# NON INVASIVE VENTILATION

## CASE STUDY

**Team:**
Daniel Smith (Leadership Fellow, Specialist Registrar), Justin Wyatt (Ward Leader Ward 43), Mark Roberts (Head of Service, Consultant Respiratory Physician), Andrew Molyneux (Clinical Lead Acute NIV Service, Consultant Respiratory Physician)

King's Mill Hospital, Sherwood Forest Hospitals Foundation NHS Trust

### Background

Inspiring Change, the 2017 NCEPOD report[1] on Non-Invasive ventilation (NIV) demonstrated fundamental concerns in the quality, timeliness and appropriateness of treatment. The report demonstrated that patient care could have been improved in 73.2% episodes, more than one in three patients died and there was a delay in starting NIV in 27.4% of cases. The report also highlighted major issues in treatment. 40% hospitals lacked capacity to deliver Acute NIV; the need to transfer patients and a lack of beds caused delays.

### NIV at Sherwood Forest Hospitals

At Sherwood Forest Hospitals we have delivered an Acute NIV service on our Respiratory Support Unit (RSU) since 2006. This service has expanded to have a capacity of 8 beds since 2017. Patients requiring Acute NIV are cohorted, with 1:2 nursing by our team of Acute Respiratory Nurses who also provide outreach service to commence NIV promptly. We have an e-learning package on Acute NIV for medical staff, and undertake regular Respiratory Ward Nurse teaching, including NIV updates. Despite this service we noted issues with delivery of Acute NIV and our service in keeping with the findings of Inspiring Change. We also noted a lack of NIV capacity; data showed that 34% of our NIV referrals breached the 4 hour target in our Emergency Department (ED).

Previous inspections by CQC had identified significant failings in our Trust; we were placed into Special Measures in 2013 inspections in 2015 also highlighted issues with our delivery of Acute NIV. We therefore carried out a Quality Improvement Project aimed at improving delivery of Acute NIV and capacity within the service. We used the recommendations from Inspiring Change, the new BTS Quality Standards for Acute NIV[2], and the BTS/ICS Guidelines for Ventilatory Management of Acute Hypercapnic Respiratory Failure (AHRF)[3] to guide this project.

Our aim was to use data collected from our service, support our staff and use published quality standards to drive up the quality of our NIV provision. The focus was 3 fold: firstly, to develop a new Acute NIV prescription chart to improve delivery of NIV to patients, secondly to improve service capacity with an online real-time dashboard and finally to audit the care of every patient under our care.

### Acute NIV Prescription

We used an initial NIV prescription but found that it was often incomplete, with poor documentation of escalation of treatment, risk of NIV failure and underlying diagnosis. Most NIV cases were started by non-respiratory specialists.

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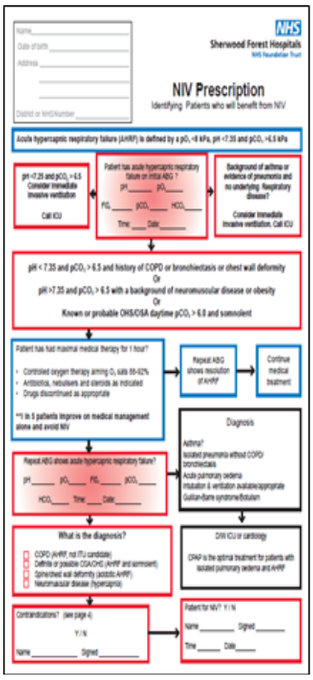
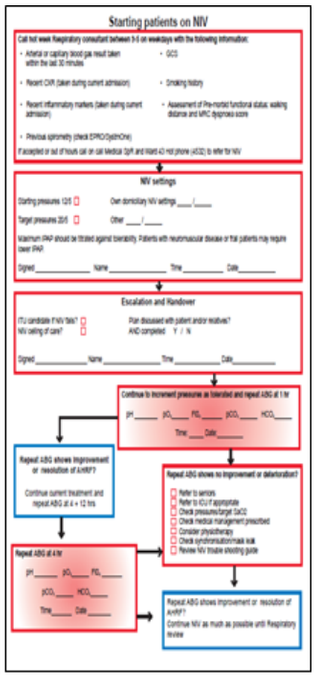
Studies of prescription charts have shown that poor structure and lack of decision support can lead to errors, and that improvements in content and design can enhance documentation[4]. For example, standardisation of an insulin sliding scale chart demonstrated a reduction in errors and decreased adverse events[5].

