Long-term, ambulatory and short-burst oxygen therapy in the community


Abstract

This article examines assessment and management strategies for all categories of domiciliary oxygen therapy for adult patients. It highlights the evidence underpinning each category, and enables dissemination of good practice to colleagues, patients and carers.

Aims and intended learning outcomes

The aim of this article is to familiarise the reader with salient aspects of domiciliary oxygen therapy. After reading this article you should be able to:
- Understand the indications for domiciliary oxygen therapy, the criteria for assessment, prescription and methods of patient assessment.
- Be familiar with various methods of oxygen delivery for domiciliary use.
- Discuss the potential effect on patients and carers and the need for education and ongoing monitoring.
- Identify guidelines concerning domiciliary oxygen therapy and know where to seek further information.

Introduction

If domiciliary oxygen therapy is given in the correct manner to the correct patient it can significantly enhance quality of life. Long-term oxygen therapy can be a life-prolonging intervention (Nocturnal Oxygen Therapy Trial (NOTT) Group 1980, Medical Research Council (MRC) Working Party 1981). While the use of oxygen therapy at home is common and expensive for the NHS, medical and nursing ignorance are widespread and can result in poor patient knowledge and concordance. The provision of domiciliary oxygen depends on a patient’s diagnosis, need and intended use and is categorised according to the therapy regimen prescribed. These categories are: long-term oxygen therapy, ambulatory oxygen therapy, short-burst oxygen therapy.

Background

In 2006, changes in the supply of oxygen services in the home were introduced in England and Wales (British Thoracic Society (BTS) 2006). This was as a result of a report by the Royal College of Physicians (RCP 1999) in response to spiralling costs of home oxygen therapy since its introduction in 1985 (Department of Health (DH) 1985). The changes included: clinical standards for assessment and prescription, follow-up requirements and optimal ongoing management, in addition to organisation and delivery of services.

For the first time BTS (2006) guidelines specify the care and assessment that each patient should receive, and provide clinicians with a structured framework. The expectation is that all patients will receive standardised care and that inequalities in health attributed to the so-called ‘postcode lottery’ are removed. The guidelines recommend that all patients should receive a formalised oxygen assessment before commencing oxygen therapy.

Hypoxia and hypoxaemia

To assess a patient for oxygen and deliver the therapy correctly it is important to understand aspects of normal anatomy and physiology that refer to the need for transport and delivery of oxygen to the tissues. Oxygen therapy is used to correct hypoxaemia (deficiency of oxygen in arterial blood) and prevent hypoxia (a lack of oxygen in the tissues). Hypoxaemia can be transient, for example when a patient desaturates during exercise. In such circumstances, patients may benefit from oxygen therapy during exercise. Hypoxaemia can also be chronic, perhaps resulting from disease processes of a respiratory and cardiac nature, including chronic obstructive pulmonary disease (COPD), interstitial lung disease, pulmonary vascular disease and chronic heart failure (BTS 2006).
Continuing professional development

1 Cor pulmonale

With chronic diseases such as COPD, if alveolar ventilation is poor, leading to chronic hypoxaemia, the lack of oxygen in alveoli causes changes in the pulmonary blood circulation that culminate in the development of pulmonary hypertension and right-sided heart failure. This can cause septal displacement, polycythaemia (an increase in the number of erythrocytes in the blood) and renal hypoxia. This is called cor pulmonale, and it can reduce life expectancy significantly in a patient with COPD, so oxygenation of the alveoli is important (Figure 1).

Oxygen delivery in the home
An oxygen concentrator is the most cost-effective method of supplying oxygen in the home. Air consists of 21% oxygen and about 78% nitrogen. An oxygen concentrator is an electrical device that uses ambient air, and through the absorption of nitrogen from the air, the percentage of oxygen increases. This means that oxygen is not stored – a consideration when assessing safety issues. One of the drawbacks of using a concentrator is that it can restrict patients to their home environment.

There is a range of portable devices available for ambulatory use, including liquid oxygen, lightweight cylinders and oxygen-conserving devices. Some portable concentrators are available to buy privately. Oxygen, irrespective of delivery method, is supplied by one of four main contractors in the UK. They are responsible for providing a contact number, installing equipment, tubing and supplying disposables and – in the case of an oxygen concentrator – reimbursement of electricity costs.

