DEVELOPMENT, IMPLEMENTATION, AND EVALUATION OF A PILOT WORKSHOP ON CLINICAL DETERIORATION USING AN EARLY WARNING SCORE

by © Grace Halley

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Abstract

Background: Early identification of acute clinical decline is critical to improve patient outcomes. Nurses work closely with patients and have an opportunity to identify early signs of clinical deterioration. Unfortunately, signs of clinical deterioration are often missed, resulting in potentially serious adverse events. The National Early Warning Score 2 (NEWS2) is an early warning score (EWS) implemented in the inpatient setting to aid nurses and other health care providers in the recognition of acute decline. No such scoring system exists in the tertiary care centre in St. John's, Newfoundland. **Purpose:** To develop and evaluate a multimodal pilot workshop to improve the early recognition of clinical deterioration through introduction of the NEWS2 tool. **Methods:** An integrative literature review was conducted to identify barriers and facilitators nurses experience when using EWS systems, as well as, to identify educational initiatives and outcomes. Knowles Theory of Andragogy informed the development of the workshop. Informal consultations were completed with key stakeholders of Eastern Health's medicine program to provide the setting and specific criteria for the workshop. The workshop was delivered to ward nurses, and evaluation surveys were completed. **Results:** The literature review identified the effectiveness of a multimodal educational workshop for ward nurses. Results from the evaluation survey indicated an overall positive response for both the delivery of the workshop and NEWS2 tool. **Conclusion:** An evidenced-based pilot workshop was developed that can aid nurses in the early detection of clinical deterioration, and improve patient outcomes. The workshop and evaluation results have been shared with members of Eastern Health with a plan to implement the workshop and NEWS2 tool in the near future.

Keywords: *Clinical deterioration, Early Warning Score, National Early Warning Score 2, education.*

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Introduction

Acute clinical decline is unfortunately a common issue on general inpatient wards. In recent years it has become a more common issue due to an aging population, with multiple co-morbidities (Liaw et al., 2011). Clinical deterioration that is not identified early, can result in serious adverse events including, unplanned transfers to the intensive care unit (ICU), sepsis, cardiac and respiratory arrest, and even death (Al-Qahtani & Al-Dorzi, 2010). Studies have shown that as many as 33.2% of hospitalized patients suffer a serious adverse event (SAE) (Marquet et al., 2015), with mortality rates as high as 5-8% (Al-Qahtani & Al-Dorzi, 2010). Prior to the development of these adverse outcomes, patients can show warning signs including, changes in vital signs and neurological status, and various symptoms for an estimated 6-8 hours (Al-Qahtani & Al-Dorzi, 2010). Although patients can exhibit these warning signs, the literature indicates that bedside nurse' ability to recognize and act on these acute clinical changes is suboptimal (Jensen et al., 2018). This is a potential missed opportunity to identify and treat patients before a possible worsening clinical course occurs (Mok et al., 2015).

Early warning score (EWS) systems have been developed to improve the management of critically ill ward patients and support ward nurses by aiding in identification of clinical deterioration at earlier stages. Using patients' physiological parameters, EWS tools calculate a score representing risk of clinical decline (Skitch et al., 2018). This calculated score can guide various medical interventions with the goal of preventing a SAE. One specific EWS tool is the National Early Warning Score 2 (NEWS2). Higher scoring of the NEWS2 predicts in hospital mortality at 24 hours (Furlan et al., 2022). Once implemented, such a system has shown to significantly reduce unplanned ICU transfers (p=0.049), and cardiopulmonary arrests (p=0.046) (Badr et al., 2021). The Royal College of Physicians of London has recommended the use of the

NEWS2 tool in all inpatient settings (Royal College of Physicians, 2017). Additionally, many hospitals across Canada have implemented the NEWS2 tool or other similar EWS systems (Vandervliet et al., 2021). In Newfoundland and Labrador (NL), the Burin Peninsula Health Care Centre within the Eastern Health Authority has recently implemented the NEWS2 tool. However, the tertiary centers in St. John's have yet to implement such an inpatient scoring system. Due to higher patient acuity, and an increased risk of clinical deterioration on the general ward (Harrison, 2004), more focus on improving the identification and management of acutely deteriorating ward patients is needed. By collaborating with key stakeholders at Eastern Health, and conducting an integrative literature review, an educational pilot workshop was developed, delivered, and evaluated on an acute medical ward at the Health Sciences Centre.

Objectives

The overall goal of the practicum project was to improve the identification and management of acute clinical decline on a medical ward through use of the National Early Warning Score 2 (NEWS2) tool. This was achieved through the development and evaluation of an evidence-informed pilot workshop targeted for ward nurses employed on a medical unit at the Health Sciences Centre in St. John's, NL.

The key practicum objectives are:

1. To examine current evidence of best practices for educating ward nurses on clinical deterioration to develop new skills, and identify barriers and facilitators of Early Warning Scores on inpatient units using an integrative literature review methodology.

2. To develop an evidence-based pilot workshop to improve identification and management of acute clinical decline on a medical ward to improve patient outcomes.

3. To demonstrate collaboration as an advanced nursing practice competency by seeking out and working closely with key stakeholders to ensure the pilot workshop is developed to align with Eastern Health's values and standards.

4. To deliver and evaluate the pilot workshop to ward nurses of an acute medical unit.

Overview of Methods

Two methods of data collection helped ensure the achievement of the objectives of this practicum project. These included an integrative literature review and informal collaborations with key stakeholders of Eastern Health.

The integrative review was an essential first step in the development of the pilot workshop. Using certified databases, the literature was searched to determine the best practices for educating ward nurses on clinical deterioration, as well as identifying barriers and facilitators of EWS systems. The critical appraisal tool of the Public Health Agency of Canada (2014) evaluated the quality and strength of the 13 selected quantitative studies and systematic reviews. Three qualitative studies were critically appraised using the Joanne Briggs Institute (JBI) (2017) checklist.

Ongoing, informal collaborations with key stakeholders of Eastern Health took place before, during, and after workshop development. Collaborations took place via phone calls, e-mail, and Microsoft Teams meetings.

Through these methods, a pilot workshop was developed and delivered to ward nurses of an acute care medicine unit at the Health Science Centre in St. John's, NL. Following delivery of the workshop, suggested changes were made based on participants' evaluation of the workshop.

Summary of the Literature Review

In order to develop an evidence-based workshop to address the role of EWS tools on clinical deterioration on an acute medical ward, an integrative literature review was completed. A systematic search of relevant databases was conducted based on inclusion criteria. English written, peer-reviewed, quantitative and qualitative studies, and systematic reviews were included in the search. Forty-five abstracts were reviewed for relevance by categorizing the studies methodology and target population. In total sixteen studies published between 2004 and 2021 were selected for the review (see Appendix A for full version of the integrative literature review).

The literature search addressed two key questions of interest:

1. What are the barriers and facilitators that practicing ward nurses experience when using an early warning score tool on medical/surgical units?
2. What are the best practices for educating direct care ward nurses to develop new skills to enhance their role in the identification and management of clinical deterioration, and what is the effectiveness of these interventions?

The findings, or themes, from the integrative review were synthesized and presented in two sections pertaining to the review questions.

Review Question One

Three themes developed from the study findings related to the first review question. These included: a) communication, b) confidence and clinical skills, and c) prioritization of care. The study findings indicated both barriers and facilitators to the use of an EWS system. All three themes highlighted mixed views regarding the implementation of EWS systems reported by

nurses. Some studies indicated that nurses who use such tools have improved confidence, communication, and prioritization of care (Jensen et al., 2018; Shaddel et al., 2014; Stafseth et al., 2016). Other studies have found that nurses experienced the tool as a deterrent in patient care (Shaddel et al., 2014). One common barrier indicated throughout the literature was lack of physician awareness towards the EWS tool (Cherry & Jones, 2015). In spite of the identified barriers, a significant number of participants across the studies reported an overall clinical benefit concerning the implementation of various EWS systems.

Review Question Two

The second review question focused on educational methods for teaching and learning strategies for acute clinical decline. Two main themes derived from the integrative review for this question included: a) the multimodal nature of effective educational initiatives, and b) the outcomes of these initiatives. The second theme included three subthemes: i) impact of perceived nursing performance, ii) patient outcomes, and iii) teamwork. Studies included in this review used a combination of teaching approaches to educate practicing nurses, these included: interactive and didactic lectures, case studies, simulation, and role-playing. The majority of studies found simulation-based cases were beneficial for learning (Harvey et al., 2014; Liaw et al., 2016). However, case studies and role-plays are also very effective and offer a more cost effective means to educate nurses (Harvey et al., 2014).

Overview

Although the quality of the studies for the above integrative review was generally low to moderate (PHAC, 2014), there is a growing body of evidence to indicate that implementation of EWS systems, and a multimodal educational approach regarding such tools is beneficial. As

discussed, EWS systems including the NEWS2, can improve nurses' clinical skills, communication, and prioritization of care (Jensen et al., 2018). Combining the implementation of the NEWS2 tool with a multimodal educational method is a best practice recommendation. Offering nurses an educational approach focusing on physiological parameters, importance of early recognition of clinical deterioration, and the nursing role, combined with teaching strategies including, interactive lectures, case studies, role-playing, and simulation have been proven effective.

Summary of Collaborations

As mentioned, collaboration took place with key stakeholders within Eastern Health before, during, and after workshop development. Collaborating with these professionals was a fundamental component to creating and delivering a workshop that was beneficial for ward nurses and feasible for implementation within the medicine program.

Preliminary consultations took place in the beginning phases of workshop development with the manager of the selected medicine unit (4SA) and the unit educator. Additionally, several meetings took place with the manager, patient care coordinator, and a senior nurse of the medical unit at the Burin Peninsula Health Care Centre where implementation of the NEWS2 tool has occurred. These individuals offered invaluable suggestions and advice for the pilot workshop.

Once the workshop was developed, consultations took place with the regional medicine program manager, patient care coordinator, and nurse educator of the medicine unit. These meetings were an integral component of the planning for delivery of the workshop. During these consultations, specific dates, times, and the platform of delivery were finalized for the workshop. Furthermore, as per Eastern Health policy, the professional practice department was also involved to approve the educational material that would be provided to the ward nurses.

Theoretical Framework

Malcolm Knowles' Theory of Adult Learning guided the development of the pilot workshop. This theory was originally developed in 1968, and states that adult learners are motivated by real-life problems and their own personal experiences (Knowles et al., 2005). Knowles' theory emphases both the art and science behind adult learning, and how the adult learner differs from the child learner (Knowles et al., 2005). The theory consists of five assumptions: self-concept, past experiences, orientation to learning, readiness to learn, and motivation to learn (Darbyshire, 1993). These five assumptions were considered throughout the workshop development to promote a positive learning experience. Combining an interactive online lecture with case studies allows participants of the workshop to reflect on their experiences to promote their overall learning goals. Moreover, by incorporating case studies into the workshop, participants are able to focus on a problem-center approach rather then content centered, which is a key concept to the Adult Learning Theory (Knowles et al., 2005). Lastly, according to Knowles', adults should be included in the planning and evaluation of their learning (Knowles et al., 2005). Therefore, during the evaluation component of the workshop, participants will have opportunity to suggest changes to future workshops. These suggestions will guide changes to the pilot workshop in preparation for future workshops.

Summary of Pilot Workshop

The pilot workshop aims to educate ward nurses about acute clinical decline. Its design will help health professionals identify and respond early through use of the NEWS2 tool. Developing this workshop involved the completion of the integrative literature review and collaboration with key stakeholders of Eastern Health. Through these two methods, the foundation of the evidence-based workshop was developed.

As discussed, the literature review identified a multimodal approach to education to optimize learning utilizing evidence based practices. After discussion with the nurse educator of the medicine unit, it was determined that a PowerPoint presentation using both an interactive lecture and case studies, would be most appropriate for the nursing audience (Buckley & Gordon, 2011). During development of the workshop, facilitator notes were also developed. This is important, as once the NEWS2 tool is implemented throughout the medical units in Eastern Health, the education must be standardized. Moreover, the development of the workshop accommodates for both in-person and online delivery. Due to COVID-19, Eastern Health has transitioned to mostly online educational presentations.

Pilot Workshop

The workshop consists of forty-four PowerPoint slides, including material for the lecture component of the workshop as well as the case studies. For a full version on the workshop, see Appendix B. Learning objectives for the workshop include:

1. Discuss and describe clinical deterioration on medical wards.
2. Describe Early Warning Scores.
3. Describe how the National Early Warning Score 2 (NEWS2) system operates on a medical ward.
4. Calculate the NEWS2 in case studies to predict escalation of medical care.

The first half of the workshop focuses on clinical deterioration and the nursing role. Participants gain a greater understanding of the most common signs and symptoms of acute clinical decline. Then, an introduction to EWS systems follows, with a focus on the NEWS2 tool. Participants learn about the tool, including how the scoring determines a patient's risk for clinical decline. During this section, the facilitator discusses the variables used for the NEWS2

tool, as well as what is expected of the nurse when a patient reaches a certain score. The next section of the workshop entails three work-related case studies. Clinical scenarios are presented and participants practice calculating the NEWS2 score. Once the score is calculated, discussion occurs on how to escalate care. The end of the workshop has time allotted for questions and discussion. In total, the workshop has an estimated length of one-hour.

Summary of Workshop Delivery

With the finalization of the content and structure of the workshop, consultation with the unit educator and patient care coordinator took place to determine when the nurses could participate in the workshop. The proposal of two dates allowed staff the ability to choose based on their schedule. The patient care coordinator sent out e-invites one week prior to the workshop. After discussing with both key stakeholders, it was determined that early afternoon would be most suitable for all participants. Workshop attendance was completely voluntarily, however, Eastern Health paid staff members who attended, one-hour of wages. In total twenty direct care nurses attended the workshop.

Summary of Workshop Evaluation

In order to evaluate the workshop, nurses had an opportunity to complete an anonymous survey at the end of the session. Surveys were available on the unit for staff members to complete and return. Nurses had two weeks to complete the evaluation surveys, with email reminders sent out one week after the workshop. Thirteen completed surveys were received at the two-week mark.

The survey consisted of nine Likert style statements, and six open-ended questions. Results from the survey provided an indication of participant's thoughts and opinions regarding

the workshop and NEWS2 tool. For the Likert portion of the survey, the mean total score was 43 (maximum score of 45), with eight of the thirteen surveys scoring above the total mean. The total median score was 44, and results ranged from 39 to 45. Regarding the open-ended portion of the survey, results are difficult to present in full given the variety of feedback. However, one major issue related to the NEWS2 scoring chart was raised. Participants expressed concern regarding the oxygen scale on the chart, as it does not address the amount of oxygen a patient is receiving. Another issue identified, was that during the case study section, the NEWS2 chart was not included with each case, making it difficult for participants to calculate the score. These suggested changes are now incorporated into the workshop for future sessions. Overall, the workshop received positive feedback by the nursing staff as outlined in the survey results. See Appendix B for full delivery and evaluation of the pilot workshop.

Overall, an educational workshop was developed from evidenced-based literature, and informal collaborations with key stakeholders within the organization of Eastern Health. The pilot workshop was then implemented and evaluated to staff nurses of an acute medicine inpatient ward at the Health Sciences Centre. This workshop combines education focused on early identification of acute clinical decline through the use of the NEWS2 tool, and work related case studies. The workshop will assist nurses' ability to monitor and respond to patient decline, ultimately improving patient outcomes.

Advanced Nursing Practice (ANP) Competencies

The Canadian Nursing Association (CNA) (2019), developed nursing competencies for advanced nursing practice that allow nurses to achieve and expand their skills and knowledge in diverse settings (CNA, 2019). This practicum project has allowed me to develop my professional

competencies. The four ANP competencies that are most applicable to my project include: i) education, ii) research, iii) leadership, and iv) consultation and collaboration.

Education

According to the CNA (2019) framework, an advanced practice nurse must be dedicated to the professional progression and education of health-care providers including students, clients and their families. The CNA (2019) states through the educational competency, nurses should disseminate new knowledge, plan and develop educational programs, recognize learning needs of nurses and other health care providers, and create and design opportunities to learn. The demonstration of this competency is the development of the pilot workshop, which aims to improve the identification and management of critically deteriorating ward patients.

Research

Research encompasses the ability to generate, synthesize, and appraise current literature (CNA, 2019). This competency is evident through the completion of the integrative review, which is a form of research and includes the analysis and synthesis of the review findings. These synthesized findings were foundational to the development of the evidence-based workshop. This workshop helped to disseminate knowledge and improve the skills of ward nurses to facilitate evidence informed practice (CNA, 2019).

Leadership

The CNA (2019) states that nurses with an advanced nursing practice are leaders within their organizations. Advanced nurses should strive for positive change and assess ways to promote and improve health care practices (CNA, 2019). This competency was evident through the creation of the workshop. The development of select clinical and teaching-learning strategies

assisted ward nurses in the identification and management of clinically deteriorating ward patients. The theoretical framework, Knowles' Adult Learning Theory also helped inform the development of the pilot workshop. It provided clear guidance on successful strategies for adult learning. To help facilitate the smooth implementation of the workshop several consultations took place with key stakeholders of Eastern Health, who approved this evidence-based workshop.

Consultations and Collaboration

Collaboration and communication with health care providers, clients, and key stakeholders is a crucial ANP competency (CNA, 2019). Collaboration was fundamental to developing, delivering, and evaluating the pilot workshop. Throughout the practicum there was continuous open communication with my supervisor, Dr. Joy Maddigan. Additionally, this was further portrayed through collaboration with key stakeholders across the organization of Eastern Health, including, unit educators, patient care coordinators, ward managers, and program managers. Collaboration with these key stakeholders gave an opportunity to work towards the goal of managing clinical deterioration on acute medical wards.

Next Steps

Once the workshop was developed, the next step was to deliver and evaluate the workshop. As above, these initial steps are completed, and results from the pilot evaluation have been submitted to members of Eastern Health for further planning. Although the initial pilot project is completed, a more detailed plan to implement the NEWS2 tool and provide additional educational workshops is required at the institution level. The medicine unit selected for the pilot workshop is currently undergoing development of a special care/step-down unit. Following

discussion with key managers and others, it is anticipated that this unit will be the first to implement the electronic NEWS2 tool.

