



LEARNING DEVELOPMENT AND PRACTICE

Learning and development opportunities for healthcare students to monitor vital signs and improve patient outcomes

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Abstract

Vital sign monitoring is a crucial component of patient care as it facilitates the detection of developing complications. This paper provides healthcare students with a practical guide for understanding the importance of monitoring vital signs, the tools available for intermittent and continuous monitoring, and the strategies and learning opportunities available to address and overcome common challenges surrounding vital signs monitoring. Normal adult physiological parameters are presented, including temperature, blood pressure, pulse rate, oxygen saturation and respiratory rate, essential for assessing a patient's status and recognising deterioration. The advantage of continuous monitoring is discussed for high-risk cases where early recognition is imperative because physiological changes can occur rapidly and indicate an impending or sudden severe deterioration, such as a cardiac arrest. Continuous vital sign monitoring enables health professionals to recognise early signs of deterioration more easily, particularly in intensive care units. Nevertheless, challenges exist for both continuous monitoring, such as difficulties in gaining precise continuous measurements, limited medical equipment to maintain continuous monitoring and the increased time required by health professionals to ensure that continuous monitoring is effective. As such, most clinical areas currently adopt intermittent vital signs monitoring using tools such as the National Early Warning Score (NEWS2). This means healthcare students must contribute towards decisions surrounding who requires continuous vital signs monitoring, the intervals or situations where measurement of vital signs is imperative for improving treatment and the recognition of vital signs changes that may indicate deterioration. This requires considerable skill and this paper outlines the learning opportunities available for healthcare students to develop skills and decision making surrounding vital signs monitoring that can improve outcomes for patients.

Keywords: *Vital signs monitoring; Physiological parameters; NEWS2*

Introduction

For healthcare students, vital sign monitoring is an essential skill because it enables changes in the condition of patients to be recognised, ensuring prompt and effective responses during clinical placements. The five vital signs used to assess the physiological status of the body include temperature, blood pressure (BP), heart rate (HR), oxygen saturation (SpO₂) and respiratory rate (RR). In healthy adults, normal vital sign ranges at rest are a temperature of 36.5 to 37.3 Celsius, BP between 90/60 and 120/80 mmHg, HR of 60 to 100 beats per minute, SpO₂ between 95% and 99% and RR of 12 to 18 breaths per minute (Ball et al., 2022). Undertaking the assessment of the vital signs enables health professionals to identify physiological changes that may indicate the presence of an underlying pathophysiological condition. This can aid clinical decision making and enable health professionals to determine the effectiveness of treatments (Mok et al., 2015a).

How are vital signs systematically monitored?

Intermittent vital signs monitoring using track and trigger systems have been used in hospitals to enhance the recognition and management of deteriorating adult patients (Wuytack et al., 2017). An example of such a system is the National Early Warning Score (NEWS2), which was developed and updated by the Royal College of Physicians (2017) and is used to enhance patient safety and outcomes. This system employs a scoring mechanism that considers six physiological parameters (RR, SpO₂, BP, HR, consciousness level, and temperature) that are commonly taken in hospitals (Treacy et al., 2022). Scores are then given depending on the deviation from the normal range to assist healthcare givers on the best actions to take to ensure positive outcomes for patients.

Key tools for monitoring vital signs

NEWS2 scoring system: Helps assess risk level for clinical deterioration by translating and assigning six key physiological parameters to a score.

RR: Measures the frequency of breaths, providing information about respiratory function and detecting signs of distress or physiological changes that are attributable to increased respiratory demand.

Pulse oximeter: Monitors oxygen saturation levels in the blood, by using red and infrared lights that pass through a part of the body such as the fingertip. Oxygenated and deoxygenated haemoglobin absorb the light sources differently so the device can measure how much light source passes through the body and provide a percentage of the oxygenated haemoglobin. This can aid in the detection of respiratory problems or can indicate an underlying condition that is increasing respiratory demand. This can include many conditions such as cardiac conditions or acute conditions like sepsis.

