; Kransfelder, Schneider, Gillen, & Feussner, 2011).

Endsley (1995) defined SA as, 'the perception of the elements in the environment in a volume of time and space, the comprehension of their meaning and the projection of their status in the near future' (p. 36). The SA Model defines three levels of decision-making: (1) perception of current situation (gathering data); (2) comprehension of current situation (interpreting information); and (3) the ability to project what can happen in the future (anticipation of future states) (Appendix B). Each incremental level is influenced by individual factors, such as ability, fatigue, preconceptions, memory and information-processing. Clinical system factors that influence SA, include: complexity, workflow, automaticity, capacity, and workload. Environmental factors such as clinical alarms and time pressures also affect SA. Many of these various factors are found in the acute care environment in the form of expanding clinical technology, high patient acuity, staffing shortages, changing workflow, and heavy workload.

The aim of SA is to avoid the evolving of critical situations. If such situations occur, it is vital for nurses to know what technical information is relevant and anticipate what will be needed to inform and support correct decision-making and avert disaster (Stubbings, Chaboyer, & Murray, 2012). Situation monitoring is the first step of decision-making, providing an understanding of 'what is going on' and 'what is likely to occur next' (Salmon, Stanton, Walker, & Jenkins, 2009). SA is essential in all complex, dynamic occupational settings reliant on human operators and decision-making (Stubbings, Chaboyer, & McMurray, 2012). Lapses in SA can stem from interpersonal behaviors, team dynamics and assertive authority figures (Gawron, 2008). Odell (2010) demonstrated that decision-making by nurses is negatively influenced by non-technical aspects, particularly interpersonal interactions with overly assertive medical providers.

The importance of SA in enhancing cognition to improve decision-making is supported by numerous studies (Flin, O'Connor, & Crichton, 2008; Mitchell & Flin, 2008; Gawron, 2008; Guimond, Sole, & Salas, 2009; Brady, Wheeler, Muething, & Kotagal, 2014). SA principles guide decision-making and skills learning so that operators can 'sense' the decision-making process during critical events in practice, thus preventing adverse events (McLucas, 2003). Evidence-based methods to teach SA and teamwork, include: (a) lecture; (b) behavioral-modeling; and (c) practice-based methods of simulation and role-playing (Flin, O'Connor & Crichton, 2008). Similarly, O'Dea and colleagues (2014) reported that the critical elements of teamwork education are practice opportunities, formative feedback, and support tools to transfer new knowledge to the work environment.

Review of Literature

Mok, Wang, and Liaw (2015) conducted an integrative review from January 1990 to November 2012 to review the literature related to VS monitoring. Three broad search categories were used: VS, deterioration, and general ward patients. Keyword search was used and search teams were used alone or in combination. All identified abstracts were assessed and the full report was retrieved for those meeting inclusion criteria. The references of all retrieved papers were checked for additional studies. The integrative review included 6 qualitative studies, 1 mixed method study, and 13 quantitative studies (9 descriptive, 2 quasi-experimental, and 2 randomized controlled trials). Patient, nursing, and organizational variables provided an analytical framework for synthesis of the findings, as described below.

Patient Variables

Physical Signs

Physical signs of deterioration, such as agitation, skin color, noisy breathing, clammy to touch, and complaints of feeling unwell, can be detected through physical assessment. These signs are frequently observed during the early compensatory phase of clinical deterioration, where deviations from baseline VS may not be prominent. Studies have reported that the ability of nurses to assess these subtle changes in patient's health status is lacking (Hogan, 2006; Wheatley, 2006; Cioffi, Conway, Everist, Scott, & Senior, 2009; James, Butler-Williams, Hunt, & Cox, 2010). Abnormalities in VS often occur hours prior to adverse events, and altered respiratory rate (RR) is identified as the most significant predictor of deterioration (Buist, Bernard, Nguyen, Moore, & Anderson, 2004; Fagan, Sabel, Mehler, & MacKenzie, 2012). Fagan et al. (2012) reported tachypnea to be the strongest predictor of arrest and Buist et al. (2004) reported bradypnea (<6 breaths/minute) to be the strongest predictor for mortality.

Nurse Variables

Nursing Knowledge

Documentation of RR has been found to be frequently omitted by nurses (Hogan, 2006; Fuhrmann et al., 2008; Leuvan & Mitchell, 2008; DeMeester et al. 2012; Ludikhuize et al. 2012). Fuhrmann et al. (2008) conducted a study of 877 patients in a teaching hospital, and despite abnormal VS in 20% of the patients, nurses were unaware of deterioration in more than half of the cases. DeMeester et al. (2012) conducted a retrospective review of 63 patient records which demonstrated an absence of RR documentation in 100% of the charts within the eight hours preceding an adverse event. The study also reported that nurses escalated concerns of abnormal VS relatively late in deterioration situations.

Nursing Role and Responsibilities

James et al. (2010) reported that VS monitoring is increasingly delegated to non-licensed support staff as the RN role expands. Although non-licensed staff may be trained to perform VS monitoring, there is evidence that knowledge deficits exist related to accurate interpretation. In addition, effective communication must occur between the support staff and the RN to convey patient deterioration and seek intervention. The role of VS monitoring may be delegated, however, the role of responding to deteriorating VS is an RN responsibility.

Nurse Reporting of Deteriorating Vital Signs

When initial signs of deterioration appear, credible evidence of physiological decline must be communicated effectively for timely and appropriate actions to be taken. Andrews and Waterman (2005) reported that nurses have difficulty in describing subtle patient condition changes. Due to a lack of confidence and experience, nurses used subjective social language to communicate deterioration, whereas experienced nurses tended to use medical terminology.

Less experienced nurses reported negative attitudes towards seeking help for fear of appearing to be incompetent. This finding is problematic as physicians require quantifiable evidence to prioritize workload and make the decision to assess a patient promptly.

System Workload

The impact of heavy workload has been found to influence the quality of VS monitoring. In a descriptive study, James et al. (2010), reported that 42% of support staff felt distracted by other patients' needs during VS monitoring. Similarly, Wheatley (2006) reported five distractions of surgical nurses during the process of VS monitoring, resulting in the omission of RR and temperature recordings.

Clinical System Technology

Technological advances have resulted in an over-reliance on digital monitoring equipment to measure VS. The negative impact of technology on patient deterioration recognition has been reported in two qualitative studies. Electronic VS monitoring limited nurses' face-to-face interaction and caused opportunities to identify early deterioration signs to be missed (Wheatley, 2006). Digital monitoring is often unable to pick up RR which is a likely reason for the omission of RR assessment and documentation by nurses (Hogan, 2006).

Continuous physiological monitoring has been proposed as a strategy for early recognition of abnormal VS among general patients. Three randomized controlled trials (RCT) studies explored the effect of continuous electronic VS monitoring on patient outcomes. In a single-site study, Watkinson and colleagues (2006) did not identify any significant difference on adverse events between high-risk medical-surgical patients in the control group and those receiving continuous VS monitoring. A larger, multi-Centre study conducted by Bellomo et al. (2012) demonstrated continuous electronic VS monitoring to be significantly associated with

quicker VS measurements, increased proportion of RRT calls activated by respiratory criteria, as well as improved survival rates of patients.

Brown and colleagues (2014) conducted a controlled study to compare a 33-bed medical-surgical (intervention unit) to a "sister" control unit for a 9-month pre- and post-implementation period. Following the intervention, all beds in the intervention unit were equipped with monitors that allowed for continuous assessment of heart and respiratory rate. A total of 7,643 patient charts (2314 were continuously monitored in the intervention arm and 5,329 in the control arms). Researchers observed a significant decrease from 4.0 to 3.6 and 3.6 days with continuous monitoring, respectively; $P<.05$). Total ICU days were significantly lower in the intervention unit (63.5 versus 120.1 and 85.36 days/1000 patients, respectively; $P=.04$). The transfer rate to the ICU did not change. Rate of code blue events decreased following the intervention from 6.3 to 0.9 and 2.1, respectively per 1000 patients ($P=.02$). Researchers concluded that continuous monitoring on a medical-surgical unit was associated with a significant decrease in total length of stay and in ICU days for transferred patients, as well as lower code blue rates.

Although more research is needed to evaluate the impact of continuous monitoring on medical-surgical wards, studies have revealed a significant decrease in total length of hospital stay, as well as the lowering of code blue and mortality rates. The socio-technical factors, such as alert burden on nursing staff, need to be considered to effectively implement this intervention in a complex healthcare environment. Gross and colleagues (2011) reported that only 34% and 63% of critical alarms and high-priority alarms respectively were true for medical-surgical patients. It has been generally agreed that standard critical care alarm limits are too sensitive for medical-surgical patients and would promote alarm fatigue, which would be counter-productive to patient safety.

