Factors affecting patient outcomes in acute non-invasive ventilation

Acute non-invasive ventilation (NIV) is most commonly used to treat chronic obstructive pulmonary disease (COPD). COPD is the second most common reason for hospital admission and accounts for 25% of all deaths from lung disease in the UK (British Lung Foundation, 2008), so it is vital to ensure that patients with the condition receive appropriate treatment. The National Confidential Enquiry into Patient Outcome and Death undertook a review of the provision of NIV in the UK (NCEPOD, 2017). The overall aim of the study was to identify and explore avoidable and remediable factors in the process of care for patients treated acutely with NIV. The study objectives focused on:

- Prompt recognition of ventilatory failure and rapid initiation of NIV;
- Appropriate documentation and management of ventilator settings;
- Escalation of treatment decisions and planning, including admission to critical care;
- Organisational aspects of care delivery for NIV.

Method

The study population consisted of patients aged 16 years or older who were admitted as an emergency between 1 February 2015 and 31 March 2015 inclusive, and who received NIV acutely. Patients were excluded if they were already on long-term NIV treatment or if they received continuous positive airway pressure and not NIV (both have the same Office of Population Censuses and Surveys code, which is the procedural classification used by clinical coders in the NHS).

Study population and design

In total, 9,299 patients were identified and a sample of 678 cases – which was limited to five cases per hospital within the UK – was selected for analysis through the use of a clinical questionnaire completed by the consultant responsible for the patient. Photocopied case-note extracts were reviewed in detail by a multidisciplinary group of clinicians, and a total of 353 sets of notes and 432 clinical questionnaires were completed. Data was also requested from each organisation in the form of a...
Physiological track-and-trigger systems have been recommended for use in all acute areas (1000 Lives Improvement, 2013; Royal College of Physicians, 2012; National Institute for Health and Care Excellence, 2007; NCEPOD, 2005). The National Early Warning Score (NEWS) was introduced by the Royal College of Physicians in 2012 as the recommended track-and-trigger system in the UK. This is a validated system used for hospital patients: the higher a patient’s score, the higher their risk of death. Escalation and clinical review are built into the NEWS system and a score of 5-6 requires urgent review by a doctor or acute team nurse.

Early warning scores were not consistently documented in the study population – in 47% of cases, they were not used. In those individuals for whom NEWS was used, 56% had a score of six or more, indicating the need for urgent clinical review (Fig 1). At initial triage, the score was nine or more in 17% of patients, suggesting the need for a critical care assessment; this group of patients requires rapid assessment and frequent monitoring.

Oxygen

For patients with COPD, a target oxygen saturation of 88-92% is recommended (British Thoracic Society, 2017) as higher levels of oxygen can contribute to acute hypercapnic ventilator failure and, as such, a requirement for NIV. At initial triage, 47% of the patients studied had an oxygen saturation >92%. Peer reviewers

<table>
<thead>
<tr>
<th>Table 1. Factors associated with mortality in patients treated with NIV</th>
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</thead>
<tbody>
<tr>
<td>Better prognosis</td>
</tr>
<tr>
<td>Early NIV (&lt;24 hours)</td>
</tr>
<tr>
<td>Started in emergency department or acute medical unit</td>
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<tr>
<td>Chronic obstructive pulmonary disease</td>
</tr>
<tr>
<td>Initial pH 7.26-7.35</td>
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<tr>
<td>pH ≥7.26 excluding O₂ toxicity</td>
</tr>
<tr>
<td>Frailty score 1-5</td>
</tr>
<tr>
<td>Respiratory rate &lt;26</td>
</tr>
<tr>
<td>Heart rate &lt;100</td>
</tr>
<tr>
<td>No pneumonia</td>
</tr>
<tr>
<td>Appropriate NIV</td>
</tr>
<tr>
<td>NIV success</td>
</tr>
<tr>
<td>Previous NIV</td>
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<td>Good documentation</td>
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</tbody>
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Source: NCEPOD, 2017

Clinical frailty on its own is increasingly recognised as a syndrome associated with poor clinical outcomes and has also been shown to be an independent predictor of inpatient mortality. In 70% of the cases studied, the primary admission diagnosis was COPD.

The overall mortality rate in the peer-reviewed cases was 34.6%. The factors associated with mortality in patients treated with acute NIV are outlined in Table 1.

Questionnaire, which included information on:
- The staff that manage NIV;
- Locations where patients treated with NIV were managed;
- Guidelines and standard operating procedures relevant to the management of patients on NIV.

**Key findings**

Within the patient group studied, 43.1% were male. The average age of males was 71.1 years, and 72.3 years for females. The majority of these patients were moderately or severely frail, as identified by the Rockwood Clinical Frailty Score (Rockwood et al, 2005), and 53% had two or more comorbid conditions.

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**Monitoring**

Physiological track-and-trigger systems have been recommended for use in all acute areas (1000 Lives Improvement, 2013; Royal College of Physicians, 2012; National Institute for Health and Care Excellence, 2007; NCEPOD, 2005). The National Early Warning Score (NEWS) was introduced by the Royal College of Physicians in 2012 as the recommended track-and-trigger system in the UK. This is a validated system used for hospital patients: the higher a patient’s score, the higher their risk of death. Escalation and clinical review are built into the NEWS system and a score of 5-6 requires urgent review by a doctor or acute team nurse.

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**Oxygen**

For patients with COPD, a target oxygen saturation of 88-92% is recommended (British Thoracic Society, 2017) as higher levels of oxygen can contribute to acute hypercapnic ventilator failure and, as such, a requirement for NIV. At initial triage, 47% of the patients studied had an oxygen saturation >92%. Peer reviewers
considered that oxygen toxicity contributed to hypercapnia in 27% of the cases, while clinicians in their own hospitals considered that oxygen toxicity contributed to hypercapnia in 23% of patients. In almost a third of cases (32%), the reviewers found that oxygen was not administered appropriately in the emergency department and, where the oxygen delivery device was recorded, only 17% used a venturi mask. Achieving the appropriate target oxygen saturation and better-controlled oxygen delivery will improve the care of this patient group and potentially reduce the need for NIV.

