The measurement frequency and completeness of vital signs in general hospital wards: an evidence free zone

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Measuring a patient's vital signs in hospital is fundamental to clinical assessment, risk evaluation and to preventing patient deterioration. It contributes significantly to routine nursing workload (1,2) on general hospital wards, as most intermittent monitoring is manual, even when using electronic equipment. Despite the significance of this activity for patients and the work of nurses, the extent to which current practice is evidence based is questionable.

Among others, the frequency and content of vital sign datasets on general wards depend upon tradition (3), national guidance and consensus statements (4-7), the patient's diagnosis, clinical leadership and decision-making, and clinical workload (8-10). There is some agreement in published guidance regarding how often measurements should be taken and what parameters should always be measured, however much of this is based upon existing custom or perceived best practice rather than evidence (4-7). A 12-hourly minimum frequency is used in the UK, where many hospitals also use an aggregate weighted score derived from vital sign measurements (i.e., an early warning score) to determine the timing of subsequent observation sets (4,5). Hospitals in other countries use different routine frequency regimens with some recommending measurement as often as 2-hourly (6, 11-14). Guidance often advises the routine recording of heart rate, blood pressure, respiratory rate, temperature, pulse oximetry, and level of consciousness (6, 7). Others additionally recommend the routine measurement of inspired oxygen concentration (5) or urine output (15) to calculate an early warning score value.

The potential to alter clinical outcomes depends upon the ability to detect and recognize an acute change in a patient's physiology. Intuitively, therefore, higher vital sign measurement frequencies and more complete observations sets should increase the probability that deterioration will be detected early. Some published research results support this. Australian researchers have reported significant reductions in unplanned ICU admissions and unexpected hospital deaths, when the mean daily vital sign measurement frequency increased from 3.4 to 4.5 times per day (16). A study from the Netherlands showed that protocolised vital signs measurement (i.e., three times daily) resulted in better detection of physiological abnormalities and more reliable activation of a rapid response team than when

undertaken only when ‘clinically indicated’ (17). Belgian researchers report that the use of a standard nurse observation protocol, in which increased sickness (calculated from the vital signs using an early warning score) led to an increased vital sign frequency, reduced hospital length of stay and mortality in postoperative patients (18), and a decrease in the number of serious adverse events for patients discharged from the ICU (19). Others suggest that a protocolised ‘once a day’ early warning score assessment may be sufficient to screen for major adverse events in hospital populations (20) and research from Denmark showed that, for low risk patients, 8-hourly was no better than 12-hourly measurement for reducing clinical deterioration (21). On the other hand, a recent review of monitoring techniques found that continuous patient monitoring allowed earlier detection of deterioration in general ward patients than ‘usual care’ and improves rapid response team activation (22). However, the authors concluded that there was insufficient evidence of effectiveness to support the routine adoption of continuous vital signs monitoring in general wards (22).

Current evidence suggests that compliance with vital sign monitoring protocols is often poor, with incomplete and infrequent observation sets (2, 15, 23-33). Hands et al. reported that the daily pattern of vital sign documentation is not uniform, with large morning and evening peaks. This suggests batching of measurements in line with nursing schedules rather than individual patient severity (25). Fewer vital signs were documented at night compared with daytime, and re-assessments were often omitted at night even when the patient was obviously ill (25). These findings mirror practices reported by the UK National Patient Safety Agency, which concluded that observations are seen as low priority tasks and staff rarely carry out routine observations during the night (24). In contrast, Yoder et al. found that approximately 50% of nighttime measurements occurred in low-risk patients and that the frequency of measurements was unrelated to the patient’s early warning score value (13).

Identifying interventions that might improve monitoring compliance would seem to be a crucial quality improvement step with the potential to improve clinical outcomes. For instance, adherence to national guidance and local protocols/policies (4-7) provides goals against which practice can be compared. Regular audits of practice with personal feedback regarding

compliance can serve to identify deficiencies and guide quality improvement measures (34, 35), especially if there is a focus on poorly performing wards (34). The establishment of local clinical champions also seems important (34). However, these need to be accompanied by staff education regarding monitoring protocols and their importance (34, 35). Clinical hierarchies, professional culture, prior experience of responses received to reporting abnormal vital signs, lack of confidence and staff opinion about the usefulness of vital signs monitoring or early warning score systems appear to be crucial in influencing adherence to monitoring policies (2, 24, 36).

