Mediterranean Nursing and Midwifery

Mediterr Nurs Midwifery 2022;1(3):120-130 DOI: 10.5152/MNM.2022.21019

RESEARCH ARTICLE

Is Respiratory Rate Measurement Important? An Audit of Fundamental Nursing Textbooks

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Abstract

Respiratory rate is a key vital sign and the most sensitive indicator of illness severity. The respiratory rate, for example, provides evidence of clinical deterioration, is an early indicator of hypoxia and is often the first sign of sepsis, shock and respiratory insufficiency. Despite the clinical importance of respiratory rate measurement, research has consistently found that this task is frequently neglected. Contributing factors include inadequate knowledge and nurses' perception of patient acuity.

As textbooks are a key resource for undergraduate nursing students, an audit was conducted of 29 fundamental nursing textbooks to appraise descriptions of respiratory rate assessment. There was consistency in the normal range of respiratory rate reported in these texts but variability in the methods for measuring respiratory rate. Most texts failed to emphasise the importance of respiratory rate measurement. This might be one factor contributing to clinicians' lack of awareness of the importance of respiratory rate measurement and the enduring neglect of this clinical task.

Keywords: Measurement, Rate, Respiratory, Textbooks

Vital signs are important indicators of physiological functioning and are the simplest, cheapest and probably the most important information gathered on hospitalised patients (Kellett & Sebat, 2017; Van Kuiken & Huth, 2016). Vital signs provide critical insight into the patient's condition including how the patient is responding to medical treatment or importantly, if their condition is deteriorating. In a recent study of 7851 patients in North America, the majority had at least one abnormal vital sign in the hours immediately before a cardiac arrest, highlighting the opportunity to act upon clinical deterioration and prevent an adverse outcome (Anderson et al., 2016).

Respiratory rate, one of the key vital signs, has been identified as the most sensitive indicator of illness severity and of a poor outcome (Cahill et al., 2011; Parkes, 2011; Ridley, 2005). The respiratory rate, for example, provides more discriminating evidence of clinical deterioration than the other vital signs (Barfod et al., 2012; Churpek et al., 2016). Changes in the respiratory rate are an early indicator of hypoxia, hypercapnia and metabolic and respiratory acidosis (Rolfe, 2019). An increased respiratory rate is often the first sign of sepsis, shock and respiratory insufficiency, and a reduced rate warns of narcotic and sedative overdose (Kellett & Sebat, 2017). Respiratory rate is often the first vital sign affected if there is a change in the patient's cardiac or neurological status (Liddle, 2013).

Despite the clinical importance of respiratory rate measurement, research has consistently found this task is frequently neglected. Research findings include: respiratory rates not being assessed or being recorded erroneously (Flenady et al., 2017); 'spot' estimates of respiratory rates (Badawy et al., 2017); respiratory rate not being assessed if the patent is 'stable' (Ansell et al., 2014); significant discrepancy between respiratory rate documentation in medical note and early warning score charts (Chen et al., 2015) and wide variation in respiratory rate measurements for the same patient (Brabrand et al., 2018). These findings are surprising and suggest that the importance of respiratory rate as a marker of deterioration is not valued or understood by many nurses (Chua et al., 2013; Mok et al., 2015).

Nurses are the health professionals with the highest level of responsibility for the accurate measurement, interpretation and documentation of physiological observations

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Cite this article as: Elliott M, Williamson R. (2022). Is Respiratory Rate Measurement Important? An Audit of Fundamental Nursing Textbooks. *Mediterranean Nursing and Midwifery*, *1*(3), 120-130.

(Considine & Currey, 2015). Despite this, few studies have examined the reasons for the neglect of respiratory rate measurement. Those that have identified inadequate knowledge regarding respiratory rate measurement and nurses' perception of patient acuity, perceived lack of time and laziness as contributing factors (J. Hogan, 2006; Philip et al., 2013; Ansell et al., 2014). One study hypothesised that nurses manipulate vital sign data to make patients appear less sick, in an attempt to reduce their workload (Kellett & Sebat, 2017). A recent systematic review of 49 studies also found manually measured respiratory rate data are subject to several sources of inaccuracy including inter-observer bias and recording omission (Kellioinen et al., 2020).