Long-term oxygen therapy
Long-term oxygen therapy is indicated for patients with chronic hypoxaemia resulting from conditions such as COPD, cystic fibrosis, chronic heart failure or nocturnal hypoventilation as a result of obesity, chest wall disease or sleep apnoea. The primary objective is to correct hypoxaemia, achieving a blood gas tension of ≥8.0 kilopascals (kPa) at rest and/or an oxygen saturation of ≥90% (BTS 2006). The evidence base for long-term oxygen therapy is two landmark studies conducted in the 1970s (NOTT Group 1980, MRC Working Party 1981). Randomised controlled trials demonstrated that in COPD patients with chronic hypoxaemia, long-term oxygen therapy increased long-term survival. The results of these studies defined the need for oxygen for at least 15 hours per day. However, survival improved when it was used for more than 20 hours per day. Oxygen should be administered overnight when physiological benefits are optimum and the psychosocial effect is minimised. Oxygen therapy administered in such a manner preserves vital organ function, reduces pulmonary hypertension (and subsequently cor pulmonale) and secondary polycythaemia. This, in turn, reduces morbidity and mortality.

Assessment
Assessment of hypoxaemia includes blood gas analysis. This is a sensitive indicator of the levels of oxygen and carbon dioxide in the blood. Normal values of these gases are: oxygen 10-14kPa and carbon dioxide 4.6-6.0kPa. Other components are also measured, such as pH and bicarbonate.

2 Hypoxaemia

Certain criteria have to be met to initiate the prescription of long-term oxygen therapy (Box 1 overleaf). Relative criteria are used when accompanied by evidence of pulmonary hypertension, cor pulmonale, nocturnal hypoxaemia (measurement of oxygen saturation in the blood (SpO2) <90% for more than 30% of the night), or secondary polycythaemia (British National Formulary (BNF) 2008). A sample for analysis of blood gases can either be taken from an artery or an arterialised capillary, usually from the ear lobe (Zavorsky et al

Figure 1 Oxygen transport

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**Time out**

Revise the definition of cor pulmonale and consider the signs and symptoms that a patient with cor pulmonale can present with. Review secondary polycythaemia. Why does this develop, what are the consequences and what is the recommended treatment? Consider the pathological processes that lead to the development of cor pulmonale.

What are the limitations of relying exclusively on pulse oximetry when assessing hypoxaemia? Why is it important to measure partial pressure of carbon dioxide in arterial blood (PaCO2) and pH when assessing patients for oxygen therapy?

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Box 1 Criteria for prescription of long-term oxygen therapy

During a period of clinical stability at least three weeks apart

**Absolute** – partial pressure of oxygen in arterial blood (PaO2) < 7.3 kilopascals (kPa).

**Relative** – PaO2 7.3-8.0 kPa with evidence of pulmonary hypertension, peripheral oedema, secondary polycythaemia or nocturnal hypoxaemia.

2006). Assessment is traditionally performed in hospital due to the nature of obtaining arterial blood gases. The procedure is often performed as an extended role by specialist nurses or physiotherapists.

With the advent of capillary blood gas sampling and the use of small portable analysers, this assessment is starting to occur in primary care, for example in nursing homes or in patients’ homes. This has provided the opportunity for general nurses, such as community nurses or community matrons, to obtain and analyse blood gas samples. Specific training in the procedure, together with robust quality assurance mechanisms, are fundamental to ensure safe practice. The assessment is also an opportunity to undertake a comprehensive patient review and ensure optimum disease management, such as pharmacological intervention. It can also be necessary to refer patients for further specialist intervention if appropriate, such as rehabilitation or lung function tests.

When conducting the assessment for domiciliary oxygen, patients should be stable and with no evidence of infection as this could worsen hypoxaemia temporarily. It is also recommended that blood gas analysis is performed on two occasions at least three weeks apart. Ideally one of these should not be on discharge from hospital following an acute exacerbation, although this can be useful as a baseline and to monitor recovery. A patient’s blood gases are assessed initially when he or she is resting and breathing room air. If patients fulfil the criteria on two occasions, then it is necessary to proceed with the assessment by establishing his or her response to long-term oxygen therapy. This is done by administering oxygen, initially at a flow rate of two litres per minute (l/min) for at least 30 minutes before a blood gas sample is taken.