BP: Measures the pressure of the circulating blood against the vessel walls in mmHg when the heart contracts (systolic pressure) and when the heart relaxes (diastolic pressure) that can identify a range of conditions. Abnormal BP is caused by abnormalities in cardiovascular function, such as hypertension due to cardiovascular disease or shock due to loss of circulating volume known as hypovolaemic shock, a lack of perfusion to the heart muscle known as cardiogenic shock, shock related to a nervous system insult known as neurologic shock or septic shock which can result in a lack of circulating volume. Abnormalities in BP can be caused for other reasons that disrupt the normal cardiovascular function of the heart.

HR: HR is a measure of how many times the heart beats each minute and can aid in the detection of several diseases and causes for deterioration. The heartbeat is regulated by a series of mechanisms, all of which could lead to a change in rhythm or rate. The heart is a unique muscle that is myogenic meaning

that it creates its own electrical signals without input from the nervous system. Despite this, the nervous system can still influence HR through mechanisms which involve receptors that measure the pressure of blood leaving the heart called baroreceptors, which send signals to the brain and can prompt the release of hormones such as noradrenaline and adrenaline. Problems can occur with electrical signals in the heart muscle or with pressure of the blood leaving the heart for numerous reasons. Changes in HR are most often patterned with changes to BP. For example, if the circulating volume reduces due to large blood loss, there will be less pressure leaving the heart, so the heart rate will increase to maintain pressure. Clinically, less circulating volume results in lower BP and increased HR (tachycardia). HR changes may reflect heart function, and aid in identifying arrhythmias, tachycardia, or bradycardia, which can signal cardiac or systemic problems.

Consciousness level assessment: Evaluates neurological status, helping detect conditions like stroke, head injury, or altered mental status.

Body temperature: Detects hyperthermia or hypothermia, indicating infections or other systemic issues.

BOX 1. BENEFITS AND CHALLENGES OF SYSTEMATIC MONITORING

Benefits of systematic monitoring

NEWS2 could prevent more than 1,800 deaths per year caused by patient deterioration within hospital facilities (National Health Service (NHS) England, 2021). Comprehensive assessments of patient health integrate changes in vital signs, overall health status and other clinical indicators (Churpek et al., 2016). Early identification supports informed decision-making (Stellpflug et al., 2021).

Challenges of systematic monitoring

Inaccurate measurements, such as insufficient counting of a duration of 60 seconds for RR, can be misleading regarding the patient's condition (Brekke et al., 2019). Inconsistent application of monitoring protocols across facilities can limit effectiveness (Kayser et al., 2023).

Intermittent vs continuous monitoring of vital signs for detection of patient deterioration: Strengths and challenges

The practice of monitoring vital signs requires more than simply recording them manually at intervals, as this approach is not always successful in detecting sudden and long-term changes in the condition of a patient during a treatment regimen (Prgomet et al., 2016). Intermittent vital signs monitoring completed at incorrect intervals can lead to delays in treatment and ultimately, adverse outcomes.

Advancements in healthcare technology, such as wearable technologies, new digital tools and methods for continuous monitoring have revolutionised vital signs monitoring. For instance, it is now possible to track vital signs in real-time providing immediate data to healthcare professionals using many types of continuous monitoring technology (Cardona-Morrell et al., 2015). The use of such technology is common practice in hospitals, especially in intensive care units (ICUs) where the timely diagnosis of deterioration is essential. Healthcare professionals can detect the earliest symptoms of patient deterioration through continuous monitoring, making it an indispensable component of health-care practice in hospitals (Brekke et al., 2019).

Regular monitoring of vital signs by either intermittent monitoring or recording vital signs from continuous monitoring at intervals, is essential experience for healthcare students that enables development of skills in evaluating treatment effectiveness, detecting complications as early as possible and confidently

participating in clinical decision-making processes (Babar and Kanani, 2020). Students can gain experience in recognising changes in vital signs associated with infections, cardiovascular diseases, fluid imbalances, and numerous other outcomes (Considine et al., 2024).

