British Thoracic Society
Respiratory Support Audit Report 2023
(Part 1: Whole cohort findings from the patient-level questionnaire)
Audit period 1 February – 31 March 2023
Audit lead: Dr Michael Davies

Number of records submitted: 4,136
Number of participating institutions: 119

Executive Summary

This BTS Audit aimed to include all hospital inpatients managed in a Respiratory Support Unit (RSU) or would have been if an RSU were available. RSUs provide higher levels of intervention and monitoring than routine wards.

The audit revealed that RSU-level care was delivered in various ward settings. Despite differences in infrastructure and staffing, patient demographics and acuity were broadly similar across these settings. Over a two-month audit period, 4,136 patient submissions were received.

Patients were a high-acuity population with a 28% hospital mortality rate. Lower hospital mortality was observed in hospitals with RSUs compared to those without. Additionally, patients receiving RSU-level care in wards with enhanced nursing models had lower mortality than those in standard ward settings. Case-mix adjustment for patients with COPD treated with acute NIV showed that the survival benefit of enhanced respiratory care increased with the severity of the initial presentation.

These findings strongly support the provision of acute RSUs in every hospital admitting patients with acute lung disease.

Key Findings

- RSU-level patients were treated in various types of wards, including 42% in RSUs and more than 30% in standard wards with no enhanced staffing. Patient acuity and demographics were broadly similar across these settings.
- Patients treated in hospitals with an RSU, even if not admitted to RSU, had lower all-cause mortality at 23% compared to 35% in non-RSU hospitals.
- Patients receiving enhanced staffing (RSU or equivalent) had lower all-cause mortality at 25% compared to those in standard wards (32%).
- The survival benefit for enhanced respiratory care was seen for all diagnostic groups. For example, RSU-level patients with acute pneumonia (n=652) had 36% mortality if managed in an RSU or equivalent, compared to 52% in standard wards.
- Case-mix adjustment using the NIVO score confirmed that the highest acuity patients gained the largest survival advantage from RSU care; for well-matched high-risk patients, hospital mortality was 33% for enhanced care settings (RSU/HDU/designated NIV area) compared to 46% mortality if managed in a standard ward.
- Escalation of acute respiratory patients to critical care was rare (<3% of the whole cohort), significantly lower than rates in comparable countries.
- High flow nasal oxygen therapy (HFT) use was common in standard ward settings, despite the high acuity of patients (median FiO_2 60% prior to starting HFT), often outside of current evidence.

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National Improvement Objectives

1. Each hospital that admits patients with acute lung disease should have an RSU or RSU equivalent to provide enhanced care. Current 60%: **Target 100%**
2. Acute respiratory support (NIV, HFT, CPAP) for patients with acute lung disease should be delivered in an RSU or equivalent area with appropriate staffing levels (including HDU and critical care areas) and should not be used routinely in unenhanced, standard ward areas. Current 49%: **Target >75%**
3. Patients with COPD who experience early NIV failure (within 2 days of starting) in the absence of high-risk prognostic factors (e.g. if NIVO score < 5) should be discussed with critical care to consider the merits of treatment escalation. Current 17%: **Target >50%**

Timeline: Within 12 months of audit publication.

Introduction

This was the first national BTS Respiratory Support audit. It builds from the previous BTS acute non-invasive ventilation (NIV) audits[1] and a successful pilot Respiratory Support audit in 2021-22.[2] Its aim was to include all adult inpatients who were treated in an acute Respiratory Support Unit (RSU), or who would have been if an RSU were available.

An RSU is an area of enhanced ward care that enables a higher level of intervention and patient monitoring than would be expected in a routine ward environment. The COVID-19 pandemic showed the significant advantage of RSUs. Patients received advanced respiratory support, such as continuous positive airway pressure (CPAP) and HFT, in rapidly established RSUs within respiratory wards. Close working with critical care enabled patients to be stepped up or down from the RSU as appropriate, saving critical care capacity for sicker patients. In collaboration with the Intensive care Society, the BTS have produced guidance on the infrastructure and function of RSUs.[3] The RSU concept essentially aims to provide a dedicated ward area for patients with acute lung disease who require enhanced care and to drive improvements in patient outcomes via the delivery of more effective, specialist care.

To gauge performance, data were also collected to calculate the Non-Invasive Ventilation Outcomes (NIVO) score,[4] a validated clinical tool to aid decisions about acute NIV for patients with chronic obstructive pulmonary disease (COPD). Since it provides a risk adjustment, it can also help with benchmarking.

The audit had two parts:

- An organisational questionnaire – one record to be submitted by each participating site
- A patient questionnaire – one record per patient

Detailed findings of the organisational audit are described in a separate report. Briefly, only 60% of hospitals were equipped with an RSU despite all providing enhanced respiratory ward care. There was considerable variability in staffing and infrastructure even for RSU-equipped hospitals. For example, only 71% of RSUs were staffed according to national standards, 61% did not meet specialist consultant cover standards, and 36% of RSUs were not equipped with remote (central) patient monitoring.

This report describes the outcomes of the patient-level questionnaire with respect to the whole cohort, with particular focus on the impact of location of care and nursing staffing ratios on patient outcomes. The audit retained a more extensive series of questions relating to patients treated with acute NIV to enable comparison to earlier NIV audits. A deeper dive into NIV outcomes is reported separately.