Aim

Inadequate knowledge is one reason why respiratory rate measurement is neglected (Philip et al., 2013; Ansell et al., 2014). The causes of this knowledge deficit are not clear, but the quality of undergraduate nursing education might be one relevant factor. As textbooks are a resource frequently prescribed as an educational resource for undergraduate students, an audit was conducted of a convenience sample of current fundamental nursing texts to appraise the accuracy of information regarding respiratory rate assessment. Three questions guided the audit:

- What does the text state is the normal respiratory rate for an adult?
- How does the text describe the technique of respiratory rate measurement?
- Does the text emphasise the clinical importance of respiratory rate measurement?

Method

Two academics (Registered Nurses) conducted a search of key publishers' websites (Cengage, Elsevier, FA Davis, Lippincott, Pearson, Sage) to identify current fundamental nursing textbooks (both theoretical and skills focussed); see Figure 1 *Google Books, Book Depository* and *Amazon* were also searched. Any relevant texts were requested via inter-library loan. To ensure the search identified texts currently available to nursing students, only texts published from 2015 were included in the audit.

Results

Twenty-nine fundamentals of nursing textbooks published from 2015 onwards were identified for audit (see Table 1).

Main Points

- Respiratory rate is the most sensitive indicator of illness severity but a frequently neglected vital sign.
- Textbook descriptions of RR measurement are inconsistent and fail to emphasise the importance of this task.
- These descriptions might be one factor contributing to clinicians' misunderstanding and the neglect of respiratory rate measurement.

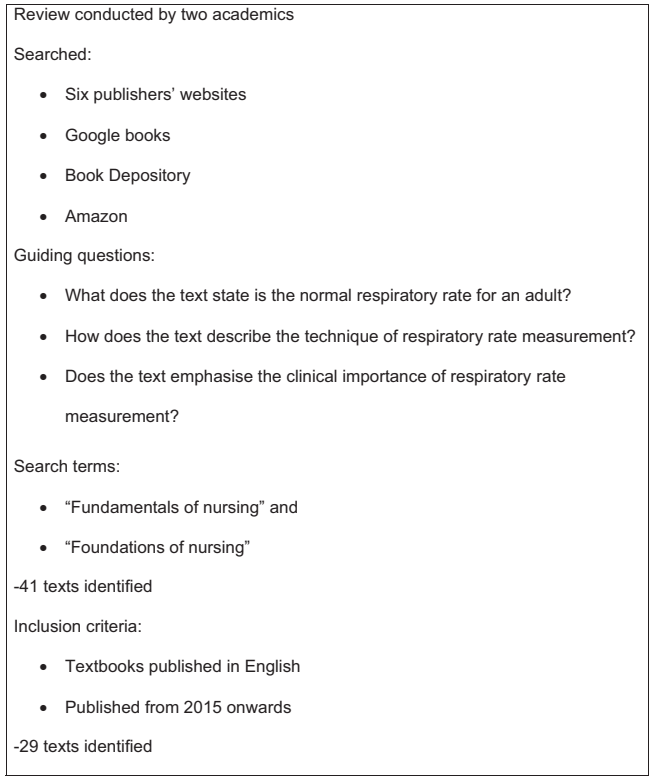

Figure 1 Textbook screening

These texts were primarily published in Australia, North America and the United Kingdom.

What is the normal respiratory rate for an adult?

Twenty-one texts (72.4%) stated the normal respiratory rate for an adult is 12-20 breaths/minute. Four texts (13.8%) stated the normal rate is 12-18 breaths/minute. One text stated the normal respiratory rate for an adult is 12-24 breaths/minute. One text differentiated respiratory rates between males and females. Two texts (6.9%) did not state the normal respiratory rate.

What is the described technique of respiratory rate measurement?

Twenty-seven texts (93%) described a technique for measuring the respiratory rate. The techniques were similar but with some variation. Six texts (20.7%) stated that the respiratory rate should be assessed without the patient's awareness. Seven texts (24%) recommended keeping your fingers on the patient's wrist after assessing the pulse whilst observing the rise and fall of the chest. Seven texts (24%) recommended placing the patient's arm across their chest to help observe the rise and fall of the chest. Sixteen texts (55%) recommended counting the respiratory rate for 30 seconds and multiplying by 2. Seventeen texts (58.6%) stated that if the respiratory pattern is irregular, the respiratory rate should be counted for a full minute. Nine texts (31%) simply advised the respiratory rate should be counted for a full minute. Four texts (13.8%) indicated the count starts after the patient has completed a breath cycle, and the rate is then measured for a minute.

