Continuous Vital Signs Monitoring Outside Intensive Care Requires New Charts

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Vital sign charts are helpful in acute care settings because they track patients' health and identify early signs of deterioration. Charts enable multidisciplinary teams to make informed clinical decisions and implement timely interventions by displaying historical and current vital signs observations accessibly (Missen et al., 2018). In intensive care units (ICUs), patients benefit from constant monitoring with a 1:1 nurse-to-patient ratio, allowing immediate access to clinicians. However, this model is too resource-intensive for general wards, where vital signs are typically measured by nurses every 4-6 hours. Nurses depend on protocols like Modified Early Warning Score (MEWS) to standardise alerts to clinicians. Duus et al. (2018) noted that intermittent monitoring fails to detect early indicators of many deteriorations, delaying action.

Continuous monitoring utilises vital sign devices, often with AI, to measure signs frequently (eg. SPO2 every 100ms, heart rate every second, blood pressure every 15 minutes). Subbe et al. (2017) and Sun et al. (2015) demonstrate clinical conditions can be detected earlier with continuous monitoring resulting in reduced mortality. (Kellett & Sebat, 2017; Brekke et al., 2019) lament that continuous monitoring outside ICU continues to be underutilised though there a trend to extend vital sign monitoring beyond ICUs to general wards, aged care, and patients' homes is emerging.

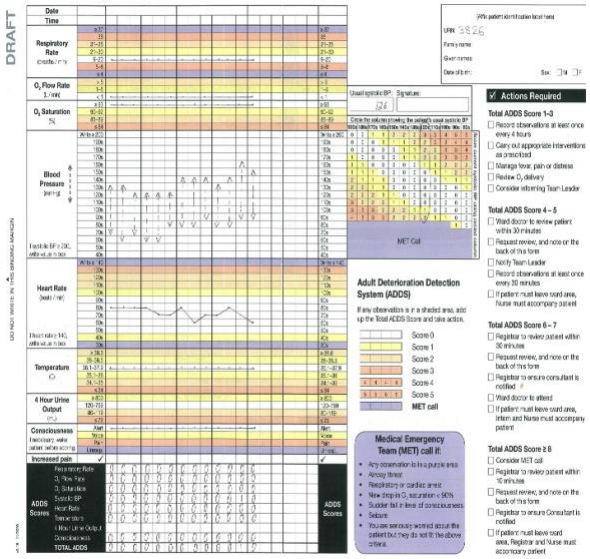

Figure 1: ADDS Chart

Traditional charts (Figure 1), such as the Adult Deterioration Detection System (ADDS) and ViCTOR (Augutis et al., 2023), display vital signs in rows and observation times in columns, using colour-coded thresholds for nurses to raise alerts. Proper interpretation of these charts is crucial, as highlighted by Soltan & Westacott (2017), yet many nurses lack adequate training for this. Cornish et al. (2019) emphasise that chart design impacts how quickly clinicians identify deterioration. They call for intuitive visual displays that summarise trends in heart

rate, oxygen saturation (SpO2), and respiration with effective colour cues.

However, current charts have been designed for intermittent vital signs monitoring and are not readily adapted for continuous monitoring that have high-frequency vital sign data.

The current research aims to develop a new type of chart depicting vital signs data generated continuously. The aim is to create a chart that nurses and clinicians can rapidly assimilate historical observations and make plausible interpretations of the patterns with reduced cognitive load.

REFERENCES

1. *Augutis, W., Flenady, T., Le Lagadec, D., & Jefford, E. (2023). How do nurses use early warning system vital signs observation charts in rural, remote and regional health care facilities: A scoping review. Australian Journal of Rural Health, 31(3), 385–394. https://doi.org/https://doi.org/10.1111/ajr.12971*
2. Brekke, I. J., Puntervoll, L. H., Pedersen, P. B., Kellett, J., & Brabrand, M. (2019). The value of vital sign trends in predicting and monitoring clinical deterioration: A systematic review. *PLOS ONE*, *14*(1), e0210875-. https://doi.org/10.1371/journal.pone.0210875
3. Cornish, L., Hill, A., Horswill, M. S., Becker, S. I., & Watson, M. O. (2019). Eye-tracking reveals how observation chart design features affect the detection of patient deterioration: An experimental study. *Applied Ergonomics*, *75*, 230–242.
4. Duus, C. L., Aasvang, E. K., Olsen, R. M., Sørensen, H. B. D., Jørgensen, L. N., Achiam, M. P., & Meyhoff, C. S. (2018). Continuous vital sign monitoring after major abdominal surgery—quantification of micro events. *Acta Anaesthesiologica Scandinavica*, *62*(9), 1200–1208.
5. Hands, C., Reid, E., Meredith, P., Smith, G. B., Prytherch, D. R., Schmidt, P. E., & Featherstone, P. I. (2013). Patterns in the recording of vital signs and early warning scores: compliance with a clinical escalation protocol. *BMJ Quality & Safety*, *22*(9), 719–726.
6. Kellett, J., & Sebat, F. (2017). Make vital signs great again–A call for action. *European Journal of Internal Medicine*, *45*, 13–19.
7. Missen, K., Porter, Joanne. E., Raymond, A., de Vent, K., & Larkins, J.-A. (2018). Adult Deterioration Detection System (ADDS): An evaluation of the impact on MET and Code blue activations in a regional healthcare service. *Collegian*, *25*(2), 157–161. https://doi.org/https://doi.org/10.1016/j.colegn.2017.05.002
8. Soltan, M., & Westacott, R. (2017). How to fill in and interpret an observation chart. *BMJ*, *356*.
9. Subbe, C. P., Duller, B., & Bellomo, R. (2017). Effect of an automated notification system for deteriorating ward patients on clinical outcomes. *Critical Care*, *21*(1), 52. https://doi.org/10.1186/s13054-017-1635-z
10. Sun, Z., Sessler, D. I., Dalton, J. E., Devereaux, P. J., Shahinyan, A., Naylor, A. J., Hutcherson, M. T., Finnegan, P. S., Tandon, V., & Darvish-Kazem, S. (2015). Postoperative hypoxemia is common and persistent: a prospective blinded observational study. *Anesthesia & Analgesia*, *121*(3), 709–715.