Clinical System Vital Signs Observation Chart Design

There is evidence that a well-designed VS observation chart facilitates early recognition of deterioration. Preece (2012 a,b), Christofidis (2013) and colleagues demonstrated that VS chart design elements based on human factors could yield significantly better performance by users. Similarly, Cahill and colleagues (2012) investigated the compliance level of VS documentation by using an observation chart and an educational program to reinforce correct practices. Findings demonstrated a significant improvement in the documentation of complete VS. The chart design that delivered the best outcomes among the three studies used a graphical format, track-and-trigger color-coding, section-banding to highlight abnormal readings, and placement of RR at the top of the chart.

Preece and colleagues (2012a) inspected 25 VS observation charts for usability problems. Every chart was found to have substantial usability problems potentially affecting the ability of hospital staff to accurately recognize patient deterioration. The majority of charts did not display observations for all of the VS in graph format. Displaying data in a tabular form makes it extremely difficult to recognize that a patient is deteriorating. To see a trend, a chart user must mentally visualize the observations in a graph-like format, and it is debatable to what extent this is possible with multivariate VS data.

Preece and colleagues (2012b) used 45 health professionals (doctors and nurses) and 46 novice chart users to evaluate the effect of observation chart design on the ability to recognize patient deterioration. There was a significant effect on chart type and error rate, $F(4.18, 371.92) = 35.88$, $p < 0.001$, $\eta^2 = 0.29$. The error rates of doctors and nurses did not differ overall, $F(1,43) = 0.24$, $p = 0.626$, $\eta^2 = 0.01$. For response time, significant main effects of chart type,

$F(2,10, 186.97) = 51.27$, $p<0.001$, $\eta^2 = 0.37$, and participant group (health professionals) were quicker to make a decision than novices.

Horswill and colleagues (2010) conducted an empirical comparison for detection of abnormal VS across six different observation chart formats. A convenience sample of 44 novices (individuals unfamiliar with using patient charts) and 45 health professionals (doctors and nurses) were recruited for the study. Results indicated there was a statistically significant effect of chart type on error rates, $F (5,435) = 42.09$, $p < .001$ and response times, $F (2.056, 178.875) = 48.96$, $p < .001$. The evidence indicated that the format of VS observation charts has an impact on patient safety, as the error rate for the worst performing chart was 3.31 times the error rate of the best performing chart.

Similarly, Christofidis and colleagues (2013) systematically evaluated the impact of several design features on chart users' detection of patient deterioration on observation charts with early warning scoring systems. A sample of 205 (final sample 188) novice chart-users were tested from March 2011 to March 2014. Participants completed 64 trials of reviewing real patient data plotted on observation charts. Analysis of response time revealed a significant main effect of data-recording format, $F(1, 186) = 82.05$, $p < .001$, $\eta_p^2 = 0.27$, qualified by a significant data-recording format x scores interaction, $F(1, 186) = 38.56$, $p < .001$, $\eta_p^2 = 0.13$. The ANOVA on error rate data revealed a significant main effect of data-recording format, $F (1, 186) = 14.88$, $p < .001$, $\eta_p^2 = 0.07$, again qualified by a significant data-recording format x scores interaction, $F (1, 186) = 6.36$, $p < .05$, $\eta_p^2 = 0.03$. Findings suggested that chart design features have a substantial impact on the ability to recognize patient deterioration.

Study of the Interventions

TeamSTEPPS© Teamwork Training

The healthcare industry has seen an increase in educational programming to improve teamwork and coordination of care. O'Dea and colleagues (2014) performed a meta-analysis to quantify the effects of teamwork education on reactions, learning, behavior, and clinical care outcomes. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement was used to guide the reporting (Liberati, Altman, Tetzlaff, Mulrow, & Gotzsche, 2009). All studies included in the meta-analysis met predetermined eligibility criteria: (a) studies must report teamwork interventions that are focused on improving teamwork within healthcare teams in acute care environments; and (b) program effectiveness must be assessed at least one level of Kirkpatrick's (1976) evaluation hierarchy (level 1: reactions; level 2: learning; level 3: behavior; and level 4: clinical care outcomes of safety, quality, or both).

The screening process resulted in nine evaluations of the impact of teamwork programs on reactions, three evaluations of knowledge, nine evaluations of attitude, seven assessments of behavior, and seven assessments of clinical care outcomes. Studies were excluded if training focused on specific technical skills or procedures versus teamwork; related to patient or family-centered communication or collaboration; or aimed at administrators or managers. The quality of the papers was evaluated using the 10-item Medical Education Research Study Quality Instrument (MERSQI) which was designed to measure the methodological quality of experimental, quasi-experimental and observational studies in medical education (Reed, Beckman, & Wright, 2008).

Twenty articles met the criteria for inclusion in the meta-analysis and included studies of interdisciplinary teams working in intensive care units, emergency departments, neonatal units,

labor and delivery, and surgery (Aebersold et al., 2013; Brock et al., 2013; Capella et al., 2010; Clay-Williams et al., 2013; France et al., 2005; Hansel et al., 2012; Hicks et al., 2012; Holzman et al, 1995; Jankouskas et al., 2007; Kurrek & Fish, 1996; McCulloch et al., 2009; Meurling et al., 2013' Morey et al., 2002; O'Connor et al., 2013; Reznek et al., 2003; Robertson et al., 2010; Sawyer, Laubach, Hudak, Yamamura, & Pocrnich, 2013; Shapiro et al., 2004; Shea-Lewis, 2009; and Watts et al., 2010). The teams tended to represent multi-level hierarchies consisting of resident physicians, anesthetists, nurses, midwives, and students. Program times ranged from 90-minutes to 2-days and included didactic lectures, simulation, and coaching. Course content included assertiveness, situation awareness, teamwork, stress management, communication, task management, team coordination, and error and crisis management. The meta-analysis cited evidence that participants' reactions to training across studies were overwhelmingly positive (4.25 out of 5 Likert response). Participants liked the training and believed that it was relevant to improving teamwork and patient safety. There was a large effect of training on participants' knowledge (1.05), a small effect on attitudes (0.22), and a large effect on behaviors (1.35).

The following literature review will focus specifically on the TeamSTEPPS© principles and the meta-analysis studies that supported the TeamSTEPPS© educational intervention for this project (Capella et al, 2010; Robertson et al., 2010; Brock et al., 2013; and Sawyer et al., 2013). Additional quantitative studies have been added to support the use of TeamSTEPPS in medical-surgical populations and undergraduate nursing programs.

Capella et al. (2010) used a pre-and post-assessment for TeamSTEPPS© education augmented with simulation. The evaluation instrument was the Trauma Team Performance Observation Tool (TPOT). From November 2008 to February 2009, a convenience sample (n =33) of trauma resuscitations were evaluated. From May to July 2009, team education

was conducted. From May to July 2009, another sample (n = 40) of resuscitations were evaluated. The study was conducted at a Level I U.S. Trauma center and included team members of surgery residents, faculty, and nurses. The trauma team showed significant improvement in all teamwork and overall ratings from pre-to post-education: leadership (2.87 to 3.6, $p = .003$), situation monitoring (3.30 to 3.91, $p = .009$), mutual support (3.4 to 3.96, $p = .004$), communication (2.9 to 3.46, $p = .001$), and overall (3.12 to 3.70, $p < .001$). Times from arrival to CT scanner (26.4 to 22.1 minutes, $p = .005$), intubation (10.1 to 6.6 minutes, $p = .49$) and the operating room (130.1 to 94.5 minutes, $p = .021$) were decreased significantly. Robertson et al. (2010) adapted the TeamSTEPPS© curriculum as an intervention to positively influence knowledge and attitudes toward teamwork skills for 213 medical and nursing students. Nurse and physician faculty facilitated student activities, and knowledge and attitudes were assessed pre- and post-intervention. Recognition of team skills were assessed using TeamSTEPPS© videos. Nursing students significantly improved attitudes toward teamwork ($P = 0.004$), whereas medical students' attitudes did not significantly increase. There was also a difference regarding the use of the "success" versus "opportunity" videos and whether team skills were observed by the students. For the "successful" teamwork video, 97.6% of the team skills were recognized, whereas only 27.7% of team skills were recognized for the "opportunity" video ($X^2 = 2163.3$, $df = 1$; $P < 0.001$). This observation reinforces previous findings that behavioral-modeling is a critical component of teamwork education.

Brock and colleagues (2013) conducted a TeamSTEPPS© communication education model with interdisciplinary healthcare students. Student groups worked in a self–selected clinical focal area (adult acute, pediatrics, and obstetrics). A sample of 306 fourth-year medical, third-year nursing, second-year pharmacy, and second-year physician assistant students took part

in a 4-hour training that included a 1-hour team simulation and feedback session. Pre-and post-assessments with the TeamSTEPPS© Teamwork Attitude Questionnaire (T-TAQ) were completed by 149 students. A paired *t*-test was conducted to evaluate the impact of the intervention on the participants' T-TAQ scores pre- and post-education. Significant positive increases were noted for TAQ total score ($p < 0.001$), TAQ situation monitoring ($p < 0.001$), TAQ team structure ($p = 0.002$), TAQ communication ($p = 0.002$) and TAQ mutual support ($p = 0.003$). There was no significant change in the TAQ leadership score ($p = 0.062$). The largest effect was seen for the TAQ situation monitoring (M = 0.19, 95% CI 0.10 to 0.38), and the smallest significant effect was for communication (M = 0.13, 95% CI 0.05 to 0.21).