Table 1
Reviewed Texts

Source	Normal Adult Range	How Should Respiratory Rate be Measured?	Is Importance of RR Assessment Emphasised?	Other Content
	12-20 breaths per minute.	Place patient's arm in a relaxed position across the abdomen or lower chest or place nurse's hand directly over the patient's upper abdomen. Observe one complete respiratory cycle. After cycle is observed, look at your watch's second hand and begin to count the rate. If the rhythm is regular, count the number of respirations in 30 seconds and multiply by 2. If the rhythm is irregular, count for 1 full minute.	Yes. States Respiratory rate is one of the most neglected vital signs, yet one of the earliest indicators that patients are at risk of deterioration' (Cretikos et al., 2008).	
Craven et al. (2020)	12-20 breaths per minute	After or before assessment of pulse, keep your fingers on the patient's wrist and observe or feel the rising and falling of the chest. When you have observed one complete cycle of inspiration and expiration, and if respiration is regular, look at the second hand of your watch and count the number of complete cycles in 1 full minute.	No	'Assess respirations during every vital sign evaluation' (p. 384).
	12-20 breaths per minute	Assess without the patient's awareness. Position the patient's arm across his or her chest or abdomen. Count the respiratory rate for 30 seconds and multiply by 2. If the patient is very ill or respirations deviate from the norm, assess for a full minute.	No	Mentioned that vital signs' assessment is commonly delegated to less qualified staff, but in doing so, the process may be taken for granted. Emphasised these signs are vital signs of life.
	12-20 breaths per minute	Place fingertip as if to assess a radial pulse. Observe respiratory rate for 60 seconds. Count each rise of the chest wall.	No	States that the ability to obtain accurate vital signs measurements is critical and that it is not a routine procedure.

Table 1
Reviewed Texts (continued)

Source	Normal Adult Range	How Should Respiratory Rate be Measured?	Is Importance of RR Assessment Emphasised?	Other Content
Lynn (2019)	12-20 breaths per minute	Whilst your fingers are assessing the pulse, note the rise and fall of the patient's chest. Count the number of respirations for 30 seconds and multiply by 2. If the respirations are abnormal, count for 1 minute.	No	States the respiratory rate assessment cab be delegated to nursing assistants but this decision must be based on careful analysis of the patient and the staff member's qualifications (p. 66).
	12-20 breaths per minute.	Place patient's arm across their abdomen or lower chest or place you hand directly over the patient's upper abdomen. Observe one complete respiratory cycle. Then look at the second hand of your watch and begin to count the rate. If the rhythm is regular, count for 30 seconds and multiply by 2. If the rhythm is irregular, rate less than 12 or greater than 20, count for one minute.	Yes. 'Respiratory rate is a strong predictor of acute illness and mortality' (p. 288).	States the skill can be delegated to assistive personnel.
	12-20 breaths per minute	Time the rate for a full minute if it is regular and for 2 minutes or more if it is irregular.	Yes. 'Respiratory rate is a vital indicator of deterioration in a sick person so it must be accurately assessed and recorded' (p. 101). 'It must not be estimated because inaccurate readings could lead to inappropriate or late intervention' (Elliott, 2016).	Tachypnoea, bradypnoea and apnoea constitute medical emergencies requiring immediate intervention (p. 101).
	Not stated	Place your hand in contact with the chest wall to feel the rise and fall of the chest. Count the number of respirations for 30 seconds and multiply by 2. Count for 1 minute if the patient has an irregular respiratory rhythm or respiratory difficulty. The patient should not be aware that the respiratory rate us being evaluated (p. 66).	Yes. States 'Accurate assessment of the respiratory status is very important because it provides information that… could save a person's life. Conversely, failing to recognise cues in respiratory assessment data could be deadly' (p. 64)	

Table 1
Reviewed Texts (continued)

Source	Normal Adult Range	How Should Respiratory Rate be Measured?	Is Importance of RR Assessment Emphasised?	Other Content
	12-20 breaths per minute	After assessing the pulse, observe the rise and fall of the chest. Count breaths for 1 full minute. If respirations are regular, count for 30 seconds and multiply by 2.	No	States that the procedure may be by delegated to Unlicensed Assistive Personnel.
	12-20 breaths per minute	Not described.	Yes. States that altered respiratory rate is a significant indication of patient deterioration (p. 560).	States that too often nurses estimate or guess a person's respiratory rate.
	12-18 breaths per minute.	Hold the patient's wrist as though taking their pulse. Observe the chest closely. Count the number of breaths over 1 minute by watching the rise and fall of the chest.	Yes. States '…abnormal respiratory rates must always be reported and acted upon as they can be an early sign of a patient's physiological deterioration' (p. 32).	
	12-20 breaths per minute	Count rate for 30 seconds (then multiply by 2) unless it is regular; then it should be counted for 1 minute. Count by watching movement of the chest wall or by placing a hand on the chest wall.	No	
	12-20 breaths per minute	Place patient's arm across abdomen or lower chest or place your hand directly over patient's upper abdomen. Observe complete respiratory cycle. After observing a cycle, look at second hand of watch and begin to count rate. If rhythm is regular, count number of respirations for 30 seconds and multiply by 2. If rhythm is irregular, count for 1 minute.	No	States 'The skill of counting respirations can be delegated to nursing assistive personnel unless the patient is considered unstable' (p. 87).

