



Discussion paper

Accurate respiratory rates count: So should you!



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ABSTRACT

It is well documented that the respiratory rate is the least accurately recorded vital sign. Despite nurses consistently confirming that they understand the physiological importance of the respiratory rate, more often than not, they estimate a value rather than count for an entire minute. Until recently, little has been known about why this phenomenon perpetuates. However, it has now been established that many emergency department registered nurses believe they are enhancing patients' outcomes by performing tasks other than counting a patient's respiratory rate. This discussion highlights the significance of recording accurate respiratory rates, as opposed to estimating a rate; emphasizing that just four breaths either side of the normal range could be indicative of impending clinical deterioration.

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Background

The physiological changes known to occur preceding cardiac arrest, unexpected deaths and unplanned intensive care unit admissions are detectable when patients are monitored [1,2]. Significantly, when accurate vital sign collection methods are utilised to monitor patients, clinical deterioration can be identified early, and responded to expeditiously. Hospitals are now encouraged to utilise observation charting systems that require nurses to measure and record scores for each vital sign observed, with the combined value of scores referred to as an early warning score (EWS) [3,4]. The EWS is most useful when the information recorded has been gathered correctly, and transcribed accurately. Recent work by Flenady, Dwyer and Applegarth [5] illustrates how forced compliance with documentation on early warning charts does not always equate to accurate entries. Nurses in their study, when forced to comply with organisational procedures, admitted to assuming a tick and flick philosophy in order to make the documents appear complete.

Nonetheless, when the early warning tools are utilised correctly, the total score from each round of observations is a reliable predictor of clinical deterioration, therefore when the score reaches a certain threshold a predetermined response is triggered [6,7]. Of the vital signs collected, the respiratory rate is significant, in that abnormal respiratory rates are an early indicator of physio-

logical conditions such as hypoxia, hypercapnia and respiratory or metabolic acidosis, all omens of ominous medical diseases [8,9]. It can be seen from this evidence, that tracking the respiratory rate of patients in acute care settings is an expedient method of identifying early signs of deterioration. Yet despite this knowledge, research reveals that the respiratory rate is often the most poorly recorded vital sign [5,8,10–13].

Why is the respiratory rate so often neglected?

Some authors have alluded to time constraints and a lack of clinical resources as contributing factors for transgression in respiratory rate recording methods [14,15]. However, very few researchers have conducted studies with the specific aim of identifying the reasons clinicians neglect to accurately record regular respiratory rate observations. The scant evidence available suggests issues such as workload, time pressures, and interruptions to work flow, a lack of specialised training and little appreciation of the value of this vital sign in regards to clinical deterioration are all determinants [10,16]. Neither of these studies focused on emergency department nurses, and yet, undeniably, the value of identifying clinically deteriorating patients in an acute care setting, before they are admitted to the wards, is obvious [17]. Once patients are transferred to the wards, the in-hospital mortality rate for patients who then go on to trigger an emergency review can be as high as 34% [18,19]. Therefore, if patients from any clinical area in particular should be closely monitored for signs of deterioration (abnormal respiratory rates), it is patients who are situated in acute care settings. In light of this

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knowledge, if acute care nurses are not performing accurate respiratory rate assessments, we need to understand why, in order to address the issue judiciously.

The Flenady, Dwyer and Applegarth [5] study collected data from seventy-nine emergency department registered nurses from across four states and a territory of Australia, and unearthed interesting results [5]. The cohort from this study believe counting respiratory rates at each round of observations is superfluous to patients' needs and wastes valuable time. Even more illuminating, results from this grounded theory study reveal that often, these nurses believe they are enhancing patients' outcomes by performing tasks other than counting respiratory rates. Overwhelmingly, this cohort stated that recording an accurate respiratory rate was not a priority unless the patient was exhibiting signs of respiratory distress, was a paediatric patient, or had a history of respiratory related illness [5]. When documentation requirements such as accurate fulfilment of observation charts demanded they collect a respiratory rate on a patient other than those mentioned here, these nurses confirmed, that more often than not, a value was entered on the observation chart without the respiratory rate being assessed at all.

There appears to be a common misconception among the cohort that this erroneous reporting is an effective method of saving time that enhances patient outcomes. These nurses genuinely believed that rather than 'wasting' time counting respiratory rates for one minute, the patient would benefit from the nurse using this time on more seemingly important aspects of patient care. However, the value of that one minute spent counting, could in some cases, be the difference between identifying clinical deterioration early enough to respond efficaciously, or not. As seen by the following discussion, subtle changes in a patient's respiratory rate are sometimes significant indicators of potentially ominous conditions, and can be overlooked if nurses are just 'ticking the box' when it comes to respiratory rate observations.

The importance of accurate respiratory rate observations

Ventilation, commonly referred to as respiration, is the act of breathing, with one breath encompassing inspiration, the intake of air into the lungs, and expiration, the expulsion of gases from the lungs [20]. The significance of this seemingly simple process of breathing in and out cannot be underestimated as ineffective ventilation negatively impacts efficacious gas exchange. The normal number of respirations for a non-respiratory compromised healthy adult is between 12 and 20 breaths per minute [20,21]. When breathing occurs within this normal range, carbon dioxide (CO_2) is removed from the lungs at the same rate at which it is produced, maintaining arterial CO_2 (PaO_2) at normal levels (40 mmHg). Hypoventilation does not keep up with CO_2 production, causing hypercapnia ($\text{PaO}_2 > 44$ mmHg), while hyperventilation removes the CO_2 faster than it is being produced, resulting in hypocapnia ($\text{PaO}_2 < 36$ mmHg) [21]. Physiologically, it is essential to understand that a shift in alveolar ventilation, manifested in either an increase or decrease in the respiratory rate, is one of the body's methods of striving for homeostasis, and can be an important sign of clinical decline. It is significant to note, that the respiratory rate provides more discriminating evidence of clinical decline in seemingly stable patients, than other vital signs [22].

