

Non-Invasive Ventilation for Chronic Obstructive Pulmonary Disease (COPD) in Ireland: How Far Have We Really Come?

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Background: The landscape of COPD and NIV

Chronic obstructive pulmonary disease (COPD) is currently the second most common cause of respiratory deaths in Ireland with its mortality being second only to that of lung cancer¹. The true prevalence and incidence of COPD in Ireland is unknown and is extrapolated from other populations with similar characteristics to Irish cohorts. The Irish thoracic society (ITS) 2018 Respiratory Health of the Nation report estimates that 500, 000 people have COPD approximately half of whom have received a formal diagnosis¹. Irish patients have the highest admission rate for acute exacerbations of COPD (AECOPD) and the third highest mortality of all Organisation for Economic Co-operation and Development (OECD) countries. Ongoing exposure to risk factors for developing COPD, a relatively high prevalence of a genetic predisposition in the form of alpha one anti-trypsin deficiency (AATD) and an aging population mean it is likely that hospitalisation rates for COPD will continue to rise.

Despite improvements in our understanding of the pathophysiology of COPD few advances in COPD therapeutics have been made in the last 30 years. A combination of targeted O₂ therapy, inhaled bronchodilators and steroids remains the pillars of treatment for an AECOPD. 20% of AECOPD are complicated by the development of acidotic hypercapnic respiratory failure (AHRF)². AHRF arises from a failure of the respiratory muscle pump, in concert with the lungs to provide enough alveolar ventilation to maintain a normal arterial pCO₂, pO₂ and pH. The severity of the resultant acidemia is a strong predictor of mortality in patients with AHRF³. Though the causes of AHRF are numerous, it is most commonly encountered as a complication of an AECOPD. British Thoracic Society (BTS) audits of NIV usage across the UK indicate that 80% of patients managed with non-invasive ventilation (NIV) have underlying COPD⁴.

NIV is the treatment of choice for AHRF and has a broad evidence base supporting its use in COPD. Repeated meta analyses have confirmed a reduction in intubation and mortality rates by 65% and 46% respectively⁵. To put this in context, the reduction in mortality afforded by NIV (46%) exceeds that afforded by percutaneous coronary intervention (PCI) post ST elevation myocardial infarction (STEMI) in patients presenting with cardiogenic shock (28%)⁶.

NIV in practice

Early non-invasive ventilators were used to support ventilation in patients with neuromuscular and chest wall disease (CWD) in the intensive care unit (ICU). The observation that NIV could substantially reduce both the need for intubation and mortality in these cohorts prompted extension of its use to other conditions that shared the final common pathway of alveolar hypoventilation. By the later half of the 1990s multiple randomised control trials (RCTs) and meta-analyses confirmed NIV as an effective therapy for COPD complicated by AHRF. The question as to whether it could be managed safely on a general medical ward however remained unanswered.

The practice-changing Yorkshire NIV (YONIV) sought to address this gap in the literature. Unlike its predecessors, the YONIV protocol mandated that NIV had to be started and managed by hospital staff and not researchers affiliated with

clinical trials⁷. To facilitate this, centres were provided with a mean amount of 7.6 hours NIV training in the 3 months preceding the trial. Thereafter each centre received 0.9 h per month to maintain their skills. 236 patients across 14 UK hospitals were randomised to receive either best medical therapy or best medical therapy with NIV. Of the 25 wards involved in the trial 22 has no prior experience with NIV. Median nurse patient ratio was high even by current standards at 1:11 (range 1:2.6-1:13). Despite these challenges the use of NIV on the wards was shown to halve intubation rates from 27% to 15%. In-hospital mortality was also reduced from 20% to 10% in the NIV group ($p=0.05$). Despite methodological challenges, YONIV directly addressed the 'real world' feasibility of NIV use and laid the foundation for expansion of acute NIV services to medical wards. Since its move out of ICU and on to general medical wards NIV usage rates have increased exponentially. A 2012 study of 7.5 million COPD admissions in the decade covering 1998-2008 showed a 462% increase in NIV usage across the United States⁸.