Sawyer and colleagues (2013) utilized TeamSTEPPS© education to improve teamwork skills during neonatal resuscitation. Interdisciplinary teams of 42 physicians, nurses, and respiratory therapists participated in TeamSTEPPS© education that included simulation with an event-based approach. TeamSTEPPS© education was conducted in four separate sessions and each included 7-13 participants. Attitudes toward teamwork on the T-TAQ improved from time one average of 4.4 $\pm$ 0.8 to time two average of 4.7 $\pm$ 0.8 (95% CI -0.34 to -0.22, $p < .001$). Teamwork knowledge on the TeamSTEPPS© Learning Benchmarks instrument improved from a pre-test average of 86.8 % $\pm$ 7.5% to a post-test average of 92.6% $\pm$ 6.3 % (95% CI – 8.32 to -3.26, $p < .001$). The effect size in teamwork attitudes was small to moderate with $d = 0.34$ and $r = 0.17$ and large for teamwork knowledge with $d = 0.84$ and $r = 0.39$.

Teamwork skills during the simulations were measured using the TeamSTEPPS© Team Performance Observation Tool (T-TPOT), which included 22 specific teamwork behaviors divided across five TeamSTEPPS© core competencies. During the neonatal resuscitation simulations, two TeamSTEPPS© trainers independently monitored and scored teamwork

performance in real time. Significant improvements in teamwork skills post-education were demonstrated for team structure (pretest 2.5 vs. posttest 4.2 [95% CI -2.0 to -1.4]; $p < .001$), leadership (pretest 2.6 vs. posttest 4.4 [95 % CI -2.0 to -1.4]; $p < .001$), situation monitoring (pretest 2.5 vs. posttest 4.3 [95% CI -1.8 to -1.0]; $p < .001$), and communication (pretest 3.0 vs. posttest 4.4 [95% CI – 1.6 to -1.1]; $p < .001$). Effect size on changes in teamwork skills were large with d = 1.49 and r = 0.6.

Deering et al. (2011) implemented a large TeamSTEPPS© training intervention during the U.S. military conflict in Iraq at the Baghdad Combat Support Hospital (CSH) between November 2007 and December 2008. Training was implemented in two sessions followed by unit-based reinforcement of team behaviors by hospital leaders. A total of 153 patient safety reports were reviewed during the 13-month deployment, 94 pre-intervention and 59 post-intervention. After education, there were significant decreases in the rates of communication-related errors, medication and transfusion errors, and needle stick incidents. The in-patient census-adjusted rate of medication and transfusion errors decreased from 7.1 to 1.2 events per 1,000 inpatient days post-intervention (Pearson's chi-square test [1 df] = 13.9, $p <.001$), an 83% decrease. The in-patient census-adjusted rates of needle stick injuries and exposures decreased from 4.0 to 1.2 events per 1,000 in-patient days post-intervention (Pearson's chi-square test [1 df] = 4.14, $p < .05$, a 70% decrease.

Vertino (2014) used a pre-and post-intervention to determine if a TeamSTEPPS© educational initiative would improve attitudes toward teamwork. The study sought to determine if there were differences in teamwork attitudes between occupational groups (RNs, LPNs, and certified nursing assistants), and years of clinical experience. A convenience sample of 26 full-time and part-time staff employed on a medical-surgical unit were eligible to participate (n = 18

completed). The project director (a board-certified psychiatric nurse practitioner), a Veteran's Health Administration Mentor, and a TeamSTEPPS© Master Trainer provided 4-hour training sessions of didactic lecture, discussion, and role-play simulation of clinical case scenarios relevant to the staff. ANCOVA revealed significant increases in total T-TAQ scores ($F1,13 = 106$, $p < .001$) for untransformed data as well as transformed data T-TAQ scores ($F1,13 = 74.6$, $p < .001$), indicating significant increases form pre-test to post-test T-TAQ scores. Results for the 5 team constructs (time variable) with transformed data were as follows: team structure ($F1,13 = 90.3$, $p \leq .001$), leadership ($F1,13 = 79.0$, $p \leq .001$), situation monitoring ($F1,13 = 36.7$, $p \leq .001$), mutual support $F1,13 = 54.2$, $p \leq .001$), and communication ($F1,13 = 35.2$, $p \leq .001$). Neither occupational group nor years of experience moderated any pre-test to post-test changes in the total T-TAQ or subscales.

Purpose of the Project

The purpose of this project was to implement an evidence-based intervention to improve nurses' knowledge and attitudes toward teamwork and situation monitoring. Specific aims of the program were: (a) increased knowledge of team communication techniques; (b) improved attitudes towards VS monitoring, especially RR assessment; and (c) improved attitudes towards early RRT activation. Findings of this project will provide support for future evidence-based RRS professional development programming. Ongoing process and clinical outcomes to be measured beyond the scope of this project, will include: numbers of RRT calls for early signs of deterioration and in-patient code blue events outside of the ICU.

Methods

Context and Implementation Framework

The Plan-Do-Study-Act (PDSA) cycle is part of the Institute for Healthcare Improvement (IHI) Model for Improvement, a simple yet effective tool for accelerating quality improvement (IHI, 2012). The PDSA cycle is frequently used in healthcare and allows for piloting change on a small scale before spreading the change prematurely across the clinical system. The steps in the PDSA cycle are: (1) plan the test or observation, including a plan for data collection; (2) do pilot the test on a small scale; (3) study the change via review of results; and (4) act by refining the change, based on what was learned during the test period (IHI, 2012).

Forming the team

The Code Blue team was chartered in July 2015 under the executive sponsorship of the Chief Nursing Officer. Team membership includes nursing leaders, clinical nurse specialists, educators, respiratory therapists, RRT nurses, pharmacists, and intensivists.

Plan

The aim of the team was to prevent code blue events outside of the ICU by improving early detection and reporting. Potential evidence-based solutions to reach the aim, include: teamwork communication education and support tools.

Do

The PDSA model guided the team to ask the question, “what can the team do that will result in an improvement (IHI, 2012). In response, the proposal for the project’s educational intervention was advanced to the CNO for review and approval.

Establishing Measures

Quantitative data is necessary to determine if a change has resulted in an improvement (IHI, 2012). A pre- and post-intervention design was used to assess attitude and knowledge changes toward teamwork and VS monitoring. A RRS monthly dashboard was developed using Microsoft Excel, and continues to be shared with the Code Blue Committee. Ongoing updates are reported to the Quality, Risk, and Safety Steering Council.

Study

Following data analysis, information was shared with clinical specialists and educators to strategically plan for the spread of new learning across the system. Implementation is underway to spread new knowledge and support tools during mandatory competency programming for all medical-surgical and progressive care nurses.

Act

The final step in the PDSA model requires evaluation of outcomes and discussion with the entire team to guide process improvements and determine next steps (IHI, 2012). Effective outcomes measures are necessary to demonstrate goal achievement and justify the time and expense of system improvement efforts.

Intervention

IRB approval exempt status was received from Eastern Kentucky University IRB and agency IRB prior to implementation of the project. The project leader provided a 3-hour evidence-based educational intervention for 23 RN residents. RN residents were given the choice to opt out of the data collection process, however attendance of a training session was required, 100% of the RN residents fully participated in the project. The demographic form, questionnaires, and letter of informed consent were presented to the RN residents. Following the

informed consent process, all participants independently completed a basic demographic form (Appendix C) and three questionnaires over 20-minutes. Questionnaires were color-coded and randomly numbered for confidentiality and clarity of data collection. Completed instruments were returned to envelopes. Next, individual pocket folders were provided, and included the following laminated support tools:

- VS observation graphic chart (front) (Appendix D)
- Deterioration bell curves (back) (Appendix E)
- SBAR template for deterioration (Appendix F)
- TeamSTEPPS© tools handout (Appendix G).
- MEWS pocket card

A 40-minute didactic lecture using customized TeamSTEPPS© RRS (2014) PowerPoint slides and videos were presented (www.AHRQ.gov). After a short break, RN residents voluntarily divided into teams of 3 to 4 members and each team received a case scenario of real patient sequela with RRT interventions. Lab values, VS, brief history, and other documented symptoms were formatted over a timeline consisting of hours to days. Teams had 30-minutes to review the clinical information, use the support tools, and formulate an SBAR script for a simulated provider call (De Meester, Verspuy, Monsieurs, & Van Bogaert, 2013). A conference phone was used to connect with a clinical educator unfamiliar to the RN residents. The male educator with over 20 years of emergency and air medical experience had previously received the case scenario data in preparation to portray the physician role during the simulation. Each group was directed to use TeamSTEPPS© communication techniques, such as SBAR, CUS words (concern, uncomfortable, safety issue), and the second-challenge rule. A CNS portrayed the role of the RRT nurse and engaged in the simulation by receiving physician orders and demonstrating repeat-back.

