Non-invasive ventilation — an overview for the primary care nurse

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Community nurses are meeting increasing numbers of patients on non-invasive ventilation (NIV) in the home setting. This article aims to provide an overview of NIV which may assist them in providing effective care to this cohort of patients. An outline of the appropriate NIV equipment used in primary care, a troubleshooting guide of common problems encountered, and the provision of some useful contact resources are included.

Introduction
One of the most exciting developments in respiratory medicine in the last two decades has been the development of non-invasive ventilation (NIV) as a treatment modality for the management of respiratory failure. The field of non-invasive ventilation continues to expand rapidly in the management of acute and chronic respiratory conditions, both in the hospital and in domiciliary contexts. This advancement has major implications for nursing practice, management and education in both primary and secondary care. Many patients who previously required hospitalisation with respiratory failure, can now live at home using NIV with the support from the primary care team.

NIV — definition
Non-invasive ventilation (NIV) refers to ‘the provision of ventilatory support through the patient’s upper airway using a mask or similar device’.¹

This may be:
• Continuous positive airways pressure (CPAP) — where the machine delivers a flow of air at a preset constant pressure during inspiration and expiration, or
• Bi-level positive airways pressure (BiPAP) ventilation which works on the principle of pressure support, delivering gases at two levels of positive pressure — inspiratory positive airway pressure (IPAP) which produces ventilation, and expiratory positive airway pressure (EPAP) which increases functional residual capacity and recruits under-ventilated lungs, improving oxygenation.

These treatments may be used as the sole treatment, a holding measure, a trial prior to intubation or the ceiling of treatment² with the aim to produce:
• Decreased work of breathing
• Increased tidal volume
• Decreased respiratory rate

‘It is important that nurses in primary care understand the nature and consequences of the patient’s respiratory condition, and the basic principles of how the ventilator works.’
Clinical Review

During NIV the patient usually wears a tightly fitting nasal or facial mask that is attached via wide-bore tubing to a portable ventilator.

Overview of indications for non-invasive respiratory support

The use of NIV in acute care includes CPAP for patients with acute hypoxaemic respiratory failure or cardiogenic pulmonary oedema, whereas BiPAP is indicated for acute hypercapnic respiratory failure, but may also be used in critical care areas in weaning patients from mechanical ventilation.

The National Institute for Clinical Excellence (NICE) guidance for the management of chronic obstructive pulmonary disease (COPD) (2004) recommends the use of NIV in acute exacerbations of COPD. The other major application of NIV is in its longer-term use to support patients with chronic hypoventilation.

Indications and benefits of domiciliary NIV

There are three main conditions that benefit from domiciliary NIV:

1. Obstructive sleep apnoea/hypopnoea syndrome (OSAHS).
2. Respiratory problems associated with neuromuscular disease and chest wall deformities.
3. Chronic obstructive pulmonary disease (COPD).

Obstructive sleep apnoea/hypopnoea syndrome is a condition in which a person experiences repeated episodes of apnoea because of a narrowing or closure of the pharyngeal airway during sleep. This is caused by a decrease in the tone of the muscles supporting the airway during sleep. CPAP treatment is the ‘gold standard’ treatment for OSAHS. A CPAP device consists of a portable unit capable of delivering pressures between 4cm-20cm H²O that generates airflow, which is directed to the airway via a mask preventing airway collapse. The overall benefit to the patient with OSAHS of using overnight NIV is improved quality of sleep, with reduced daytime lethargy and improved concentration.

Neuromuscular disease/chest wall deformities

NIV is the treatment of choice to support patients with restrictive lung diseases who develop chronic respiratory failure. This varies from patients with chest wall abnormalities such as kyphoscoliosis through to patients with neuromuscular conditions such as motor neuron disease (MND) and Duchenne Muscular Dystrophy. The application of NIV will potentially improve tidal volumes, reduce the effort of breathing and thus provide symptomatic support and possibly delay the onset of end-stage respiratory failure.

Chronic obstructive pulmonary disease

COPD patients with chronic hypercapnia and nocturnal hypoventilation may benefit from domiciliary ventilator support, but this remains controversial. However, the NICE guideline (2004) recommends:

- Optimally treated patients with chronic hypercapnic respiratory failure, who have required ventilation during an exacerbation or who are hypercapnic or acidic on long term oxygen therapy, should be referred to a specialist centre for assessment for long-term NIV.

Equipment for non-invasive ventilation: ventilators, interfaces and accessories

The ventilator

This machine consists of a pump that draws air from the room through a filter and blows it out under pressure. The bi-level device delivers two levels of pressure: a higher level of pressure on inspiration (inspiratory positive airways pressure) and a lower level of pressure on expiration (expiratory positive airways pressure). CPAP machines deliver a constant pressure.