### i) Designing a new prescription chart

We used practice mapping, discussions with Respiratory nurses, doctors and physiologists, and design interventions to influence prescriber behaviour to design a new multidisciplinary NIV prescription chart. The chart includes guidance on patient selection, treatment, and reference figures adapted from the BTS 2016 Guidelines for AHRF[3]. We applied checklist methodology and flowcharts to simplify and standardise decision making and treatment for clinicians using the chart, and we included an NIV Treatment Log to assist nursing staff to record delivery of NIV.




### ii) Assessing the impact

We performed an audit to assess the timeliness and appropriateness of NIV administration and the quality of documentation, before and after introduction of the new NIV chart. We delivered training about the prescription to junior doctors in Medicine and ED, at team meetings and Medical Grand Rounds, and taught Respiratory Ward Nurses.

### iii) Findings

A total of 41 patients (mean age 71.4, 52.4% female) were reviewed from January to March 2017 and January to March 2018, before and after the introduction of the new chart respectively.
Documentation of a ceiling of care and appropriateness of NIV improved (from 73.3 % to 76.9%, and from 93.3% to 100% respectively). The time from blood gas indicating AHRF to starting NIV reduced by a statistically significant margin (median of

**Table 1** Comparison of the quality of NIV treatment before and after implementation of the chart

| | Prior to intervention (n=15) | Post update of prescription (n = 26) | p-value |
|---|---|---|---|
| Average Age (Yrs) | 75.3 | 69.2 | |
| % female | 40.0% | 61.5% | |
| Median time from admission to NIV (Mins) | 316.5 | 129.0 | 0.1436 |
| Median time from blood gas to NIV (Mins) | 164.0 | 81.0 | 0.0471 |
| Documentation of the ceiling of care | 73.3% | 76.9% | 0.7985 |
| NIV treatment appropriate? | 93.3% | 100.0% | 0.1869 |

164 to 81 minutes, p= 0.0471); time from admission to NIV also fell from median 317 minutes to 129 (p=0.1436, Table 1).

### iv) Conclusions

The introduction of a new NIV prescription chart significantly reduced delays in NIV, improving delivery of treatment towards the targets advised by the BTS and NCEPOD. Our experience suggests that a structured prescription, combined with training can improve delivery of Acute NIV. The prescription chart is designed to not be burdensome, guide decision making and provide a reference of best practice adapted from the BTS/ICS guidelines therefore clinical adoption was not problematic as prescribers readily identified the benefits. The Acute NIV service responded to the NCEPOD report rapidly and due to the weight of its findings we received support from the trusts executives and divisional clinical governance groups ensuring there were no barriers to implementation. We presented our findings at the 2018 Summer BTS conference and was delighted to win the Quality Improvement Abstract award. We proposed that our learning could be replicated nationally and the BTS adopted our design as part of the National NIV Toolkit to help deliver better care(https://www.brit-thoracic.org.uk/standards-of-care/quality-improvement/non-invasive-ventilation/).

## Online dashboard

The BTS Quality Standards for Acute NIV state that hospitals must ensure that there is adequate capacity for Acute NIV[2]. Having demonstrated that an Acute NIV Prescription significantly reduced delays in treatment (above), we noted a lack of NIV capacity; data from our ED showed that 34% of our NIV referrals breached the 4 hour target.

We therefore set out to collect data on our Acute NIV Service capacity, using a real time, online service dashboard, alongside an escalation and bed policy for the Service.

### i) Methods

From Autumn 2017 we recorded the following 5 quality metrics for delivery of Acute NIV, at our daily 9am board round on our Respiratory Support Unit:
1) Bed availability
2) Nurse availability
3) Consultant availability
4) Ventilator availability
5) Blood gas availability.