During the simulation debrief, RN residents shared personal perspectives of the experience and were informed of the outcomes of the real patients which was a 50% survival rate. RN residents voiced concerns regarding incomplete VS monitoring and expressed that the RRT should have been called much earlier in the patients' sequela. Following a 20-minute debrief, the questionnaires were repeated and the RN residents were thanked for participating.

Measures

TeamSTEPPS© Teamwork Attitude Questionnaire

The TeamSTEPPS Teamwork Attitudes Questionnaire (T-TAQ) was designed to measure individual attitudes for five subscales: team structure, leadership, mutual support, situation monitoring, and communication. The T-TAQ is a 30-item self-report inventory developed as a research instrument to measure attitudes toward teamwork in the healthcare population (Baker, Krokos, & Amodeo, 2008). Respondents rate each item on a Likert Scale: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree, and 5 = Strongly Agree. Lower scores are associated with negative attitudes related to teamwork. Four questions are negatively worded (items 20, 21, 24, and 30) and the entire instrument can be completed in 5 to 10 minutes. Survey developers recommend users not customize the instrument and subscales can be used separately. Cronbach's alpha for the instrument and subscales exceeded 0.7, and the scales were moderately correlated (Baker, Amodeo, Krokos, Slonim, & Herrera, 2010).

V-Scale Attitudes towards VS Monitoring

Mok, Wang, Cooper, Ang, and Liaw (2015) conducted a literature review and interviewed over 300 nurses regarding VS monitoring practices. Findings led to the development of the V-Scale Questionnaire which was designed to measure nurses' attitudes towards VS monitoring and surveillance practices. The V-Scale is a 16-item instrument with

five subscales: (a) technology, (b) communication, (c) key indicators, (d) workload, and (e) knowledge. A four-point Likert rating scale (1 = Strongly Disagree, 4 = Strongly Agree) was used and lower scores are associated with positive attitudes related to VS monitoring practices. Cronbach's alpha for internal consistency was 0.71 for the V-Scale instrument. The correlation coefficients between items and their respective subscales ranged between 0.56 and 0.89, with overall ICC of 0.85. Permission to use the scale was granted by Dr. Sok Ying Liaw RN, PhD; Assistant Professor, Alice Lee Centre for Nursing Studies, Yong Loo Lin School of Medicine, National University of Singapore, Singapore (Appendix H).

TeamSTEPPS Knowledge Test

Jones and colleagues (2013) developed four TeamSTEPPS© knowledge assessment questions to add to the AHRQ Survey on Safety Culture in a study to measure the effect of TeamSTEPPS© education across 24 U.S. hospitals. Researchers used the multiple-choice questions to assess knowledge of TeamSTEPPS© techniques (Brief, SBAR, CUS, STEP). Cronbach's alpha for internal consistency for the instrument was 0.71. Permission and psychometrics were obtained from Dr. Katherine Jones, Division of Physical Therapy Education, School of Allied Health Professions, Nebraska Medical Center (Appendix I).

Analysis

The convenience sample consisted of 23 RN residents aged 19 to 48 years, with a mean age of 28 years. The group was predominantly female (91%) and prepared at the Associate Degree level (74 %; Table 1). Most of the RN residents (83%) reported no previous experience with either RRT or EWS. Table 2 highlights frequencies for the residents' previous experience with RRT and EWS.

Table 1. Sample Demographics

Characteristic (N=23)	n (%)
Age (years)	
≤30	15 (65)
31- 40	7 (30)
>40	1 (04)
Gender	
Male	2 (09)
Female	21 (91)
Highest education	
Associate Degree	17 (74)
Bachelor Degree	5 (22)
Master Degree	1 (04)

Table 2. Previous experience with RRT and EWS

Experience	n (%)
RRT	
No	19 (83)
Yes	4 (17)
Positive experience	3 (13)
Negative experience	1 (.04)
EWS	
No	19 (83)
Yes	4 (17)
MEWS	2 (09)
Stoke	1 (.04)
Scoring of VS/Appearance	1 (.04)
BP Monitor	1 (.04)

Analysis

IBM SPSS (Version 24, 2015) software was used for data analysis. Descriptive statistic frequency, range, means, SD were used to describe sample demographics and questionnaire item analysis. Paired-samples (two-tailed) *t*-tests were used to identify the mean difference between pre- and post-intervention changes in attitude scores.

V-Scale Attitudes towards VS Monitoring

A paired samples *t*-test was conducted to evaluate the impact of the intervention on the RN residents' total V-Scale scores. There was a statistically significant increase in V-Scale total scores from Time 1 (M = 36.00, SD = 2.844) to Time 2 (M = 37.87, SD = 4.445), t (-2.484) = 22, p = .041 (two-tailed). The mean increase in V-Scale score was 1.87 with a 95% confidence interval ranging from -3.430 to -3.09. The eta squared statistic (0.22) indicated a large effect size. Results of paired *t*-tests for V-Scale total and sub-scales are shown in Table 3.

Table 3. Paired t-test for V-Scale (N=22)

Subscales **M (SD)**	***t***	***p***	**η^2**
Technology Pre 8.13 (1.66) Post 8.57 (2.39)	-.73	.471	Small (.02)
Communication Pre 6.65 (1.34) Post 6.96 (0.97)	-1.23	.231	Moderate (.06)
Workload Pre 8.22 (1.65) Post 7.39 (1.67)	2.82	.01*	Large (.27)
Key Indicators Pre 5.22 (1.41) Post 7.48 (1.59)	-7.16	000*	Large (.69)
Knowledge Pre 7.78 (1.13) Post 7.48 (1.59)	.66	.519	Small (.02)
Overall Total Pre 36.00 (2.84) Post 37.87 (4.45)	-2.49	.041*	Large (.22)

Changes in overall total pre-and post-scores demonstrated a significant effect on attitude change toward VS monitoring. These findings support previous studies that VS measurements may not be performed predictably, accurately, or completely (Mok, Wang, & Liaw, 2015.

TeamSTEPPS© Teamwork Attitudes Questionnaire (T-TAQ)

A paired samples *t*-test was conducted to evaluate the impact of the intervention on the RN residents' total T-TAQ score. There was a statistically significant increase in T-TAQ total scores from Time 1 (M = 134.86, SD = 7.479) to Time 2 (M = 136.64, SD = 8.174), t (-2.179) = 21, p = .041 (two-tailed). The mean increase in T-TAQ overall score was 1.78 with a 95% confidence interval ranging from -3.465 to -.081. The eta squared statistic (.18) indicated a large effect size. None of the T-TAQ questions showed an overall attitude change from disagreement to agreement, or the opposite. Results of paired *t*-tests for T-TAQ total and subscales are shown in Table 4.

Table 4. Paired t-test for T-TAQ

Subscales M (SD)	*t*	df	*p*	η²
Team Structure Pre 25.96 (2.18) Post 27.00 (2.02)	-1.83	22	.081	Large (.46)
Leadership Pre 28.09 (1.76) Post 28.17 (2.13)	-.23	22	.820	(.002)
Situation Monitoring Pre 27.00 (2.22) Post 26.96 (2.01)	1.60	22	.125	Moderate (.10)
Mutual Support Pre 27.61 (1.99) Post 27.70 (2.77)	-.19	22	.851	(.002)
Communication Pre 25.77 (2.69) Post 27.14 (2.64)	-2.52	21**	.02*	Large (.23)
Overall Total Pre 134.86 (7.48) Post 136.64 (8.17)	-2.18	21	.041*	Large (.18)

** Communication Subscale had one missing response on post-TAQ

TeamSTEPPS Knowledge Assessment

TeamSTEPPS© knowledge of communication techniques was assessed with four multiple-choice questions, and the findings demonstrated that SBAR appeared to be hardwired into local nursing programs. Nine RN residents reported no formal education of teamwork skills and none reported previous exposure to TeamSTEPPS©. These findings demonstrated an opportunity for a structured approach to teaching teamwork communication techniques in local nursing programs. All nine RN residents who reported no formal teamwork education were graduates of an associate degree program and this may reflect time constraints of the curriculum

and the focus on technical skills. This finding supports previous reports that educational degree qualifications had the most significant influence on attitudes scores towards VS monitoring ($\beta = 0.201$, $P < 0.001$) (Mok, Wang, & Liaw, 2015). Percentages of correct answers for knowledge assessment questions are reported in Table 5.