The circuit

A flexible tube that allows the flow of air between the machine and the mask.

The mask

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There are several different types of masks available. Full face masks are most commonly used to cover the nose and mouth if the patient tends to breathe through his mouth. Some patients prefer a nasal mask that just covers the nose. [Nasal pillows or the total face mask may be used in a small number of patients.]

Masks systems consist of a mask frame, headgear and a soft cushion seal. Mask fitting is an essential element of a patient’s success with NIV because if affects compliance and treatment efficacy.

**Warning:** All masks should have an **exhalation port** (usually small holes or a vent) to allow exhalation of carbon dioxide. This must **never** be covered.

*It is important to note that circuits and masks used in the hospital are not suitable for domiciliary use. The reusable mask and circuits provided with the ventilator for home use should always be used.*

<table>
<thead>
<tr>
<th>Problem</th>
<th>Advice</th>
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<tr>
<td>Poor mask seal with consequent air leakage</td>
<td>There should be a leak from the vents/exhalation port on the mask, to allow exhalation of carbon dioxide. Leak from the interface should be minimised by adjusting the head straps and adjustment clip (if applicable) to ensure a good seal. The machine will compensate for some leak but too much leak can compromise pressure delivery and the therapy. If problems continue, contact service provider.</td>
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<td>Eye irritation</td>
<td>Adjust mask to eliminate leaks into the eyes. Follow mask fitting instructions.</td>
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<td>Nasal bridge redness/ ulceration</td>
<td>Ensure correct application of mask — follow guidelines on mask fitting Loosen headgear slightly to relieve pressure on the nasal bridge. Adjust forehead clip (if present) to reduce pressure on nasal bridge. Contact nurse specialist for advice on suitable dressings if appropriate for susceptible or broken skin.</td>
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<tr>
<td>Nasal and oral dryness</td>
<td>Humidify flow Re-hydrate Consider nasal sprays</td>
</tr>
<tr>
<td>Nasal and oral congestion</td>
<td></td>
</tr>
<tr>
<td>Missing mask port plug</td>
<td>Not a major problem Machine will compensate for small leak Do not stick anything over port Contact service provider</td>
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<tr>
<td>Ventilator alarms/ problems</td>
<td>Ventilator settings are set as prescribed by the doctor and are locked into the machine, and should only be adjusted on the advice of the doctor/appropriate healthcare professional. Some common alarms include: Blank display — check power connection Patient disconnect alarm — check circuit, mask are appropriately attached to ventilator. Assess for leak in system. Refer to fitting guidelines. High or low pressure alarms — check mask fitting — too much leak can cause low pressure alarms. High pressure alarms can result if there is a blockage — check that filters are clean and the tubing is free from blockage.</td>
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<td>How to reset alarms</td>
<td>The technician, on initial set up of domiciliary NIV, will have shown the alarm silence button and how to reset the alarm on the machine. The patient is always advised to react to an alarm, try to identify the cause, rectify the problem and reset. Contact service provider if alarms are constant.</td>
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Once-daily Victoza® (lixisline), in combination with metformin, impacts on multiple factors associated with type 2 diabetes, providing from baseline:

- **Reductions in HbA1c:** up to 1.30%\(^1,2\)
- **Reductions in weight:** up to 2.8kg\(^1,2\)
- **Reductions in systolic blood pressure**\(^1,2\)
- **Improvements in beta-cell function**\(^1,2\)

**Hypersensitivity to the active substance or any of the excipients. Warnings and Precautions for use:**

- **Victoza®** should not be used in patients with type 1 diabetes mellitus or for the treatment of diabetic ketoadiposis. Limited experience in patients with congestive heart failure New York Heart Association (NYHA) class I-IV and no experience in patients with NYHA class IV. Due to limited experience Victoza® is not recommended for patients with inflammatory bowel disease and diabetic gastroparesis.