Table 1
Reviewed Texts (continued)

Source	Normal Adult Range	How Should Respiratory Rate be Measured?	Is Importance of RR Assessment Emphasised?	Other Content
	12-20 breaths per minute.	Whilst your fingers are still in place after counting the pulse, observe the person's respirations. Note the rise and fall of the chest. Using a watch with a second hand, count the number of respirations for a minimum of 30 seconds. Multiply the number by 2. If the respirations are abnormal, count the respirations for at least 1 minute. Note the depth and rhythm of the respirations.	Yes. States 'Respiratory rate abnormalities are important predictors of deteriorating patients and serious events'(Ansell et al., 2014).	
	12-20 breaths per minute	Place your hand on the chest (palpating) or observe the number of times the chest or abdomen rises and falls. If the respiratory rhythm is regular, count the rate for 30 seconds and multiply by 2. If respirations vary from normal, you should count for 1 minute by auscultation.	No	States 'For a new patient or when you need to ensure accuracy, you must count for 60 seconds. In some situation, for example for a patient you know well, you may count for only 30 seconds and multiply by 2' (p. 441).
	12-20 breaths per minute	Look for a way to distract the patient. Count for 30 seconds by watching the rise and fall of the chest and multiply by 2. If the patient is ill, count for 1 minute.	Yes. States a change in respiratory rate may indicate a change in a patient's condition (p. 361).	States: 'Respirations are measured each time a full set of vital signs is taken' (p. 361).
	12-20 breaths per minute (p. 108). Also states 12-24 breaths/minute (p. 556)	Place your hand against the person's chest to feel the chest movements with breathing, or place the person's arm across the chest and observe the chest movements whilst supposedly taking the pulse. Count the rate for 30 seconds if the respirations are regular, Count for 60 seconds if they are irregular.	No	
	12-20 breaths per minute	Observe the chest rise and fall or through auscultation. Count the respirations without the patient being aware of it. Count for a minimum of 30 seconds to one minute.	Yes. 'Respiratory rate greater than 20 breaths/ minute is often one of the first signs of deterioration' (p. 442).	Emphasises that normal value of vital signs can vary greatly. States that the use of innovative equipment does not negate the required skill competency (p. 105).

Table 1
Reviewed Texts (continued)

Source	Normal Adult Range	How Should Respiratory Rate be Measured?	Is Importance of RR Assessment Emphasised?	Other Content
	12-18 breaths per minute	Observe or feel the rising and falling of the chest with respiration. If respiration is regular, count the number of respiratory cycles in 1 full minute.	No but recommends assessing vital signs during every vital sign evaluation.	'Although measuring vital signs is usually part of routine care, they provide valuable information, and their evaluation should not be taken lightly' (p. 330). However describes the delegation of respiratory rate assessment to Unlicensed Assistive Personnel.
	12-20 breaths per minute	Whilst your fingers are still in place after counting the pulse, observe the person's respirations. Note the rise and fall of the chest. Using a watch with a second hand, count the number of respirations for a minimum of 30 seconds. Multiply the number by 2. If the respirations are abnormal, count the respirations for at least 1 minute. Document the rate on the observation chart. Report any abnormal findings.	No	
	12-20 breaths per minute	Place the patient's arm across the abdomen or chest. Observe one complete respiratory cycle. Using a watch with a second hand, count the respirations for 1 minute.	Yes. States 'An individual's respiratory status is the first observation that will indicate a deterioration in a person's condition and predict a serious adverse event' (p. 417).	Also states 'If the rhythm is regular, count number of respirations in 30 seconds and multiply by 2. If rhythm is greater than 16 respirations per minute, count for a full minute' (p. 418).
	12-18 breaths per minute	Keep fingertips on the patient's pulse. Observe the rise and fall of the chest. Can also be counted by placing the hand on the patient's chest or abdomen, or with a stethoscope on the chest. Count for 30 seconds and multiply by 20 or for 1 minute or irregular.	Yes. States 'observing respiration closely is necessary to detect signs of interference with the breathing process' (p. 580).	States vital signs are indicators of life-sustaining functions (p. 572).
	12-18 breaths per minute (p. 261). 12-20 breaths per minute (p. 281).	Place hand on chest or observe chest rise and fall and count respirations preferably for 1 minute or for 30 seconds and multiply by 2.	States 'the quality of breathing is important information and can give early indications of respiratory deterioration' (p. 261).	States '…respiratory rate is the most overlooked and least recorded vital sign' (p. 261).