Table 5. Pre- and Post-TeamSTEPPS© Knowledge Questions by Percentage Correct (N=23)

TeamSTEPPS© Techniques	**Pre** **Post**
Brief (Planning session prior to start discussing team formation; assign roles; expectations and climate; and anticipated outcomes and contingencies)	45.5 72.7
SBAR (Situation, Background, Assessment, Recommendations)	95.7 100
CUS Words (Concern, Uncomfortable, Safety Issue)	4.5 56.5
STEP (Status of patient, Team members, Environment, Progress towards Goals)	8.7 43.5

Ethical Considerations

Although not apparent, the RN residents may have experienced anxiety during the simulated provider call as they believed that they were speaking with a physician rather than a clinical nurse educator. The session facilitators demonstrated supportive behaviors during the simulation and the RN residents worked in teams.

Results

Missing data were minimal. A single question was not answered by one RN resident in the post-TAQ Communication subscale. The facilitators felt rushed during the first educational session with 16 participants, however the second session with 7 participants was appropriately timed and allowed for increased participation during the simulated provider call.

Summary

It is apparent that SA cognition can be influenced by individual factors, but it is a skill that can be acquired by nurses and improved with education (MacEachin et al. 2009). Effective education incorporates both technical and non-technical aspects that can promote decision-making effectiveness. A key finding of the project was the realization that many nursing graduates transition to practice without the benefit of knowledge and practice of EWS and teamwork communication skills. Both are evidence-based practices that improve patient safety and reduce errors (Duncan, McMullen, & Mills, 2012; O'Dea, O'Connor, & Keogh, 2014).

Interpretation

The simulated call allowed for a relatively large number of RN residents to participate in teamwork education over a 90-minute timeframe. Simulation labs are often costly and scenarios can be time-consuming to run for large RN residency groups. Professional Development and Information Technology personnel resources are often lean. Technical competence for simulation scenario development may by lacking among educators. The teaching methods described were efficient, inexpensive, and provided an evidence-based approach. Clinical deterioration scenarios are frequently taught in the simulation lab during undergraduate and residency programs, however, learning objectives often focus on the emergency response and resuscitation skills versus early recognition and effective RRS escalation. Evidence-based teaching methods to improve participants' attitude, knowledge, and performance of effective SBAR and communication techniques for escalation should be an important component of undergraduate and RN Residency programming. O'Dea and colleagues (2014) reported that effective teaching methods must include practice and behavioral-modeling, formative feedback, and support tools for knowledge transfer to the work environment. Situation monitoring tools

such as early warning scores, human factors-based deterioration tracking models, and SBAR templates are useful for clinicians who have little experience with deteriorating patients.

V-scale Attitudes towards VS Monitoring

The following V-scale questions demonstrated an attitude change from an overall majority disagreement to agreement: (a) respiratory rate value is usually estimated for stable patients during routine vital signs monitoring (Technology subscale); (b) complete and accurate vital signs monitoring is neglected due to time constraints (Workload subscale); and (c) changes in VS were not interpreted accurately by nurses (Knowledge subscale). The RN residents initially demonstrated an almost equal split regarding the estimation of RR for stable patients as a routine VS monitoring practice. Following the intervention, agreement increased from 48% to 68%. Similarly, when asked if electronic VS monitoring resulted in casual monitoring of RR, the percentage of agreement increased from 52% to 80%.

When initially asked if VS changes were not interpreted accurately by nurses, resulting in the absence or delay of appropriate nursing actions, only 26% were in agreement with the statement. Following the intervention, 74% expressed agreement. Similarly, another question asked if complete and accurate VS monitoring is neglected due to time constraints? The percentage of agreement on this question increased from 35% to 61%. The RN residents' attitude change demonstrated a new situation awareness of variable VS monitoring and surveillance practices, as cited in the literature (Hazelhurst, McMullen, & Gorman, 2007; Yule et al., 2008; Kransfelder, Schneider, Gillen, & Feussner, 2011, and Mok, Wang, & Liaw, 2013).

The RN residents reported high confidence for communication skills with providers pre- and post-intervention, 83% and 91% respectively. However, the RN residents demonstrated a strong reliance on the SBAR template during the simulation, especially for recommendations.

The RN residents had a high percentage of correct answers (100%) related to the importance of RR as an early predictor of deterioration, and there was minimal confusion regarding the substitution of RR with pulse oximetry monitoring pre-intervention (4%). Unlike findings of previous studies, a small percentage (17%) initially expressed that blood pressure is often the first parameter than reflects abnormality when a patient deteriorates and SpO^2 is a more reliable indicator of early respiratory dysfunction than respiratory rate (9%) (Mok, Wang, Cooper, Ang, & Liaw, 2015).

TeamSTEPPS© Teamwork Attitudes Questionnaire (T-TAQ)

None of the T-TAQ responses changed from an overall opinion of disagreement to agreement, or the reverse. Strong agreement increased from 70% to 91% related to the importance of asking patients and their families for feedback regarding patient care. Strong agreement increased from 35% to 52% related to the importance of monitoring the emotional and physical status of team members. The communication subscale demonstrated the greatest percentage changes for strong agreement, and included the following questions: (a) adverse events may be reduced by maintaining an information exchange with patients and their families (39% to 55%); (b) I prefer to work with team members who ask questions about information I provide (26% to 57%); and (c) it is important to have a standardized method for sharing information when handing-off patients (48% to 70%). During the simulation debriefing, several RN residents shared that they had not thought about including the patient and family in RRT and provider escalation decisions.

RN Residency Curriculum

The original project plan was to conduct the intervention for the RNs and NAs already working together as a team on a select nursing unit. Due to staffing challenges and leadership

vacancy, a convenience sample of the 23 RN residents was chosen. An unintended benefit of working solely with RN residents was the opportunity to measure attitudes towards teamwork and VS monitoring at the beginning of professional role transition. Environments where decision-making skills are scrutinized can cause anxiety for novice nurses, which affects the ability to use SA, negatively impacts clinical judgment, and leads to defensive practice (Cooper et al. 2010). Project findings will be used for future residency planning and will be shared with local academic partners. Although the educational intervention bundle was implemented with RN residents, new learning will be shared with all medical-surgical and progressive care nurses, nursing assistants, and RRT members to improve SA cognition and team communication in the work environment.

Limitations

The convenience sample of 23 RN residents was small and a self-report method was used. The intervention may not have the same results when used with experienced nurses.

Conclusions

Evidence of TeamSTEPPS© effectiveness across healthcare settings is beginning to accumulate, with research studies showing improvements in situation monitoring, leadership, mutual support, and communication. Improved clinical outcomes have also been reported, such as reduced medical errors related to communication, medication, needle-stick incidents, and endotracheal intubation (Capella et al., 2010; Deering et al., 2011). Inter-professional SA learning has been effective in promoting more cohesive, participatory working practices, improving care coordination, and increasing continuity in patient management (Mitchell & Flin, 2008; Guimond et al., 2009; MacEachin et al., 2009).

Basic RRS information is presented via didactic lecture during new employee orientation programs, however evidence supports that critical elements for teamwork education include behavior-modeling, practice opportunities, and formative feedback (O'Dea, O'Connor, & Keogh, 2014). For this reason, participatory teamwork education and simulation is a goal for future on-boarding programs. Support tools are also needed to assist nurses and nursing assistants with the detection and escalation of subtle VS and physical deterioration changes. Lapses in cognition due to lack of awareness or knowledge, and the tendency to interpret patient data as single strands rather than collectively has been found to contribute to suboptimal decision-making by nurses and negatively affect patient care (Endacott et al., 2010). When working in a chaotic environment such as a busy nursing unit, team communication and situation monitoring techniques are in danger of being missed without the integration of support tools and methods to guide practice and sustain a culture of safety (Clapper & Kong, 2012).

It is important that essential situation monitoring skills are identified by further research and subsequently incorporated into undergraduate and post graduate level nursing education to improve decision-making and ultimately patient outcomes. More research is needed to determine the effect of teamwork education on clinical outcomes, and there is a need for greater precision in outcomes assessment and standardization of methods and measures of education effectiveness (O'Dea, O'Conner, & Keogh, 2014

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Appendix A

Modified Early Warning Score

Modified Early Warning Score (MEWS)

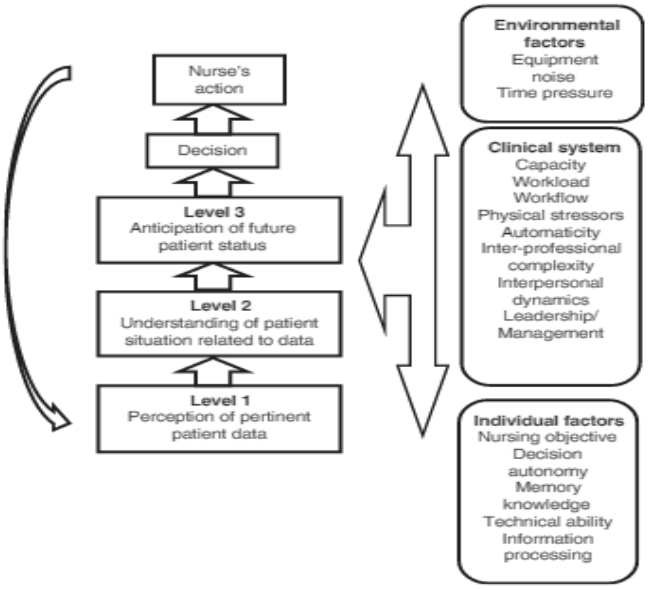
Score	3	2	1	0	1	2	3
Central Nervous System (CNS)- Level of Consciousness		Confused or agitated		Alert	Drowsy/ Respond to voice or newly confused	Respond to pain	Unre-spon-sive
Respiratory Rate (breaths/min)		< 8		9 - 14	15 - 20	21 - 29	≥ 30
Heart Rate (Beats/min)		≤ 40	41 - 50	51 - 100	101 - 110	111 - 129	≥ 130
Systolic Blood Pressure (mmHg)	< 70	71 - 80	81 - 100	101 - 199		≥200	
Temperature (F)		≤ 95.0^0		95.1^0 – 101.2^0		≥ 101.3^0	

Duncan, K.D., McMullan, C., & Mills, B.M. (2012). Early warning systems: The next level of response. *Nursing 2012*; February, retrieved from www.Nursing2012.com.