Despite evidence for the benefits of protocols for observation based on early warning scores the choice of vital signs for measurement and the subsequent clinical actions often appear to rely solely on nurses' clinical judgement or time availability, rather than on policies (2). There is also evidence that intuition plays an important part in nurses' detection of deterioration, and vital signs are used to validate intuitive feelings (37). Therefore, organisations need to reinforce good practice based on an understanding of human factors to remove barriers to compliance (34). The introduction of standardised observation and escalation protocols has been shown to increase the frequency of vital sign measurement (17, 18, 21, 34, 38). Applying consistent policies across an organization is also likely to reduce the potential for errors in monitoring practice. Ensuring a clear, documented vital signs measurement plan for each patient with unambiguous instructions regarding the variables to be measured and the frequency of measurement is essential (4-7). Ideally, vital sign datasets should also be complete every time they are collected; otherwise, physiological instability can be missed (39). Senior staff should always be involved in decisions to reduce monitoring frequency below recommended levels (4,7).

The presence of sufficient equipment to measure vital signs and its proper functioning are crucial to staff's ability to comply with vital signs protocols. There is a clear association between low levels of monitoring equipment, and wards' abilities to undertake observations to an agreed 4-hourly target and to increase the assessment frequency as advised by an early warning score policy (34). Similarly, clinical resource issues (e.g., clinical staffing, workload,

patient turnover) and competing nursing activities also impact on the ability of wards to achieve vital sign compliance (9, 10, 34). Although there are no data to support a minimum number of nurses on duty at any one time for this purpose, evidence indicates that an increase in nurses' workload increases the likelihood of inpatient hospital deaths (40) and of nursing activities related to surveillance remaining undone (41). Therefore, specific research is required to understand (a) the relationship between nurse staffing, workload, vital signs monitoring and outcomes, and (b) the reasons behind the apparent reduction in patient monitoring at night.

Introducing an early warning score system has been shown to increase the respiratory rate recording on general wards (33, 42). However, as the early warning score value dictates when the next set of vital signs is due, errors in early warning score calculation may affect both the frequency at which vital signs are measured and the resulting staff workload (43, 44). Similarly, early warning score systems with poor sensitivity and specificity, and poorly designed escalation protocols, may also have an influence on the number of escalations, which, in time, may produce alarm fatigue (45). This could impact on future compliance with monitoring protocols. Understanding staff attitudes towards early warning score systems is also crucial in ensuring their appropriate and correct use. For instance, Bunkenborg et al. reported that nursing staff adhered less to an early warning score algorithm in patients with higher total early warning score values that called for more frequent measurements (38). Likewise, interviewees in a study by Skyttberg et al. described the perceived importance of following a standardized vital sign measurement process, but felt that the standard might not be regarded as relevant where patients had minor conditions. They also reported that experienced staff were more likely to deviate from the standard (35).

The introduction of a rapid response team appears to lead to an increase in vital signs monitoring (42, 46), as do the design and standardization of vital signs charts (47-51). Paterson et al. found that vital signs, particularly respiratory rate and conscious level, were more completely documented after introducing a standardised early warning score chart (47). Elliott et al. investigated the impact on monitoring of a range of different charts and found that

compliance improved (48). Several studies have shown that the combination of a new observation chart and associated training led to improved completeness (16, 49-51) and frequency (51) of vital sign sets. However, others have shown no significant improvement in the frequency of vital signs sets, completeness of observations or rechecking of vital signs in line with an early warning score protocol (52-55).

Technology may have a role to play in improving patient monitoring. For instance, methods known to reduce the time taken to document vital signs in the patient's record (e.g., mobile devices) might be expected to free up clinical time making it possible for staff to document more observations (56). Although use of automated continuous monitoring appears to be an attractive approach to increasing the frequency of vital sign monitoring in general wards, currently, not all components of early warning score can be measured continuously and automatically. Continuous monitoring is also currently costly and it is unclear whether its hospital-wide implementation would be beneficial (22). Electronic health records do not necessarily improve the documentation of vital signs (57). Skyttberg et al. studied vital sign data quality, including completeness in electronic health records used in Swedish emergency departments (35) and some of their findings seem transferable to general hospital wards. Interviewees believed that well-designed information systems that facilitated vital sign measurement and documentation, and allowed vital signs to be viewed at the bedside were useful in improving practice (35). Such technology facilitates accurate summation of the early warning score and appears to improve staff adherence to requests to taking of observations at predefined time points (58, 59).

Despite being amongst the most common hospital practices, many questions remain unanswered regarding vital signs monitoring. Current practice cannot be said to be evidence based. Little is known about which vital signs should be measured routinely and at what frequency predominantly because evidence regarding the timing, patterns, and rates of deterioration in different patients and conditions is sparse. Whilst there are still uncertainties about how often vital signs should be measured and what parameters should always be measured, it would appear that improved patient monitoring improves some patient outcomes

and yet compliance with established protocols remains poor. There are opportunities to improve the frequency and content of vital signs datasets and some evidence regarding which interventions may be useful. However, properly designed, prospective studies are urgently required to measure the impact of individual or grouped interventions on measurement compliance and clinical outcomes.

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