We developed a real time online dashboard to record these metrics, integrated with an escalation/bed policy for Acute NIV, with the aim to increase visibility of capacity, improve vigilance of service pressures, and flag issues with actions. Our policy was agreed with medical, nursing and bed managers. We introduced the dashboard/policy in Spring 2018, with no other additional investment.

### ii) Findings

Data pre-and post-dashboard were analysed. Data for 76 days pre-dashboard showed that an NIV bed or nurse were only available on 39.5% and 35.5% of days, respectively. Data for 141 days post-dashboard showed significantly improved availability of an NIV bed, nurse and consultant, and an improvement in total score (out of 5, mean increasing from 3.6 to 4.6, p<0.00001, see table 2).

**Table 2: Service quality metrics pre- and post-introduction of online service dashboard**

| METRICS | PRE | POST | Statistical analysis* |
|---|---|---|---|
| ① **BED**: Is there capacity for new NIV admissions? | 39.5% (30/76) | 80.9% (114/141) | p<0.00001 |
| ② **NURSE**: Is there nursing capacity to provide 1-2 nursing? | 35.5% (27/76) | 88.7% (125/141) | p<0.00001 |
| ③ **CONSULTANT**: Is there Respiratory consultant review of patients? | 88.2% (67/76) | 95.7% (135/141) | p=0.049 |
| ④ **VENTILATOR**: Is there sufficient NIPPY machines and supplies? | 100% (76/76) | 100% (141/141) | ns |
| ⑤ **BLOOD GASES**: Is it possible to perform an ABG? | 97.4% (74/76) | 97.2% (137/141) | ns |
| **MEAN TOTAL SCORE (SD)** | 3.6 (0.91) | 4.6 (0.60) | p<0.00001 |

*Fisher's exact test, two-tailed for each metric
Mann Whitney U for total score, Z=7.34

## iii) Conclusions

We have demonstrated that a real-time online service dashboard, with an escalation/bed policy, significantly increased capacity to deliver Acute NIV. The dashboard utilised human factors and checklist methodology to increase situational awareness and influence decision-making to maintain a safe and efficient service, and delivered improvements with no additional financial investment. We believe such an approach is generalisable, and recommend the adoption of service dashboards/checklists as part of a National NIV Toolkit to help deliver better care.

## Implementation/Learning/Challenges:

Both the Acute NIV Prescription and the Service Dashboard demonstrate significant improvements in care and service delivery for Acute NIV. In our latest CQC inspection in 2018 our Acute NIV Service was highlighted for outstanding care, and the Trust was given an overall 'Good' rating and outstanding for care. We continue to review and develop these initiatives, and are happy to share them as part of the BTS NIV QI Toolkit. We are keen to hear from other services, and are happy to receive all comments.

In terms of the success of our project there have been four key drivers. The first is team working, both within Respiratory Medicine (doctors, nurses, and physiologists particularly), and within the Trust (particularly working with Acute and Emergency Medicine, and the management team in implementing our escalation and bed policy). The second is time to develop the service: it is essential that there is an identified lead for Acute NIV (ideally both medical and nursing/AHP) with protected time within their jobs to manage these services. However, our project would not have been possible without our Leadership Fellow, who had both the time and skills to drive the development, implementation and assessment of these initiatives. Thirdly our initiatives were designed to be sustainable as they were delivered without additional investment and are not dependent on individuals post implementation to succeed. The final driver is data, collected routinely and prospectively, using systems designed to make this simple – Inspiring Change showed that less than half of Trusts did annual audits of Acute NIV, and only 24% routinely collected data on NIV episodes. Without such data it is impossible to assess performance, or study the impact of changes.

