# British Thoracic Society
# NIV Audit 2013 (national audit period 1 February – 31 March 2013)

Dr Mike Davies

THE BTS has conducted an annual audit of adult patients treated with acute non-invasive ventilation (NIV) since 2010. Data is collected over a 2 month period (February and March) with questions covering premorbid function, the underlying indications for NIV, the delivery of NIV, and outcomes. By providing a pragmatic snapshot of real-life outcomes, the audit enables participating hospitals to review the composition and effectiveness of their service, benchmarked against the collated national average. This year, the audit is the most successful to date, and comprises data on 2693 patients submitted from 148 UK hospitals. Sincere thanks to all of those who have participated.

## Patient characteristics

The mean age was 72 years and, as may be expected, prior performance status was limited in 36% (limited activity, but self-care) and very limited in a further 43% (limited self-care or bed / chair-bound ). COPD was the indication for acute NIV in 61%, with cardiogenic pulmonary oedema in 8%, obesity-hypoventilation syndrome in 8% and chest-wall / neuromuscular disorders in 4%. These baseline characteristics have remained essentially unchanged over the 4 audit periods to date.

The chest X-Ray demonstrated consolidation in 40%, a finding that is perhaps surprisingly high for predominantly ward-based NIV, but one which again remains consistent across all audit periods. Oxygen toxicity was thought to contribute to the need for NIV in 17% of all patients (18% in 2012); where data was available, hospital care was implicated in 60%, and pre-hospital care in 40%.

## Initial management with NIV

Despite the relative stability of the above characteristics, we seem to be treating an increasingly sick patient population. Since the first audit in 2010, there has been a progressive reduction in pre-NIV pH values. This year, the average pH at the start of NIV was 7.24, whereas it had been 7.30 in 2010. The most recent guidance, a joint BTS/RCP document in 2008, stated that COPD patients with a pH <7.26 may benefit from NIV but should be managed in a high dependency or ICU setting due to the higher risk of treatment failure. Prior to NIV, 893 (47%) COPD patients presented with a pH < 7.26 and it is noteworthy that the majority (91%) were managed in a ward-based environment.

Pressure support ventilation with a back-up rate <16 was the most frequently used setting. Over the first 24 hours, NIV was used for 15 (± 8) hours. The average initial $PaCO_2$ was 10.2kPa prior to NIV, and fell by 1.3kPa at 1 hour, and 1.9kPa at 4-6 hours to 8.3kPa. The acidosis had resolved in 45% patients by 4-6 hours of NIV.

## Patient outcomes

NIV success was defined as achieving pH > 7.3 and a reduction in $PaCO_2$ by 0.5kPa; this was achieved in 66% (69% in 2012). Treatment failure was recorded in 30% and a further 3% failed NIV, but proceeded to intubation. Reasons for NIV failure remain consistent with prior audits; general deterioration and a worsening $PaCO_2$ was implicated in 48%, suggesting a role for more aggressive optimisation of ventilation. General intolerance or agitation was seen in 31%, in which situation sedation was frequently attempted (84%). If NIV failed, then it was discontinued within 6 hours in 24%, at 6-24 hours in 28%, and at a later stage in 47%.

We asked if a treatment plan covering the possibility of NIV failure was evident. The medical notes documented a treatment plan in 74%; in those recording a plan, NIV was the “ceiling of therapy” in 67%, there was an intention to invasively ventilate if necessary in 21%, and there was a more palliative intent in 9%.

Overall, 66% patients treated with acute NIV were discharged from hospital. The median length of stay was 9 days. Respiratory follow-up was organised in 71%. 32% were discharged with oxygen therapy and 16% were treated with home ventilation (or referred to a home ventilation centre).

34% died during the admission, representing a slight increase over the preceding 3 audits. Understandably, NIV failure was associated with a worse outcome. Late NIV failure (>24 hours) was especially ominous. Following NIV failure, 81 (3%) proceeded to intubation. Death due to a respiratory cause was not increased in this group (27%), although it should be noted that they were younger (63 ± 14 years) and had less prior functional limitation (45% either unrestricted or limited by strenuous exertion only) than the wider patient cohort.