Service organisation and protocols
There is clear variation in how NIV services are organised: only 23% of hospitals had out-of-hours cover by a respiratory consultant at all times, while only 80% of respiratory wards were able to provide continuous oxygen saturation monitoring. Just under half of the hospitals in the study (49%) had a defined ratio of nurses to NIV patients, as previously recommended by the British Thoracic Society (BTS, 2008).

As recommended in the BTS (2008) guidelines, 97% of the hospitals had a local guideline or protocol for the provision of NIV. Most of these listed indications, contraindications and a recommendation to make an escalation plan when initiating NIV treatment. Prescription forms, on the other hand, were not used in 31% of the hospitals and 17% did not have an NIV-specific observation chart.

Documentation
Reviewers felt that monitoring could have been improved in 46% of the cases and that the frequency of documented NIV observations was not appropriate in 33% of cases reviewed. The reviewers were also of the opinion that ventilator settings were not adequately documented in 51% of the cases. Use of a prescription form and a standard NIV observation chart can improve reliability of patient treatment and monitoring. Some hospitals had exceptionally well-structured observation charts but, at times, these were inadequately completed, as highlighted by the case study in Box 1.

Ventilator management
Ventilator management was felt to be inappropriate in 35% of the cases reviewed, with inspired positive airway pressure not documented in 25% of the cases. Despite 82% of the hospitals reporting a competency assessment for the delivery of NIV, more than a third allowed staff without this competency to supervise patients on NIV.

Implications for nursing and nursing services
There are many opportunities for nurses to improve the quality and consistency of care for patients requiring acute NIV. Physiological track-and-trigger systems provide a common language for the monitoring, review and escalation of patients who are at risk of deterioration. Patients requiring acute NIV are mostly older people, frail and vulnerable. They will require rapid assessment and frequent monitoring; vital signs should be recorded at least hourly until the respiratory acidosis has resolved.

Documentation of all changes to ventilator settings is essential and NCEPOD recommends the use of a standardised pro forma, an example of which is provided in the appendices of its report (NCEPOD, 2017). To provide patients with the close monitoring they require during the acute phase of NIV, NCEPOD also concurs with the BTS recommendations that a ratio of one nurse to two patients be required as a minimum. It is recognised that the length of time for which this should continue will be determined by each patient’s response to NIV; this does not necessarily mean the patient will require transfer to a level 2 area (high dependency unit) and will depend on how services are organised within individual hospitals.

Having the correct level of competency to care for patients requiring NIV is essential. NCEPOD recommends that all staff who prescribe, or make changes to, acute NIV treatment must have the required level of competency as stated in their hospital operational policy. A list of competent staff should be maintained. The operational policy should include:
- Appropriate clinical areas in which acute NIV can be provided, along with the minimum safe level of staff competencies in those areas;
- Staff-patient ratios for the care of...
Box 2. Summary of recommendations

1. All hospitals should have a clinical lead for their acute NIV service.
2. Continuous positive airways pressure should be coded separately.
3. Acute NIV should only be provided in clinical areas equipped with continuous pulse oximetry and electrocardiogram monitoring, and rapid access to results of blood gas analysis.
4. Patients with known COPD or other risk factors for hypercapnic respiratory failure should have an oxygen saturation of 88-92% maintained.
5. Treatment with NIV must be started within one hour of identified need.
6. A minimum ratio of one nurse to two acute NIV patients must be maintained.
7. All hospitals where NIV is provided must have an operational policy to guide staff.
8. All staff who prescribe/change NIV treatment must have the required level of competency as stated in their hospital operational policy.
9. All patients treated with NIV must have an escalation plan in place before beginning treatment.
10. All patients treated with acute NIV must be discussed with a specialist competent in its management when treatment is started or as soon as possible after.
11. All patients receiving acute NIV should have, as a minimum, daily consultant review.
12. All patients treated with acute NIV must have their vital signs recorded at least hourly until respiratory acidosis has resolved.
13. All changes to ventilator settings should be documented; use of a standardised pro forma is recommended.
14. Use of acute NIV could act as a flag to consider referral to palliative care services.
15. Following an episode of acute NIV, a structured plan for future treatment should be discussed with the patient and/or carer at the point of discharge or at subsequent follow-up.
16. In the absence of a recognised indication for its use (e.g. COPD), acute NIV should not be considered standard treatment for patients with acute ventilatory failure and evidence of pneumonia.
17. All organisations providing acute NIV should have governance arrangements in place.
18. All acute NIV services should keep records of the number of patients treated.
19. All acute NIV services should be audited annually.
20. All hospitals should monitor their acute NIV mortality rate and quality of acute NIV care; this should be reported at board level.
21. A quality standard for acute NIV is required to facilitate improvement.

Source: NCEPOD, 2017

and monitoring:

- Nursing staff providing care for patients receiving acute NIV must be competent to do so regardless of patient location, in line with the Nursing and Midwifery Council’s (2015) guidance.
- Minimum staffing levels will always be a challenge for nurses to adhere to in times of austerity but, as previously recommended by the BTS, a minimum staffing ratio of one nurse to two patients receiving acute NIV must be in place. As the data suggests, this is a particularly vulnerable group of patients who are acutely ill – older people and those who are frail.

Hospital managers and staff members should do their best to improve patient care by ensuring that the suggested recommendations are not only put in place, but also adhered to.

References


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