There are two fundamental methods of monitoring respiratory rates; continuous, which usually requires the use of equipment such as capnography, or discontinuous, which is simply the manual counting of a person's breathing for between 30 and 60 s utilising auscultation and or inspection skills [1]. Best practice guidelines suggest that clinicians count the number of breaths over a full minute, also noting any abnormalities in the depth, rhythm, quality

and effectiveness of respirations [23–25]. Ideally, to avoid an inaccurate result due to the patients' awareness of being studied, the clinician should assess the respiratory rate surreptitiously [26]. As evidenced by these gold standard guidelines, an accurate respiratory rate can be attained in approximately one minute.

Subtle changes – what triggers an abnormal respiratory rate

Despite the minimal amount of time required to achieve an accurate assessment, the Flenady, Dwyer and Applegarth [5] study reveals many registered nurses 'tick and flick' this component of the vital signs on the observation chart. This practice is concerning, as evidence confirms that just four breaths per minute either side of the normal range of 12–20 per minute for an adult, can indicate early signs of serious clinical deterioration that would otherwise go undetected [27,28]. For example, a large study involving data collected from over one million participants over a two year time frame, indicated that even a small increase of breaths per minute to 24–28 represented an increase to the risk of mortality by 5% [27]. There is also recent data reporting that when the respiratory rate is 8 or less, a patient has up to 18.1 times higher odds of death within 24 h of presentation when compared to a patient with a normal respiratory rate [28]. These studies confirm that just four breaths difference either side of the normal range can indicate impending catastrophic events, and are therefore critical data to obtain from patients.

A subtle reduction in breaths per minute to just 8, can in some cases indicate an imminent medical emergency such as cardiac arrest due to cerebral hypoxia [21]. A decrease in alveolar ventilation is recognisable when an adult takes less than 12 breaths per minute, and is nearly always due to respiratory acidosis. There can be many underlying causes of respiratory acidosis, including drug toxicity, cerebral hypoxia, infarct, haemorrhage or tumour, envenomation from snake bite, pulmonary oedema, pneumothorax, aspiration, or an upper airway obstruction. Conversely, increased alveolar ventilation, which is discernible by a respiratory rate greater than 20, can be triggered by hypoxia, hypercapnia and metabolic acidosis; symptoms of underlying diseases that have potentially poor outcomes if left untreated [1]. As can be seen, the respiratory rate provides valuable cues, albeit sometimes subtle, that if detected early, offer clinicians the opportunity to deliver potentially lifesaving treatment.

Special circumstances

In certain circumstances, the value of the respiratory rate as a measure of physiological instability has no equal. For example, a recent study involving over 200 000 participants, found that whilst medications such as beta blockers have the potential to impact the accuracy of many vital signs, the respiratory rate remains largely unaffected, and persists as an accurate indicator of clinical acuity [29]. Hypertension is a high risk factor for mortality in the elderly, therefore this demographic are more likely to be taking some form of antihypertensive medication than younger people [30]. Significantly, this population are also the most likely to fall prey to heart and lung conditions such as pneumonia, which unfortunately is claiming a growing number of lives each year [31]. The polypharmacy regime that a large number of the elderly population adhere to may result in seemingly normal vital signs if the respiratory rate is not accurately assessed. Importantly, evidence confirms an abnormal respiratory rate is nearly always associated with conditions such as pneumonia, and may be the only indicator in this demographic that something ominous is occurring.

When nurses in the Flenady, Dwyer and Applegarth [5] study described circumstances when they believed counting respiratory rates was a waste of their valuable time, they included presenta-

tions such as abdominal issues as undeserving of respiratory rate observations. However, published research reveals that patients are more likely to die while in a hospital setting when they have presented with an abdominal issue than if their presenting condition was chest pain [2]. A study that included over 6000 participants found that in-hospital mortality rates were higher for patients who presented with gastro-intestinal issues such as blood in the stool or vomit, and diarrhoea, than those who presented with chest pain [2]. Results from this same study reveal that the respiratory rate is the second most sensitive vital sign, after saturation of peripheral oxygen as a predictor of in hospital mortality. When evidence such as this is considered, it becomes clear that when nurses just ‘tick and flick’ a patient’s respiratory rate in order to use their time more wisely to improve patients’ outcomes, they could in fact be doing the complete opposite.

Conclusion

The information presented here commences the dialogue around this topic in order to develop the level of understanding required to engender change and optimise patient safety. To achieve the shift in culture necessary to effect change, the significance of recording accurate, regular respiratory rate observations for all patients in acute care settings must continue to be discussed on as many platforms as possible.

Authors’ contributions

All three authors contributed to all of the following: (1) the conception and design of the paper, (2) drafting the article or revising it critically for important intellectual content, (3) final approval of the version to be submitted

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