Table 1
Reviewed Texts (continued)

Source	Normal Adult Range	How Should Respiratory Rate be Measured?	Is Importance of RR Assessment Emphasised?	Other Content
	Males 14-18 breaths per minute. Females 16-20 breaths per minute.	Ensure the patient is unaware of being watched. If breathing is effortless, count for a fractional portion of 1 minute then multiply to calculate the rate. Count for a full minute if breathing is effortless (p. 226).	No	States 'the respiratory rate varies considerably in healthy people' (p. 206).
	12-20 breaths per minute	'…Allow the patient to rest for 5 minutes before counting. Count the patient's breathing for 1 full minute' (p. 166).	Yes. 'Rate is considered the most useful sign in determining clinical signs of deterioration and is also viewed as an antecedent to an adverse event' (p. 166).	Counting the rate for 30 seconds and multiplying by two is not viewed as good practice as the patient's respiratory rate can change from one reading to the next very quickly' (p. 167).
	12-20 breaths per minute	Count the number of breaths taken per minute	Yes. '…it has often been a neglected vital sign because its measurement was not considered important and not been automated' (p. 524)	'It is one of the most sensitive and specific markers of…deterioration' (p. 524)
	Not stated	Not stated	Yes states 'identifying and responding to early signs of respiratory compromise reduces the risk of respiratory failure' (p. 76)	
	12-18 breaths per minute	The rate should be counted for 1 full minute to fully assess both the rate and rhythm (p. 625).	Yes. States than an increase from the patient's normal respiratory rate by as little as 3-5 breaths/minute is an early and important sign of respiratory distress.	States that patients with a respiratory rate greater than 24 breaths/minute should have frequent observations and be closely monitored (p. 625).
	12-20 breaths per minute	Observe the rise and fall of the chest as the patient breathes. Count for 30 seconds and multiply by 2, or count for 60 seconds if respirations are irregular (p. 188).	No	Respiratory rates <8 breaths/minute or >40 breaths/minute should be reported promptly (p. 189).

Do texts emphasise the important of respiratory rate measurement?

Sixteen texts (55.2%) emphasised the clinical importance of respiratory rate measurement. Examples included: respiratory rate is a strong predictor of acute illness and mortality (Potter et al., 2019); respiratory rate is a vital indicator of deterioration (Tollefson & Hillman, 2019); and a respiratory rate greater than 20 breaths/minute is often one of the first signs of deterioration (Bloomfield et al., 2017).

Discussion

This audit examined contemporary nursing textbooks to appraise content regarding respiratory rate measurement

and to determine if texts promote the importance of respiratory rate measurement. Textbooks should emphasise this assessment as respiratory rate is considered the most useful sign in determining clinical deterioration and is an antecedent to adverse events (Moore & Cunningham, 2016). Despite this, the audit found considerable variation in textbook descriptions of respiratory rate assessment. Whilst some differences are expected, the findings are a concern and provide some insight into the clinical neglect of respiratory rate measurement pertaining to nurses' knowledge.

The majority of texts stated the normal adult respiratory rate is either 12-18 or 12-20 breaths/minute. There are, however, few studies to support this normal range (Kellett, 2017) and none of the audited texts provided supporting evidence for the 'normal' respiratory rate. In an observational study in six tertiary referral hospitals in North America, respiratory rates of 18 or 20 breaths/minute accounted for 72% of all recordings, but documented respiratory rates were higher than those directly observed by independent researchers (Semler et al., 2013).

Many of the reviewed texts recommended that respiratory rate be measured by counting the rate for 30 seconds and then doubling the number. This, however, is not viewed as best practice as the patient's respiratory rate can change from one reading to the next very quickly (Moore & Cunningham, 2016). In a study of 82 adult volunteers, counting the respiratory rate for shorter durations (eg 15 seconds) was found to underestimate respiratory rates by an average of 2 breaths/minute (A Hill et al., 2018). Although some texts said that if the respiratory rate or pattern is irregular, the rate should be counted for a full minute, only nine texts stated the respiratory rate should be routinely counted for one minute.