Implementation of the NEWS2 Tool

In order to implement the NEWS2 tool on an acute care medicine unit, members of professional practice and quality improvement will be involved. Initial planning has begun based on the NEWS2 implementation at the health care center in Burin, NL. Members of professional practice and quality improvement plan on forming focus groups with members including: bedside nurses, unit educators, nurse managers, respiratory therapists, resident physicians, attending physicians, and members of the information technology (IT) department. Prior to implementation, it will be important that the NEWS2 chart is available on the electronic charting record (Meditech). In addition, by working with the IT department, the tool will be auto-calculated once the nurse enters patients' vital signs. Additionally, depending on the score obtained, a 'pop-up' alert will recommend interventions for the nurse. Through collaboration within the focus group, potential interventions will be established, and may include increased frequency of clinical monitoring, notification of appropriate medical team, and potential transfer to higher level of care.

Implementation of Educational Workshop

The initial pilot workshop has been implemented within the acute medicine unit at the Health Sciences Centre. However, once the NEWS2 tool is incorporated into the electronic medical record, additional workshops can begin. Depending on time lapse between the initial pilot workshop, ward nurses will likely require an additional workshop prior to a 'go-live' date. Therefore, ongoing conversation and collaboration with the unit manager and educator are

essential. As evaluation of the pilot workshop has already occurred, nurses will receive education on the updated workshop, which will undergo continuous assessment. New information about how the scoring system will work on the electronic medical record will be added to the workshop. It will be important to include the workshop in the site orientation for nurses entering the medicine program.

Expanding the Pilot Project

Although the goal of this practicum project was to improve identification and management of acutely deteriorating patients on an acute medical ward, this project has value for other, non-medicine units throughout Eastern Health. Moreover, although the target audience for this workshop is ward nurses, it is also important to engage physicians, respiratory therapists, and other healthcare professionals. Thus, developing physician engagement letters to expand their knowledge of the tool will be an important step. As well, inviting these healthcare professionals to future workshops will be important, as they are valuable members of the healthcare team.

Conclusion

Identifying and managing acute clinical deterioration on medical wards is important to prevent potential SAEs. Providing ward nurses with the appropriate knowledge to utilize EWS tools is an essential step to improving patient outcomes. After conducting an integrative literature review and collaborating with key stakeholders of Eastern Health, it was determined that a multimodal educational workshop would be an achievable best-practice intervention to improve the identification and management of acutely declining ward patients. This workshop combines an interactive lecture and case studies to educate nurses about clinical deterioration and early detection using the NEWS2 tool. Eastern Health through the Department of Professional Practice

has approved and supported this project. Once implemented, the NEWS2 tool will assist ward nurses who care for patients at risk for decline by reducing morbidity and mortality.

References

Al-Qahtani, S., & Al-Dorzi, H. M. (2010). Rapid response systems in acute hospital care. *Annals of Thoracic Medicine*, *5*(1), 1–4. https://doi-org.qe2a-proxy.mun.ca/10.4103/1817-1737.58952

Badr, M. N., Khalil, N. S., & Mukhtar, A. M. (2021). Effect of National Early Warning Scoring System Implementation on Cardiopulmonary Arrest, Unplanned ICU Admission, Emergency Surgery, and Acute Kidney Injury in an Emergency Hospital, Egypt. *Journal of multidisciplinary healthcare*, *14*, 1431–1442. https://doi-org.qe2a-proxy.mun.ca/10.2147/JMDH.S312395

Buckley, T., & Gordon, C. (2011). The effectiveness of high-fidelity simulation on medical-surgical registered nurses' ability to recognise and respond to clinical emergencies. *Nurse Education Today*, *31*(7), 716–721. https://doi-org.qe2a-proxy.mun.ca/10.1016/j.nedt.2010.04.004

Canadian Nurses Association (2019). *Advanced practice nursing: A Pan-Canadian Framework.* Ottawa, ON. https://hl-prod-ca-oc-download.s3-ca-central-1.amazonaws.com/CAN/2f975e7e-4a40-45ca-863c-5ebf0a138d5e/UploadedImages/documents/nursing/Advanced_Practice_Nursing_framework_e.pdf

Cherry, P.G., & Jones, C.P. (2015). Attitudes of nursing staff towards a modified early warning

system. *British Journal of Nursing, 24*(16), 812-818. https://doi-org.qe2a-proxy.mun.ca/10.12968/bjon.2015.24.16.812

Darbyshire P. (1993). In defence of pedagogy: a critique of the notion of andragogy. *Nurse

education today*, *13*(5), 328–335. https://doi-org.qe2a-proxy.mun.ca/10.1016/0260-6917(93)90072-a

Ferreira, D. (2018). Andragogy in the 21st century: Applying the assumptions of adult learning

online. *Academia,* 10-19.

Furlan, L., Gianni, F., & Costantino, G. (2022). Prediction tools in clinical practice: Carefully

read instructions before use. *European journal of internal medicine*, *98*, 37–38.
https://doi-org.qe2a-proxy.mun.ca/10.1016/j.ejim.2022.02.003

Harrison J. (2004). Addressing increasing patient acuity and nursing workload. *Nursing

management (Harrow, London, England : 1994)*, *11*(4), 20–25. https://doi-org.qe2a-proxy.mun.ca/10.7748/nm2004.07.11.4.20.c1984

Harvey, E. M., Echlos, S. R., Clark, R., & Lee, E. (2014). Comparison of two TeamSTEPPS

training methods on nurse failure-to-rescue performance. *Clinical Simulation in Nursing,
10*(2), e57-e64. https;//doi-org.qe2a-proxy.mun.ca/10.1016/j.ecns.2013.08.006

JBI Checklist for Qualitative Research (2020). Available at:

https://jbi.global/sites/default/files/2020-08/Checklist_for_Qualitative_Research.pdf

Jensen, J. K., Skår, R., & Tveit, B. (2018). The impact of early warning score and rapid

    response systems on nurses' competence: An integrative literature review and

    synthesis. *Journal of Clinical Nursing*, *27*(7-8), e1256–e1274. https://doi-org.qe2a-

    proxy.mun.ca/10.1111/jocn.14239

Knowles, M. S., Holton, E. F., & Swanson, R. A. (2005). The Adult Learner. The Definitive

    Classic in Adult Education and Human Resource Development. Boston: Taylor & Francis

    Ltd.

Liaw, S. Y., Scherpbier, A., Klainin-Yobas, P., & Rethans, J. J. (2011). A review of educational

    strategies to improve nurses' roles in recognizing and responding to deteriorating

    patients. *International Nursing Review*, *58*(3), 296–303. https://doi-org.qe2a-

    proxy.mun.ca/10.1111/j.1466-7657.2011.00915.x

Liaw, S. Y., Wong, L. F., Lim, E. Y., Ang, S. B., Mujumdar, S., Ho, J. T., Mordiffi, S. Z., &

    Ang, E. N. (2016). Effectiveness of a web-based simulation in improving nurses'

    workplace practice with deteriorating ward patients: A pre- and post-intervention

    Study. *Journal of Medical Internet Research*, *18*(2), e37. https://doi-org.qe2a-

    proxy.mun.ca/10.2196/jmir.5294

Marquet, K., Claes, N., De Troy, E., Kox, G., Droogmans, M., Schrooten, W., Weekers, F.,

    Vlayen, A., Vandersteen, M., & Vleugels, A. (2015). One fourth of unplanned transfers

    to a higher level of care are associated with a highly preventable adverse event: a patient

    record review in six Belgian hospitals. *Critical care medicine*, *43*(5), 1053–1061.

    https://doi-org.qe2a-proxy.mun.ca/10.1097/CCM.0000000000000932

Mok, W. Q., Wang, W., & Liaw, S. Y. (2015). Vital signs monitoring to detect patient

deterioration: An integrative literature review. *International Journal of Nursing*

Practice, *21 Suppl 2*, 91–98. https://doi-org.qe2a-proxy.mun.ca/10.1111/ijn.12329

Public Health Agency of Canada (2014). Infection prevention and control guidelines

critical appraisal toolkit. Available at:

http://publications.gc.ca/site/eng/470818/publication.html

Royal College of Physicians. (2017, December 19). *National Early Warning Score (NEWS) 2*.

Royal College of Physicians London; Royal College of Physicians.

https://www.rcplondon.ac.uk/projects/outputs/national-early-warning-score-news-2

Shaddel, F., Khosla, V., & Banerjee, S. (2014). Effects of introducing MEWS on nursing staff in

mental health inpatient settings. *Progress in Neurology & Psychiatry, 18*(2), 24-27.

https://doi-org.qe2a-proxy.mun.ca/10.1002/pnp.325

Skitch, S., Tam, B., Xu, M., McInnis, L., Vu, A., & Fox-Robichaud, A. (2018). Examining the

utility of the Hamilton early warning scores (HEWS) at triage: Retrospective pilot study

in a Canadian emergency department. *CJEM*, *20*(2), 266–274. https://doi-org.qe2a-

proxy.mun.ca/10.1017/cem.2017.21

Stafseth, S. K., Grønbeck, S., Lien, T., Randen, I., & Lerdal, A. (2016). The experiences of

nurses implementing the modified early warning score and a 24-hour on-call mobile

intensive care nurse: An exploratory study. *Intensive & Critical Care Nursing*, *34*, 25–33.

https://doi-org.qe2a-proxy.mun.ca/10.1016/j.iccn.2015.07.008

Vandervliet, T., Flemming, S., & Rathwell, M. (2021, January 11). *Nurses implement early*

warning system to detect patient deterioration. Community.cna-Aiic.ca. https://www.cna-

aiic.ca/dev-cn-en/blogs/cn-content/2021/01/11/nurses-implement-early-warning-system-

to-detect-pa

Appendix A

Improvement of the Detection and Management of Ward Patient Clinical Deterioration

An Integrative Literature Review

Abstract

Background: Acute medical deterioration on general hospital wards continues to increase creating a greater risk for potentially serious adverse events. Nurses work closely with patients and have multiple opportunities to recognize clinical change and thus prevent deterioration. Unfortunately, clinical cues of patient decompensation are often overlooked. Early warning score (EWS) systems have been implemented in the inpatient setting, and have been shown to be beneficial in the detection of clinical deterioration. However, without proper education regarding EWS systems, nurses cannot optimally use them. *Purpose:* To assess current evidence on the use of EWS tools and related education of clinical deterioration on general medical/surgical wards to ultimately be used to develop an educational program for the initiation of an EWS system on a medical ward in the Health Science Centre, of St. John's, NL. *Methods:* A systematic search was conducted using CINAHL, PubMed, Google Scholar, and Memorial University of Newfoundland OneSearch. Sixteen relevant articles were identified and research studies were critically appraised. The overall quality of the literature was weak to moderate, and strength and weaknesses were identified. *Findings:* The literature search was conducted in two parts. The first objective focused on the barriers and facilitators' that nurses' experience when using such tools. It is organized into three themes: communication, confidence and clinical skills, and prioritization of care. The second objective focused on educational initiatives and outcomes, and has two themes: multimodal educational programs and outcomes of the initiatives. *Conclusion:* Findings from the literature can be used to develop a combined educational workshop to improve the identification and management of clinical deterioration on an acute medical unit. Evidence suggests that using a multimodal approach to educate ward nurses provides a positive impact on nursing care and overall patient outcomes.

Key words: clinical deterioration, education, early warning score (EWS), nurse, and nurse education.

Improvement of the Detection and Management of Ward Patient Clinical Deterioration

Acute medical crisis on general medical wards have become increasingly more complex in recent years due to an aging population, and limited intensive care unit (ICU) level support (Liaw et al., 2011). Patients typically have various medical co-morbidities increasing their risk for deterioration (Wood et al., 2019). Early recognition of acute decline on a hospital ward is critical for patient outcomes. Serious adverse events seen on hospital wards include, developments of sepsis, unplanned ICU transfers, cardiac or respiratory arrest, and death (Al-Qahtani & Al-Dorzi, 2010). Usually, prior to these events, patients have a change in clinical parameters including tachycardia, tachypnea, hypotension, shortness of breath, or an altered level of consciousness (LOC) sometimes for an estimated 6-8 hours (Al-Qahtani & Al-Dorzi, 2010). Unfortunately if undetected, a serious adverse event (SAE) may occur. Many of these markers may be recognized through a standard vital sign assessment. Although nurses are accountable for completing and documenting assessments, studies have shown indications of acute decline are often missed (Liaw et al., 2011; Odell et al., 2009), and may go undetected until patients require emergent care (De Meester et al., 2013; Fuhrmann et al., 2008). This data suggests a potential weakness in nurses' ability to identify and synthesize signs of clinical deterioration, which can lead to a missed opportunity to initiate needed medical care (Mok et al., 2015).

Early warning score (EWS) systems have been developed to improve identification and management of clinical deterioration. These systems aid nurses by detecting potential deterioration at earlier stages and thus help trigger appropriate medical interventions (Nagarajah et al., 2022). By incorporating physiological parameters, a numerical value is calculated to estimate risk of patient deterioration (Skitch et al., 2018). Studies have assessed various EWS systems and have found they improve in-hospital patient outcomes (Saab et al., 2017). They have

been implemented in healthcare systems in the United Kingdom (UK), the United States (US), and Canada (Royal College of Physicians, 2017; Skitch et al., 2018; Vandervliet et al., 2021). At present time in Newfoundland and Labrador (NL), the tertiary care center in St. John's, under the Eastern Regional Health Authority, has not implemented a clinical early warning scoring system.

The purpose of this integrative literature review is to assess the current evidence related to EWS tools and related education of clinical deterioration on general medical/surgical wards. The review will identify and synthesize the barriers and facilitators that ward nurses' experience when using the tools. In addition, current teaching-learning strategies used to educate practicing nurses about acute clinical decline, and the effectiveness of these educational interventions, will be examined. This information will be used in the development of an evidence-based workshop to educate nurses working on the Nephrology and Respirology medical ward. The development of an educational workshop will aim to inform the nurses of this unit of the importance of early detection and management of clinical deterioration through the appropriate use and interpretation of the National Early Warning Score 2 (NEWS2). Once completed, the final goal of this workshop will be to implement a quality improvement project on 4 South A to prevent a SAE through improvement in early recognition and management of patient deterioration using NEWS2.

Background

Though there have been numerous advancements in health care, serious adverse events including, development of sepsis, cardiac or respiratory arrest, unplanned ICU admissions, and death continue to occur in hospitals (Van Galen et al., 2016). Although patients' underlying medical conditions may affect potential for acute decline, human related errors also play a role in an acutely declining patient (Zegers et al., 2006; Van Galen et al., 2016). As nurses represent

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health care professionals with the most direct patient care, an opportunity exists for them to recognize subtle physiological changes, which may represent a changing condition (Orique et al., 2019). Unfortunately, studies show that acute physiological changes often go undetected on general medicine wards, resulting in poor patient outcomes. An investigative study by Van Galen et al. (2016) found that 46% of unplanned ICU transfers were healthcare worker associated. These unplanned transfers were secondary to inaccurate monitoring of vital signs and lack of intervention when documentation of clinical deterioration was evident (Van Galen et al., 2016). Fuhrmann et al. (2008) found that on various wards in a University Hospital in Copenhagen, nursing staff were unaware of declining parameters in 43% of patients. Comparably, a systematic review by Burke et al. (2022) showed 11% of patients in the UK in 2007 died due to lack of recognition of acute decline. Likewise, the same study found that in the US, failure to rescue was deemed a major patient safety indicator (Burke et al., 2022). Specifically, amongst 7.5 million surgical patients, lack of attention to clinical deterioration was noted as a key improvement area for patient safety (Burke et al., 2022).

National Early Warning Score 2

As a means to support ward nurses in the early identification of acute patient decline, early warning score (EWS) tools have been developed. These scoring systems are designed to identify deterioration with the goal of preventing a SAE. The National Early Warning Score 2 (NEWS2) is a standardized EWS that has been implemented across hospitals in the UK and most of Europe (Royal College of Physicians, 2017). Originally developed in 2012 by the Royal College of Physicians, the tool was updated in 2017, to include new onset confusion, and patients with hypercapnic respiratory disorders, such as COPD (Royal College of Physicians, 2017). The NEWS2 tool is the most commonly used EWS worldwide, and has been utilized in

medical/surgical units and in the emergency department (Baker et al., 2021; Laluaza et al., 2022; Silcock et al., 2019). Wibisono et al. (2022) studied the predictability of the NEWS2 tool in relation to mortality in COVID-19 patients. Researchers found that the NEWS2 tool had 80.4% sensitivity and 89.3% specificity in the prediction of death in COVID-19 patients (Wibisono et al., 2022).

The NEWS2 assigns a numeric value to patients regarding risk of decline based on six physiological parameters including: temperature, systolic blood pressure, oxygen saturation, respiration rate, heart rate, and new onset confusion/LOC (Royal College of Physicians, 2017). The updated version of the NEWS2 includes two oxygen saturation scales; one for patients with hypercapnic respiratory disorders (88-92%) and one for patients without these disorders (Echevarria et al., 2019). Each physiological value can receive a score between 0-3; all individual scores are then added together to calculate an overall score (Nazarko, 2020). The score ranges from 0 to 20; the higher the score, the higher the risk of clinical deterioration (Nazarko, 2020). Based on the total score, various medical interventions are suggested to optimize patient care with the goal of preventing a SAE (Smith et al., 2008). A score of 5 or more should prompt the ward nurse to notify the patient's responsible medical team for assessment, and continue to complete assessments to 'track' the score (Echevarria et al., 2019). A score of 7 or higher should trigger the ward nurse to have immediate medical review of the patient as this score signifies a potential emergent situation (Echevarria et al., 2019; Nazarko, 2020) (See Appendix I for NEWS2 tables).

The NEWS2 has been shown to aid in prioritisation of care and provide help to nurses when communicating medical concerns to physicians (Spangfors et al., 2020). Although the NEWS2 is a valuable clinical tool in recognizing early stages of clinical deterioration (Baker et

al., 2021; Laluaza et al., 2022; Silcock et al., 2019), it should not replace critical thinking skills of the nurse, but rather act as a clinical adjunct. The efficiency of the tool is dependent on multiple nursing factors including, identifying, understanding, and acting on clinical changes. These factors are learned through education and experience (Butler, 2020), and thus proper education of ward nurses regarding an EWS system is important when implementing these and determining the effectiveness.

Review Questions

Two questions are addressed in this review:

1. What are the barriers and facilitators that practicing ward nurses experience when using an early warning score tool on medical/surgical units?
2. What are the best practices for educating direct care ward nurses to develop new skills to enhance their role in the identification and management of clinical deterioration? What is the effectiveness of these interventions?

