

# Respiratory rate 3: how to take an accurate measurement

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**Abstract** A change in respiratory rate is arguably the first sign of patient deterioration, yet this vital sign is often poorly measured or omitted. This third article in a six-part series describes the procedure for observing and measuring respiratory rate.

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## Box 1. Causes of abnormal respiratory rate

### Tachypnoea

- Anxiety
- Emotional distress
- Pain
- Fever
- Exercise
- Asthma
- Pulmonary embolism
- Pneumonia
- Acute respiratory distress syndrome
- Anaphylaxis
- Heart failure
- Shock
- Diabetic ketoacidosis
- Neuromuscular disorders
- Chronic obstructive pulmonary disease

### Bradypnoea

- Depression of the respiratory centre
- Opioid overdose
- Increased intracranial pressure
- Diabetic coma
- Exhaustion caused by severe airway obstruction
- Sleep apnoea
- Obesity hypoventilation syndrome

**R**espiratory rate (RR) is an essential vital sign and a fundamental element of patient assessment. Generally, changes in RR occur automatically in response to a physiological demand but it is possible to consciously increase or decrease RR for short periods. Changes from as little as three to five breaths per minute (bpm) may indicate a change in the patient's condition (Field, 2006), and are often the first sign of deterioration (Dougherty and Lister, 2015). RR therefore provides a baseline for future comparisons and helps determine the patient's acuity.

Other key indications for measuring RR include:

- Post-operative monitoring;
- Detecting complications such as pulmonary oedema associated with blood transfusion and administration of intravenous fluids;
- Identifying patients who are deteriorating and are critically ill;
- Evaluating response to treatment – for example use of opiates, which can cause respiratory depression;
- Monitoring chronic lung disease such as chronic obstructive pulmonary disease, and response to treatment;
- Monitoring patients receiving oxygen therapy (Dougherty and Lister, 2015; Jevon, 2010).

Table 1. Respiratory rate classification in adult patients

RR	Range
Eupnoea (normal relaxed breathing)	12-20bpm (Royal College of Physicians, 2017)
Normal range >65 years	12-25bpm (Rodrigues-Molinero et al, 2013)
Normal range >80 years	10-30bpm (Rodrigues-Molinero et al, 2013)
Bradypnoea (slow RR)	<12bpm (RCP, 2017)
Tachypnoea (fast RR)	>20bpm (RCP, 2017)

bpm = breaths per minute; RR = respiratory rate

## Normal and abnormal RR

Measurement of RR is part of the Resuscitation Council UK's Airway, Breathing, Circulation, Disability, Exposure (ABCDE) assessment process ([bit.ly/ABCDEFResus](http://bit.ly/ABCDEFResus)), in combination with heart rate, blood pressure, temperature and oxygen saturation. This approach helps to form a picture and detect impending adverse events in conjunction with the National Early Warning Score (NEWS) 2 (Royal College of Physicians, 2017). NEWS2 sets the normal RR range for adults as 12-20bpm (Table 1).

RR varies with age; for example some older people have a higher baseline RR, which may partly be due to deconditioning (Renwick, 2001). Higher RRs have been reported in patients in nursing or residential homes, and Rodríguez-Molinero et al (2013) suggest that tachypnoea can be defined in this group as 28bpm. This increase is due to age-related changes that affect the body's ability to meet physiological demands and is why RR must be part of a holistic patient assessment. Monitoring should be increased if the patient shows signs of deterioration.

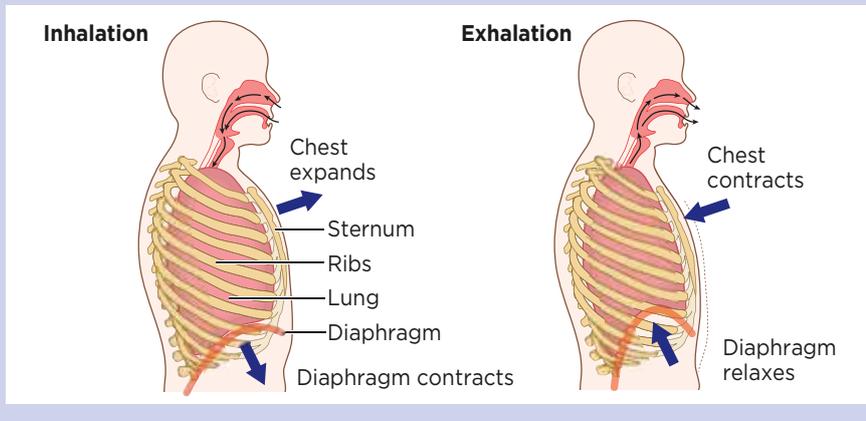
Smith et al (2013) noted that an RR of >27bpm is a key predictor of cardiac arrest. Conversely, an RR of <12bpm (bradypnoea) is also a concern and should alert the health professional to consider causes (Box 1).