In certain monitoring of vital signs is especially important for improving outcomes, such as in critical cases. In these situations, undertaking a vital signs assessment accurately provides the clinical team with crucial information related to the condition of a patient and subsequent treatment decisions (Da Silva, 2021). For instance, elevated BP and HR can prompt anticipation of the need for urgent resuscitation and timely response and treatment may prevent complications and ultimately be lifesaving (Mubthia et al., 2024).

Students need to be familiar with patterns of physiological change that may indicate specific underlying health issues. For instance, Septic shock may present with low BP, increased HR, low or high body temperature and increased RR that reflects the underlying pathophysiology and precedes life-threatening complications of sepsis such as cardio-pulmonary arrest (Nino et al., 2020). The holistic picture of the patient and the variations and patterning of vital signs over time can improve the effectiveness of recognising deterioration and improving outcomes. This is a limitation of NEWS2 because subtle changes in vital sign patterning may indicate impending deterioration that may not reach the level of triggering concern on the NEWS2 scoring. Being able to recognise vital signs patterning can enable earlier recognition of deterioration and improve treatment efforts and outcomes. This is true in acute and non-acute circumstances. For example, in patients receiving treatment for hypertension, an improvement in BP may indicate the value of the treatment but the NEWS2 score may not change (Sahu et al., 2022). Conversely, patterning changes of vital signs may imply the need for further diagnosis or modification of existing treatment, even when the scoring on NEWS2 does not change. Despite the significant advancements, challenges remain, such as using real-time data in decisions and the lack of standard protocols for vital signs (Giordano et al., 2021). Learning to address these issues helps students detect problems early, make better decisions, and improve patient safety and outcomes (Haegdorens et al., 2024).

This paper offers a comprehensive guide to vital sign monitoring for healthcare students. It starts by exploring the significance of monitoring and the main parameters used. Next, it examines tools like the National Early Warning Score (NEWS2) and discusses the difficulties students may face, such as inaccurate measures and resource limitations. Lastly, it provides useful methods for efficient monitoring, highlighting the role of these skills in improving patient safety, building confidence during clinical placements, and enhancing teamwork in healthcare settings.

Effectiveness of vital signs monitoring for improving outcomes

Several studies highlight the predictive value of vital sign monitoring in healthcare settings:

- **Physiological changes:** can occur six to 48 hours before events such as cardiac arrest and ICU admission (Sun et al., 2020).
- **Abnormal vital signs** found in 59% of patients one to four hours prior to cardiac arrest, with critically abnormal signs in 13% (Andersen et al., 2016).
- **Decline indicators:** 80% of patients displayed indications of a decline in vital signs 24 hours prior to a negative event (Trocki and Craig-Rodrigues, 2020).

Collectively, these studies emphasise the need for early identification and management of abnormal vital signs to prevent complications. Studies by Mok et al. (2015b) and Kayser et al. (2023) revealed that nurses' attitudes and practices determine the reliability of intermittent vital sign monitoring that accurately indicates a patient's health status. These studies suggest that vital sign monitoring is not always effective

and varies according to who is undertaking the assessment. However, it is worth noting that Mok et al.'s (2015b) research was undertaken at a single hospital, so the results may not be generalisable. One solution to variation according to individual practitioner is to undertake vital signs monitoring continuously. Stellpflug et al. (2021) demonstrated the potential for continuous monitoring with the help of tools, which can improve identification of the deterioration of a patient and Verrillo et al. (2019) observed that there are benefits of continuous monitoring in postoperative care. However, continuous monitoring requires advanced technology equipment which is costly and not widely available for every patient.

In 2015, 7% of acute hospital deaths and serious incidents reported to the National Reporting and Learning System were attributable to the failure to recognise or manage a patient's deterioration or to respond to it in a timely manner (NHS Improvement, 2016). Contributory factors may include improper and infrequent assessment and calculation of vital signs, leading to the generation of inaccurate assessment, and increased likelihood of a failure to recognise changes in the patient's status (Brekke et al., 2019). For instance, RR is often obtained incorrectly because it is not taken for the recommended full minute (Rimbi et al., 2019).