Just over half of the reviewed texts promoted the clinical significance of respiratory rate measurement. This is a concern and provides some insight into why respiratory rate measurement is often neglected in clinical practice. In a recent observational study in an 800 bed teaching hospital in Australia, vital signs assessment practices rarely adhered to the policy-mandated full set of vital sign measures (Cardona-Morrell et al., 2016). This is not surprising as research has found that patient acuity, lack of time and laziness influences vital sign assessment practices (J. Hogan, 2006; Philip et al., 2013; Ansell et al., 2014).

One of the challenges to undergraduate students is the vast amount of knowledge that must be remembered, understood and applied in clinical practice. However, in a qualitative study involving 10 Registered Nurses working in adult wards in three hospitals in New Zealand, participants reported that the skills of respiratory rate measurement were not clearly demonstrated during their undergraduate studies (Ansell et al., 2014). Similarly, a study involving 41 medical and nursing staff on medical and surgical wards at one British hospital found that a lack of training or knowledge was one of the key reasons respiratory rate measurement was neglected in clinical practice (Philip et al., 2013). Nurse educators should ensure inclusion of relevant content in nursing curricula and orientation curricula for new graduates (Lynn, 2018).

Nearly a decade ago, it was recommended that clinicians be taught that respiratory rate is the most useful marker for identifying patients at risk of adverse events and therefore warrants frequent assessment and documentation (Guinane et al., 2013). This message is still relevant, but the varying content found by this audit suggests that textbooks might not be a reliable resource for this important information and the message is possibly overlooked.

Limitations

The results of this audit reflect a convenience sample of current nursing textbooks globally available to students. Whilst an attempt was made to audit as many current texts as possible, the results may have differed if a larger sample was obtained such as the inclusion of textbooks published in other languages. However, no relevant texts were identified, which were not able to be included in the audit.

Respiratory rate is the most clinically important vital sign. Despite this, research has found it is the most clinically neglected vital sign. The reasons for this are not clear but inconsistencies in nursing textbooks might be one relevant factor. Academics and nurse educators must be alert for limitations of educational resources prescribed to student nurses.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – M.E.; Literature Search – M.E., R.W.; WritingManuscript – M.E., R.W.; Critical Review – M.E., R.W.

References

Anderson L., Kim W., Chase M., Berg K., Mortensen S., Moskowitz A., Novack V., Cocchi M., Donnino M. (2016). The prevalence and significance of abnormal vital signs prior to in-hospital cardiac arrest. *Resuscitation, 98*, 112-117. [Crossref]

Ansell H., Meyer A., Thompson S. (2014). Why don't nurses consistently take patient respiratory rates? *British Journal of Nursing, 23*(8), 414-418. [Crossref]

Badawy J., Nguyen O., Clark C., Halm E., Makam A. (2017). Is everyone really breathing 20 times per minute? Assessing epidemiology and variation in recorded respiratory rate in hospitalised adults. *BMJ Quality & Safety, 26*(10), 832-836. [Crossref]

Barfod C., Lauritzen M., Danker J., Soletormos G., Forberg J., Berlac P., Lippert F, Lundstrøm L, Antonsen K, Lange K. (2012). Abnormal vital signs are strong predictors for intensive care admission and in-hospital mortality in adults triaged in the emergency department – A prospective cohort study. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, 20* (1). [Crossref]

Berman A., Snyder S., Levett-Jones T., Burton T., Harvey N. (2017). *Skills in Clinical Nursing*. Pearson.

Berman A., Snyder S., Levett-Jones T., Dwyer T., Hales M., Harvey N., Moxham L., Langtree T., Reid-Serl K., Rolf K., Stanley D.. (2018). *Kozier and Erb's Fundamentals of Nursing: Concepts, Process and Practice* (4th Aust ed). Pearson.

Bloomfield J., Pegram A., Wilson R., Pearson A., Procter N., McGuiness W., Stein-Parbury J., Bristow S., Dally J., Gillespie B., Hay B., Lakeman R., Kunst E., Smith Z., Norton-Westwood D.,

Robertson-Malt S., Shaban R., van de Mortel T., Zimmerman P., Wood E., Cruikshank M.. (2017). *Clinical Nursing Skills: An Australian Perspective*. Cambridge University Press.