Ideally oxygen should be delivered via an oxygen concentrator to establish the optimal flow rate, because the patient will use this device at home, rather than the higher pressure wall-piped oxygen used in hospitals. The aim is to increase the oxygen tension to a minimum of 8.0 kPa without causing an increase in arterial carbon dioxide tension (which is a risk in some patients).

Occasionally some patients will need more than 2 l/min, others might need less. If patients do not fulfil the criteria, but the results are borderline, it might be appropriate to repeat the test in three months’ time.

Pulse oximetry can be a useful screening tool for chronic hypoxaemia and can signify the need for a comprehensive assessment. The National Institute for Health and Clinical Excellence (NICE) guidelines on the management of COPD advocate the use of pulse oximetry in the management of chronic stable disease (National Collaborating Centre for Chronic Conditions 2004). This helps to identify all patients eligible for formal assessment for oxygen therapy – those with SpO2 ≤ 92% when breathing room air.

It is vital not to delay assessment for long-term oxygen therapy as there is evidence that oxygen therapy is delayed it might be less effective, perhaps because of pulmonary capillary remodelling (NOTT Group 1980, MRC Working Party 1981). Pulse oximetry, when used correctly, can be an invaluable aid when assessing the need for oxygen therapy. Pulse oximeters are now commonplace in most healthcare settings, are relatively easy to use and results can be interpreted easily. As with all equipment used in clinical areas, healthcare staff should be trained to use the device and be aware of its limitations.

Once patients meet the criteria for oxygen therapy and the decision has been made to commence long-term oxygen therapy, they should be made aware of the prescription, what to expect and where to seek help. Long-term oxygen therapy should be used for a minimum of 15 hours, administered overnight and usually via a nasal cannula. It might also be appropriate for nurses to instruct patients to use it during exertion, particularly if there is evidence of desaturation, for instance when bathing.

Patients and their carers should be reassured that they are not receiving oxygen because their life is immediately in danger. This is a common misconception that can result in reluctance to leave the equipment. Therapy should improve a patient’s quality of life, not detract from it. Initial and ongoing education of patients and carers is, therefore, an important part of a nurse’s role, regardless of the healthcare setting or how long the therapy has been in place.

Reassurance can be given and advice about outings, holidays and portable oxygen can be invaluable. The British Lung Foundation (BLF) website (www.lunguk.org) is a useful resource for patients and nurses and provides advice on issues such as air travel and the provision of long-term oxygen therapy abroad. The BLF runs the Breathe Easy support group network, which can put patients in touch with veteran oxygen users.

Patients will need to make considerable psychosocial adjustment to living with long-term oxygen therapy and support is important from all healthcare staff involved in their care to ensure concordance with therapy. A home visit is also advocated within a month of initiation of therapy for specialist nurse review, including repeat
blood gases in three months (BTS 2006). This ensures that hypoxaemia remains corrected (>8kPa) and that hypercapnia (high carbon dioxide levels in the blood) has not developed or worsened.

Although the use of oxygen therapy in interstitial lung disease or other causes of chronic hypoxia has not been studied as extensively as in COPD, it is still important in the management of those patients with chronic hypoxaemia. Evaluation for this group of patients should include measures of oxygen saturation at rest and during exercise. This is because many will commonly show a more profound lack of oxygen with exertion. Despite the lack of empirical evidence, normal oxygen tensions are still considered necessary to prevent secondary pulmonary hypertension and subsequently right-sided heart failure – complications that will worsen a patient's dyspnoea and subsequent quality of life.

For patients receiving long-term oxygen therapy, other issues and problems can exist that affect psychosocial wellbeing and require addressing by any nurse involved in their care, ideally all forming part of the ongoing assessment, monitoring and support of patients. Referral to occupational therapy and social services for specific needs and equipment might be necessary.

### Assessment procedure

**Time out**

Identify a patient who is receiving long-term oxygen therapy. How was he or she assessed? Was the assessment procedure outlined here followed? If not, why was this? What are the implications of suboptimal assessment? What, if any, specific instructions did he or she receive about when and for how long to take the oxygen therapy?