As in prior audits and studies, hospital mortality was higher in those with consolidation evident on the chest X-Ray than in those without (43% vs. 28%), as was NIV failure (37% vs. 25%).

Outcomes in the COPD group were analysed separately. Hospital mortality was higher in those who presented with more severe acidosis (36% if pH < 7.26 on arrival; 26% if pH 7.26-7.35). In the severe acidosis group, hospital mortality was 28% in a HDU/ICU setting, and 40% if started outside HDU/ICU. Whilst initial blood gas measurements were similar, evidence of consolidation was more likely in those receiving ward-based care (37% vs. 26%). The differing outcomes could reflect differences in the delivery of care, but equally may represent a more severely ill patient group within the ward environment. Neither possibility is entirely satisfactory. If there is positive treatment intent (as appears to be the case), these findings reinforce the need to consider a more intensive environment for patients who present with markers of adverse outcome such as consolidation and significant respiratory acidosis.

**Summary**

Across all audit periods, acute NIV is usually employed as the ceiling of therapy in patient groups with quite severe physiological derangements. The reported evidence base does inform the clinical indications to a large extent. However, it is also clear that acute NIV is often attempted in a ward environment when there is a high risk of failure (severe acidosis and consolidation).

Whilst the current audit demonstrates little overall change in outcomes, it is encouraging to note that the data provided has enabled individual trusts to take action as a result of their participation. In a separate part to the audit, we invited individual centres to reflect upon the impact of the audit upon their service. The results of the preceding audit were discussed in 79% institutions. More importantly, 40% participating centres reported that they have made changes as a result of the last audit. Such changes include improved education, better utilisation of oxygen alert cards, and plans for introducing more availability to critical care services.

On a general level, some of the outcomes reflect the fact that acute NIV in the UK has evolved as ward-based service. This was in part driven by evidence [(1)] that demonstrated that the early use of NIV in a ward setting provided clear benefit in patients with COPD exacerbations complicated by acidotic ventilatory failure. In light of the current audit data, it is timely to reiterate the findings of this key study, now more than a decade after publication. As noted clearly by the authors at the time, no significant benefit was identified in patients who had presented with a pH < 7.30. They argued that patients presenting with more severe acidosis should be managed in a more intensive environment. Nevertheless, ward-based NIV has expanded in the UK, whereas its use within ICU in acute COPD patients remains uncommon. Moreover, there are also significant issues around access to higher dependency areas in the UK, where ICU bed provision is extremely limited; the UK has 3 ICU beds per 100,000 population, whereas Germany has 25, for example[(2)]. Even assuming an expertise in acute NIV and a willingness to treat, current UK ICU services would struggle to meet the possible demand. In the current audit, 43% of the whole cohort presented with pH <7.25.

One solution, of course, is the earlier delivery of care when possible and this returns us to the principles of the ward-based study [(1)]. Alongside appropriate patient selection, a key principle for the successful delivery of acute NIV is in its timing. Once a downward spiral of worsening ventilatory failure towards hypercapnic coma develops, then its reversal is increasingly difficult. This audit did not include data around a “door to mask” time or other factors that might affect the timing of therapy. However, the fact that most of the pre-NIV patient characteristics have remained absolutely stable over a four year period with the exception of pre-NIV pH suggests an opportunity to intervene at an earlier stage. It is perhaps timely that next year will see a wider analysis of secondary care outcomes in patients with COPD. The core aim of this COPD audit programme is to drive improvements in the quality of care and services provided for COPD patients at least in part by characterising the patient journey. It is hoped that this will identify further strategies to improve the delivery of acute NIV in this patient group, and that this may be transferrable to other patients.

With the COPD audit covering data collection in secondary care between February – May 2014, the next NIV audit will take place in early 2015. The strength of the current NIV data rests in the large numbers of real-life outcomes that are available. The British Thoracic Society sincerely thanks all who have participated and we look forward to a successful audit in 2015. Such national benchmarks are essential in striving to improve the delivery of care. Overall, the findings reinforce the need to continue to focus upon achieving the best quality of care in patients with a proven indication for acute NIV and to consider the most appropriate location for this care to be delivered.

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References


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2. Wunsch H, Angus DC, Harrison DA, et al. *Crit Care Med*. 2008 Oct;36(10):2787-93.