Brabrand M., Hallas P., Folkestad L., Lautrup-Larsen C., Brodersen J. (2018). Measurement of respiratory rate by multiple raters in a clinical setting is unreliable: A cross-sectional simulation study. *Journal of Critical Care*, *44*(April), 404-406. [Crossref]

Burchill C., Anderson B., O'Connor P. (2015). Exploration of nurse practices and attitudes related to postoperative vital signs. *Medsurg Nursing*, *24*(4), 249-255.[Crossref]

Burton M., Smith D., Ludwig L. (2019). *Fundamentals of Nursing Care: Concepts, Connections and Skills* (3rd ed). FA Davis.

Cahill H., Jones A., Herkes R., Cook K., Stirling A., Halbert T., Yates A, Lal S, Gardo A, Donnelly R, Gattas D J. (2011). Introduction of a new observation chart and education programme is associated with higher rates of vital sign ascertainment in hospital wards. *BMJ Quality & Safety*, *20*(9), 791-796. [Crossref]

Cardona-Morrell M., Prgomet M., Lake R., Nicholson M, Harrison R, Long J, Westbrook J, Braithwaite J, Hillman K. (2016). Vital signs monitoring and nurse-patient interaction: A qualitative observational study of hospital practice. *International Journal of Nursing Studies*, *56*, 9-16. [Crossref]

Chen Y., Patch J., Rose K., Soon W, West K, Nagendran M, Srikantharajah D. (2015). Measurement and recording errors of the respiratory rate. *Clinical Medicine*, *15*(3), s16. [Crossref]

Chua W., Mackey S., Ng E., Liaw S. (2013). Front line nurses' experiences with deteriorating ward patients: A qualitative study. *International Nursing Review*, *60*(4), 501-509. [Crossref]

Churpek M., Adhikari R., Edelson D. (2016). The value of vital sign trends for detecting clinical deterioration on the wards. *Resuscitation*, *102*(May), 1-5. [Crossref]

Considine J., Currey J. (2015). Ensuring a proactive, evidence-based, patient safety approach to patient assessment. *Journal of Clinical Nursing*, *24*(1-2), 300-307. [Crossref]

Cooper S., Cant R., Sparkes L. (2014). Respiratory rate records: The repeated rate? *Journal of Clinical Nursing*, *23*(9–10), 1236-1238. [Crossref]

Cooper K., Gosnell K. (2019). *Foundations and Adult Health Nursing* (8th ed. (Elsevier.

Craven R., Hirnle C., Henshaw C. (2017). *Fundamentals of Nursing: Human Health and Function* (8th ed). Wolters Kluwer.

Craven R., Hirnle C., Henshaw C. (2017). *Fundamentals of Nursing: Human Health and Function* (8th ed). Wolters Kluwer.

Crisp J., Taylor C., Douglas C., Rebeiro G., Waters D.. (2021). *Potter and Perry's Fundamentals of Nursing* (6th ed). Elsevier.

Cretikos M., Bellomo R., Hillman K., Chen J., Finfer S., Flabouris A. (2008). Respiratory rate: the neglected vital sign. *Medical Journal of Australia*, *188*(111), 657-659. [Crossref]

DeLaune S., Ladber P., McTier L., Tollefson J., Lawrence J. (2016). *Australian and New Zealand Fundamentals of Nursing*. Cengage.

Delves-Yates C., Everett F., Wright W. (2018). *Essential Clinical Skills for Nurses: Step by Step* (2nd ed). Sage.

Dougherty L., Lister S. (2015). *The Royal Marsden Manual of Clinical Nursing Procedures* (9th ed). Wiley.

Elliott M. (2016). Why is respiratory rate the neglected vital sign? A narrative review. *International Archives of Nursing & Health Care*, *2*(3). [Crossref]

Flenady T., Dwyer T., Applegarth J. (2017). Explaining transgression in respiratory rate observation methods in the emergency department: A classic grounded theory analysis. *International Journal of Nursing Studies*, *74*(September), 67-75. [Crossref]

Guinane J., Bucknall T., Currey T., Jones D. (2013). Missed medical emergency team activations: Tracking decisions and outcomes in practice. *Critical Care & Resuscitation*, *15*(4), 266-272.

Hill A., Kelly E., Horswill M., Watson M. (2018). The effects of awareness and count duration on adult respiratory rate measurements: An experimental study. *Journal of Clinical Nursing*, *27*(3-4), 546-554. [Crossref]

Hill R., Hall H., Glew P. (2017). *Fundamentals of Nursing and Midwifery: A Person-centred Approach to Care* (3rd ed. (Lippincott.