Methods

Search Strategy

A systematic search was conducted using CINAHL, PubMed, Google Scholar, and Memorial University of Newfoundland OneSearch. A consultation took place with the Health Science librarian through Memorial University to formulate key questions and search terms. Search terms included "nurse", "clinical deterioration", "experience", "medical ward", "surgical ward", "early warning score", "national early warning score", "education", "teaching strategies", and "nurse education". Inclusion criteria included studies written in English, peer-reviewed, publication dates within the last two decades, qualitative and quantitative designs, and systematic

reviews. Studies were excluded if they were not written in English, and if the sample population was not practicing nurses, as some studies focused on nursing trainees. Additionally, all EWS tools and both medical and surgical units were included as there were limited results when searches consisted of only NEWS2 and medical wards. Therefore it is important to note that throughout the current review both medical and surgical wards are referred to when the term general ward is referenced.

Forty-five abstracts were reviewed for relevance by identifying the phenomena of interest, methodology, and target population. To evaluate the quality and strength of the thirteen quantitative studies and one literature review that were chosen for the review, the Public Health Agency of Canada (PHAC) (2014) critical appraisal tool kit was used to (Appendix II). The Joanna Briggs Institute (JBI) (2017) critical appraisal checklist was used to appraise three qualitative studies (Appendix II). The sixteen studies selected in this review were published between 2004 and 2021. The literature search was conducted in two parts, reflecting the two separate key questions of interest.

Data Evaluation

The two search strategies yielded 16 studies for inclusion in the review. A range of study designs included: three qualitative designs (Jensen et al., 2019; Petersen et al., 2017; Stafseth et al., 2016), one literature review (Jensen et al., 2018), one mixed-method design (Cherry & Jones, 2015), three descriptive cross-sectional studies (Buckley & Gordon, 2011; Fox & Elliott, 2015; Spangfors et al., 2020), five uncontrolled before and after designs (Cooper et al., 2013; Featherstone et al., 2005; Fuhrmann et al., 2009; Liaw et al., 2016; Shaddel et al., 2014), one controlled before and after trial (Mitchell et al., 2010), one quasi-experimental two-group

comparison before an after trail (Harvey et al., 2014), and one interrupted times series design
(Kinsman et al., 2021).

Assessment of Study Quality: Review Question One

The PHAC (2014) critical appraisal tool and JBI (2017) qualitative research checklist
were used to appraise the literature for review question one. Overall, the quality of the eight
studies that contributed findings to the first question was moderate. Among the four quantitative
research studies, the literature review by Jensen et al. (2018) was a strong design with medium
quality. The two descriptive cross sectional studies (Fox & Elliott, 2015; Spangfors et al., 2020),
and one uncontrolled before and after trial by Shaddel et al. (2014) were of weak design, with
quality ranging from medium (Fox & Elliott, 2015; Shaddel et al., 2014) to high (Spangfors et al,
2020). There was also one mixed-methods design (Cherry & Jones, 2015). From a quantitative
perspective the cross-sectional design was weak with low quality (PHAC, 2014). The JBI (2017)
quality assessment tool was used for the qualitative designs. Cherry & Jones (2015) qualitative
component had moderate credibility and was trustworthy. Finally, two of the qualitative designs
were of high credibility and trustworthiness (Stafseth et al., 2016; Petersen et al., 2017), and one
was of moderate trustworthiness due to issues with credibility and dependability of the research
(Jensen et al., 2019). However, some strategies were taken to enhance the quality, giving the
study reasonable authenticity and confirmability.

Strengths and Weaknesses. Several strengths and weaknesses were identified in the four
quantitative research studies. Selection bias was of concern as participants completed the
questionnaires on a voluntarily basis. Three of the studies (Cherry & Jones, 2015; Fox & Elliott,
2015; Shaddel et al., 2014) recruited participants from a single site, which could lead to
misclassification bias and generalizability concerns (PHAC, 2014). Two of the studies used a

validated survey tool, which is commonly used to assess experiences of utilization of the NEWS tool (Fox & Elliott, 2015; Spangfors et al., 2020). All studies made note of ethical considerations and ensured confidentiality of medical information.

Assessment of Quality: Review Question Two

The PHAC (2014) critical appraisal tool was used to appraise the literature for quality and strength of the studies for the second review question. Overall, the quality of each of the eight studies ranged from weak (Featherstone et al., 2005; Furhmann et al., 2009; Mithell et al., 2010) to moderate (Buckley & Gordon, 2011; Cooper et al., 2013; Harvey et al., 2014; Liaw et al., 2016; Kinsman et al., 2021). Regarding design, the cross sectional study by Buckley and Gordon (2011), and four uncontrolled before and after trials (Cooper et al., 2013; Featherstone et al., 2005; Furhmann et al., 2009; Liaw et al., 2016) were of weak design. The interrupted time series design by Kinsman et al. (2021) was of moderate design, while the controlled before and after trial (Mitchell et al., 2020), and two-group comparison trial (Harvey et al., 2014) were moderately strong designs.

Strengths and Weaknesses. With regards to the eight quantitative studies selected for question two, there were strengths and weaknesses identified. Selection bias was a concern in many of the studies as participation rates were not ideal in many studies. Due to the nature of the study designs, control of confounding variables was an issue, as the studies did not always have a control group. However, some studies did use appropriate statistical testing to control for confounding factors. It is also important to consider the limitations of interpreting results due to small sample sizes evident in many of these studies. Furthermore, most of the studies did not assess the long-term effectiveness of the interventions, and therefore sustainability could not measured.

Many studies incorporated valid and reliable data collection tools, as well, five of the studies used interventions developed from established programs. Most of the interventions received generally positive feedback from participants.

Data Analysis

Data analysis was conducted to examine and synthesize the relevant findings from the studies selected for the review. Two separate analyses were conducted, one for each review question. The first question is addressed through the analysis of the barriers and facilitators nurses experience related to EWS tools. Findings were extracted, considered, and grouped thematically to summarize the data. Three themes were developed based on the study findings: communication, confidence and clinical skills, and prioritization of care. This first question resulted in eight studies. Findings relevant to this question were both of quantitative and qualitative designs, however, the quantitative designs had a descriptive methodology only.

For the second review question, educational strategies designed to improve recognition and responses to clinical deterioration were examined. Studies were analyzed by type of intervention as all studies used a combined educational approach with the vast majority including simulation strategies. The studies were then reviewed to determine similarities and differences in interventions. Outcomes were grouped and synthesized by intervention type. The second review question resulted in a total of eight studies. Findings used to answer this review question resulted in quantitative designs with the majority being analytic.

<div align="center">

Results

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The findings from the integrative review are presented in two sections pertaining to each review question including: i) the barriers and facilitators of EWS system use, and ii) best

teaching-learning methods for direct care nurses. Each section is presented in themes developed

from the data analysis. A total of sixteen studies were included in the review. As discussed, the

studies included a mix of both quantitative and qualitative designs, including: one mixed-method

design (Cherry & Jones, 2015), one literature review (Jensen et al., 2018), five uncontrolled

before and after trial designs (Cooper et al., 2013; Featherstone et al., 2005; Fuhrmann et al.,

2009; Liaw et al., 2016; Shaddel et al., 2014), three cross-sectional studies (Buckley & Gordon,

2011; Fox & Elliott, 2015; Spangfors et al., 2020), one controlled before and after trial (Mitchell

et al., 2010), one quasi-experimental comparison trial (Harvey et al., 2014), one interrupted times

series (Kinsman et al., 2021), and three qualitative designs (Jensen et al., 2019; Petersen et al.,

2017; Stafseth et al., 2016). The majority of studies were conducted in Europe (Cherry & Jones,

2015; Featherstone et al., 2005; Fox & Elliott, 2015; Fuhrmann et al., 2009; Jensen et al., 2019;

Jensen et al., 2018; Petersen et al., 2017; Shaddel et al., 2014; Spangfors et al., 2020; Stafseth et

al., 2016), while others were conducted in Australia (Buckley & Gordon, 2011; Cooper et al.,

2013; Kinsman et al., 2021; Mitchell et al., 2010), Singapore (Liaw et al., 2016), and the US

(Harvey et al., 2014). All studies were conducted on either medical or surgical units, with the

exception of one study, which was conducted on a psychiatric unit (Shaddel et al., 2014).

Review Question One: Barriers and Facilitators of EWS system Use

Three themes were developed from the review findings, including: a) communication, b)

confidence and clinical skills, and c) prioritization of care. From these themes, both barriers and

facilitators to the use of an EWS system were identified within the literature.

Communication

The first major theme was communication. This theme highlighted the mixed views reported by nurses regarding nurses' communication to other members of the health care team when the Early Warning Score (EWS) system was activated. Some studies indicated that nurses who used the tool had more confidence when communicating patients medical concerns (Stafseth et al., 2016), while other nurses found the EWS system was a deterrent when relaying concerns to the physician (Spangfors et al., 2020). Nurses felt that physicians did not have a proper understanding of the system and did not respond in a timely manor (Spangfors et al., 2020). The two subthemes for the communication theme include: i) facilitators and ii) barriers.

Facilitators. Proper communication when addressing patients' medical concerns is imperative to efficient and timely medical interventions. Positive communication was evident across three of the studies (Jensen et al., 2018; Jensen et al., 2019; Stafseth et al., 2016). In an integrative review, Jensen et al. (2018) used 36 studies to assess the impact of an EWS system on nurses' competence and experience with such systems. In addition to the integrative review, two qualitative studies used either an exploratory approach (Stafseth et al., 2016) or a hermeneutic design (Jensen et al., 2019) to explore nurse experiences. Participants were recruited from both surgical and medical wards. Both Stafseth et al. (2016) and Jensen et al. (2019) conducted semi-structured interviews to assess experiences of seven (Stafseth et al., 2016), and fourteen ward nurses (Jensen et al., 2019). Although Stafseth et al. (2016) guided the interviews in focus groups, and Jensen et al. (2019) completed individual interviews, both studies found that nurses communicated more effectively with use of an EWS system. Two of the studies used the six-step thematic analysis guided by Braun and Clarke (2006) to analyze data (Jensen et al., 2019; Stafseth et al., 2016), while the third study by Jensen et al. (2018) used Whittemore and Knafl (2005) recommendations for analysis.

In the 2018 review by Jensen et al, implementation of an EWS system was found to positively improve ward nurse's communication style and skills (Jensen et al., 2018). Nurses reported that through use of the EWS they were able to communicate their concerns to physicians more effectively (Jensen et al., 2018). In the study by Stafseth et al. (2016), nurses discussed that before implementation of the EWS, they experienced difficulty communicating clinical scenarios to physicians. They stated that they focused a lot on their feelings and intuitions, at the expense of discussing the patient's clinical picture. With use of the EWS, nurses found they were able to express their clinical findings and assessments more confidently to the medical team, as they concentrated more on the patients' physiological parameters (Jensen et al., 2018; Stafseth et al., 2016). Jensen et al. (2018) reported that when communicating with physicians, nurses focused more on the abnormal physiological parameters and not the overall score. Nurses found that with their 'new' detailed language, they felt more credible when reporting to other members of the medical team and generally they were able to assess patients' faster (Jensen et al., 2018; Stafseth et al., 2016).

Barriers. Although improved communication was a significant benefit of EWS tools, five of the studies reported concerns with the efficiency of response from patients' medical team (Cherry & Jones, 2015; Fox & Elliott, 2015; Jensen et al., 2018; Petersen et al., 2017; Spangfors et al., 2020).

Three of the studies used questionnaires to assess nurse experiences (Cherry & Jones, 2015; Fox & Elliott, 2015; Spangfors et al., 2020). Two of the studies (Fox & Elliott, 2015; Spangfors et al., 2019) used the same validated questionnaire from Green & Allison (2006) to collect data. The mixed-method study by Cherry and Jones (2015) used a questionnaire designed by researchers to assess nurse experiences with EWS, followed by focus group interviews with

nine nurses. Similarly, Petersen et al. (2017) also conducted focus groups to interview 18 Danish ward nurses regarding EWS experiences. To analyze data, Petersen et al. (2017) used Krippendroff's content analysis, while Cherry and Jones (2015) used framework analysis for the qualitative portion of the mixed methods design.

Spangfors et al. (2020) found an overwhelming 50% of nurses reported not using the EWS due to lack of response from responsible physicians. Likewise, Cherry and Jones (2015) reported that nurses felt relaying patients EWS scores to the medical team was irrelevant to patient care due to lack of intervention and response from the physician. Often it was felt physicians would disregard the score, as they did not understand the clinical importance of a higher score (Cherry & Jones, 2015; Jensen et al., 2019). Petersen et al. (2017) found that nurses were hesitant to contact junior physicians with a high EWS, feeling that their medical interventions may not be appropriate for the patient. Interestingly, Spangfors et al. (2020) found that nurses with less experience using the EWS reported better communication with the physician, which was not the case for more senior nurses ($p < 0.001$). Lack of response resulted in feelings of frustration due to delays in care (Petersen et al., 2017). Also some nurses did not want to inconvenience the physician with the patient's score (Petersen et al., 2017). Finally, Fox and Elliott (2015) reported that 85% of nurses felt that when provided with an EWS, physicians did not assess patients within the suggested timeline. This was thought to be due to lack of awareness of the score and significant workload (Fox & Elliott, 2015).

Confidence and Clinical Skills

The second major theme derived from the integrative review was confidence and clinical skills. This was evident within five of the reviewed manuscripts. Again, there were mixed findings in the literature around the use of EWS systems and the influence on nurses' confidence

and clinical skills. The two subthemes for the second theme include: i) facilitators and ii) barriers.

Facilitators. Five of the studies reported beneficial evidence for the use of an EWS in adding value and certainty to nurse confidence and clinical skills (Jensen et al., 2018; Jensen et al., 2019; Shaddel et al., 2014; Spangfors et al., 2020; Stafseth et al., 2016). Shaddel et al. (2014) conduced an uncontrolled before and after (UBCA) trial involving 19 mental health nurses. An EWS was introduced to the unit, and nurses completed a questionnaire before and after implementation. Mean confidence in clinical judgement significantly improved from 3.73 to 4.63 with the use of an EWS (p=0.0001). Higher awareness and attention to vital signs was apparent, with more focus on the respiratory rate (Jensen et al., 2019). Nurses communicated that they had a greater understanding of observing and assessing patients to ensure patient safety (Jensen et al., 2019). Moreover, nurse's reported their clinical instincts were supported by the EWS, adding confidence to their overall clinical judgement (Jensen et al., 2019; Spangfors et al., 2020; Stafseth et al., 2016). Spangfors et al. (2020) found that 77% of nurses felt that the NEWS matched their 'gut intuition' when caring for a deteriorating patient. This was found to improve nursing communication with the physician, ultimately resulting in appropriate medical interventions (Jensen et al., 2018). While the tool is useful to support clinical intuition, nurses also stated that the tool provided an appropriate guide in assessing and caring for patients (Jensen et al., 2018; Stafseth et al., 2016). The score was also found to be beneficial to new nurses who were developing their clinical assessment skills (Petersen et al., 2017).

Barriers. Though positive findings are evident throughout the literature regarding the use of EWS tools, three of the studies identified various barriers when using the system on the hospital ward (Jensen et al., 2018; Jensen et al., 2019; Spangfors et al., 2020). Interestingly,

nurses in two studies (Jensen et al., 2018; Jensen et al., 2019) felt that an EWS weakened their professional competence, taking away from their physical assessment as a nurse. Spangfors et al. (2020) reported that new nurses were more enthusiastic about using an EWS compared to senior nurses (p<0.001). Some senior nurses felt that the EWS added to their workload with no valuable use, describing the system as 'undesirable' (p=0.002) (Spangfors et al., 2020). Moreover, Jensen et al. (2018) found that senior nurses felt that such scoring systems would hinder novice nurses' critical thinking skills resulting in this population relying to heavily on the tool.

Prioritization of Care

The final theme related to question one was prioritization of care. Patient to nurse ratios are high on general inpatient wards, and thus, understanding the importance of prioritizing care is of utmost importance. Seven of the studies found differing conclusions regarding nursing views around the use of EWS in prioritization of care. The studies included two descriptive cross-sectional designs (Fox & Elliott, 2015; Spangfors et al., 2020), three qualitative designs (Jensen et al., 2019; Petersen et al., 2017; Stafseth et al., 2016), one uncontrolled before and after trial (Shaddel et al., 2014), and one literature review (Jensen et al., 2018). The two sub-themes for the third outlined theme include: i) facilitators and ii) barriers.

Facilitators. Prioritization of optimal nursing care is crucial for positive patient outcomes. As nurse-to-patient ratios on general wards are higher than in critical care units, nurses must triage to properly prioritize issues to optimize patient care. Six of the studies identified prioritization of care as a favourable component of the EWS (Fox & Elliott, 2015; Jensen et al., 2019; Petersen et al., 2017; Shaddel et al., 2014; Spangfors et al., 2020; Stafseth et al., 2016). Shaddel et al. (2014) found that nurses' decision-making skills improved significantly (p<0.00001), while Spangfors et al. (2020) reported that 71% of nurses stated better ability to

prioritize care. Petersen et al. (2017) found that ward nurses used the EWS to prioritize patient workload and break coverage to ensure patient safety. Several studies identified the EWS as a beneficial means to know when to alert the physician of clinical changes (Fox & Elliott, 2015; Jensen et al., 2019; Shaddel et al., 2014; Spangfors et al., 2020). More specifically, 70% of nurses felt that the score supported their judgement to notify the physician for further medical intervention (Fox & Elliott, 2015). Additionally, based on the score, nurses were encouraged to increase the frequency of their clinical assessments by identifying which patients required more frequent monitoring (Fox & Elliott, 2015; Jensen et al., 2019). Stafeth et al. (2016) found that nurses used the system to identify subtle changes in patients' conditions that they otherwise may not have recognized.

Barriers. Although EWS systems have been found to be useful in prioritization of care, in the review by Jensen et al. (2018) nurses found it difficult to make clinical decisions when the EWS was low but their clinical gestalt suggested a worrisome clinical scenario. It was thus reported that it was difficult to escalate care when the score did not support their clinical instinct (Jensen et al., 2018). Additionally, nurses also reported that EWS systems parameters were not appropriate for all patient situations, for example patients who vital signs regularly differ from the normal due to an illness (Jensen et al., 2019). Thus, though the EWS system can be beneficial for nursing care, it does not replace critical thinking in clinical scenarios (Jensen et al., 2018).