MEWS Action Algorithm for Clinical Decision Support	
MEWS	Inpatients Action (EXCLUDES DNR, Comfort Care /Hospice Patients) *Note: Nurses may notify RRT for any score at their discretion.
0 – 2	Continue routine/ordered monitoring
3	Increase VS frequency to every 4 hours X 3; Calculate the MEWS each time. Inform charge nurse.
4	At first reading, inform charge nurse to assess patient. Increase VS frequency to every 1 hour X 3; include pulse oximetry-Calculate MEWS each time. Strict I & O – call if UOP <100mL/4 hrs; if Foley catheter present, observe UOP< 30 mL/hr. If score is 4 at change of shift, re-evaluate to determine if this score is patient's baseline.
5	**Call RRT**. Increase VS frequency to every 1 hour include pulse oximetry-Calculate MEWS each time. Strict I & O – call if UOP <100mL/4 hrs; if Foley catheter present, observe UOP< 30 mL/hr. Inform physician. If patient remains "5" for three consecutive readings, request order for possible transfer to higher level of care. Is end-of-life discussion with patient/family indicated
≥6	**Call RRT and physician stat**. Recommend transfer to higher level of care. Is end-of-life discussion with patient/family indicated?

Appendix B

Concept Map of Situational Monitoring and Nursing Decision-making



Stubbing, L., Chaboyer, W., & McMurray, A. (2012). Nurses' use of situation awareness in decision-making: An integrative review. *Journal of Advanced Nursing, 68*(7): 1443-1453.

Appendix C

Demographic Data Form for RN Residents

Sex: _____ Female _____Male

Age: _____

Highest Level of Education:

GED _____

High School Degree_____

Associate Degree _____

Baccalaureate Degree _____

Master's Degree _____

Doctoral Degree _____

Other _____

Have you activated a Rapid Response Team (RRT) call? Yes _____ No _____

If Yes, was the RRT call a positive experience for you? **Yes _____No _____**

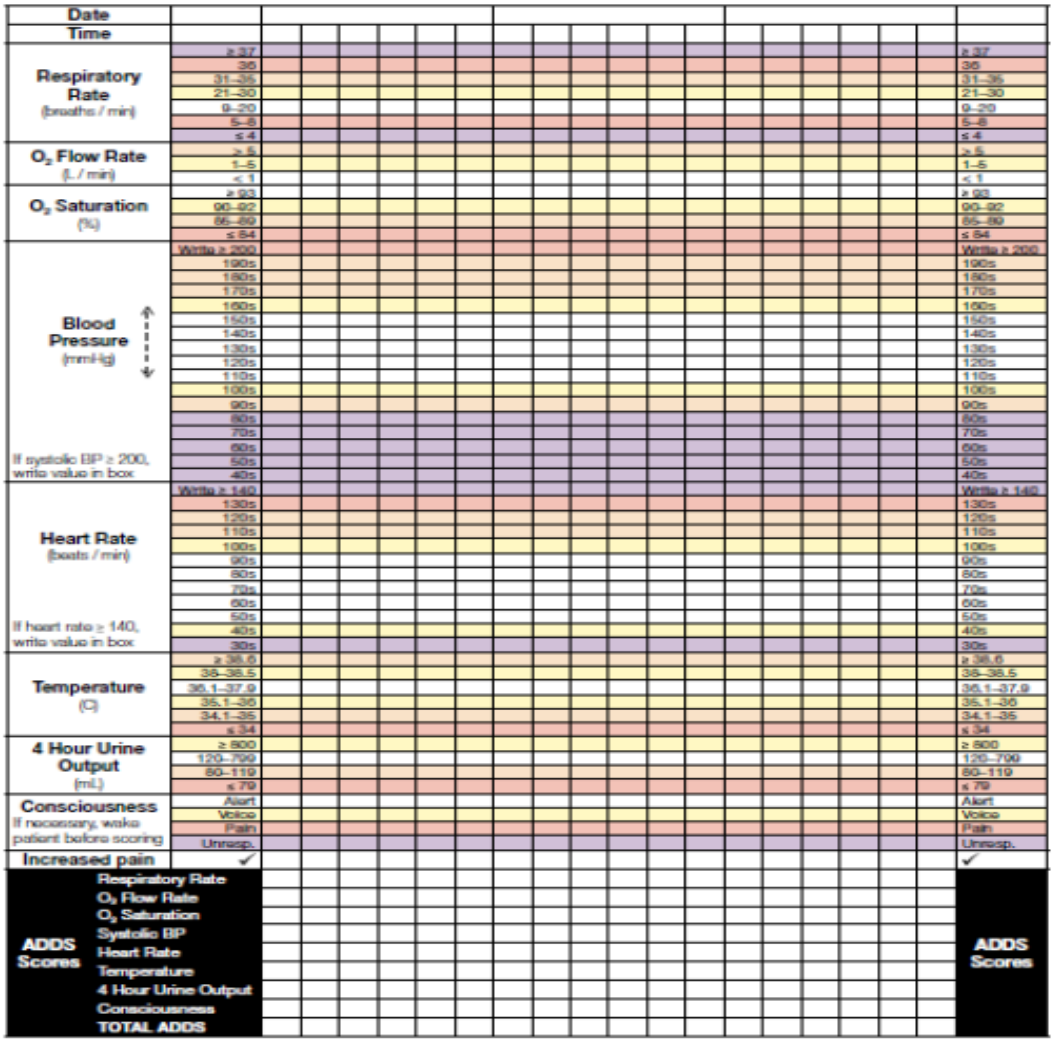
Do you have previous experience with an Early Warning Tool to detect Clinical Deterioration? Yes _____ No _____

If Yes, please describe:

Thank you for your participation

Appendix D

Vital Signs Observation Chart

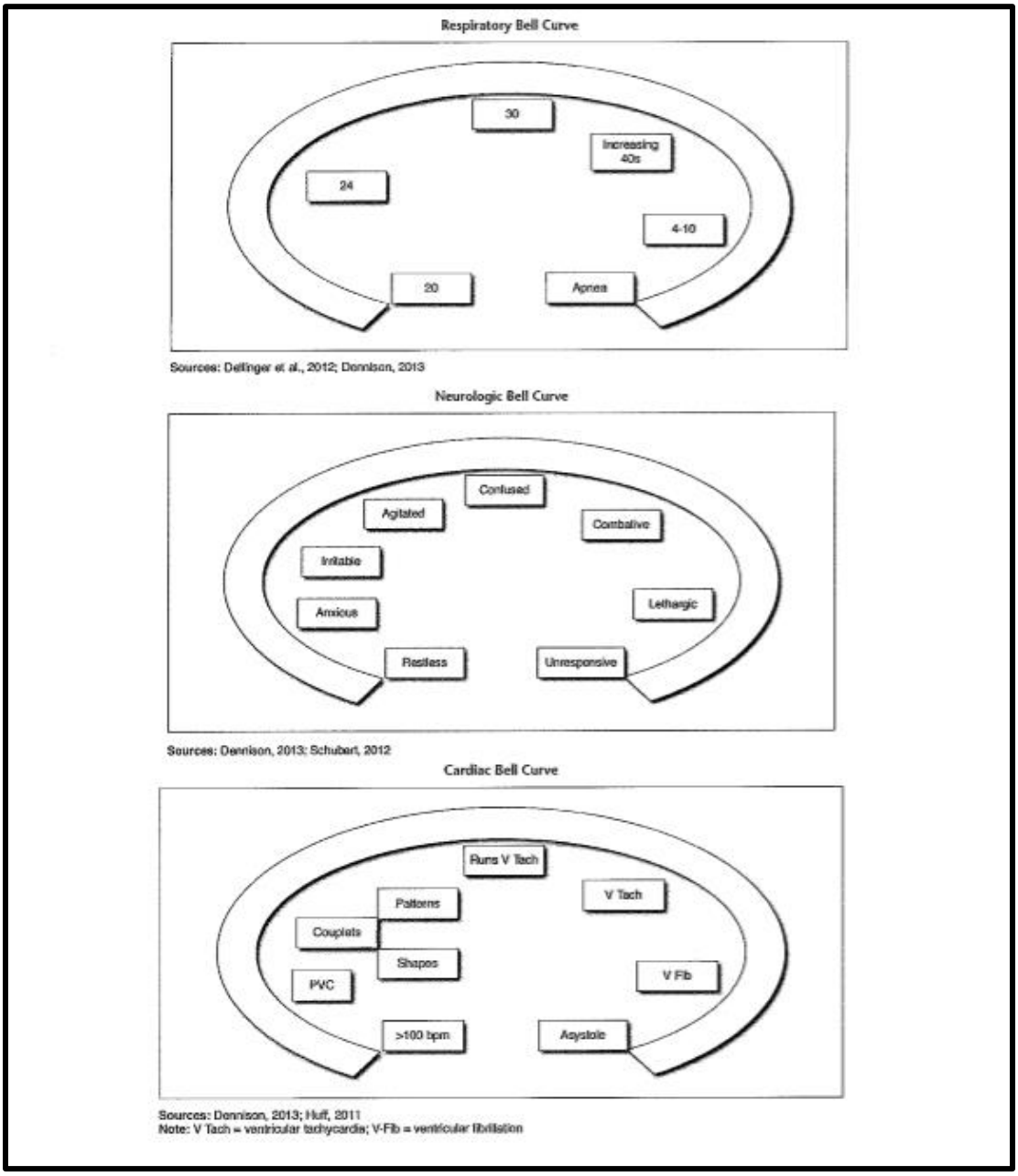


Date																			
Time																			
Respiratory Rate (breaths / min)	≥ 37																		≥ 37
	36																		36
	31–35																		31–35
	21–30																		21–30
	9–20																		9–20
	5–8																		5–8
	≤ 4																		≤ 4
O_2 Flow Rate (L / min)	≥ 5																		≥ 5
	1–5																		1–5
	< 1																		< 1
O_2 Saturation (%)	≥ 93																		≥ 93
	90–92																		90–92
	86–89																		86–89
	≤ 84																		≤ 84
Blood Pressure (mmHg) ↑ ⋮ ↓	Write ≥ 200																		Write ≥ 200
	190s																		190s
	180s																		180s
	170s																		170s
	160s																		160s
	150s																		150s
	140s																		140s
	130s																		130s
	120s																		120s
	110s																		110s
	100s																		100s
	90s																		90s
	80s																		80s
	70s																		70s
If systolic BP ≥ 200, write value in box	60s																		60s
	50s																		50s
	40s																		40s
Heart Rate (beats / min)	Write ≥ 140																		Write ≥ 140
	130s																		130s
	120s																		120s
	110s																		110s
	100s																		100s
	90s																		90s
	80s																		80s
	70s																		70s
	60s																		60s
	50s																		50s
If heart rate ≥ 140, write value in box	40s																		40s
	30s																		30s
Temperature (C)	≥ 38.6																		≥ 38.6
	38–38.5																		38–38.5
	36.1–37.9																		36.1–37.9
	35.1–36																		35.1–36
	34.1–35																		34.1–35
	≤ 34																		≤ 34
4 Hour Urine Output (mL)	≥ 800																		≥ 800
	120–799																		120–799
	80–119																		80–119
	≤ 79																		≤ 79
Consciousness If necessary, wake patient before scoring	Alert																		Alert
	Voice																		Voice
	Pain																		Pain
	Unresp.																		Unresp.
Increased pain	✓																		✓
ADDS Scores	**Respiratory Rate**																		**ADDS Scores**
	O_2 Flow Rate																		
	O_2 Saturation																		
	Systolic BP																		
	Heart Rate																		
	Temperature																		
	4 Hour Urine Output																		
	Consciousness																		
	TOTAL ADDS																		

Adapted from: Preece, M., Hill, A., Horswill, M., & Watson, M. (2012). Supporting the detection of patient deterioration: Observation chart design affects the recognition of abnormal vital signs. *Resuscitation, 83*: 111-1118.

Appendix E

Bell Curves Model of Clinical Deterioration



In Garvey, P. (2015). Failure to rescue: The nurse's impact. *MedSurg Nursing*, 24(3): 145-149.

Appendix F

SBAR Template for Deterioration

S	**SITUATION** - **I am calling about** <patient name and location>. - **The patient's code status is** <code status> - **The problem I am calling about is: _____.** I am **concerned** the patient is going to arrest. **I have just assessed the patient personally:** - **Vital signs are**: Blood pressure _____ Pulse____ RR _____ Temp_____ MEWS _____. - I am **concerned about the:**
B	**BACKGROUND** **The patient's mental status is:** - Alert and oriented to person place and time _____ - Confused and cooperative or non-cooperative _____ - Agitated or combative _____ - Lethargic but conversant and able to swallow _____ - Stuporous and not talking clearly, and possibly not able to swallow_____ - Comatose, eyes close, not responding to stimulation _____ **The patient's skin is:** - Skin warm, pale, dry _____ - Skin mottled _____ - Skin Diaphoretic _____ - Extremities cold _____ - Extremities warm _____ **The patient's oxygenation status is:** - Patient is not on oxygen - Patient has been on _____(l/min) or (%) oxygen for _ minutes (hours). - Pulse oximeter is reading _____ % or the oximeter does not detect a good pulse and is Giving erratic readings.
A	**ASSESSMENT** - The problem seems to be cardiac – infection - neurologic - respiratory - This is what I think the problem is: **<say what you think is the problem** - "I am not sure what the problem is but the patient is unstable and may arrest."
R	**RECOMMENDATION** **I suggest or request that you** <say what you would like to be done> - Transfer the patient to critical care. - Talk to the patient or family about code status. - See patient now. - Ask for a consultant to see the patient. **Are any tests needed:** Do you need any tests like CXR, ABG, EKG, CBC, or BMP? Others? **If a change in treatment is ordered, then ask:** How often do you want vital signs? How long to you expect this problem will last? If the patient does not improve, when would you want us to call?

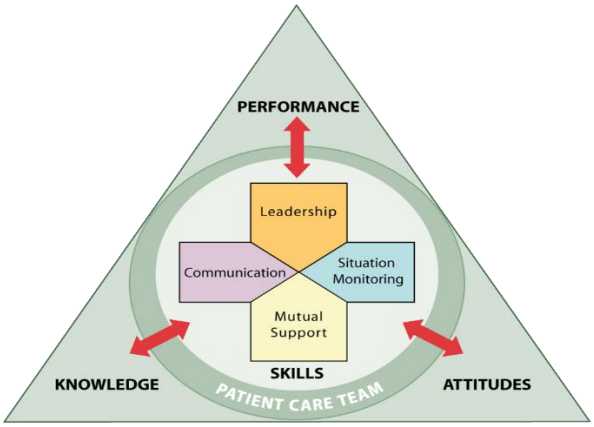
***This SBAR tool was developed by Kaiser Permanente. Please feel free to use and reproduce these materials in the spirit of patient safety, and please retain this footer in the spirit of appropriate recognition.*

Appendix G

TeamSTEPPS© Tools Overview

TeamSTEPPS© Tools

TeamSTEPPS© (Team Strategies and Tools to Enhance Performance and Patient Safety) is an evidence-based framework to optimize team performance across the healthcare delivery system. The core of the TeamSTEPPS© framework is comprised of four skills: Leadership, Situation Monitoring, Mutual Support, and Communication. These skills must interplay with the Team Competency Outcomes: Knowledge, Attitudes, and Performance.



LEADERSHIP

There are two types of leaders: (1) Designated, and (2) Situational. An effective team leader:

- Organizes the team
- Articulates clear goals
- Makes decisions through collective input of members
- Empowers members to speak up and challenge, when appropriate
- Actively promotes and facilitates good team work
- Skillfully resolves conflicts

Team Events

Brief: A short session for planning prior to start to discuss team formation; assign essential roles; establish expectations and climate; and anticipate outcomes and likely contingencies.

Huddle: When problem solving is needed, this ad hoc planning is used to reestablish situation awareness, reinforce plans already in place, and assess the need to adjust the plan.

Debrief: This informal information exchange session is designed to improve team performance and effectiveness. Feedback from the team drives future process improvement.

