Breathing New Life into Vital Sign Measurement

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As you review the electronic health record before rounds in the morning, you notice a red exclamation mark in the chart of a patient who was admitted two days ago for an acute chronic obstructive pulmonary disease (COPD) exacerbation. The patient's respiratory rate (RR) this morning is recorded at 24 breaths per minute (bpm). His RR last evening was 16 bpm and he remains on two liters per minute of supplemental oxygen. No one has notified you that he is getting worse, but you stop by the room to confirm that he is clinically stable.

During rounds, the resident states "The respiratory rate is recorded as 24 bpm, which is high, but I never trust the respiratory rate." You silently agree and confirm your mistrust of the recorded RR.

Elevated RR has been associated with numerous poor outcomes, including mortality after myocardial infarction[1] and death and readmission after acute COPD exacerbation.[2] Furthermore, RR is used in models to predict mortality and intensive care unit admission,[3] as well as in models to identify and predict mortality from sepsis.[4] Recorded RRs are frequency inaccurate,[5] and medical staff lack confidence in recorded RR values.[6] Based on this evidence, you feel justified in your mistrust of recorded RR values. You might even believe that until a high-tech RR monitoring system is invented and implemented at your hospital, human error will forever prevent you from knowing your patients' true RRs.

However, there is hope. In this issue of the *Journal of Hospital Medicine*, Keshvani et al.[7] describe a successful quality improvement project where they employed plan–do–study–act methodology in a single inpatient unit to improve the accuracy of recorded RR. Before their project, only 36% of RR measurements were accurate, and there was considerable heterogeneity in the RR measurement technique. To address this problem, an interdisciplinary team of patient care assistants (PCAs), nurses, physicians, and hospital administration developed a plan to identify barriers, improve workflow, and educate stakeholders in RR recording.

The authors created a low-cost, "low-tech" intervention that consisted of training and educating PCAs on the correct technique and the importance of RR measurement, modifying workflow to incorporate RR measurement into a 30-second period of automated blood pressure measurement, and adding stopwatches to the vital sign carts. The RR measurements obtained by PCAs were compared with the RR measurements obtained by trained team members to assess for accuracy. PCA-obtained RR measurements were also compared with two control units, both before and after the intervention. Secondary outcomes included time to complete vital sign measurements and the incidence of systemic inflammatory response syndrome (SIRS) specifically due to tachypnea. The authors hypothesized that improved RR accuracy would reduce the number of falsely elevated RRs and could reduce the rate of SIRS.

The intervention improved the accuracy of PCA-obtained RRs from 36% to 58% and decreased the median RR from 18 to 14 breaths per minute. The implementation also resulted in a more normal distribution of RR in the intervention unit compared with the control unit. Interestingly, this intervention did not increase the time spent in obtaining vital signs—in fact, the time to complete vital signs decreased from a median of 2:26 to 1:55 minutes. In addition, tachypnea-specific SIRS incidence was reduced by 7.8% per hospitalization. An important implication of this finding is that reducing the false-positive rate of SIRS could possibly decrease unnecessary testing, medical interventions, and alert fatigue.

This project shows that meaningful interventions need not be expensive or overly technologic to have very real clinical effects. It would be very easy for a system to advocate for funding to purchase advanced monitors that purport to remove human error from the situation rather than trying first to improve human performance. Certainly, there is a role for advanced technologies—but improvement need not wait for, or be completely predicated on, these new technologies. The first barrier often expressed when evaluating a potential improvement initiative is that "we don't have time for that". This project demonstrates that innovations to improve care can also benefit the care team and improve workflow. Certainly, this project is not definitive and should be replicated elsewhere, but it is an important first step.

In an era where technology is expanding rapidly and the pace of innovation is breathtaking, we have an obligation to ensure that we are getting the basics right. Further, we must not take core tasks—such as vital signs, physical examination, and medication reconciliation—for granted, nor should we accept that they are as they will be. We discuss and debate the merits of advanced imaging, artificial intelligence, and machine learning—which are certainly exciting advances—but we must occasionally pause, breathe, and examine our practice to make sure that we do not overlook things that are truly vital to our patients' care.

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