In addition to measurement issues, other factors that impact recognition of patient deterioration include a lack of resources in healthcare facilities and fluctuating patient status which can occur rapidly (Vincent et al., 2018). For instance, a rapid decrease in BP may suggest shock or haemorrhage, whilst fluctuations in SpO₂ may suggest respiratory problems (Richards and Wilcox, 2014). Identifying changes at the right time can help to promptly identify deterioration aiding timely decisions about treatment (Leenen et al., 2020). NHS Improvement (2016) indicates that lack of recognition or management of a patient's deterioration is one of several factors contributing towards hospital mortality. Other factors include a high workload, lack of resources, and the complexity of patients' diseases (Vincent et al., 2018). Resource constraints and staff shortages can impede the implementation of effective vital signs monitoring practice, while rapidly changing patient conditions and deterioration poses additional challenges (Griffiths et al., 2018). The effectiveness of vital sign monitoring also varies across different healthcare settings and students can prepare through engagement in real world learning opportunities to build skills in vital signs monitoring.

Real-world learning opportunities for building skills in vital signs monitoring

Vital signs monitoring should be undertaken and interpreted in context, meaning that individual patients and their unique health status and history should be critically considered in the interpretation of any assessment undertaken. This section summarises the opportunities that students can engage with to build skills in vital signs assessment

Case-based learning opportunities

Case-based learning can offer healthcare students opportunities to make judgments in situations that mimic real patient scenarios. A case study encourages students to apply theoretical knowledge to real-world problems through active processes of assessment, diagnosis, care planning, and evaluation of treatment options (Mahdi et al., 2020). The process of engaging with case studies encourages active learning and integration of knowledge specific to the context of cases, including individual related pharmacology, physiology, and individualised patient care planning. For example, a healthcare student could be presented with the case of a 65-year-old male with poorly controlled diabetes, hypertension, and a recent stroke. They would need to assess the patient's medical history, understand potential drug interactions, and suggest a treatment plan that addresses both the stroke and diabetes management. In so doing, the student would learn how to think critically and apply theoretical knowledge in a practical setting and case (Rizka et al., 2024).

Simulation-based learning opportunities

Simulation-based learning involves creating realistic practice scenarios where students can participate in undertaking clinical skills, such as vital signs monitoring in a controlled environment. This is especially useful for skills that present risk to patients' safety, such as managing a cardiac arrest or administering anaesthesia. Simulation provides opportunity for students to practice hands-on skills without any immediate pressure or risk to real patients (Sanasilapin and Karunasawat, 2023).

For example, A student may participate in a simulation where they must anticipate collapse by recognition of vital signs deterioration and perform Cardio-Pulmonary Resuscitation (CPR) on a mannequin in a simulated hospital setting. Aspects of the simulation may include time-based elements for vital signs monitoring and feedback on technique of monitoring and performing CPR. Individual simulation scenarios can provide students with individualised feedback about specific areas to improve vital signs monitoring, decisions made surrounding monitoring and on CPR, such as chest compression depth. Simulation enables students to learn in a low-pressure environment while encountering realistic vital signs deterioration scenarios which can build confidence in skills and abilities (Poudel, 2021).

Peer learning and collaborative opportunities

Healthcare is inherently collaborative, requiring effective teamwork between nurses, doctors, technicians, and other professionals. Peer learning exercises help students understand the dynamics of interprofessional collaboration and improve their communication and problem-solving skills (Frei-Landau and Levin, 2023). For example, in a group exercise, healthcare students might be asked to manage a patient in a simulated emergency room. Students can assume the roles of different professionals. The multi-professional team must communicate vital signs assessments effectively, make timely decisions collaboratively, and ensure they are effectively working together. Peer learning opportunities involving teamwork can build skills in teamwork that crucial to patient outcomes (Şipoş et al., 2024).

Simulated patient interaction opportunities

In healthcare, the ability to communicate clearly with patients and colleagues is essential. Students can practice patient interaction skills through communication-based simulation exercises following assessment of vital signs. This can include developing communication skills surrounding vital signs monitoring such as delivering bad news, explaining a concern or possible diagnosis, or reassuring an anxious patient (Kwame and Petrucka, 2020). Feedback from peers or instructors on communication style, tone, and clarity helps to refine students' skills and ability to handle sensitive conversations in real-world healthcare environments (Lee et al., 2020).