There continue to be challenges in our Trust. Particularly, we continue to see failures to identify AHRF leading to delays in initiating Acute NIV, as well as inappropriate use of treatment. Much of this relates to education needs, particularly among non-specialists, and this is a focus of some of our ongoing projects (see Future work

below).
The greater challenge is Nationally. We await the results of the next BTS Acute NIV Audit in 2019. We hope to see an improvement, but Inspiring Change showed that there is much work to be done. We note that huge improvements in care of other conditions, such as Stroke and Heart Attacks, have been driven by mandatory National Audits, such as SSNAP[6] and MINAP[7], through Regional Stroke and Cardiovascular Networks, meeting the highest of National and International standards. We ask why no parallel Respiratory Networks exist to focus on AHRF, a condition with an effective treatment that is poorly delivered with poor outcomes. We strongly believe that to consistently improve outcomes for all patients receiving Acute NIV requires a National QI Project, using tools such as the BTS QI Toolkit, alongside Respiratory Networks to drive improvement, using the BTS Quality Standards.

**Future work:**
These two initiatives are part of a larger ongoing project to improve delivery of Acute NIV in our Trust. We have also introduced a Patient Quality Dashboard to measure the quality of care to individual patients, based upon Inspiring Change and BTS Quality Standards; we present this data at our new quarterly NIV Morbidity and Mortality Meeting, and now send email feedback on performance to individual junior doctors and consultants. We are developing new checklists to use when taking referrals for Acute NIV, and for daily NIV ward rounds on our RSU; we have worked closely with our Respiratory Physiologists to develop checklists and pathways for those discharged on domiciliary NIV.

All members of our multi-disciplinary team are engaged with our quality improvement key drivers and our specialty nurses are independently developing and are leading new projects. These include designing information posters to raise the awareness of respiratory failure and oxygen toxicity in the Emergency Department and Acute Medical Admissions unit and a new leaflet explaining to patients, their carers and family the treatment they are undergoing.

We have revised our e-learning package and are making it mandatory for all doctors involved in Acute Medical admissions and Emergency Medicine. We have developed a Sim Training Package for junior doctors and Respiratory Nurses, to promote better hands on training and experience for front line staff. We also aim to improve our training of non-specialist staff, particularly nurses in Emergency and Acute Medicine, to assist early identification of patients who may require Acute NIV to reduce delays to treatment.

We continue to be keen to share our work and learn from others best practice. We have been approached by regional quality improvement networks due to the four key drivers of quality improvement we champion and together with the East Midlands Leadership Academy developed a video with one of our patients to communicate our successes with this approach (https://www.youtube.com/watch?v=tPe6hKulgfw).

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## References

1. NCEPOD Inspiring Change. 2017. London https://www.ncepod.org.uk/2017niv.html
2. Davidson AC et al, BTS/ ICS Guidelines for the Ventilatory Management of Acute Hypercapnic Respiratory Failure in Adults Thorax April 2016 Volume 71 Supplement 2 https://www.brit-thoracic.org.uk/document-library/clinical-information/acute-hypercapnic-respiratory-failure/bts-guidelines-for-ventilatory-management-of-ahrf/
3. Davies M et al, BTS Quality Standards for Acute Non-Invasive Ventilation in Adults. BMJOpen RespRes 2018;5:e000283 https://www.brit-thoracic.org.uk/document-library/clinical-information/niv/niv-quality-standards/bts-quality-standards-for-acute-niv-in-adults/
4. King D et al, Redesigning the 'choice architecture' or hospital prescription charts: a mixed methods study incorporating in situ simulation testing. BMJOpen 2014;4:e005473 https://bmjopen.bmj.com/content/4/12/e005473
5. Donihi et al, Use of standardized protocol to decrease medication errors and adverse events related to sliding scale insulin. Qual.Saf.HealthCare 2006;15:89–91
6. https://www.strokeaudit.org
7. http://www.ucl.ac.uk/nicor/audits/minap

## Contact details & related links:

Dr Andrew Molyneux, Clinical Lead Acute NIV. andrew.molyneux@nhs.net

Dr Daniel Smith, Leadership and Management Fellow. danielsmith3@nhs.net

Justin Wyatt, Ward Leader Ward 43, Nursing Lead Acute NIV. justin.wyatt1@nhs.net

Kings Mill Hospital, Sherwood Forest Hospitals Foundation NHS Trust
Mansfield Road, Sutton-in-Ashfield,
Nottinghamshire, NG17 4JL. UK.