- **Victoza®** is associated with transient gastrointestinal adverse reactions, including nausea, vomiting and diarrhea. Other GLP-1 analogues have been associated with pancreatitis; patients should be informed of symptoms of acute pancreatitis: persistent, severe abdominal pain. If pancreatitis is suspected, Victoza® and other suspect medicinal products should be discontinued. Thyroid adverse events, including increased blood calcium, goitre and thyroid neoplasms reported in clinical trials particularly in patients with pre-existing thyroid disease. Risk of hypoglycaemia in combination with sulphonylureas; lowered by dose reduction of sulphonylureas. No studies on the effects on the ability to drive and use machines performed. Patients should be advised to take precautions to avoid hypoglycaemia while driving and using machines, in particular when Victoza® is used in combination with a sulphonylurea. Substances added to Victoza® may cause deiodination; in the absence of comparability studies Victoza® must not be mixed with other medicinal products. Pregnancy and lactation: Victoza® should not be used during pregnancy or during breast feeding. If a patient wishes to become pregnant, or pregnancy occurs, treatment with Victoza® should be discontinued; use of insulin is recommended instead. Undesirable effects: During clinical trials with Victoza® the most frequently observed adverse reactions which varied according to the combination used (sulphonylurea, metformin or a thiazolidinedione) were: Very common: nausea, diarrhoea, hypoglycaemia when used in combination with metformin and a sulphonylurea and headache when used in combination with metformin; Common: hypoglycaemia when used in combination with a thiazolidinedione, vomiting, constipation, abdominal pain, discomfort and distension, dyspepsia, gastritis, flatulence, gastrooesophageal reflux disease, gastroenteritis, viral, toothache, headache, dizziness, nausea, pyrosis, pruritus, arthrosis, appetite decreased, fatigue and pyrexia. Gastrointestinal adverse reactions are more frequent at start of therapy but are usually transient. Very few hypoglycaemia episodes observed other than with sulphonylureas. Patients \(>70\) years or with mild renal impairment (creatinine clearance \(\geq 60\) ml/min) may experience more gastrointestinal effects. Consistent with medicinal products containing protein/peptides, patients may develop anti-lixisline antibodies following treatment but this has not been associated with reduced efficacy of Victoza®. Few cases reported of angioedema (0.05%), acute pancreatitis (0.2%) and injection site reactions (approx. 2%). Injection site reactions usually mild. Causal relationship between Victoza® and pancreatitis cannot be established nor excluded. Thyroid neoplasms, increased blood calcium and goitres are the most frequent thyroid adverse events and were reported in 0.5%, 1% and 0.8% of patients respectively. The Summary of Product Characteristics should be consulted for a full list of side effects.

**Overdose:** In the event of overdose, appropriate supportive treatment should be initiated according to the patient’s clinical signs and symptoms. **MA numbers:** Victoza® 2 x 3ml pre-filled pens EUR15952/002 Victoza® 3 x 3ml pre-filled pens EUR19852/003. Legal Category: POM. For complete prescribing information please refer to The Summary of Product Characteristics which is available on www.medicines.ie or by email from infotline@novonordisk.ie or from Medical department. Novo Nordisk Limited, 3-4 Upper Pembroke Street, Dublin 2, Ireland; www.novonordisk.ie. Date created: July 2009

**Further Information is available from:**

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Lo Call: 1850 665 665
www.novonordisk.ie

**References:**


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Date of preparation: July 2009. RRU0709/0268
Organisation of home NIV in Ireland

The assessment for home NIV is performed in hospital by a specialist respiratory team. Patients will be established on NIV before their discharge into the community. An NIV service, usually on a rental scheme, is organised by the area PCCC for medical card holders. Patients eligible under the Drug Refund Scheme may reclaim their monthly rental charge payments from their local PCCC. The monthly rental fee includes initial installation — set up, delivery and training, and annual service and consumable replacement. An education programme for the patient and carer, covering the rationale and practicalities of use of NIV, equipment assembly and care, mask application/removal and safety issues should be facilitated as part of the hospital discharge planning for patients being initiated on long term NIV therapy.

Conclusion

Non invasive ventilation is increasingly being used in primary care. Patients receive support from the service provider to maintain this treatment, although they may also seek help from the respiratory specialist centre and community nurses. It is important that nurses in primary care understand the nature and consequences of the patient’s respiratory condition, and the basic principles of how the ventilator works, in order to ensure informed practice, offer appropriate support, help maintain compliance and ensure optimum patient safety. They also need to be aware of how to contact help and seek advice for patients who may be experiencing non-invasive ventilation associated problems.

Useful contact numbers

General practice nurses/community nurses may access Respiratory Clinical Nurse Specialists/respiratory team in appropriate hospital for advice and support.

Local PCCC
Air Products: 01 8091800
1850 240202
BOC: 09064 70910
1890 220202
Home Healthcare: 09064 74854
Medicare: 01 2014900
Respicare Ltd.: 01 8904020
Useful website/email addresses
www.airproducts.ie
www.homehealthcare.com
www.medicare.ie
email: sales@respicare.ie
www.irishthoracicsociety.com
www.brit-thoracic.org.uk
www.nice.org.uk
www.sleep-apnoea-trust.org
www.isat.ie (Irish Sleep Apnoea Trust)

The issues which community nurses may encounter in the provision of care to patients on domiciliary NIV therapy revolve around two areas — compliance with the therapy and equipment care.

References