SITUATION MONITORING

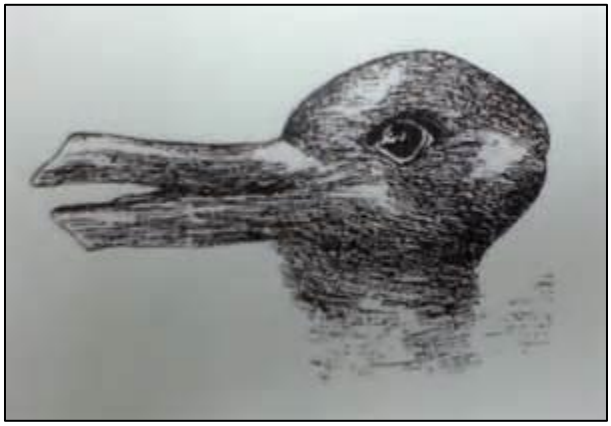
Situation monitoring is the process of continually scanning and assessing what's going on around you to maintain situation awareness. **(STEP = Status of the patient, Team members, Environment, Progress towards Goals).**

S	T	E	P
Status of Patient **Patient History** **Vital Signs** **Medications** **Physical Exam** **Plan of Care** **Psychosocial Issues**	**Team Members** **Stress** **Fatigue** **Workload** **Task** **Performance** **Skill**	**Environment** **Facility Information** **Administrative Info** **Human Resources** **Triage Acuity** **Equipment**	**Progress Towards Goals** **Status of Patient(s)?** **Established Team Goals?** **Task/Actions of Team?** **Is Plan Still Appropriate?**

SITUATION AWARENESS

Situation Awareness is "knowing and what is going on around you" and knowing the conditions that affect your work.

Shared Mental Models result from each team member maintaining his or her situation awareness and sharing relevant facts with the entire team so everyone on the team is "on the same page."



Cross Monitoring: an error reduction strategy that involves monitoring actions of other team members; providing a safety net within the team; ensuring mistakes or oversights are caught quickly and easily, and "watching each other's backs."

MUTUAL SUPPORT

Task assistance is one form of mutual support in which team members:

- Protect each other from work overload situations
- Place all offers and requests for assistance in the context of patient safety
- Foster a climate where it is expected that assistance will be actively sought and offered

COMMUNICATION

Effective communication is complete, clear, brief, and timely**. SBAR** is a technique for communicating critical information that requires immediate attention and action concerning a patient's condition and is especially important during handoff.

- **Situation** – What is going on with the patient?
- **Background** – What is the clinical background or context?
- **Assessment** – What do I think the problem is?
- **Recommendation and Request** – What would I do to correct it?

Using **"CUS"** words is one way to "STOP the line" and alert other ream members to your concerns.

- I am **CONCERNED**
- I am **UNCOMFORTABLE**
- This is a **SAFETY** issue or I don't feel like this is **SAFE**

Examples: "I am concerned about Mr. Smith's heart rate. I am uncomfortable with what we're seeing. I don't feel like this is safe. I think we should call the Rapid Response Team."

Two Challenge Rule

When an initial assertion is ignored:

- It is your responsibility to assertively voice concern at least two times to ensure it has been heard, and the team member being challenged must acknowledge the concern.
- If the outcome is still not acceptable: (1) take a stronger course of action; (2) utilize supervisor or chain of command

The Two Challenge rule empowers all team members to "stop the line" if they sense or discover an essential safety breach.

Appendix H

Permission to Use V-Scale

Permission to use V-Scale Request

LY

Liaw Sok Ying <nurliaw@nus.edu.sg>

Reply all |

Tue 1/31, 12:13 A

Dear Rose,

Thank you for your interest. Please go ahead to use the tool.

All the best for your research study.

Sent from my iPhone

Patrick, Rosemarie A.

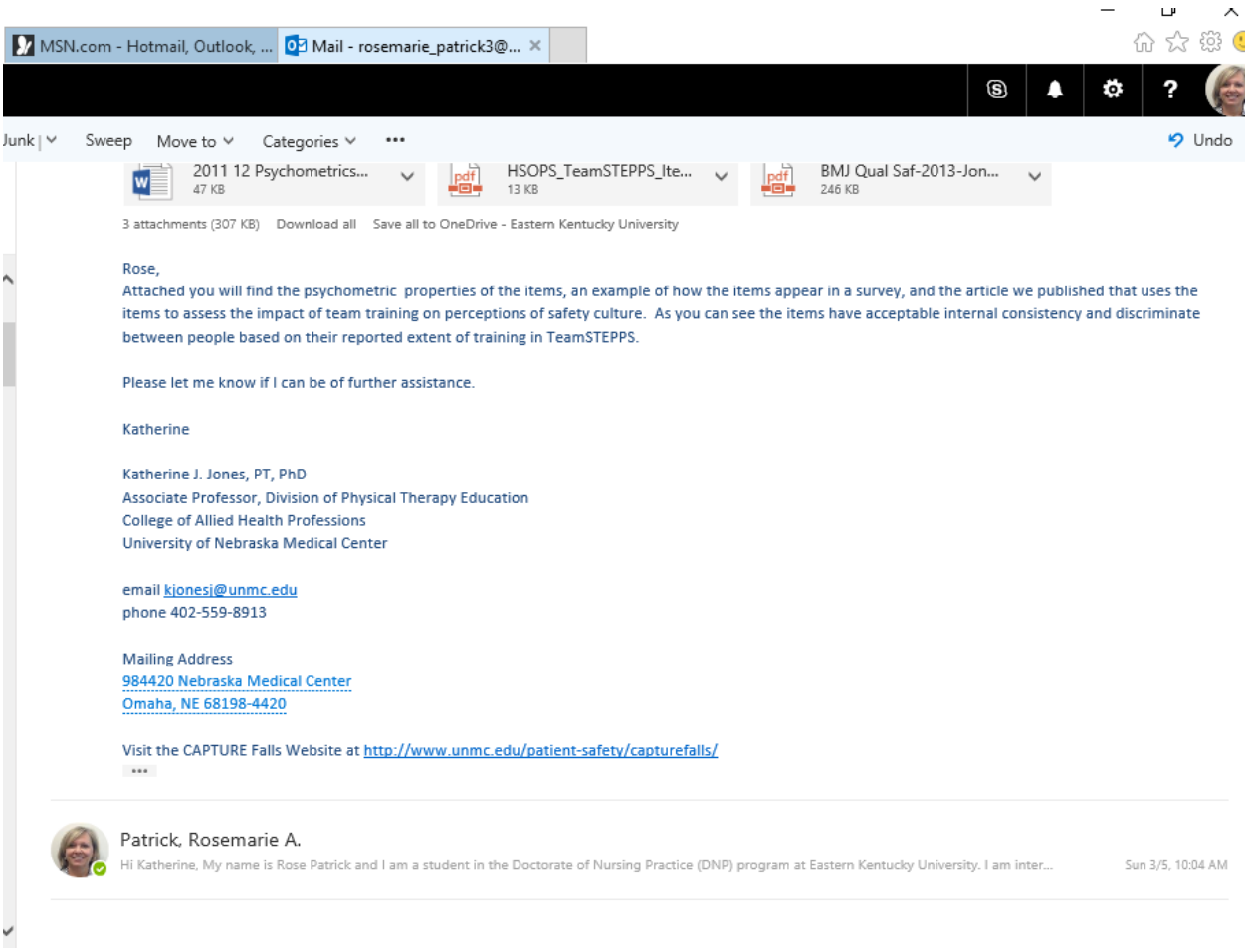
Permission to use V-Scale Request

Mon 1/30, 9:46 PM

Greetings, My name is Rose Patrick and I am a DNP student at Eastern Kentucky University. I am seeking permission to use the V-Scale to assess attitudes toward vital signs monitoring in the detection of clinical deterioration as a part of my DNP capstone project.

Appendix I

Permission to Use TeamSTEPPS Knowledge Assessment Questions



MSN.com - Hotmail, Outlook, ... | Mail - rosemarie_patrick3@...

Junk | Sweep | Move to | Categories | ••• | Undo

2011 12 Psychometrics... 47 KB | HSOPS_TeamSTEPPS_Ite... 13 KB | BMJ Qual Saf-2013-Jon... 246 KB

3 attachments (307 KB) Download all Save all to OneDrive - Eastern Kentucky University

Rose,
Attached you will find the psychometric properties of the items, an example of how the items appear in a survey, and the article we published that uses the items to assess the impact of team training on perceptions of safety culture. As you can see the items have acceptable internal consistency and discriminate between people based on their reported extent of training in TeamSTEPPS.

Please let me know if I can be of further assistance.

Katherine

Katherine J. Jones, PT, PhD
Associate Professor, Division of Physical Therapy Education
College of Allied Health Professions
University of Nebraska Medical Center

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Mailing Address
984420 Nebraska Medical Center
Omaha, NE 68198-4420

Visit the CAPTURE Falls Website at http://www.unmc.edu/patient-safety/capturefalls/

Patrick, Rosemarie A.
Hi Katherine, My name is Rose Patrick and I am a student in the Doctorate of Nursing Practice (DNP) program at Eastern Kentucky University. I am inter... Sun 3/5, 10:04 AM