## Is technology useful?

In acute or critical care areas, RR may be monitored using impedance pneumography, which measures electrical activity in the chest during inhalation and exhalation. However, this method has limitations: patient movement or disconnected chest leads can cause inaccurate measurements, and obstruction to airflow may go undetected as chest wall movement will continue to register as a patient tries to breathe (Wilkinson and Thanawala, 2009).

Capnography monitors, which measure carbon dioxide levels breath by breath, may be a more accurate measurement of RR. These devices are generally only available in critical care areas, where they are used primarily with patients who are intubated and sedated. On general wards, any patient activity such as talking can cause inaccurate measurements. This can lead to

Fig 1. Chest movements with inhalation and exhalation



increased alarm fatigue. The observation of RR remains the method of choice, but requires skill and diligence.

### The procedure

1. Wash hands with soap and water to reduce infection risk (Dougherty and Lister, 2015).
2. Gain the patient's consent (Nursing and Midwifery Council, 2015).
3. Position the patient in a comfortable position. Maintain a constant temperature to prevent shivering, which can increase RR. If possible, remove bulky clothing or bed covers from the upper part of the patient's body to facilitate counting RR and observing depth, symmetry and pattern of breathing. If the patient is sitting, their feet must be flat on the floor; sitting with legs suspended can reduce venous return, which may increase heart rate and subsequently RR.
4. If a patient has been prescribed oxygen, ensure the oxygen mask or nasal cannula is correctly positioned and recorded on the observation chart before recording RR.
5. Allow the patient to rest, if possible, for 20 minutes before taking the measurement. RR may increase after activity, giving an abnormal baseline. Some medication can affect RR so this should also be taken into consideration.

### Professional responsibilities

This procedure should be undertaken only after approved training, supervised practice and competency assessment, and carried out in accordance with local policies and protocols.

6. While you are preparing the patient, observe their respiratory function, for example, whether they can talk in full sentences (Dougherty and Lister, 2015). Taking a breath mid-sentence or one-word answers may be a sign of respiratory distress.

7. Note whether the patient is alert and orientated to time and place (Dougherty and Lister, 2015). Changes in cognitive status, such as confusion, may be due to hypoxia, cerebral injury or side-effects of medication, such as opiates.

8. It may be useful to assess RR at the same time as pulse rate or oxygen saturation. This will give a more accurate rate and minimise any subconscious influence, as patients may alter their breathing if they know they are being observed.

9. Using a watch with a second hand, count breaths (number of times the chest moves up and down) (Fig 1) for a full minute. This length of time is needed as changes can occur in the respiratory pattern and rate.

10. While observing the RR, note the rhythm, which may indicate signs of underlying illness. Respirations should be regular with equal pause between each breath (see part 4 for more details).

11. Observe the patient's lips for signs of cyanosis (blue tinge), which may indicate hypoxia (low oxygen saturation [SpO<sub>2</sub>]). Pulse oximetry is a valuable tool to measure SpO<sub>2</sub> but it has limitations when a patient's peripheral circulation or condition is compromised – for example, through tremor, shivering, hypovolaemia, hypothermia, heart failure or vaso-constriction (Elliott and Coventry, 2012). Pulse oximetry is less accurate when SpO<sub>2</sub> is <80% (Jubran, 2006).

12. Record the RR on the observation chart and report any abnormalities according to local policy.

13. Check your patient is comfortable, then wash and dry your hands.

### Summary

While other vital signs can be measured continuously using technology, RR often relies on visual observation of chest movement at periodic intervals. There are limitations to intermittent measurement, which can be affected by issues such as anxiety and activity. Nurses must be aware of the importance of measuring RR immediately if they have concerns about the patient's condition – but measuring RR over time is a much more useful measure of decline or recovery.

New technologies have been developed to support nurses to continuously monitor RR and these will be discussed in part 6. **NT**

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### CLINICAL SERIES

### Respiratory rate series

- Part 1:** Why measurement and recording are crucial  
[Bit.ly/RespiratoryR1](http://bit.ly/RespiratoryR1)
- Part 2:** Anatomy and physiology of breathing  
[Bit.ly/RespiratoryR2](http://bit.ly/RespiratoryR2)
- Part 3:** How to take an accurate measurement
- Part 4:** Respiratory rhythms and chest movement
- Part 5:** Respiratory rate and the deteriorating patient
- Part 6:** Technology in respiratory assessment