Time management skills in vital signs monitoring

Learning opportunities that enable time management and prioritisation skills in vital signs assessments for patients can aid student skills in leadership and decision making in real-world settings. Healthcare students often face demanding workloads involving multiple patients with varied needs. Learning opportunities that include time-management strategies, such as using a to-do list or the 'two-minute rule' (immediately tackling tasks that take less than two minutes), enables students to become more efficient in real-world settings (Molina-Mula and Gallo-Estrada, 2020).

Clinical reflection learning opportunities

Reflection allows healthcare students to critically evaluate their actions and decisions, learn from mistakes, and identify areas for improvement. In clinical practice, students reflect on their experiences and integrate their observations into their learning (Cattani Rentes, 2023). Vital signs monitoring can inform clinical reflection on assessments and decision making that may improve patient care and outcomes. Reflection on assessment through methods which includes vital signs monitoring encourages continuous professional learning, self-assessment and growth (Johnson-Agbakwu et al., 2023).

Discussion

Research evidence discussed highlights aspects of vital sign monitoring important for consistently preventing patient deterioration (Padilla and Mayo, 2018). For healthcare students, learning vital signs monitoring skills early in training through diverse learning opportunities prepares them to identify deterioration promptly and make informed clinical decisions during placements. Accurate and regular monitoring in combination with proper understanding and interpretation of all vital signs is essential for timely diagnosis and intervention (Downey et al., 2018).

The implementation and utilisation of systematic monitoring instruments, exemplified by NEWS2, clearly demonstrates their advantageous role in the standardisation of clinical assessments and the facilitation of appropriate interventions (Massey et al., 2017). Students can benefit from a variety of learning opportunities that may improve real-world application of knowledge including, case-based scenarios, practical simulations, peer and collaborative learning opportunities, interaction-based simulations, management-based scenarios and reflective tasks. Studies reveal the need for improvement in training of all healthcare professionals, particularly healthcare students surrounding vital signs monitoring and recognition of patient deterioration. Learning opportunities need to address current challenges in healthcare including the often-limited resources available and workload pressures (Weenk et al., 2017). Learning opportunities outlined in this paper can aid in navigating current challenges surrounding vital signs monitoring and recognition of patient deterioration, but healthcare policy and the integration of advanced technology for continuous monitoring also plays a role in improving vital signs monitoring. Improvements in communication and data sharing among stakeholders will also enhance the efficacy and sensitivity of monitoring practices (Kühl et al., 2020). Future research should focus on investigating how emerging technologies, especially wearable sensors, impact patient health monitoring methods and outcomes and improved analysis and focus is required to explore how cultural and demographic factors influence and potentially alter normal physiological parameters (Bechtsis et al., 2021).

Conclusion

This paper examined the significance of vital sign monitoring in recognising patient deterioration and the learning opportunities that students can engage with to improve vital signs monitoring skills during training. Early detection of health issues and prompt interventions are essential for improving patient outcomes and systematic monitoring and precise vital sign interpretation are key components of this process. For healthcare students, gaining expertise in these areas during their training builds a strong foundation for professional practice. Students can benefit from a variety of learning opportunities that may improve real-world application of knowledge including, case-based scenarios, practical simulations, peer and collaborative learning opportunities, interaction-based simulations, time management-based scenarios and reflective tasks. Engagement with learning opportunities can help healthcare students to overcome current challenges and aid preparation for changing practice influenced by advanced technologies and continuous monitoring.

Key takeaways

- Monitoring vital signs is fundamental to detecting early clinical deterioration and improving patient outcomes.
- Familiarity with systematic tools like NEWS2 enhances decision-making and patient safety.
- Developing confidence in vital sign monitoring prepares students for placements and future professional roles.

Integration of training that includes diverse learning opportunities with and without advanced technologies prepares students for current challenges surrounding vital signs monitoring.

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