**Ambulatory oxygen therapy**

Ambulatory oxygen therapy refers to the use of oxygen during exercise and activities of daily living (BTS 2006). Oxygen is delivered by equipment that can be carried by most patients. The need for ambulatory oxygen therapy is governed by patients' oxygen levels when resting and during exercise and their need to leave home. There are three distinct categories depending on patient need:

- **Long-term oxygen therapy – low activity.** For patients who are on long-term oxygen therapy via a concentrator for 24 hours a day but may require oxygen to leave the house occasionally to visit relatives, for example.
- **Long-term oxygen therapy – active group.** For patients who are mobile and wish to leave the house on a regular basis.
- **Non-long-term oxygen therapy patients.** This group includes patients who do not have chronic hypoxaemia but show evidence of exercise oxygen desaturation. Assessment for these patients is specific and needs to demonstrate exercise desaturation, improvement in exercise capacity and/ or breathlessness (BTS 2006).

**Assessment** The purpose and nature of this assessment depends on a patient's activity and ability to leave home. Most assessments involve objective measurement of response to supplemental oxygen while patients are performing an exercise test, for example a six-minute walk test or shuttle walk test (Singh et al 1992).

Desaturation during exercise is defined as a reduction in SpO2 of 4% to a value ≤90% (Eaton et al 2006). Evidence is still lacking in this area, although short-term studies suggest that people with COPD respond to oxygen when exercising (Bradley and O'Neill 2005) and that they can tolerate more exercise and do not feel as breathless. Assessments should be performed by a specialist, who is often a nurse and/or physiotherapist, to assess the extent of desaturation, improvement in exercise capacity and flow rate required to correct the desaturation. Ideally this should be after a course of pulmonary rehabilitation (BTS 2006), and following optimisation of drug therapy.

The number of hours that patients are likely to require ambulatory oxygen therapy should be established, and the weight of the device to be used should also be considered. Patients should, therefore, be assessed using the method of delivery to be used, for example liquid oxygen. Patients’ motivation to use oxygen outside the home should also be assessed. Ambulatory oxygen is expensive to prescribe so the likely benefits need to be established. A decision about the nature of equipment prescribed should take into account the number of hours and the flow rate required (Table 1).

Once ambulatory oxygen therapy is started the true value should be judged after two months by interview, diary card and oxygen usage. It should be withdrawn if it is found to be unhelpful (BTS 2006). Since the inclusion of ambulatory oxygen therapy in recent guidelines there has been considerable interest and, although evidence to date is limited, it is anticipated that guidance will evolve. The nurse’s role in educating patients is essential to ensure correct use and

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<td>Use</td>
<td>Equipment</td>
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<tr>
<td>&lt;90 minutes</td>
<td>Small cylinder</td>
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<tr>
<td>90 minutes–4 hours</td>
<td>Small cylinder with oxygen-conserving device</td>
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<tr>
<td>&gt;4 hours</td>
<td>Liquid oxygen</td>
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<tr>
<td>&gt;30 minutes if flow rate &gt;2 l/min</td>
<td>Liquid oxygen</td>
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(Adapted from National Collaborating Centre for Chronic Conditions 2004)
concordance with therapy, and to provide support and reassurance by addressing any concerns or anxieties.

### Relieving dyspnoea

**Time out**

- **Can you identify any patients in your care who are receiving short-burst oxygen therapy?**
- **Have any other strategies been tried to relieve their dyspnoea? Are there any alternative or more effective strategies available?**

#### Short-burst oxygen therapy

This refers to the intermittent, occasional use of supplemental oxygen at home. Traditionally, it has been prescribed to relieve the sensation of dyspnoea or to provide oxygen before and/or after exercise. The use of short-term oxygen in this way is widespread and expensive. There is, however, little evidence to support the prescription in patients who are not chronically hypoxic at rest or who demonstrate desaturation during exercise (Stevenson and Calverley 2004), although patients often report subjective benefit. There could be a number of reasons for this apparent benefit. It might be a placebo effect, or there may be a cooling effect on the face (Schwartzstein et al. 1987). It could also be that when patients are receiving oxygen, they need to breathe less strenuously to ensure that their blood remains oxygenated during exercise (O’Donnell et al. 1997). There is no evidence for using short-burst oxygen for symptomatic relief before or after exercise (Lewis et al. 2003, Stevenson and Calverley 2004, Eaton et al. 2006). There is an obvious and urgent need for further research in this area. Importantly, oxygen should not be used as a costly coping mechanism and nurses should explore other management strategies for the relief of dyspnoea on an individual basis.