For these studies, the nursing experience with using an EWS on the general ward has shown varying opinions of its role. It is thus imperative that nurses are educated on such tools prior to implementation and that other members of the medical team support its role.

Review Question Two: Teaching-Learning Methods

The second review question focused on educational methods for teaching and learning strategies for clinical deterioration. Two main themes were derived from the literature review for this question: a) the multimodal nature of effective educational initiatives and b) the outcomes of these initiatives. There were no subthemes identified for the first theme, however, three relevant subthemes of the second theme included: i) impact of perceived nursing performance, ii) patient outcomes, and iii) teamwork. The eight selected studies all used a combination of various teaching strategies to educate practicing nurses. These strategies included: interactive and didactic educational lectures, case studies, role-playing/case-base scenario, and simulation.

Educational Programs

Eight studies implemented an intervention using a combination of teaching strategies. These studies combined interactive and didactic lectures, case discussions, debriefing, role-playing, and clinical simulation techniques (Buckley & Gordon, 2011; Cooper et al., 2013; Featherstone et al., 2005; Fuhrmann et al., 2009; Harvey et al., 2014; Kinsman et al., 2021; Liaw et al., 2016; Mitchell et al., 2010). All studies with the exception of the study by Kinsman et al. (2021) included participants from both medical and surgical wards. Kinsman et al. (2021) included only acute medicine units from a rural hospital in Australia. The majority of studies were conducted in Australia (Buckley & Gordon, 2011; Cooper et al., 2013; Kinsman et al., 2021; Mitchell et al., 2010), while others were conducted in the UK (Featherstone et al., 2005), Denmark (Fuhrmann et al., 2009), Singapore (Liaw et al., 2016), and the US (Harvey et al., 2014). The studies included nurses with varying levels of experience. Additionally, three studies included other allied health healthcare workers (Featherstone et al., 2005; Mitchell et al., 2010), physicians (Featherstone et al., 2005), and enrolled/graduate nurses (Liaw et al., 2016). The majority of the studies delivered one-day educational programs ranging from two to eight hour

sessions (Cooper et al., 2013; Featherstone et al., 2005; Fuhrmann et al., 2009; Harvey et al., 2014; Kinsman et al., 2021; Liaw et al., 2016; Mitchell et al., 2010). In comparison, Buckley and Gordon (2011) provided a program consisting of fourteen hours of educational lectures, followed by two workshops consisting each of three hours of clinical scenarios.

All education interventions for nurses incorporated didactic lectures either in person (Buckley & Gordon, 2011; Cooper et al., 2013; Featherstone et al., 2005; Fuhrmann et al., 2009; Harvey et al., 2014; Kinsman et al., 2021) or online (Kinsman et al., 2021; Liaw et al., 2016; Mitchell et al., 2010). Education focused on physiological parameters with an emphasis on the importance of recognizing early changes, proper clinical assessment, pathophysiology of common clinical presentations, communication, and management of clinical deterioration. Educational lectures were followed by smaller group sessions to promote practice of skills and discussion. All studies excluding one (Featherstone et al., 2005) use simulation followed by debriefing in their education programs. Featherstone et al. (2005) incorporated interactive clinical scenarios and role-play to encourage teamwork in acute situations. Additionally, Fuhrmann et al. (2009) based their educational technique on FAIR (feedback, activities, individualisation, and relevance) criteria. Researchers used ward-specific case discussions and skills training during the education session. Moreover, videos were used to show specific learning objectives and specific skills stations included airway management and interpretation of arterial blood gases. Harvey et al. (2014) compared simulation-based training to case study reviews. Participants in the case study group reviewed cases similar to the simulation group, however, the review was in a question and answer format (Harvey et al., 2014). Kinsman et al. (2021) compared web-based and in-person simulation education programs. Participants in both groups received the same content but different delivery modes (Kinsman et al., 2021).

Five of the studies were based on formalized programs, which included the FIRST2ACT program (available in both an online and face-to-face version) (Kinsman et al., 2021), e-RAPIDS web simulation (Liaw et al., 2016), COMPASS program, ALERT (a multi-professional training program) (Featherstone et al., 2005), and TeamSTEPS (used to improve knowledge and performance of health care professionals) (Harvey et al., 2014).

Outcomes of Educational Programs

Three main outcomes were measured from the eight multidimensional educational interventions to determine the effectiveness of the intervention: impact of perceived nursing performance, patient outcomes, and teamwork.

Impact of Perceived Performance. Five studies measured the impact of educational programs on nurses' perceived performance (Buckley & Gordon, 2011; Cooper et al., 2013; Featherstone et al., 2005; Harvey et al., 2014; Liaw et al., 2016). Perceived performance was measured using a variety of questionnaires. Participants in the study by Featherstone et al. (2005) reported significantly more knowledge in their ability to recognize a critically ill patient ($p<0.01$) after attending the ALERT program. Participants also had a significant increase in confidence ($p<0.01$) pertaining to recognizing clinical deterioration, and performing life-saving measures (Featherstone et al., 2005). Nursing confidence also increased significantly ($p<0.001$) after education in the study by Liaw et al. (2016). Buckley and Gordon (2011) reported that 80% of participants were able to better manage breathing difficulties in patients after attending education sessions. After receiving the web-based educational intervention, participants in the study by Liaw et al. (2016) demonstrated significantly better scores in knowledge of clinical deterioration ($p<0.01$). This resulted in positive attitudes regarding transferring of skills to clinical practice. Comparatively, Cooper et al. (2013) found that knowledge was significantly higher in younger

participants (p=0.001) and those with less experience (p=0.005) compared to senior nurses. High knowledge scores were significantly associated with nurses' situation awareness (p=0.021). Knowledge improved in both case study (34.7 +/-3.8) and simulation-based (36.4 +/-2.1) groups in the study by Harvey et al. (2014), with no significant difference among groups. However, confidence did not improve for the case-study group (p=0.080), but did significantly improve for the simulation-based group post intervention (p<0.05).

Patient Outcomes. Four studies assessed patient outcomes as a factor of multimodal educational interventions (Fuhrmann et al., 2009; Kinsman et al., 2021; Liaw et al., 2016; Mitchell et al., 2010). Kinsman et al. (2021) found that following the educational intervention there was a significant increase in initiation of clinical reviews for patients who met criteria (e.g.: breach of a single physiological parameter outside of normal limits) (13% to 28.8%, p<0.01). Similarly, Liaw et al. (2016) reported a significant increase in clinical cases requiring review on the medical wards (p<0.001), however, there was no significant increase on surgical units. Documentation of clinical interventions in the interrupted time series design by Kinsman et al. (2021) also increased from 14.3% to 34.75% (p<0.001). Additionally, documentation of pain assessments (p<0.0001) and patients LOC (p<0.0001) increased significantly post-educational interventions (Kinsman et al., 2021). There was no difference between web-based and face-to-face groups in the study by Kinsman et al. (2021) regarding outcome measures. Mitchell et al. (2010) found that there was a significant decrease in unplanned ICU transfers (p=0.005) after nurses completed the COMPASS program. Interestingly, length of hospital stay increased in two of the studies. Mitchell et al. (2010) found that after the education program, patients had an increased hospital stay (p=0.03), while Liaw et al. (2016) reported that patients on the surgical unit had a significant increase in length of stay (p<0.05). Mitchell et al. (2010) reported that vital

sign frequency increased significantly (p=0.001). In contrast, Fuhrmann et al. (2009) reported no statistical differences following the intervention regarding patient outcomes. More specifically, there was no difference in patients' 30-day or 180-day mortality rates. Additionally, there was no difference detected in nurse's awareness of abnormal vital signs (Fuhrmann et al., 2009).

Teamwork. Cooper et al. (2012) and Harvey et al. (2014) also assessed participant's teamwork skills. Cooper et al. (2012) used the TEAM measure tool to rate team performance, which measures three domains: leadership, teamwork, and task managements. Harvey et al. (2014) used the TeamSTEPPS observation tool, which measures five domains including: team structure, leadership, situation, monitoring, mutual support, and communication. Harvey et al. (2014) reported that teamwork improved significantly in the simulation group (p<0.05) for all domains, while the case study group had significant improvement in three domains (p<0.05). Similarly, Cooper et al. (2012) found a positive association between teamwork and participants clinical performance. Harvey et al. (2014) also assessed clinical skills among participants. Clinical skills in the simulation group significantly improved (p=0.010) compared to those in the case-study group (p=0.354). Finally, Liaw et al. (2016) reported that nurses found the e-RAPIDS program highly relevant to clinical practice and were motivated to learn from such educational opportunities.

Overall, outcome measures using a multimodal educational approach were shown to improve patient outcomes and nurse performance. Because the interventions comprised a number of different strategies, study findings represent the effect of the whole intervention and the impact of any one particular activity or strategy cannot be determined. Thus, a combined educational approach provides weak but growing evidence of its impact for improving identification and management of clinical deterioration.

Discussion

A significant number of nursing participants in the studies reviewed for objective one reported a clinical benefit regarding implementation of EWS systems. Numerous nurses indicated that the EWS tool was valuable for communication, confidence of clinical skills, as well as prioritization of nursing care (Jensen et al., 2019; Shaddel et al., 2014; Spangfors et al., 2020). Nurses expressed that with the use of the tool, their communication to the physician improved, and they could relay concerns more confidently. The tool added value to clinical assessments, and allowed nurses to better understand the importance of physiological parameters. Though implementation of EWS systems has many facilitators to improve nursing care, studies also indicated that these tools have certain barriers. Most notably, nurses identified lack of physician awareness with regards to the interpretation of patients' EWS score (Cherry & Jones, 2015). Many nurses conveyed the need for physicians to be notified of the importance and meaning of such scoring systems. Additionally, some nurses expressed concern that the tool negatively impacted their clinical skills, by relying heavily on the tool itself and possibly neglecting nursing clinical assessments.

Results obtained from review question one led to the information collected from the second part of the literature search. It was important to consider best practices used to educate practicing ward nurses regarding identification and management of clinical deterioration. The findings of review question two provide weak to moderate evidence that a multidimensional educational approach is most advantageous (PHAC, 2014). Many of the studies found that face-to-face and web-based learning using a combination of lectures, case studies, role-playing, and simulation, have beneficial effects on both nursing performance and patient outcomes (Harvey et al., 2014; Kinsman et al., 2021; Liaw et al., 2016; Mitchell et al., 2010). The majority of the

studies in objective two use simulation as a component of their educational program. Simulation

has been shown to provide effective learning in real life settings (Harvey et al., 2014; Liaw et al.,

2016). Use of both role-play and case studies are also effective educational efforts (Harvey et al.,

2014), and may offer a more cost effective means to educate ward nurses.

Conclusion

The purpose of this integrative literature review was to identify current evidence related

to EWS tools and their role in clinical deterioration on general wards. Though the quality of the

literature was generally low, several clinical approaches can be taken from the results which can

be effective in aiding ward nurses in the identification and management of deteriorating patients.

For example, implementation of an EWS system such as the NEWS2 tool can support nurses

with clinical assessments, communication, and prioritization of care (Jensen et al., 2018). A

successful approach would combine implementation of the NEWS2 with education consisting of

a multimodal approach. Providing educational workshops to ward nurses with a focus on

physiological parameters, pathophysiology of common acute decline, and importance of early

recognition has been proven effective in studies reviewed in this manuscript. Moreover, using

teaching strategies including: case studies, role-playing, simulation, and debriefing help provide

a means for ward nurses to practice their clinical skills in a trained real-life like setting.

Combining these two approaches can help guide the development and implementation of an

educational workshop to equip ward nurses on a medical ward in the Health Science Centre of

Eastern Health to better identify and manage clinical deterioration, and thus continue to provide

optimal patient centered care.

References

Al-Qahtani, S., & Al-Dorzi, H. M. (2010). Rapid response systems in acute hospital care. *Annals of Thoracic Medicine*, *5*(1), 1–4. https://doi-org.qe2a-proxy.mun.ca/10.4103/1817-1737.58952.

Baker, K. F., Hanrath, A. T., Schim van der Loeff, I., Kay, L. J., Back, J., & Duncan, C. J. (2021). National early warning score 2 (NEWS2) to identify inpatient COVID-19 deterioration: A retrospective analysis. *Clinical Medicine (London, England)*, *21*(2), 84–89. https://doi-org.qe2a-proxy.mun.ca/10.7861/clinmed.2020-0688.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Buckley, T., & Gordon, C. (2011). The effectiveness of high-fidelity simulation on medical-surgical registered nurses' ability to recognise and respond to clinical emergencies. *Nurse Education Today*, *31*(7), 716–721. https://doi-org.qe2a-proxy.mun.ca/10.1016/j.nedt.2010.04.004.

Burke, J. R., Downey, C., & Almoudaris, A. M. (2022). Failure to rescue deteriorating patients: A systematic review of root causes and improvement strategies. *Journal of Patient Safety*, *18*(1), e140–e155. https://doi-org.qe2a-proxy.mun.ca/10.1097/PTS.0000000000000720.

Butler,Z. A. (2020). Implementing the national early warning score 2 into pre-registration

nurse education. *Nursing Standard,* 35(3), 70-75. https://doi-org.qe2a-

proxy.mun.ca/10.7748/ns.2020.e11470.

Cherry, P.G., & Jones, C.P. (2015). Attitudes of nursing staff towards a modified early warning

system. *British Journal of Nursing, 24*(16), 812-818. https://doi-org.qe2a-

proxy.mun.ca/10.12968/bjon.2015.24.16.812.

Cooper, S., Cant, R., Porter, J., Missen, K., Sparkes, L., McConnell-Henry, T., & Endacott, R.

(2013). Managing patient deterioration: Assessing teamwork and individual

performance. *Emergency Medicine Journal : EMJ*, *30*(5), 377–381. https://doi-org.qe2a-

proxy.mun.ca/10.1136/emermed-2012-201312.

De Meester, K., Van Bogaert, P., Clarke, S. P., & Bossaert, L. (2013). In-hospital mortality after

serious adverse events on medical and surgical nursing units: A mixed methods

study. *Journal of Clinical Nursing*, *22*(15-16), 2308–2317. https://doi-org.qe2a-

proxy.mun.ca/10.1111/j.1365-2702.2012.04154.x.

Echevarria, C., Steer, J., & Bourke, S. C. (2019). Comparison of early warning scores in patients

with COPD exacerbation: DECAF and NEWS score. *Thorax*, *74*(10), 941–946.

https://doi-org.qe2a-proxy.mun.ca/10.1136/thoraxjnl-2019-213470.

Featherstone, P., Smith, G. B., Linnell, M., Easton, S., & Osgood, V. M. (2005). Impact of a one-

day inter-professional course (ALERT) on attitudes and confidence in managing critically ill adult patients. *Resuscitation*, *65*(3), 329–336. https://doi-org.qe2a-proxy.mun.ca/10.1016/j.resuscitation.2004.12.011.

Fox, A., & Elliott, N. (2015). Early warning scores: A sign of deterioration in patients and systems. *Nursing management (Harrow, London, England : 1994)*, *22*(1), 26–31. https://doi-org.qe2a-proxy.mun.ca/10.7748/nm.22.1.26.e1337.

Fuhrmann, L., Lippert, A., Perner, A., & Østergaard, D. (2008). Incidence, staff awareness and mortality of patients at risk on general wards. *Resuscitation*, *77*(3), 325–330. https://doi-org.qe2a-proxy.mun.ca/10.1016/j.resuscitation.2008.01.009.

Fuhrmann, L., Perner, A., Klausen, T. W., Østergaard, D., & Lippert, A. (2009). The effect of multi-professional education on the recognition and outcome of patients at risk on general wards. *Resuscitation*, *80*(12), 1357–1360. https://doi-org.qe2a-proxy.mun.ca/10.1016/j.resuscitation.2009.07.002.

Green, A., & Williams, A. (2006). Staff experiences of an early warning indicator for unstable patients in Australia. *Nursing in Critical Care*, *11*(3), 118–127. https://doi-org.qe2a-proxy.mun.ca/10.1111/j.1362-1017.2006.00163.x.

Harvey, E. M., Echlos, S. R., Clark, R., & Lee, E. (2014). Comparison of two TeamSTEPPS training methods on nurse failure-to-rescue performance. *Clinical Simulation in Nursing, 10*(2), e57-e64. https;//doi-org.qe2a-proxy.mun.ca/10.1016/j.ecns.2013.08.006.

JBI Checklist for Qualitative Research (2020). Available at:

https://jbi.global/sites/default/files/2020-08/Checklist_for_Qualitative_Research.pdf

Jensen, J. K., Skår, R., & Tveit, B. (2019). Hospital nurses' professional accountability while

using the national early warning score: A qualitative study with a hermeneutic

design. *Journal of Clinical Nursing*, *28*(23-24), 4389–4399. https://doi-org.qe2a-

proxy.mun.ca/10.1111/jocn.15021.

Jensen, J. K., Skår, R., & Tveit, B. (2018). The impact of early warning score and rapid

response systems on nurses' competence: An integrative literature review and

synthesis. *Journal of Clinical Nursing*, *27*(7-8), e1256–e1274. https://doi-org.qe2a-

proxy.mun.ca/10.1111/jocn.14239.

Kinsman, L., Cooper, S., Champion, R., Kim, J. A., Boyle, J., Cameron, A., Cant, R. P., Chung,

C., Connell, C., Evans, L., McInnes, D., McKay, A., Norman, L., Penz, E., Rana, M., &

Rotter, T. (2021). The impact of web-based and face-to-face simulation education

programs on nurses' response to patient deterioration: A multi-site interrupted time series

study. *Nurse Education Today*, *102*, 104939. https://doi-org.qe2a-

proxy.mun.ca/10.1016/j.nedt.2021.104939.

Lalueza, A., Lora-Tamayo, J., de la Calle, C., Sayas-Catalán, J., Arrieta, E., Maestro, G.,

Mancheño-Losa, M., Marchán-López, Á., Díaz-Simón, R., García-García, R., Catalán,

M., García-Reyne, A., de Miguel-Campo, B., Lumbreras, C., & COVID+12 Group

(2022). The early use of sepsis scores to predict respiratory failure and mortality in non-

ICU patients with COVID-19. *Revista Clinica Espanola*, *222*(5), 293–298. https://doi-org.qe2a-proxy.mun.ca/10.1016/j.rceng.2020.10.004.

Liaw, S. Y., Scherpbier, A., Klainin-Yobas, P., & Rethans, J. J. (2011). A review of educational strategies to improve nurses' roles in recognizing and responding to deteriorating patients. *International Nursing Review*, *58*(3), 296–303. https://doi-org.qe2a-proxy.mun.ca/10.1111/j.1466-7657.2011.00915.x.