NIV and the Aging Irish

Since the establishment of the HSE in 2005, repeated restructuring and re-organisation of health services has contributed to the development of considerable heterogeneity of NIV practices across different institutions. The current model of health care delivery as described in the 2010 Report of the Acute Medicine Programme (AMP) outlines four Irish hospital models. Different models (1-4) denote the level of service that can safely be provided within the constraints of available resources, staffing and facilities. As per the AMP report, all hospitals designated Model 2 or above are expected to deliver care up to and including NIV⁹. Model 2 hospitals identify and admit "low acuity medical patients" and have ambulance bypass protocols in place to transfer unwell patients to larger centres. Accurately identifying low acuity patients and predicting who is likely to deteriorate remains challenging. Established track and trigger tools such as the Early Warning Score (EWS) are unreliable predictors of future behaviour. A 2014 Danish study of 6257 Emergency Department (ED) admissions found that despite normal vitals on arrival, 31% of patients deteriorated significantly with 24 hours of presentation¹⁰.

Multiple Randomised Control Trials (RCTs) have demonstrated that mortality from AHRF is highest in patients who develop acidosis during the course of their admission rather than at the time of presentation⁵. This has considerable implications for the seventeen model 2 hospitals across Ireland tasked with caring for deteriorating patients without ICU support available. When combined, a lack of familiarity with NIV and poor theoretical knowledge of the principles of good NIV management can lead to patient outcomes falling far short of those seen in clinical trials.

A National Health Service (NHS) report, the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) highlighted concerns about the management of NIV across UK hospitals¹¹. Care delivered was judged by a panel of experts as being "less than good" in 80% of the 353 cases reviewed. NCEPOD investigators identified a mean age of 71.1 years for men and 72.3 years for women requiring NIV. 56% (242/432) of patients managed with NIV had a Clinical Frailty Scale (CFS) of 6 or above indicating a poor performance status with individuals requiring help with all outdoor activities and housework. 20% of cases reviewed were inappropriately commenced on NIV- a figure reflected in available Irish audit data.

Recent census data suggests that older patients with multiple co morbidities will continue to populate the wards of Irish hospitals. The 2016 Irish census reported an increase in growth rate of 3.8% since 2011 with much of the rise seen in people over the age of sixty¹². The over-sixties population in Ireland is projected to represent 23% of the total population by 2026. As many of the characteristics of aging lungs mimics the changes seen in COPD development of AHRF will continue to feature heavily on medical wards. In the eighteen years since the publication of the YONIV rates of NIV usage on medical wards have increased substantially in parallel with the growth of an aging populous. UK data suggests that the full scale of the challenge facing acute hospitals over the coming years may be under-recognised with accurate data on NIV usage often buried in discharge statistics due to poor coding practices.

NIV is a safe and highly effective treatment for a condition that occurs frequently in older frail populations. Audit data from model 4 and 3 hospitals in Dublin showed that 20% of patients starting on NIV did not have an appropriate indication. 58% of the changes made to ventilator settings were inappropriate and 30% of patient had reassessment at 1-2 hours post commencement of treatment as recommended by the BTS guideline¹³. An audit of practice in Cork university hospital showed that 60% of patients requiring NIV for AHRF experienced a delay of more than one hour between the need for treatment being recognised and starting on NIV¹⁴. If available data suggests that tertiary referral centres are not meeting best practice guidelines, it raises questions about what may be happening in less well-resourced settings. Without the clarity provided by audit suboptimal practices will continue to go unchecked.

Conclusion

The exponential growth of NIV usage requires a concomitant commitment to training of medical and nursing staff if the potential benefit of NIV is to be received. NCHDs undertake mandatory training in manual handling, hand washing, data protection, transfusion and the use of thrombolysis protocols for stroke - a condition with lower mortality and median one year survival than AHRF^{15noN}. In light of this, it is our view that at a minimum, basic training in NIV merits inclusion in induction programs across all hospital models. Furthermore, a national guideline is needed to ensure all patients have equal access to timely and effective NIV independent of hospital model. A long-term commitment of time and resources together with national audit will be required to finally start to see the results the trials of the nineties promised.

Declaration of Conflicts of Interest:

The authors have no conflict of interest to declare.

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