**Assessment** Because of the lack of evidence to support the use of short-burst oxygen therapy, there is no specific method of assessment for its prescription. The BTS (2006) working group on home oxygen services recommended that other causes of breathlessness should be excluded, and patients should report subjective improvement if short-burst therapy is to be continued. Patients receiving short-burst oxygen therapy should be reviewed at least once a year to assess whether there is a continuing need. It might also be necessary to assess for long-term oxygen therapy. This assessment will often be performed during a routine review by, for example, a practice nurse, community nurse or respiratory specialist nurse.

#### Home oxygen in palliative care

Control of symptoms is central to the practice of palliative medicine. Dyspnoea is a common distressing symptom in many terminal conditions and one for which oxygen is often prescribed. There is some evidence that oxygen can have a useful role in the palliation of dyspnoea in selected patients with advanced cancer and COPD (Booth et al. 2004). Oxygen is only part of supportive care and adverse effects should be assessed.

When considering the end stages of chronic lung disease, nurses should recognise psychological and environmental factors that can influence patient wellbeing, as well as the physiological causes of breathlessness. The experience of anxiety in patients can add significantly to the experience of dyspnoea. As well as optimising pharmacological management and physical functioning, the treatment of anxiety, especially in the end stages of disease, can benefit overall management.

Caution with any palliative approach should always be adopted to prevent the onset of new symptoms. These might include exacerbation of hypercapnia caused by injudicious use of oxygen, which could induce drowsiness or headaches. Indeed, there is evidence that the use of supplemental oxygen might be a cause of increasing oxidative stress and therefore worsening inflammation in the lungs (Carpagnano et al. 2004). There appears to be no physiological rationale for administering oxygen to patients with an SpO2 >92% at rest. Patients who experience relief are probably experiencing a placebo effect from facial cooling and relief of anxiety (Muers 2005). Fan therapy or opening a window can often have similar benefits through the cooling effects stimulating facial nerves (Schwartzstein et al. 1987). Nebulisers probably work in a similar way.

The use of oxygen as a placebo might cause psychological dependence and could interfere with relationships between carers and patients. However, oxygen continues to be recommended for use in the palliation of dyspnoea in patients (even if they have an SpO2 of 96%) if their dyspnoea is not relieved by other treatments (NICE 2004, BNF 2008).

Although an assessment with blood gases is not appropriate in this patient group, Booth et al. (2004) supported the notion of assessment. They advised that symptom diaries should be kept on the efficacy of oxygen in respect of reduction in dyspnoea and any improvements in quality of life. NICE (2004) also suggested that this therapy should only be continued if an improvement in breathlessness following therapy was documented. It remains a common but controversial issue in palliative care and is an area that requires urgent investment in further research.

#### Humidification

Humidification is not usually required as flow rates are low. Providers will not usually supply humidification for patients who are on flow rates of <4 l/min as ambient air entrainment should supply sufficient humidification for the total inspired gas. However, if a nurse feels
that patients would benefit from humidification, he or she can contact customer advisers of oxygen suppliers who can provide alternative solutions and humidifiers if required. If patients use a humidifier, knowledge of cleaning and sterilisation procedures is vital.

5 Smoking policy

Consider your local policy on smoking, fire hazards and oxygen. Describe the ethical and/or safety issues.

Oxygen therapy as a fire hazard

Health and safety are important in the prescription of any form of home oxygen. Nurses should encourage smoking cessation and guidance should be given on safety with gas fires and cookers. In some areas, the local fire service will initiate a risk assessment before oxygen is installed. Cylinders pose a fire and explosion risk in the home. Although a concentrator does not store oxygen, patients are still at risk from burns if they are exposed to a naked flame while using oxygen. Despite guidance, many patients will continue to smoke and, in these situations, it is important that nurses educate them and document that advice has been given.

Smoking and domiciliary oxygen therapy

Smoking in relation to oxygen in the home is contentious. There is anecdotal evidence that some patients have been denied oxygen because they continue to smoke. There is no evidence to support the withholding of oxygen because they continue to smoke. However, there is evidence to support the withholding of oxygen from those who smoke. A significant proportion of patient samples included in early long-term oxygen therapy studies continued to smoke (NOTT Group 1980, MRC Working Party 1981) and these patients benefited from oxygen therapy.