Liaw, S. Y., Wong, L. F., Lim, E. Y., Ang, S. B., Mujumdar, S., Ho, J. T., Mordiffi, S. Z., & Ang, E. N. (2016). Effectiveness of a web-based simulation in improving nurses' workplace practice with deteriorating ward patients: A pre- and post-intervention Study. *Journal of Medical Internet Research*, *18*(2), e37. https://doi-org.qe2a-proxy.mun.ca/10.2196/jmir.5294.

Mitchell, I. A., McKay, H., Van Leuvan, C., Berry, R., McCutcheon, C., Avard, B., Slater, N., Neeman, T., & Lamberth, P. (2010). A prospective controlled trial of the effect of a multi-faceted intervention on early recognition and intervention in deteriorating hospital patients. *Resuscitation*, *81*(6), 658–666. https://doi-org.qe2a-proxy.mun.ca/10.1016/j.resuscitation.2010.03.001.

Mok, W. Q., Wang, W., & Liaw, S. Y. (2015). Vital signs monitoring to detect patient deterioration: An integrative literature review. *International Journal of Nursing Practice*, *21 Suppl 2*, 91–98. https://doi-org.qe2a-proxy.mun.ca/10.1111/ijn.12329.

Nagarajah, S., Krzyzanowska, M. K., & Murphy, T. (2022). Early warning scores and their

   application in the inpatient oncology settings. *JCO Oncology Practice*, OP2100532.

   Advance online publication. https://doi-org.qe2a-proxy.mun.ca/10.1200/OP.21.00532.

Nazarko, L. (2020, April 1). *How to read the NEWS: The new early warning system*.

   Www.independentnurse.co.uk. Available at:

   https://www.independentnurse.co.uk/professional-article/how-to-read-the-news-the-new-

   early-warning-system/218551/

Odell, M., Victor, C., & Oliver, D. (2009). Nurses' role in detecting deterioration in ward

   patients: Systematic literature review. *Journal of Advanced Nursing*, *65*(10), 1992–2006.

   https://doi-org.qe2a-proxy.mun.ca/10.1111/j.1365-2648.2009.05109.x.

Orique, S. B., Despins, L., Wakefield, B. J., Erdelez, S., & Vogelsmeier, A. (2019). Perception

   of clinical deterioration cues among medical-surgical nurses. *Journal of Advanced

   Nursing*, *75*(11), 2627–2637. https://doi-org.qe2a-proxy.mun.ca/10.1111/jan.14038.

Petersen, J. A., Rasmussen, L. S., & Rydahl-Hansen, S. (2017). Barriers and facilitating factors

   related to use of early warning score among acute care nurses: A qualitative study. *BMC

   Emergency Medicine*, *17*(1), 36. https://doi-org.qe2a-proxy.mun.ca/10.1186/s12873-017-

   0147-0.

Public Health Agency of Canada (2014). Infection prevention and control guidelines

   critical appraisal toolkit. Available at:

   http://publications.gc.ca/site/eng/470818/publication.html

Royal College of Physicians. (2017, December 19). *National Early Warning Score (NEWS) 2*.

> Royal College of Physicians London; Royal College of Physicians.

> https://www.rcplondon.ac.uk/projects/outputs/national-early-warning-score-news-2

Saab, M. M., McCarthy, B., Andrews, T., Savage, E., Drummond, F. J., Walshe, N., Forde, M.,

> Breen, D., Henn, P., Drennan, J., & Hegarty, J. (2017). The effect of adult Early Warning

> Systems education on nurses' knowledge, confidence and clinical performance:

> A systematic review. *Journal of Advanced Nursing*, *73*(11), 2506–2521. https://doi-

> org.qe2a-proxy.mun.ca/10.1111/jan.13322.

Shaddel, F., Khosla, V., & Banerjee, S. (2014). Effects of introducing MEWS on nursing staff in

> mental health inpatient settings. *Progress in Neurology & Psychiatry, 18*(2), 24-27.

> https://doi-org.qe2a-proxy.mun.ca/10.1002/pnp.325.

Silcock, D. J., Corfield, A. R., Staines, H., & Rooney, K. D. (2019). Superior performance of

> national early warning score compared with quick sepsis-related organ failure assessment

> score in predicting adverse outcomes: A retrospective observational study of patients in

> the pre-hospital setting. *European Journal of Emergency Medicine : official journal of*

> *the European Society for Emergency Medicine*, *26*(6), 433–439. https://doi-org.qe2a-

> proxy.mun.ca/10.1097/MEJ.0000000000000589.

Skitch, S., Tam, B., Xu, M., McInnis, L., Vu, A., & Fox-Robichaud, A. (2018). Examining the

> utility of the Hamilton early warning scores (HEWS) at triage: Retrospective pilot study

> in a Canadian emergency department. *CJEM, 20*(2), 266–274. https://doi-org.qe2a-

> proxy.mun.ca/10.1017/cem.2017.21.

Smith, G. B., Prytherch, D. R., Schmidt, P. E., & Featherstone, P. I. (2008). Review and

performance evaluation of aggregate weighted 'track and trigger'

systems. *Resuscitation*, *77*(2), 170–179. https://doi-org.qe2a-

proxy.mun.ca/10.1016/j.resuscitation.2007.12.004.

Spångfors, M., Molt, M., & Samuelson, K. (2020). National early warning score: A survey of

registered nurses' perceptions, experiences and barriers. *Journal of Clinical*

Nursing, *29*(7-8), 1187–1194. https://doi-org.qe2a-proxy.mun.ca/10.1111/jocn.15167.

Stafseth, S. K., Grønbeck, S., Lien, T., Randen, I., & Lerdal, A. (2016). The experiences of

nurses implementing the modified early warning score and a 24-hour on-call mobile

intensive care nurse: An exploratory study. *Intensive & Critical Care Nursing*, *34*, 25–33.

https://doi-org.qe2a-proxy.mun.ca/10.1016/j.iccn.2015.07.008.

Van Galen, L. S., Struik, P. W., Driesen, B. E., Merten, H., Ludikhuize, J., van der Spoel, J. I.,

Kramer, M. H., & Nanayakkara, P. W. (2016). Delayed recognition of deterioration of

patients in general wards is mostly caused by human related monitoring failures: A root

cause analysis of unplanned ICU admissions. *PloS One*, *11*(8), e0161393. https://doi-

org.qe2a-proxy.mun.ca/10.1371/journal.pone.0161393.

Vandervliet, T., Flemming, S., & Rathwell, M. (2021, January 11). *Nurses implement early*

warning system to detect patient deterioration. Community.cna-Aiic.ca. https://www.cna-

aiic.ca/dev-cn-en/blogs/cn-content/2021/01/11/nurses-implement-early-warning-system-

to-detect-pa

Whittemore, R., & Knafl, K. (2005). The integrative review: updated methodology. *Journal of Advanced Nursing*, *52*(5), 546–553. https://doi-org.qe2a-proxy.mun.ca/10.1111/j.1365-2648.2005.03621.x.

Wibisono, E., Hadi, U., Bramantono, Arfijanto, M. V., Rusli, M., Rahman, B. E., Asmarawati, T. P., Choirunnisa, M. L., & Rahayu, D. (2022). National early warning score (NEWS) 2 predicts hospital mortality from COVID-19 patients. *Annals of Medicine and Surgery (2012)*, *76*, 103462. https://doi-org.qe2a-proxy.mun.ca/10.1016/j.amsu.2022.103462.

Wood, C., Chaboyer, W., & Carr, P. (2019). How do nurses use early warning scoring systems to detect and act on patient deterioration to ensure patient safety? A scoping review. *International Journal of Nursing Studies*, *94*, 166–178. https://doi-org.qe2a-proxy.mun.ca/10.1016/j.ijnurstu.2019.03.012.

Zegers, M., de Bruijne, M. C., Wagner, C., Hoonhout, L. H., Waaijman, R., Smits, M., Hout, F. A., Zwaan, L., Christiaans-Dingelhoff, I., Timmermans, D. R., Groenewegen, P. P., & van der Wal, G. (2009). Adverse events and potentially preventable deaths in Dutch hospitals: Results of a retrospective patient record review study. *Quality & Safety in Health Care*, *18*(4), 297–302. https://doi-org.qe2a-proxy.mun.ca/10.1136/qshc.2007.025924.

Appendix I

Chart 1: The NEWS scoring system

Physiological parameter	Score 3	Score 2	Score 1	Score 0	Score 1	Score 2	Score 3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO₂ Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO₂ Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

Chart 2: NEWS thresholds and triggers

NEW score	Clinical risk	Response
Aggregate score 0–4	Low	Ward-based response
Red score Score of 3 in any individual parameter	Low–medium	Urgent ward-based response*
Aggregate score 5–6	Medium	Key threshold for urgent response*
Aggregate score 7 or more	High	Urgent or emergency response**

* Response by a clinician or team with competence in the assessment and treatment of acutely ill patients and in recognising when the escalation of care to a critical care team is appropriate.

**The response team must also include staff with critical care skills, including airway management.

Chart 4: Clinical response to the NEWS trigger thresholds

NEW score	Frequency of monitoring	Clinical response
0	Minimum 12 hourly	• Continue routine NEWS monitoring
Total 1–4	Minimum 4–6 hourly	• Inform registered nurse, who must assess the patient • Registered nurse decides whether increased frequency of monitoring and/or escalation of care is required
3 in single parameter	Minimum 1 hourly	• Registered nurse to inform medical team caring for the patient, who will review and decide whether escalation of care is necessary
Total 5 or more Urgent response threshold	Minimum 1 hourly	• Registered nurse to immediately inform the medical team caring for the patient • Registered nurse to request urgent assessment by a clinician or team with core competencies in the care of acutely ill patients • Provide clinical care in an environment with monitoring facilities
Total 7 or more Emergency response threshold	Continuous monitoring of vital signs	• Registered nurse to immediately inform the medical team caring for the patient – this should be at least at specialist registrar level • Emergency assessment by a team with critical care competencies, including practitioner(s) with advanced airway management skills • Consider transfer of care to a level 2 or 3 clinical care facility, ie higher-dependency unit or ICU • Clinical care in an environment with monitoring facilities

Appendix II Literature Summary Table

Study/Design	Methods	Key Results	Comments
Authors: Featherstone et al., 2005 Design: Uncontrolled before and after trial Aim: To evaluate the impact of ALERT program on confidence and attitudes of healthcare staff on recognizing and managing acutely ill patients	N: 315 Healthcare Professionals (80 RNs, 43 Doctors, 6 Physiotherapists, 2 not identified). Questionnaire distributed to all participants prior to commencing ALERT courses between August 2002 & January 2003 Country/Setting: United Kingdom (20 Hospital Centers) Intervention: ALERT Program Participants received 70-page handbook prior to course (covers topics during training). Participants given laminated card (ABCDE assessment). 1-Day course included: interactive seminars, role-play and scenarios. Educators emphasize the need to consider calling for help, appropriate communication, and review of patient charts. Data Collection: Follow-up questionnaires 6 wks post Knowledge & Experience: Open-ended question and Likert scale Confidence: open-ended questionnaire and Likert scale Teamwork: 10 point Likert scale Outcomes: 1. Knowledge 2. Confidence 3. Teamwork	**1. Knowledge** • Significant increase in knowledge in recognizing critical decline ($p<0.01$) **2. Confidence** • Significant increase in mean scores for confidence in ability to recognize critically ill patients ($p<0.01$) • Keeping a patient alive ($p<0.01$) • Remembering life saving measures ($p<0.01$) • Participants less worried about caring for critically ill patient ($p<0.003$) **3. Teamwork** • Significant improvement in confidence to work with interdisciplinary team when caring for critically ill patient ($p<0.05$)	**Strength of Design: Weak** **Quality: Weak** Limitations/Comments: • Only 41.6% of participants completed follow-up questionnaires • Potential issues for control of confounding variables, no control group, and simple statistical testing used

Study/Design	Methods	Key Results	Comments
Authors: Harvey et al., 2014 Design: Two group comparison before and after trial Aim: To explore the impact of two types of evidence based training methodologies (SBT vs. CSR) on practicing nurse early warning sign knowledge, confidence, teamwork and clinical skill	N: 39 Registered nurses from 2 medical/surgical units recruited by convenience sampling Country/Setting: 825-Bed, academic medical center, Level 1 trauma center, USA Intervention: All Participants 2.5hr education lecture included: TeamSTEPPS rapid response team system module, ten signs of vitality presentation SBT Group: Used interactive simulator SimMan. Groups of 4 to 5 RNs completed two 10-minute simulations. Simulation followed by 20-minute debriefing. Debriefing structured by SMARTER CSR Group: 60-Minutes in total (2 cases, 30-minutes each). 4 to 5 RNs analyzed early warning signs in clinical conditions and identify appropriate interventions for the same simulation cases. Case study structured in question and answer format. Data Collection: 28 MC Early Identification Exam Tool 14 Likert scale Pre/post confidence surveys 5 pt Scale TeamSTEPPS Observation Tool SMARTER Evaluation Outcomes: 1. Knowledge 2. Confidence 3. Teamwork 4. Clinical skills	1. Knowledge Knowledge scores improved in both SBT ($3.47 +/- 3.8$) and CSR ($36.4 +/- 2.1$) groups 2. Confidence SBT improved significantly ($p<0.05$) CSR showed no significant improvement 3. Teamwork SBT increased significantly in all 5 domains ($p<0.001$) Overall teamwork for SBT significant ($p<0.05$) CSR increased significantly in leadership, mutual support, and communication ($p<0.05$) 4. Clinical Skill Significant improvement in SBT group ($p=0.010$) No significant improvement in CSR group	**Strength of Design: Moderately Strong** **Quality: Medium** Limitations/Comments: • Lack of validity and reliability for knowledge and clinical skill measurements • Relatively small sample size • CSR group had a 30% turnover of staff, reducing recruitment availability • Participants in SBT group clocked longer training, may have influenced performance

Study/Design	Methods	Key Results	Comments
Authors: Jensen et al., 2019 Design: Hermeneutic Design Aim: To explore general hospital ward nurses experiences with the NEWS tool and determine impact on professionalism	N: 14 Hospital nurses from medical/surgical wards recruited by nurse leaders Country/Setting: One state-funded hospital, Norway Data Collection: Collected over 1-year after implementation of NEWS tool. Individual semi-structured interviews Interview guide was used, participants were asked to describe a situation when they used NEWS. Participants asked if NEWS influenced their assessments or decisions. Participants were also asked about clinical judgment, discretion, and professional competence with NEWS. Finally, participants were asked about change in their practice since NEWS. Interviews last 28-58 minutes, took place in designated room in hospital. Data Analysis: Interviews were digitally recorded and transcribed verbatim. Field notes were taken during the interviews Thematic analysis based on Braun & Clarke (2005) Hermeneutic circle was used to facilitate a deeper understanding of the interview	**Themes:** **1. NEWS & Clinical Judgment** • Used NEWS to support clinical judgment • NEWS contributed to awareness of vital signs • Concerns expressed that NEWS could undermine professional competence **2. Responding to NEWS Standards** • Some felt NEWS decreased nurse responsibility • Stating it was another task • Some felt doctors did not listen when they were told about a certain score • Some felt that NEWS helped them decide when to call the doctor **3. Involving Professional Community** • Focus on parameters more than overall score • NEWS helped with confidence in communication **4. Adjusting Tool** • NEWS does not fit all patient situations	**JBI: Moderate Credibility** The researcher conducting the interviews worked in the same hospital affecting the studies credibility **Trustworthiness: Moderate** Findings are confirmable and authentic due to thick vivid description, direct quotes, and interviews were recorded and transcribed verbatim. Transferability and dependability could not be assessed.

Study/Design	Methods	Key Results	Comments
Authors: Jensen et al., 2018 Design: Integrative Literature Review Aim: To describe, interpret, and synthesize current research on the impact of EWS and RRS on nurses competence in identifying and managing deteriorating patients in general hospital wards	N: 36 Studies Country/Setting: Studies selected from UK, US, and Australia Data Collection: Integrative review from December 2015 to February 2016 using CINAHL, Ovid MEDLINE, EMBASE, PubMed, and Cochrane Library. Inclusion criteria: articles relating to EWS or RRT on nurses, published between January 2005 and January 2016, peer-reviewed, published in English or Scandinavian language Data Evaluation: CASP, 2013 was used for qualitative and quantitative studies Data Analysis: Followed recommendations by Whittemore and Knafl (2005). Included extracting findings and coding data from primary sources Phase 1: Data reduction and extracting findings Phase 2: Identify patterns, themes, or relationships Phase 3: Analytic themes generated Phase 4: synthesis important elements for each theme	**1. Impact on RNs Competence** • Research describe EWS as helped in sensing deterioration, improving practice and patient outcomes • Increased awareness of abnormal vital signs • EWS described as aid to support clinical judgment • Some described EWS as undesirable • Felt to deskill junior nurses **2. Impact on Competence to Refer Patients** • Supported nurses to call physicians • Using EWS helped nurses advocate for patients • Nurses found is difficult to summon help when EWS was low but were concerned **3. Impact on Coping** • Influence nurses belief in their own ability *Other Outcomes (not relevant):* • Also assessed RRT	**Strength of Design: Strong** **Quality: Medium** Limitations/Comments: • Included studies were restricted by language

Study/Design	Methods	Key Results	Comments

Authors: Kinsman et al., 2021
 	
Design: Non-randomized interrupted times series
 	
Aim: To measure the impact of simulation on nurses responses to patient deterioration in an acute medical ward setting and compare web-based versus face-to-face modalities
	N: 126 Registered Nurses from 4 recruited medical wards. All qualified nursing staff (RNs & ENs) invited to participate
	
	Country/Setting: Four acute care medicine wards, Victoria, Australia
	
	Intervention: All Participants (either web-based or face-to-face) complete FIRST2ACT: educational material, pre/post course assessments, multiple choice questions, high fidelity simulation, participant review and feedback
	
	Web-Based: 3 scenarios lasting 8-minutes. For scenario participants should 'click' appropriate actions (IV insertion, take vitals, get ECG). Feedback provided. 1-1.5Hrs.
	