Hogan J. (2006). Why don't nurses monitor the respiratory rates of patients? *British Journal of Nursing*, *15*(9), 489-493. [Crossref]

Hogan M. (2018). *Nursing Fundamentals – Reviews and Rationales* (4th ed). Pearson.

Kallioinen N., Hill A., Christofidis M., Horswill M, Watson M. (2021). Quantitative systematic review: Sources of inaccuracy in manually measured adult respiratory rate data. *Journal of Advanced Nursing*, *77*(1), 98-124. [Crossref]

Kellett J. (2017). *The assessment and interpretation of vital signs*. In De Vita M., Hillman K., Bellomo R. (eds). *Textbook of Rapid Response Systems*. Switzerland: Springer.

Kellett J., Sebat F. (2017). Make vital signs great again – A call for action. *European Journal of Internal Medicine*, *45*(November), 13-19. [Crossref]

Koutoukidis G., Stainton K., Hughson J. (2017). *Tabbner's Nursing Care – Theory and Practice* (7th ed). Elsevier.

Liddle C. (2013). Postoperative care: Principles of monitoring post-operative patients. *Nursing Times*, *109*(22), 24-26.

Lynn P. (2018). *Taylor's Clinical Nursing Skills: A Nursing Process Approach* (5th ed). Lippincott.

Mok W., Wang W., Cooper S., Ang E., Liaw S. (2015). Attitudes towards vital signs monitoring in the detection of clinical deterioration: Scale development and survey of ward nurses. *International Journal of Quality in Health Care*, *27*(3), 207-213. [Crossref]

Moore T., Cunningham S. (2016). *Essential Skills for Nursing Practice*. Routledge.

Parkes R. (2011). Rate of respiration: The forgotten vital sign. *Emergency Nurse*, *19*(2), 12-18. [Crossref]

Perry A., Potter P., Ostendorf W. (2018). *Clinical Nursing Skills and Techniques* (9th ed). Elsevier.

Philip K., Richardson R., Cohen M. (2013). Staff perceptions of respiratory rate measurement in a general hospital. *British Journal of Nursing*, *22*(10), 570-574. [Crossref]

Potter P., Perry A., Stockert P., Hall A. (2019). *Essentials for Nursing Practice* (9th ed). Elsevier.

Ridley S. (2005). The recognition and management of critical illness. *Annals of the Royal College of Surgeons of England*, *87*(5), 315-322. [Crossref]

Rolfe S. (2019). The importance of respiratory rate monitoring. *British Journal of Nursing*, *28*(8), 504-508. [Crossref]

Rosdahl C., Kowalski M. (2017). *Textbook of Basic Nursing* (11th ed). Wolters Kluwer.

Semler M., Stover D., Copland A., Hong G., Johnson M., Kriss M., Otepka H., Wang L., Christman B., Rice T. (2013). Flash mob research: a single-day, multicenter, resident-directed study of respiratory rate. *Chest*, *143*(6), 1740-1744. [Crossref]

Shaw S., Horne W., Reid D., Reed K. (2016). *A Guide to Clinical Skills for Health Students*. Oxford University Press.

Smith S., Duell D., Martin B., Aebersold M., Gonzalez L. (2017). *Clinical Nursing Skills – Basic to Advanced* (9th ed). Pearson.

Taylor T. (2015). *Fundamentals of Nursing Made Incredible Easy!* (2nd ed). Wolters Kluwer.

Taylor C., Lynn P., Bartlett J. (2018). *Fundamentals of Nursing: The Art and Science of Person-centred Nursing Care* (9th ed). Wolters Kluwer.

Timby B. (2017). *Fundamental Nursing Skills and Concepts* (11th ed). Wolters Kluwer.

Tollefson J., Hillman E. (2019). *Clinical Psychomotor Skills: Assessment Tools for Nurses* (7th ed). Cengage.

Treas L., Wilkinson J., Barnett K., Smith M. (2018). *Basic Nursing: Thinking, Doing & Caring* (2nd ed). FA Davis.

Van Kuiken D., Huth M. (2016). What is normal? Evaluating vital signs. *Nephrology Nursing Journal*, *43*(1), 49-59.

Vaughan B., Keogh J. (2019). *Nursing Fundamentals Demystified* (2nd ed). McGraw Hill.

Williams P. (2018). *deWit's Fundamental Concepts and Skills for Nursing* (5th ed). Elsevier.

Yoost B., Crawford L. (2019). *Fundamentals of Nursing: Active Learning for Collaborative Practice*. Elsevier.