Oxygen aids combustion, but is not flammable and, although it is imperative that patients who smoke receive adequate safety advice, it can be deemed unethical to deny them this potentially life-prolonging therapy (Lacasse et al 2006). Smoking cessation slows the decline in lung function in COPD (Fletcher and Peto 1977) and can improve daily symptoms.

Conclusion

Domiciliary oxygen therapy is prescribed according to indication. It can prolong survival in hypoxaemic patients and improve exercise capacity and quality of life in patients who need to use oxygen outside the home. Oxygen therapy is expensive and can restrict patients’ lifestyles. Therefore, it is important that patients are assessed correctly before it is prescribed. This assessment strategy depends on the therapy being considered, but usually involves analysis of blood gases.

Education of patients, relatives and carers is an essential part of a nurse’s role to enhance acceptance and concordance with treatment. Careful consideration of health and safety issues should be part of this assessment process, and smoking cessation should be encouraged at every opportunity.

6 Practice profile

Now that you have completed the article you might like to write a practice profile. Guidelines to help you are on page 46.

References


Fletcher C, Peto R (1980) MRC Working Party 1981) and these patients benefited from oxygen therapy.


Practice profile

What do I do now?
- Using the information in section 1 to guide you, write a practice profile of between 750 and 1,000 words – ensuring that you have related it to the article that you have studied. See the examples in section 2.
- Write ‘Practice Profile’ at the top of your entry followed by your name, the title of the article, which is: ‘Long-term, ambulatory and short-burst oxygen therapy in the community’, and the article number, which is PHC310.
- Complete all of the requirements of the cut-out form provided and attach it securely to your practice profile. Failure to do so will mean that your practice profile cannot be considered for a certificate.
- You are entitled to unlimited free entries.
- Using an A4 envelope, send for your free assessment to: Practice Profile, RCN Publishing Company, Freepost PAM 10155, Harrow, Middlesex HA1 3BR by July 2010. Please do not staple your practice profile and cut-out slip – paperclips are recommended. You can also email practice profiles to practiceprofile@rcnpublishing.co.uk. You must also provide the same information that is requested on the cut-out form. Type ‘Practice Profile’ in the email subject field to ensure you are sent a response confirming receipt.
- You will be informed in writing of your result. A certificate is awarded for successful completion of the practice profile.
- Feedback is not provided: a certificate indicates that you have been successful.
- Keep a copy of your practice profile and add this to your professional profile – copies are not returned to you.

1. Framework for reflection
- Study the checklist (section 3).
- What have I learnt from this article?
- To what extent were the intended learning outcomes met?
- What do I know, or can I do, now, that I did not/could not before reading the article?
- What can I apply immediately to my practice or client/patient care?
- Is there anything that I did not understand, need to explore or read about further, to clarify my understanding?
- What else do I need to do/know to extend my professional development in this area?
- What other needs have I identified in relation to my professional development?
- How might I achieve the above needs? (It might be helpful to convert these to short/medium/long-term goals and draw up an action plan.)

2. Examples of practice profile entries
- **Example 1** After reading a CPD article on ‘Communication skills’, Jenny, a practice nurse, reflects on her own communication skills and re-arranges her clinic room so that she will sit next to her patients when talking to them. She makes a conscious decision to pay attention to her own body language, posture and eye contact, and notices that communication with patients improves. This forms the basis of her practice profile.
- **Example 2** After reading a CPD article on ‘Wound care’, Amajit, a senior staff nurse on a surgical ward, approached the nurse manager about her concerns about wound infections on the ward. Following an audit that Amajit undertook, a protocol for dressing wounds was established which led to a reduction in wound infections in her ward and across the directorate. Amajit used this experience for her practice profile and is now taking part in a region-wide research project.

3. Portfolio submission
- Checklist for submitting your practice profile
  - Have you related your practice profile to the article?
  - Have you headed your entry with: the title ‘Practice Profile’; your name; the title of the article; and the article number?
  - Have you written between 750 and 1,000 words?
  - Have you kept a copy of the practice profile for your own portfolio?
  - Have you completed the cut-out form and attached it to your entry?

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