	Face-to-Face: Simulated ward environment. Same 3 scenarios as web-based. 30-Minute debrief
	
	Data Collection:
	• Patient charts audited retrospectively (4-6 months) post intervention categorized into:
	   o Escalation
	   o Monitoring and Observation
	   o Interventions
	Outcomes:
	1. Escalation
	2. Assessment and Observation
	3. Clinical Interventions
	4. Comparison of Delivery Mode
		1. Escalation
		• Increase in patients receiving medical review who met criteria for review 13% to 28% (p<0.001)
		
		2. Assessment & Observation
		• Increase in recording of patients conscious state from 91.1% to 100% (p<0.001)
		• Pain documentation increased from 97.8% to 99.8% (p<0.001)
		• No change in frequency of vital sign assessments for those meeting clinical review
		
		3. Clinical Interventions
		• Documentation of any intervention increased from 14.3% to 34.75% (p<0.001)
		
		4. Comparison of Delivery Mode
		• No difference between modes
		
		Other outcomes not relevant to key question: MET activation
			Strength of Design: Moderate
			
			Quality: Medium
			Limitations/Comments:
			• Only 126 participants from 4 wards
			• Lack of generalizability
			• Participants not blinded to intervention
			• Potential Hawthorne effect
			• Researchers not blinded to intervention groups during chart audits

Study/Design	Methods	Key Results	Comments
Authors: Liaw et al., 2016 Design: Uncontrolled before and after trial Aim: To evaluate the impact of web-based simulation on nurses recognition of and response to deteriorating patients in clinical settings	N: 99 nurses from surgical and medical wards (64 RNs and 35 ENs). Wards were chosen based on high trigger rates from previous data of each ward. Country/Setting: Surgical and Medical wards of acute tertiary hospital, Singapore Intervention: 2.5-3-hour e-RAPIDS web version (different version for RNs & ENs). Included: animated video focusing on vital signs & case scenario. Multimedia instructional material on lung sounds. Five-simulation scenarios association with clinical deterioration. Data Collection: 14-Month Period • IMMS Survey (5 point Likert scale) • 30-Item MCQ (before and after education) • Self-reported questionnaire (3-4 months post intervention) (5 point Likert scale) • Clinical records on cases triggered checked (6 months pre and 6 months post intervention) Outcomes: 1. Motivational reaction 2. Knowledge 3. Training transfer at workplace 4. Trigger cases Data Analysis: • Descriptive statistics using means, SDs, counts, and percentages	**1. Motivation** • Overall mean scores for motivation increased (mean 3.78, SD 0.56, $p<0.001$) • Overall higher confidence (mean 2.73, SD 0.53, $p<0.001$) **2. Knowledge** • RN group significant increase ($p<0.001$) • EN group significant increase ($p<0.001$) **3. Training Transfer at Workplace** • RN & EN showed positive attitudes transferring learning to clinical practice (mean 3.89, SD 0.49) **4. Trigger Cases** • Increase in hospital length of stay for surgical pts ($p<0.05$) • Increase in review by physician on medicine unit ($p<0.001$) • No difference for review of surgical patients	**Strength of Design: Weak** **Quality: Medium** Limitations/Comments: • Lack of control group, control of confounding variables an issue • Short time line, trigger cases were measured over a short period, lack of sustainability • Single site, 2 wards • 84% Response rate

Study/Design	Methods	Key Results	Comments

Authors: Mitchell et al., 2010
 	
 Design: Controlled before and after Trial
 	
 Aim: Hypothesized that by implementing a track-and-trigger system and education program (COMPASS) the frequency of vital sign assessments would increase, and unplanned ICU admissions, and unexpected deaths would decrease
	N: 177 Medical / Surgical ward RNs, 28 Junior medical officers, 5 physiotherapists. Adult subjects admitted during study period. Wards were chosen based on high acuity.
	
	 Country/Setting: 2 Teaching hospitals, Australia
	
	 Control: 4 months, outcomes measured under normal operating conditions
	 Intervention: Educational package
	 • COMPASS Program
	  o e-Learning package
	  o 3 Hr face-to-face low fidelity simulation
	 Data Collection: Pre-Intervention
	 Ward chart: Vital signs documented on y-axis with scales for each variable, no policy for frequency
	 Medical Review: two informal medical responses to patient deterioration
	 1. Nursing staff request ad hoc medical review by physician
	 2. Activation of MET once calling criteria fulfilled
	 Post-Intervention:
	 Ward Chart: Vital signs documented on y-axis, measurement policy was developed q6hr unless otherwise specified. MEWS score developed
	 Medical Review: MEWS score triggering physician response. If no response, MET system triggered
	 Outcomes:
	 1. Patient outcomes
	 2. Vital sign measurements
	 3. Communication & Medical review
		1. Patient Outcomes
		 • Significant decrease in pts requiring unplanned ICU transfer (p=0.005; RRR: 0.28)
		 • Significant decrease in unexpected deaths (p=0.03; RRR: 1.57)
		 • Increase in hospital LOS (p=0.03)
		
		 2. Vital Sign Measurements
		 Average daily frequency of documentation of all vital signs (BP, HR, RR, SpO2, & temperature) increased significantly (p=0.001)
		
		 3. Communication & Medical Review
		 • Significant increase in medical review (p<0.001)
		 • No difference in communication between nurses and medical staff
		
		 Other Outcomes Measured not relevant to key question:
		 • Number of times MET team was activated appropriately
			Strength of Design: Moderately strong
			
			 Quality: Weak
			
			 Limitations/Comments:
			 • Lack of concurrent control group
			 • Control period (4 months) studied 1157 patients versus 985 during intervention (4 months)
			 • Significantly more medical admissions during intervention period
			 • 25% of patients were randomly selected for sub-group of in-depth analysis of vital sign measurements and communication

Study/Design	Methods	Key Results	Comments
Authors: Spangfors et al., 2020 Design: Cross-sectional descriptive study Aim: To describe RNs perception, experiences, and barriers for using the NEWS in relation to their work experience and medical affiliation	N: 3,165 RNs (general ward, emergency department, cardiac high dependency unit) from general somatic hospital wards. All RNs using NEWS recruited Country/Setting: Southern Sweden (Healthcare region consists of 8 hospitals, 1 university hospital and 7 community hospitals) Data Collection: • Validated 23 item self-report questionnaire based by Green & Allison (2006) • Survey items translated into Swedish • Swedish questionnaire supplemented with 6 items: o MC question on patients with NEWS, 2 likert scale questions on adherence, 1 MC question about reason for not adhering, 1 likert scale on need for more education of NEWS • 7 Reminders sent to nonresponses with 14 day intervals Outcomes: 1. Instruction 2. Nursing experience 3. Medical affiliation	**1. Instruction** • 89% of RNs felt clear instruction of what to do if patient triggered a certain score • 81% felt NEWS aided them in decision to call physician • 71% reported better ability to prioritize care • 77% felt NEWS supported 'gut feeling' **2. Nursing Experience** • Less experience nurses answered more positively to NEWS ($p<0.001$) • Less experience found better response from physicians ($p<0.001$) • More senior nurses felt NEWS added work ($p=0.002$) **3. Medical Affiliation** • Highest adherence reported on surgical units • Lowest adherence reported from cardiac high dependency unit	**Strength of Design: Weak** **Quality: High** Limitations/Comments: • Low response rate of 40% (1,263) resulting in non-response bias

Appendix B

Report of the Development, Implementation, and Evaluation of the Early Warning Score

Pilot Workshop

Table of Contents

Report of the Development, Implementation, and Evaluation of the Early Warning Score

Pilot Workshop

Acute clinical decline in hospitalized patients is not uncommon (Purling & King, 2012). Early recognition of acute deterioration on medical wards is essential to prevent poor patient outcomes. Nurses thus play a pivotal role in recognition of acute clinical decline. Many clinical variables including various physiological parameters, signify, and can help predict the likelihood of clinical deterioration (Odell, 2015). However, in isolation, physiological parameters are often not synthesized with a patient's overall clinical picture, resulting in a potential missed opportunity to detect acute decline early (Mok et al., 2015). Unfortunately, this missed opportunity may lead to serious adverse events including, unplanned transfers to the intensive care unit (ICU), development of sepsis, cardiac and respiratory arrest, and even death (Mok et al., 2015). The literature has shown that patients, who experience these serious adverse events, generally display physiological disturbances for an estimated 6 to 8 hours prior to acute clinical deterioration (Al-Qahtani & Al-Dorzi, 2010, Mok et al., 2015). While physiological parameters are important, unfortunately, some studies indicate that nurses often fail to consistently monitor, document, and report abnormal vital signs (Mok et al., 2015). In a retrospective observational study, Leuvan and Mitchell (2008) found that nurses frequently failed to document respiration rate, compared to other physiological parameters. Additionally, Fuhrmann et al. (2008) found that 43% of nurses were naive to their patients vital sign abnormalities, in 18% of cases where patients demonstrated physiological disturbances. This indicates a need for a quality improvement (QI) initiative to aid in the early detection of clinical deterioration on acute medical wards.

Early warning score (EWS) tools have been developed to improve the management of ward patients by supporting nurses and other health care providers in the identification of clinical decline at earlier stages and in the prevention of serious adverse events. Through the identification of acute decline at an earlier stage, certain medical interventions can be provided to optimize patient care (Skitch et al., 2018). One EWS is the National Early Warning Score 2 (NEWS2). The NEWS2 uses a patient's physiological parameters including, systolic blood pressure, respiration rate, heart rate, temperature, oxygen saturation, and confusion, to calculate a total score representing a risk of clinical decline (Royal College of Physicians, 2017). By categorizing the patient's severity of illness, an appropriate clinical response can be initiated with the goal of improving patient outcomes (Royal College of Physicians, 2017). The NEWS2 tool has been shown to predict in hospital mortality at 24 hours (Furlan et al., 2022). Additionally, in a quasi-experimental trial, Badr et al. (2021) found benefits of the NEWS tool including significant reductions in cardiopulmonary arrest ($p=0.046$) and unplanned ICU admissions ($p=0.049$). Moreover, the researchers found that after implementation of the NEWS tool, there was a significant increase in patients receiving medical reviews ($p<0.0001$) (Badr et al., 2021).

The NEWS2 tool has been endorsed by the London Royal College of Physicians for use in all acute care settings (Royal College of Physicians, 2017). It also is the standardized tool used in all hospital systems across England (Royal College of Physicians, 2017). In Canada, hospitals have implemented the NEWS2 tool or other similar scoring systems (Vandervliet et al., 2021). In Newfoundland (NL), the Burin Peninsula Health Care Centre within the Eastern Health Authority has started to use the NEWS2 tool. Unfortunately, hospitals within the metro St. John's region have yet to implement such a clinical scoring system into patient care in the inpatient setting. Therefore, in an effort to improve the identification/management of acutely

deteriorating patients in a tertiary centre in St. John's, an educational workshop was developed

for the nurses of a medical ward (4 South A) at the Health Sciences Centre.

Planning

The Health Sciences Centre is the tertiary care centre serving NL, located in St. John's. It

houses 346 acute care beds, 90 of which are acute medicine beds. Within the hospital there are

three acute care medical units, all of which are located on the fourth floor (4 South A, 4 South B,

and 4 North A). 4 South A specializes in the care of patients with renal and respiratory medical

issues, as well as other general medicine concerns. This unit was identified as the appropriate

medicine unit to deliver the educational workshop due to the writer's familiarity with the ward

and patient population. Additionally, ongoing efforts are currently underway for the development

of a special care unit/step-down unit on this ward. The literature indicates that special care units

are often associated with the use of various EWS tools to help identify patients who require a

higher level of care (Balshi et al., 2020), thus, making 4 South A appropriate for the QI project.

The manager of 4 South A at the time of the project, and Regional Medicine Program

Manager, were approached with the idea of the QI project. Preliminary consultations occurred

during the months of May to August, and a proposal was sent and approved by the Regional

Director of Medicine.

Workshop Development

After completing a literature review to assess the current evidence related to EWS tools

and related educational aspect of clinical deterioration on general medical/surgical wards, it was

evident that use of such tools can be beneficial to patient outcomes (Alam et al., 2014). The

literature review also demonstrated the importance of education prior to implementation of such

scoring systems to ensure appropriate utilization. Additionally, it identified barriers and facilitators that ward nurses experience when using the tool, and, also reviewed teaching-learning strategies used to educate bedside nurses about clinical deterioration.

Using an evidence-based approach, an educational workshop was developed. It was determined that a PowerPoint slide presentation and lecture would be most appropriate for the nursing audience (Buckley & Gordon, 2011; Cooper et al., 2013). The review also indicated that many nursing education workshops use a multimodal approach to learning. The use of simulation labs was often cited as the most valuable means for educating nursing staff about clinical deterioration and use of an EWS tool (Liaw et al., 2016). Unfortunately, due to gathering limitations as a result of the COVID-19 pandemic, it was concluded that a simulation lab would not be possible. However, the literature review also found that use of case studies was another valuable means to educate ward nurses about acute clinical decline (Harvey et al., 2014). Therefore, case studies were developed and incorporated into the PowerPoint presentation. During the development of the workshop, facilitator notes were also developed to aid with the delivery of the workshop, and implementation of the NEWS2 tool. This was deemed important, as prior to implementation of the NEWS2 tool on the units of the metro region of Eastern Health hospitals, nurse educators will require facilitator notes to standardize the educational experience.

Collaboration

Collaboration occurred with multiple staff members from Eastern Health. Prior to, and during the development of the workshop, informal consultations took place with the medicine manager of the Burin Peninsula Health Care Centre in NL. The medicine unit within the Burin Hospital was the location of a previous pilot project for the NEWS2 tool. The manager gave suggestions towards the workshop and discussed how the education session was delivered to

staff nurses at that location. Additionally, the writer also consulted with the patient care coordinator of the medicine unit at the Burin Hospital and a senior nurse who was heavily involved in the planning and implementation of the NEWS2 tool. Consultations mainly took part over email, and the stated individuals discussed issues that arose during the pilot project and certain obstacles they faced during the education sessions. These concerns were taken into consideration during the workshop development for 4 South A.

Specific to 4 South A, the writer consulted with the regional medicine program manager, patient care coordinator, and nurse educator to discuss the workshop. These individuals all have extensive education and knowledge of the unit. Several online meetings occurred with the regional program manager and educator to finalize specific dates and times for delivery of the workshop. The patient care coordinator and unit educator acted as valuable individuals to promote the workshop, as they work daily with the ward nurses. As per policy of Eastern Health, the professional practice department was involved to oversee the educational material and give recommendations. The finalized workshop was sent to members of professional practice for approval prior to the delivery date. No significant modifications to the workshop were required.

<div align="center">**Ethical Considerations**</div>

The consultations during the development phase of the workshop were informal in nature. Consent and agreement to collaborate with the writer were inferred with written email responses. All participant collaboration was voluntary. To determine if review by the ethics board was required the Health Research Ethics Authority Screening Tool (HREA, 2021) was used. As per item number 1, it was determined that ethical review was not necessary as it is a quality improvement project (Appendix I).

Part II

Workshop Slides and Facilitator's Guide

Clinical Deterioration and the NEWS2 Tool Workshop

Clinical Deterioration & The NEWS2 Tool

Grace Halley
Memorial University of Newfoundland
Master of Science in Nursing

Facilitator note: * Introduce yourself and the topic. Clinical deterioration is not new, and is a global issue. The NEWS2 is a tool that aids to identify clinical decline early and can potentially improve patient outcomes. The purpose of the workshop is to discuss clinical decline on the medical unit and how the tool can be utilized to assist nurses.

Objectives

☐ Discuss and describe clinical deterioration on medical wards.

☐ Learn about Early Warning Scores.

☐ Describe how the National Early Warning Score 2 (NEWS2) system operates on a medical ward.

☐ Calculate the NEWS2 in case studies to predict escalation of medical care.

Facilitator note: *Discuss the first portion will summarize clinical deterioration, then followed by the NEWS2 tool. The second portion will then use case studies to gain a better understanding of the tool.

What is Clinical Deterioration?

- Hospitalized patients may be at risk of clinical deterioration.

- Often defined as:
  - A serious physiological disturbance
  - Loss of ability to maintain homoeostatic function

- Objective and subjective medical data help to define deterioration.

Padilla & Mayo, 2018

Facilitator note: We all know all hospitalized patients are at risk of clinical deterioration. When you look in the literature there are several definitions that describe this phenomenon. However, it is most commonly described as a variation in physiological parameters, describing how a patient moves into a negative dynamic state, losing their ability to maintain homeostatic function. This is generally exhibited through a change in the patient's physiological parameters.

Can be defined by both objective and subjective data.

Objective: Most common way to assess deterioration, and often a real time indicator of clinical deterioration (e.g. monitoring vital signs).

Subjective: Clinical intuition, or nurses "sense of clinical doom"

Clinical Deterioration

☐ Acute deterioration is not uncommon on medical wards.

☐ Occurring more frequently on medical wards due to:
  ☐ Multiple co-morbidities
  ☐ Older population

☐ Associated with serious adverse events.

Facilitator note: As you all know clinical deterioration is not uncommon on 4 South A. Now more than ever, the acuity on wards is increasing. This is due to our older population, and with that comes multiple co-morbidities. These issues together increase a patient's risk for clinical decline.

Serious Adverse Events

- Development of sepsis
- Cardiac arrest
- Respiratory arrest
- Death
- Unplanned ICU transfer

Al-Qahtani & Al-Dorzi, 2010

Facilitator note: Early recognition of deterioration on a hospital ward is critical for patient outcomes. If these clinical changes are not identified early than we run the risk of a serious adverse event.

Predicting Deterioration

☐ Patients generally show warning signs 6-8 hours prior to a serious adverse event.

☐ Warning signs typically characterized by significant physiological disturbances:
   ☐ Hypotension/ hypertension
   ☐ Bradypnea/ Tachypnea
   ☐ Increased/ decreased temperature
   ☐ Bradycardia/ Tachycardia
   ☐ Confusion

Facilitator note: So how do we assess for clinical deterioration? As mentioned previously objective data is our main indicator! Interestingly, the literature shows that patients typically exhibit warning signs 6-8 hours prior to a SAE, and some studies even suggest as long as 24 hours (Mitchell et al., 2010)!

Facilitator note: Therefore main take away is Early detection = Improved patient outcomes!

Nursing Responsibility

☐ Play a pivotal role in recognizing deterioration.

☐ Nurses work closely with patients
  ☐ Assessments
  ☐ Vital signs
  ☐ Administration of medications
  ☐ Have a unique opportunity to detect subtle clinical changes

Al-Moteri et al., 2019

Facilitator note: As nurses, we are the healthcare professionals who work the most closely with our patients of all healthcare providers, we provide 24/7 care to our patients, and, therefore, play a pivotal role in recognizing clinical deterioration. Therefore, this allows us a unique opportunity to pick up on subtle clinical changes that our patients may be displaying.

Nursing Responsibility

- Essential to identify and respond to patient deterioration through pertinent observations & assessment

- Early intervention and management can improve patient outcomes

- Thus effective monitoring of vital signs, documentation, and communication is crucial

Al-Moteri et al., 2019

Facilitator notes: Therefore it is essential that we identify and respond to acute decline through pertinent observations. Identifying and recognizing changes early can allow for early interventions to prevent further decline and potentially stabilize the patient.

Unfortunately…

☐ Failure to rescue is common on acute care wards

☐ Sometimes clinical deterioration is not identified

☐ Timely recognition and response is a concern

Al-Moteri et al., 2019

Facilitator note: In saying this, unfortunately this cannot always go as planned and failure to rescue (as termed in the literature) is common on general acute care wards.

Can anyone think of why this might go missed?

*Pause here for responses

Possible answers: novice nurses, burn out, high nurse to patient ratios, short staffed

What Causes Failure to Rescue?

- Lack of awareness of signs and symptoms
- Vital signs not monitored consistently
- Inexperience
- Ineffective communication
- Subtle changes missed

- Lack of confidence
- Distractions
- Increased workload
- Burnout
- Unsure of how to escalate care

Facilitator note: Unfortunately many factors play a role in nurse's ability to identify and recognize early stages of acute clinical decline

*Pause here for discussion

What Has Been Done??

Facilitator note: How do we address this issue?

What has been done to help nurses pick up on these clinical clues and identify clinical deterioration early to prevent serious adverse events?

Pause here for response

Early Warning Scores

Facilitator note: Early Warning Scores have been developed to help monitor and track clinical deterioration. Has anyone heard of or have an idea of what an early warning score is?

Early Warning Scores

☐ Early warning scores have been developed to aid the medical team in identifying clinical deterioration.

☐ Facilitate early recognition by categorizing patients' severity of illness and prompting nursing staff to request a medical review at specific thresholds.

  ☐ Improve patient outcomes
  ☐ Decrease adverse events

Mitchell et al., 2010

Facilitator note: By identifying patients early, action can take place, potentially preventing adverse events. The systems rely on routinely collected physiological parameters, where changes prompt an action. Responses may range from a simple action such as increasing observation times to more complex action such as alerting the medical team.

These systems help to: decrease adverse events, and improve patient outcomes

National Early Warning Score 2 (NEWS2)

Facilitator note: The National Early Warning Score 2 (NEWS2) has been implemented across all hospitals in the UK, (Royal College of Physicians, 2017). As mentioned at the beginning of the workshop Eastern Health has started implementation of this tool in more rural areas, and will soon be implemented to the metro region.

NEWS 2 Tool

- Standardized tool

- Originally developed in 2012
  - Updated in 2017

- Used to assess, monitor, and track acute care patients by:
  - Assessing illness severity
  - Detecting clinical deterioration
  - Aiding in initiating a clinical response

Royal College of Physicians, 2017

Facilitator note: Originally developed in 2012 by the Royal College of Physicians in the United Kingdom. The tool was further updated in 2017, which will be discussed further.

NEWS2 Tool

☐ Simple aggregate scoring system based on vital signs.

☐ A score is allocated to 6 physiological parameters:
- ☐ Respiration rate
- ☐ Oxygen saturation
- ☐ Systolic blood pressure
- ☐ Heart rate
- ☐ Level of consciousness or new confusion
- ☐ Temperature

Royal College of Physicians, 2017

Facilitator note: So how exactly does the tool work? It's a simple scoring system in which a score of 0-3 is allocated to a single physiological value.

NEWS2 Tool

- Two scales for oxygen saturation
  - Patients without hypercapnic respiratory disorders
  - Patients with hypercapnic respiratory disorders (e.g.: COPD)

- Each physiological value can receive a score of 0-3

- Scores are totaled together

- Total score ranges from 0-20
  - Higher score = great risk for clinical deterioration

Echevarria et al., 2019; Nazarko, 2020

Facilitator note: The NEWS2 tool is different than other early warning scores as it has two oxygen scales. Patients with hypercapnic respiratory disorders (e.g.: COPD) whose base SpO2 level is generally lower are scored on a different scale compared to patients without hypercapnic pulmonary disorders. The score ranges from 0 to 20; the higher the score, **the higher the risk of clinical deterioration**

Based on the total score, various medical interventions are suggested to optimize patient care with the goal of preventing a SAE (Smith et al., 2008). Once this tool is implemented, the electronic medical record (e.g. Meditech) will auto-calculate this score.

Chart 1: The NEWS scoring system

Physiological parameter	Score 3	Score 2	Score 1	Score 0	Score 1	Score 2	Score 3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO₂ Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO₂ Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

Royal College of Physicians, 2017

Facilitator note: Typically, this would be auto-calculated by the electronic medical record, so once the vitals are documented into the EMR then you get a real-time score. This is why for the scoring system it is important to document your patient's vital signs as you are taking them. In Burin, the score is auto-populated for the nurses in Meditech.

A score of 0 is given when the values are within normal limits, as you can see from the center row.

ACVPU Scale

ACVPU		
A	Alert	The patient is awake
C	Acute confusion	New onset of confusion, disorientation, delirium or any new alteration to mentation
V	Voice	The patient requires verbal stimulus to initiate a response
P	Pain	The patient requires a pain stimulus to initiate a response
U	Unresponsive	Unresponsive to all stimuli

Used in National Early Warning Score 2 (RCP, 2017)

Facilitator note: Anything other than alert gives the patient a score of 3. However, use your clinical judgement when considering this score (e.g. patient sleeping). If a patient has baseline dementia, then they would not score, as this is their baseline. **It's anything that's considered new.** *Ask for examples of how to assess pain stimuli (e.g. sternal rub, pressure to nail bed).

Triggers

NEW score	Clinical risk	Response
Aggregate score 0–4	Low	Ward-based response
Red score Score of 3 in any individual parameter	Low–medium	Urgent ward-based response*
Aggregate score 5–6	Medium	Key threshold for urgent response*
Aggregate score 7 or more	High	Urgent or emergency response**

* Response by a clinician or team with competence in the assessment and treatment of acutely ill patients and in recognising when the escalation of care to a critical care team is appropriate.

**The response team must also include staff with critical care skills, including airway management.
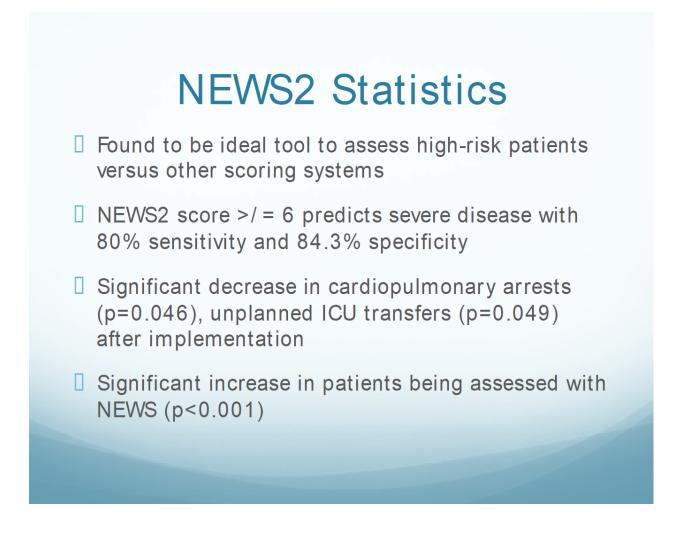
Facilitator note: Review chart. Explain as the NEWS2 score gets higher, the higher the clinical risk to decline, and nurse responses/interventions become more urgent.

Chart 4: Clinical response to the NEWS trigger thresholds

NEW score	Frequency of monitoring	Clinical response
0	Minimum 12 hourly	• Continue routine NEWS monitoring
Total 1–4	Minimum 4–6 hourly	• Inform registered nurse, who must assess the patient • Registered nurse decides whether increased frequency of monitoring and/or escalation of care is required
3 in single parameter	Minimum 1 hourly	• Registered nurse to inform medical team caring for the patient, who will review and decide whether escalation of care is necessary
Total 5 or more Urgent response threshold	Minimum 1 hourly	• Registered nurse to immediately inform the medical team caring for the patient • Registered nurse to request urgent assessment by a clinician or team with core competencies in the care of acutely ill patients • Provide clinical care in an environment with monitoring facilities
Total 7 or more Emergency response threshold	Continuous monitoring of vital signs	• Registered nurse to immediately inform the medical team caring for the patient – this should be at least at specialist registrar level • Emergency assessment by a team with critical care competencies, including practitioner(s) with advanced airway management skills • Consider transfer of care to a level 2 or 3 clinical care facility, ie higher-dependency unit or ICU • Clinical care in an environment with monitoring facilities

Facilitator note: Review threshold chart. *Discuss this is recommendation by Royal College of Physicians of London. If the responsible medical team has more frequent vital signs ordered, follow the physician order.

Allow time for questions. Make sure participants understand the tool prior to moving on.

NEWS2 Statistics

- Found to be ideal tool to assess high-risk patients versus other scoring systems

- NEWS2 score >/ = 6 predicts severe disease with 80% sensitivity and 84.3% specificity

- Significant decrease in cardiopulmonary arrests (p=0.046), unplanned ICU transfers (p=0.049) after implementation

- Significant increase in patients being assessed with NEWS (p<0.001)

Facilitator note: Several studies have found the NEWS2 tool to be superior to other clinical scoring systems. More recently, studies have looked at the NEWS2 tool with regards to COVID and found that the tool is valuable in detecting patients likely to deteriorate.

Benefits of NEWS2

- Timely transfer of deteriorating patient to higher level of care (e.g.: special care unit, ICU)

- Decrease number of code blues on acute care wards

- Appropriate monitoring of patient

- Timely assessments and interventions

- **Improve patient outcomes**

Facilitator note: *Pause here for break prior to beginning case studies

Case Study 1

Mr. Smith is a 40 year old admitted with abdominal pain NYD. On assessment, Mr. Smith is alert and oriented x 3, pleasant and cooperative. His vital signs are:

- RR: 12 rpm
- Sp02 Scale 1: 96%
- Room Air
- BP: 120/60 mmHg
- HR: 60 bpm
- Conscious
- Temperature: 36.4 C

Facilitator note: Discuss with participants their thoughts on the patient's vital signs. Are they concerned? Promote discussion.

Case Study 1: Mr. Smith

Vital Signs

RR: 12 rpm

SpO2 Scale 1: 96%

Room Air

BP: 120/60 mmHg

HR: 60bpm

Conscious

Temp: 36.4

Chart 1: The NEWS scoring system

Physiological parameter	Score						
	3	2	1	0	1	2	3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO$_2$ Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO$_2$ Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

Facilitator note: *Pause here to allow calculation of score. Let participants discuss what they have calculated for the score.

Case Study 1

- Vital signs:
  - RR: 12 rpm
  - Sp02 Scale 1: 96%
  - Room Air
  - BP: 120/60 mmHg
  - HR: 60 bpm
  - Conscious
  - Temperature: 36.4 C

- Total score = 0

- Continuing monitoring as normal

Facilitator note: Discuss risk for clinical decline is small. Patients score is 0, as all vitals are within normal limits.

Case Study 1

You return to Mr. Smith's room to administer his morning medications and notice Mr. Smith appears tachypneic, diaphoretic, and drowsier. This alerts you to complete another assessment. His latest vital signs are now:

- RR: 24 rpm
- SpO2 Scale 1: 96%
- Room Air
- BP: 108/ 55 mmHg
- HR: 130 bpm
- Temperature: 38.1

Facilitator note: Discuss Mr. Smith's new vital signs. What do participants think about these values?

Case Study 1

Chart 1: The NEWS scoring system

Physiological parameter	Score						
	3	2	1	0	1	2	3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO₂ Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO₂ Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

Vital Signs

RR: 24 rpm

SpO2 Scale 1: 96%

Room Air

BP: 108/55 mmHg

HR: 130 bpm

Alert

Temp: 38.1

Facilitator note: *Pause here to allow calculation of score. Once participants have had a few minutes ask what score they calculated.

Vital Signs	NEWS2 Score
RR: 24 rpm	2
SpO2 Scale 1: 96%	0
Room Air	0
BP: 108/55 mmHg	1
HR: 130 bpm	2
Alert	0
Temp: 38.1	1

Chart 1: The NEWS scoring system

Physiological parameter	Score						
	3	2	1	0	1	2	3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO₂ Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO₂ Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

Total Score = 6

Facilitator note: *Discuss where the score comes from using the chart.

Case Study 1: Response

- Monitor vital signs every hour

- Request assessment from medical team
  - SBAR

- If LPN caring for patient consider transferring care to RN

Facilitator note: What is SBAR: Situation, background, assessment, and recommendation.

Case Study 2

Mrs. Full is a 75 year old admitted to the medicine unit with chronic kidney disease. At baseline her family states that Mrs. Full has a history of dementia. On assessment Mrs. Full's vital signs are:

- RR: 19
- SpO2 Scale 1: 97%
- Air or Oxygen: room air
- BP: 108/49
- HR: 102
- Temperature: 37.7

Facilitator note: Discuss the vital signs. Are participants concerned about the patient?

Case Study 2: Mrs. Full

Vital Signs

RR: 19

SpO2 Scale 1: 97%

Room air

BP: 108/49

HR: 102

Baseline dementia

Temp: 37.7

Chart 1: The NEWS scoring system

Physiological parameter	Score						
	3	2	1	0	1	2	3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO₂ Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO₂ Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

Facilitator note: *Pause here to allow calculation of score

Vital Signs	NEWS2 Score
RR: 19	0
SpO2 Scale 1: 97%	0
Room air	0
BP: 108/ 49	1
HR: 102	1
Baseline dementia	0
Temp: 37.7	0
	Total Score = 2

Chart 1: The NEWS scoring system

Physiological parameter	Score						
	3	2	1	0	1	2	3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO₂ Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO₂ Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

Facilitator note: *Discuss where the score comes from using the chart.

Case Study 2: Response

- Clinical risk for deterioration is low

- Ward-based interventions

- RN to decide is increase frequency of monitoring is to be completed

Case Study 3

Mr. Butler is a 55 year old admitted with exacerbation of COPD, CO2 retainer, on home oxygen with acute SOB x 2 days, notably in distress. His vital signs are:

- Respirations: 30 rpm
- SpO2 scale 2: 94%
- Air or Oxygen: Oxygen
- BP: 74/30
- Pulse: 125 bpm
- Consciousness: responds to voice
- Temperature: 36.6

Facilitator note: Prior to moving ahead discuss the patient's vital signs. What vitals are outside of the normal limit? What are participants concerned about?

Case Study 3: Mr. Butler

Vital Signs

RR: 30

SpO2 Scale 2: 94%

Receiving O2

BP: 74/30

HR: 125 bpm

Responds to voice

Temp: 36.6

Chart 1: The NEWS scoring system

Physiological parameter	Score						
	3	2	1	0	1	2	3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO$_2$ Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO$_2$ Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

Facilitator note: *Pause here to allow calculation of score

Vital Signs	NEWS2 Score
RR: 30	3
SpO2 Scale 2: 94%	1
Receiving Oxygen via NP	2
BP: 74/30	3
HR: 125 bpm	2
Responds to voice	3
Temp: 36.6	0
	Total Score = 12

Chart 1: The NEWS scoring system

Physiological parameter	3	2	1	Score 0	1	2	3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO₂ Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO₂ Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

Facilitator note: *Discuss where the score comes from using the chart.

Case Study 3: Response

- Continuous monitoring of vital signs

- RN to immediately inform medical team
  - SBAR
  - Medical team should assess quickly

- Potential ICU transfer or higher level of care

Next Steps

- Create focus/ working groups (e.g. key stakeholders)

- Education sessions

- Physician memo

- Posters

- Evaluation

- Expansion

Facilitator note: Once the quality and safety team begin the implementation process focus groups will be very important! If you are interested I recommend joining such groups.

Who would our key stakeholders be? (e.g. front line nurses, residents, physicians, respiratory therapists, members of IT department to develop key triggers for Meditech)

Lessons From Other Sites

☐ Physician engagement

☐ Timely documentation of vital signs

☐ Modifications may be required for chronic conditions

☐ Medically discharged patients/ ALC

Facilitator note: Physician engagement is imperative!

Timely documentation of vital signs is also a key factor for this tool to be beneficial.

For patients with chronic conditions, modifications may need to be made which the medical team will have to assess.

Facilitator note: *Allow time for questions and discussion.

References

Al-Moteri, M., Plummer, V., Cooper, S., & Symmons, M. (2019). Clinical deterioration of ward patients in the presence of antecedents: A systematic review and narrative synthesis. *Australian Critical Care : Official Journal of the Confederation of Australian Critical Care Nurses, 32*(5), 411–420. https://doi-org.qe2a-proxy.mun.ca/10.1016/j.aucc.2018.06.004

Al-Qahtani, S., & Al-Dorzi, H. M. (2010). Rapid response systems in acute hospital care. *Annals of Thoracic Medicine, 5*(1), 1–4. https://doi-org.qe2a-proxy.mun.ca/10.4103/1817-1737.58952.

Badr, M. N., Khalil, N. S., & Mukhtar, A. M. (2021). Effect of National Early Warning Scoring System Implementation on Cardiopulmonary Arrest, Unplanned ICU Admission, Emergency Surgery, and Acute Kidney Injury in an Emergency Hospital, Egypt. *Journal of multidisciplinary healthcare, 14*, 1431–1442. https://doi-org.qe2a-proxy.mun.ca/10.2147/JMDH.S312395. Available at: https://pubmed-ncbi-nlm-nih-gov.qe2a-proxy.mun.ca/34163171/

Echevarria, C., Steer, J., & Bourke, S. C. (2019). Comparison of early warning scores in patients with COPD exacerbation: DECAF and NEWS score. *Thorax, 74*(10), 941–946. https://doi-org.qe2a-proxy.mun.ca/10.1136/thoraxjnl-2019-213470

Martín-Rodríguez, F., López-Izquierdo, R., Del Pozo Vegas, C., Delgado Benito, J. F, Carbajosa Rodríguez, V, Diego Rasilla, M. N., Martín Conty, J. L., Mayo Iscar, A., Otero de la Torre, S., Méndez Martín, V, & Castro Villamor, M. A. (2019). Accuracy of National Early Warning Score 2 (NEWS2) in Prehospital Triage on In-Hospital Early Mortality: A Multi-Center Observational Prospective Cohort Study. *Prehospital and disaster medicine, 34*(6), 610–618. https://doi-org.qe2a-proxy.mun.ca/10.1017/S1049023X19005041

Miles, A. H., Spaeder, M. C., & Stockwell, D. C. (2016). Unplanned ICU transfers from npatient units: Examining the prevalence and preventability of adverse events associated with ICU transfer in pediatrics. *Journal of Pediatric Intensive Care, 5*(1), 21–27. https://doi-org.qe2a-proxy.mun.ca/10.1055/s-0035-1568150

Mitchell, I. A., McKay, H., Van Leuvan, C., Berry, R., McCutcheon, C., Avard, B., Slater, N., Neeman, T., & Lamberth, P. (2010). A prospective controlled trial of the effect of a multi-faceted intervention on early recognition and intervention in deteriorating hospital patients. *Resuscitation, 81*(6), 658–666. https://doi-org.qe2a-proxy.mun.ca/10.1016/j.resuscitation.2010.03.001.

Myrstad, M., Ihle-Hansen, H., Tveita, A. A., Andersen, E. L., Nygård, S., Tveit, A., & Berge, T. (2020). National Early Warning Score 2 (NEWS2) on admission predicts severe disease and in-hospital mortality from Covid-19 - a prospective cohort study. *Scandinavian journal of trauma, resuscitation and emergency medicine, 28*(1), 66. https://doi-org.qe2a-proxy.mun.ca/10.1186/s13049-020-00764-3

Nazarko, L. (2020, April 1). *How to read the NEWS: The new early warning system.* Www.independentnurse.co.uk. Available at: https://www.independentnurse.co.uk/professional-article/how-to-read-the-news-the-new-early-warning-system/218551/

Padilla R. M, & Mayo A. M. Clinical deterioration: A concept analysis. *Journal of Clinical Nursing.* 2018, (7-8):1360-1368. doi: 10.1111/jocn.14238. Epub 2018 Feb 15. PMID: 29266536.

Royal College of Physicians. (2017, December 19). *National Early Warning Score (NEWS)* 2. Royal College of Physicians London; Royal College of Physicians. https://www.rcplondon.ac.uk/projects/outputs/national-early-warning-score-news-2

Part III

Workshop Evaluation

Evaluation

The workshop was delivered on two separate dates via Microsoft Teams. Two dates were offered to give nursing staff an opportunity to select a date best suited for their schedule. Nurses were encouraged to join the workshop on their day off, as this would not interfere with their work routine. The patient care coordinator emailed an E-invite to all nursing staff of 4 South A one week prior to the first workshop. Attendance to the workshop was voluntarily, however, to increase attendance, Eastern Health agreed to pay staff straight time for one hour, as they recognized the value of this workshop. A total of 20 staff nurses attended the two workshops. Currently, 4 South A employs a total of 30 staff nurses. The workshop was approximately one hour including time for discussion and questions. At the end of each workshop, staff members were asked to complete a voluntarily anonymous evaluation survey. After consultation with the nurse educator, it was agreed that the survey would be handed out on the unit for staff members to complete and return during working hours. In-person and email reminders from the patient care coordinator were sent to the nurses one week after the workshop. The surveys were collected two weeks after the date of the workshop, with a total of 13 completed surveys (Appendix II).

Results

The evaluation survey consisted of nine Likert style statements, scored from 1 to 5, and six open-ended questions (Appendix II). The results from the survey provide an overview of participants' thoughts and opinions towards the delivery of the workshop, as well as the NEWS2 tool. Regarding the Likert portion of the survey, the mean total score was 43, with eight surveys scoring above the total mean. Results ranged from a score of 39 to 45. The median total score

was 44. The median score for each individual statement was 5. Results of each question follow below:

Statement one. "The presentation was clear and easy to understand". The mean score for this statement was 5. Results from this statement concluded that the workshop was clear to follow and comprehend, thus requiring no modifications to be made for the overall delivery and presentation of the workshop.

Statement two. "The workshop was useful to my clinical practice on 4 South A". The mean score for this statement was 4.77. This indicates that the staff found the workshop valuable and beneficial for their clinical practice and will be beneficial to use in the future for any new on-boarding of nurses to the unit.

Statement three. "The case studies gave me a better understanding of the NEWS2 tool and it's use in the clinical setting". The mean score for this statement was 4.92. Results from this statement indicated the importance and value of the case studies within the workshop. Having case studies allowed participants to calculate the score themselves and gain a better understanding of the score.

Statement four. "The information provided was sufficient to allow me to use the NEWS2 tool on the unit". The mean score for this statement was 4.77. This shows the importance of a workshop prior to implementation. Once Eastern Health implements the NEWS2 tool within the metro region, it will be beneficial to use the developed workshop to educate nurses about the scoring tool for clinical deterioration.

Statement five. "After attending the workshop I feel more confident in my ability to recognize clinical deterioration". The mean score for statement five was 4.62. This statement

indicates that many nurses feel that the workshop was useful in gaining knowledge in the recognition of clinical deterioration.

Statement six. "After attending the workshop I feel more confident in my clinical skills". The mean score for this statement was 4.38. This was the lowest mean for all of the statements. However, this score still indicates that many participants felt the workshop aided in their clinical skills as a nurse.

Statement seven. "The NEWS2 will be easy to use in the clinical setting". The mean score for this statement was 4.85. This is a valuable score, and will be beneficial for professional practice. This indicates that the participants of the workshop feel confident and ready for the NEWS2 tool to be implemented into practice. Although this statement does not directly impact the workshop, it shows that staff nurses are ready and willing for change to occur.

Statement eight. "Once the NEWS2 tool is implemented, I feel it will be useful for my nursing practice". The mean score for this statement was 4.85. This suggests that participants feel that the NEWS2 tool will add value to their nursing practice, and are ready for change in their clinical practice. These positive results also will allow professional practice to gain a greater understanding of how the tool will be accepted once implemented.

Statement nine. "I'm happy with the amount of information presented in today's workshop". The mean score for this statement was 4.85. This score implies that the workshop was the appropriate length. Developing the workshop, it was important to ensure all appropriate information was provided, however, also crucial not the overwhelm participants.

It can be inferred from the results that the NEWS2 tool workshop was beneficial based on the high scores in the collected surveys. As part of the survey, participants were given the

opportunity to answer six open-ended questions. Due to the nature of the data it is difficult to present the results in full. Please see Appendix III for a variety of answers of each question. In general the presentation was received well, and the objectives of the workshop were met. One major issue outlined included, the oxygen scale on the scoring chart. More specifically, the scoring chart itself does not discriminate the 'type' of oxygen the patient is receiving. Therefore, a patient receiving 1 litre of oxygen via nasal prongs compared to a patient receiving 70% via high-flow oxygen would receive the same score. Another issue outlined was that during the case study portion of the workshop the chart was in a separate screen making it difficult for participants to calculate a score. Therefore, changes were made so case studies are side-by-side with the scoring chart allowing future participants more ease when calculating the score. Participants also mentioned that it would be beneficial to see statistics of beneficial outcomes of the tool with regards to ICU transfers, and other outcomes. Therefore, a slide was added to show statistical evidence of the tool. Changes to the workshop have been made in the above slides.

Next Steps

Results from the pilot workshop evaluation will be submitted to members of Eastern Health. This will include, members of professional practice department, quality improvement (QI), the Regional Medicine Program Manager, and Regional Director of Medicine. The results from the evaluation of the pilot workshop will be valuable to QI and professional practice as it shows a measurable means to determine the success of the workshop and NEWS2 tool within the medicine program.

Once implementation plans begin by the professional practice and QI team, with the permission of Eastern Health, the writer will reach out to the current manager of 4 South A and other medicine units to review the educational workshop. It will also be important to meet with

the nurse educator to discuss the workshop and facilitator notes, as the nurse educator will be delivering future workshops. Additionally, it will be important to include the workshop in the site orientation for novice nurses entering the medicine program. The implementation of this workshop and tool will provide a valuable resource to staff nurses caring for ward patients who have the potential to deteriorate. Most important, once implemented, this workshop has the potential to change patient outcomes with the goal of saving lives.

References

Al-Qahtani, S., & Al-Dorzi, H. M. (2010). Rapid response systems in acute hospital care. *Annals of thoracic medicine*, *5*(1), 1–4. https://doi-org.qe2a-proxy.mun.ca/10.4103/1817-1737.58952.

Alam, N., Hobbelink, E. L., van Tienhoven, A. J., van de Ven, P. M., Jansma, E. P., & Nanayakkara, P. W. (2014). The impact of the use of the Early Warning Score (EWS) on patient outcomes: A systematic review. *Resuscitation*, *85*(5), 587–594. https://doi-org.qe2a-proxy.mun.ca/10.1016/j.resuscitation.2014.01.013.

Badr, M. N., Khalil, N. S., & Mukhtar, A. M. (2021). Effect of National Early Warning Scoring System Implementation on Cardiopulmonary Arrest, Unplanned ICU Admission, Emergency Surgery, and Acute Kidney Injury in an Emergency Hospital, Egypt. *Journal of multidisciplinary healthcare*, *14*, 1431–1442. https://doi-org.qe2a-proxy.mun.ca/10.2147/JMDH.S312395.

Balshi, A. N., Huwait, B. M., Noor, A., Alharthy, A. M., Madi, A. F., Ramadan, O. E., Balahmar, A., Mhawish, H. A., Marasigan, B. R., Alcazar, A. M., Rana, M. A., & Aletreby, W. T. (2020). Modified Early Warning Score as a predictor of intensive care unit readmission within 48 hours: a retrospective observational study. Modified Early Warning Score como preditor de readmissão à unidade de terapia intensiva dentro de 48 horas: um estudo observacional retrospectivo. *Revista Brasileira de terapia intensiva*, *32*(2), 301–307. https://doi-org.qe2a-proxy.mun.ca/10.5935/0103-507x.20200047.

Buckley, T., & Gordon, C. (2011). The effectiveness of high-fidelity simulation on medical-

surgical registered nurses' ability to recognise and respond to clinical emergencies. *Nurse*

Education Today, *31*(7), 716–721. https://doi-org.qe2a-

proxy.mun.ca/10.1016/j.nedt.2010.04.004.

Cooper, S., Cant, R., Porter, J., Missen, K., Sparkes, L., McConnell-Henry, T., & Endacott, R.

(2013). Managing patient deterioration: Assessing teamwork and individual

performance. *Emergency Medicine Journal : EMJ*, *30*(5), 377–381. https://doi-org.qe2a-

proxy.mun.ca/10.1136/emermed-2012-201312.

Fuhrmann, L., Lippert, A., Perner, A., & Østergaard, D. (2008). Incidence, staff awareness and

mortality of patients at risk on general wards. *Resuscitation*, *77*(3), 325–330. https://doi-

org.qe2a-proxy.mun.ca/10.1016/j.resuscitation.2008.01.009.

Furlan, L., Gianni, F., & Costantino, G. (2022). Prediction tools in clinical practice: Carefully

read instructions before use. *European journal of internal medicine*, *98*, 37–38.

https://doi-org.qe2a-proxy.mun.ca/10.1016/j.ejim.2022.02.003.

Harvey, E. M., Echlos, S. R., Clark, R., & Lee, E. (2014). Comparison of two TeamSTEPPS

training methods on nurse failure-to-rescue performance. *Clinical Simulation in Nursing,*

10(2), e57-e64. https;//doi-org.qe2a-proxy.mun.ca/10.1016/j.ecns.2013.08.006.

Health Research Ethics Authority Ethics review required? Health Research Ethics Authority.

(n.d.). Retrieved October 2, 2022, from https://www.hrea.ca/how-to-apply/ethics-review-

required/

Leuvan, C. H., & Mitchell, I. (2008). Missed opportunities? An observational study of vital sign

measurements. *Critical care and resuscitation : journal of the Australasian Academy of*

Critical Care Medicine, *10*(2), 111–115.

Liaw, S. Y., Wong, L. F., Lim, E. Y., Ang, S. B., Mujumdar, S., Ho, J. T., Mordiffi, S. Z., &

Ang, E. N. (2016). Effectiveness of a web-based simulation in improving nurses'

workplace practice with deteriorating ward patients: A pre- and post-intervention

Study. *Journal of Medical Internet Research*, *18*(2), e37. https://doi-org.qe2a-

proxy.mun.ca/10.2196/jmir.5294.

Mok, W. Q., Wang, W., & Liaw, S. Y. (2015). Vital signs monitoring to detect patient

deterioration: An integrative literature review. *International Journal of Nursing*

Practice, *21 Suppl 2*, 91–98. https://doi-org.qe2a-proxy.mun.ca/10.1111/ijn.12329.

Odell, M., Victor, C., & Oliver, D. (2009). Nurses' role in detecting deterioration in ward

patients: Systematic literature review. *Journal of Advanced Nursing*, *65*(10), 1992–2006.

https://doi-org.qe2a-proxy.mun.ca/10.1111/j.1365-2648.2009.05109.x.

Purling, A., & King, L. (2012). A literature review: Graduate nurses' preparedness for

recognising and responding to the deteriorating patient. *Journal of clinical*

nursing, *21*(23-24), 3451–3465. https://doi-org.qe2a-proxy.mun.ca/10.1111/j.1365-

2702.2012.04348.x.

Royal College of Physicians. (2017, December 19). *National Early Warning Score (NEWS) 2*.

Royal College of Physicians London; Royal College of Physicians.

https://www.rcplondon.ac.uk/projects/outputs/national-early-warning-score-news-2

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Skitch, S., Tam, B., Xu, M., McInnis, L., Vu, A., & Fox-Robichaud, A. (2018). Examining the

utility of the Hamilton early warning scores (HEWS) at triage: Retrospective pilot study

in a Canadian emergency department. *CJEM, 20*(2), 266–274. https://doi-org.qe2a-

proxy.mun.ca/10.1017/cem.2017.21.

Vandervliet, T., Flemming, S., & Rathwell, M. (2021, January 11). *Nurses implement early*

warning system to detect patient deterioration. Community.cna-Aiic.ca. https://www.cna-

aiic.ca/dev-cn-en/blogs/cn-content/2021/01/11/nurses-implement-early-warning-system-

to-detect-pa

Appendix I: Health Research Ethics Authority (HREA) Screening Tool

Student Name: Grace Halley

Title of Practicum Project: The Development of an Educational Workshop for Ward Nurses to Improve Management and Identification of Deteriorating Ward Patients

This project is exempt from HREA approval because it matches item number 1 from the list below.

The following are examples of activities that do not require review by a research ethics board (REB). These may, nevertheless, raise ethical issues that would benefit from careful consideration outside of the REB.

1. Quality assurance and quality improvement studies, program evaluation activities, performance reviews, and testing within normal educational requirements if there is no research question involved (see below for further information);

2. Research that relies exclusively on publicly available information when the information is legally accessible to the public and appropriately protected by law; or the information is publicly accessible and there is not reasonable expectation of privacy;

3. Research involving naturalistic observation in public places (where it does not involve any intervention staged by the research, or direct interaction with the individual or groups; individuals or groups targeted for observation have no reasonable expectation of privacy; and any dissemination of research results does not allow identification of specific individuals);

4. Research based on review of published/publicly reported literature;

5. Research exclusively involving secondary use of anonymous information or anonymous human biological materials, so long as the process of data linkage or recording or dissemination of results does not generate identifiable information;

6. Case reports which may be based on the clinical notes of an individual patient/client collected with informed consent; and

7. Creative practice activities (where an artist makes or interprets a work or works of art).

Appendix II: Workshop Evaluation Survey

Please indicate your level of agreement with the following statements using the 5-point

Likert, whereby '**1**'= strongly disagree, '**2**'= disagree, '**3**'= neither agree nor disagree, '**4**'= agree and, '**5**'= strongly agree.

Evaluation Statements	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1. The presentation was clear and easy to understand					
2. The workshop was useful to my clinical practice on 4 South A					
3. The case studies gave me a better understanding of the NEWS2 tool and it's use in the clinical setting					
4. The information provided was sufficient to allow me to use the NEWS2 tool on the unit					
5. After attending the workshop I feel more confident in the ability to recognize clinical deterioration					
6. After attending the workshop I feel more confident in my clinical skills					
7. The NEWS2 tool will be easy to use in the clinical setting					
8. Once the NEWS2 tool is implemented, I feel it will be useful for my nursing practice					
9. I'm happy with the amount of information presented in today's workshop					
TOTAL SCORE					

Open-ended questions:

1. What elements of the workshop did you enjoy the most?

_____
_____
_____

2. What, if anything, did you dislike about the workshop?

_____
_____
_____

3. How would you rate your overall learning experience?

_____
_____
_____

4. If you were participating in this workshop again in the future, what would you like to see added?

_____
_____
_____

5. Do you have any concerns about the NEWS2 tool being implemented in the future?

_____
_____
_____

6. Other comments?

_____
_____
_____

THANK YOU

Please return the completed questionnaire to the nursing unit on 4 South A

Appendix III: Examples of Short Answer Responses

What elements of the workshop did you enjoy the most?

    a. *"The fact that a patients clinical monitoring can be charted and used to track their improvement and/or deterioration. Thus patients outcomes have a better chance."*

    b. *"That there was a numerical value associated with a deteriorating clinical status. Often times our nursing judgement can be very subjective – "a feeling that something isn't right". This is a value that we can present to physicians (along with other nursing expertise) when a patient is declining."*

    c. *"I enjoyed the case study presented. It allowed a better understanding of the NEWS2 tool for the clinical setting."*

If you were participating in this workshop again in the future, what would you like to see added?

    a. *"Images were a bit hard to see when calculating scores. Not sure how you would fix this though, unless in person."*

    b. *"Case studies and NEWS2 scale side by side on a screen."*

    c. *"Any statistics regarding the success of the tool with ICU transfers."*

Do you have any concerns about the NEWS2 tool being implemented in the future?

    a. "*No, I think it will be an extremely valuable tool in the workplace."*

    b. *"Absolutely not. I believe it will be a great asset to nursing care and monitoring patient outcomes."*

    c. *"I think it will be a great asset to the unit. The only thing that many be beneficial to the tool is if oxygen amounts were included in the scale."*

d. *"The O2 section of the scoring is vague especially if the patient is on home O2 and on O2 in hospital, but makes sense to not make the tool/chart too long. Possible to implement when the tool is a part of Meditech?"*

e. *"No, only differentiating the amount and type of oxygen used."*