Aims and Objectives

- To provide benchmarking data on adult patients requiring enhanced ward-level monitoring and treatment to gain insight into variations in clinical practice and outcome.
- To use these benchmarks to assess patient outcomes against the existing standards, including the BTS/ICS Guideline for the ventilatory management of acute hypercapnic respiratory failure,[5] BTS quality standards for acute NIV[6] and BTS/Intensive Care Society joint national guidance for the development and implementation of RSUs.[3]

- In light of prior evidence from the NCEPOD enquiry into acute NIV care[7] and the 'Getting It Right First Time' Programme's National Specialty Report for Respiratory Medicine,[8] to establish if there are any concerns about patient safety within current service provision of RSU/NIV services nationally that may inform further quality improvement initiatives.

Methods

The audit ran from 1 February – 31 March 2023, with a data entry period of 1 February - 30 June 2023. Data were entered onto the online data collection tool via the BTS audit system by a lead clinician at each site.

Inclusion Criteria

Any patient requiring a level of monitoring or treatment of an acute respiratory problem that exceeds routine ward provision. Such patients include:

- Patients receiving non-invasive respiratory support for an acute respiratory condition (e.g. NIV for acute acidaemic hypercapnic respiratory failure (AHRF), continuous positive airway pressure (CPAP) for acute hypoxaemia, and high flow nasal oxygen therapy (HFT) for acute hypoxaemia
- Patients receiving Long Term Ventilation who are admitted acutely with a respiratory problem
- ICU step down with ongoing single organ respiratory failure including tracheostomy or laryngectomy management and Mechanical Insufflation-Exsufflation (MI-E) therapy
- Acute pulmonary embolism (PE)
- Acute Asthma
- Any other respiratory condition characterised by a clinician-assessed requirement for continuous oxygen saturation monitoring

These clinical categories and audit inclusion decisions were on the basis of clinician judgement. For example, 'acute pneumonia' reflects a clinical diagnosis of acute pneumonia in addition to a perceived requirement for enhanced care (for either monitoring or intervention). It would therefore not include patients whom the clinician perceived could be safely managed in a ward environment without enhanced staffing, monitoring, or respiratory support.

Results

Patient Demographics

There were 4,136 patient episodes submitted from 119 hospitals. Table 1 shows the primary reason for admission:

Primary reason for enhanced respiratory care / RSU admission	Number	%
Acute hypercapnic respiratory failure treated with NIV	1,987	48
Acute pneumonia	667	16
Acute hypoxaemic respiratory failure (known or suspected COVID-19)	212	5
Acute exacerbation of COPD (not requiring NIV)	205	5
Complex pleural management (fluid or pneumothorax)	169	4
Acute asthma	117	3
Acute exacerbation of Interstitial lung disease	113	3
Acute pulmonary embolism	109	3
Acute cardiac pathology	106	3
Neuromuscular / secretion clearance (not requiring NIV)	68	2
Tracheostomy management	44	1
Specified acute non-respiratory issues requiring enhanced level care	92	2
Overflow/hospital capacity issues/other	247	6
Total	**4,136**	

Table 1: Primary reason for enhanced respiratory care / RSU admission (all patients)

Median age was 71 years (50% female gender). Treatment escalation plans were completed within 24 hours of admission for 3,965 (96%) patients, with 34% considered for escalation to critical care. The Rockwood frailty score was completed for 2,982 patients (72%) and its distribution shown in Figure 1:

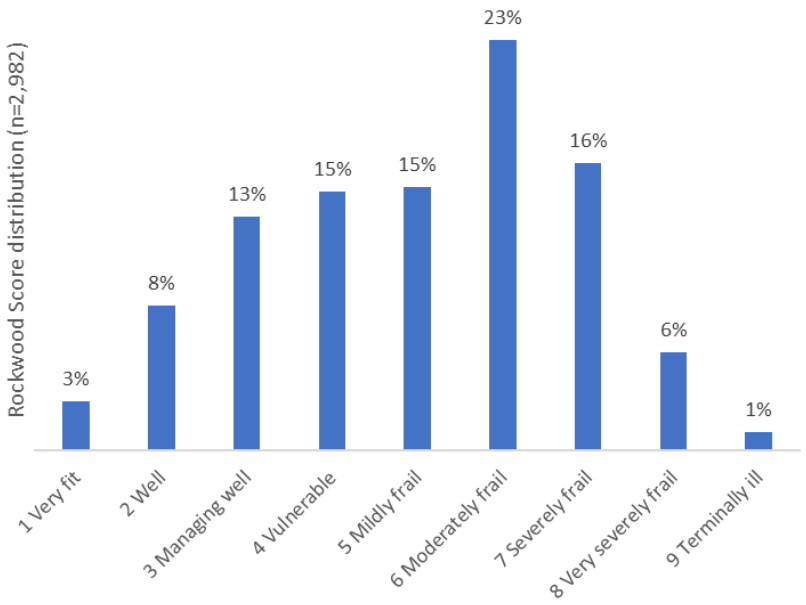

Figure 1: Rockwood frailty score distribution (n=2,982)

Use Of Respiratory Support

A requirement for non-invasive respiratory support served as a strong identifier for audit inclusion, representing 3,072 (74%) of the total population.

NIV was typically used for ventilatory failure, whereas HFT and CPAP were used for patients with acute hypoxaemic respiratory failure not controlled by oxygen alone. A small proportion of patients received more than one form of respiratory support (Table 2):

Type of respiratory support used	Number of patients
NIV alone	1,937
HFT alone	760
CPAP alone	164
CPAP + HFT	75
NIV + HFT	74
NIV + CPAP	50
NIV + CPAP + HFT	12
Total	**3,072**

Table 2: Types of respiratory support used (all patients)

HFT usage was common and showed some drift from the current evidence base. Figure 2 below shows the distribution in HFT use according to primary diagnosis. For example, 401 of 667 (60%) patients with acute pneumonia received HFT during their period of enhanced respiratory ward care. Patients with ILD represented the highest proportion of HFT usage at 65% of that cohort:

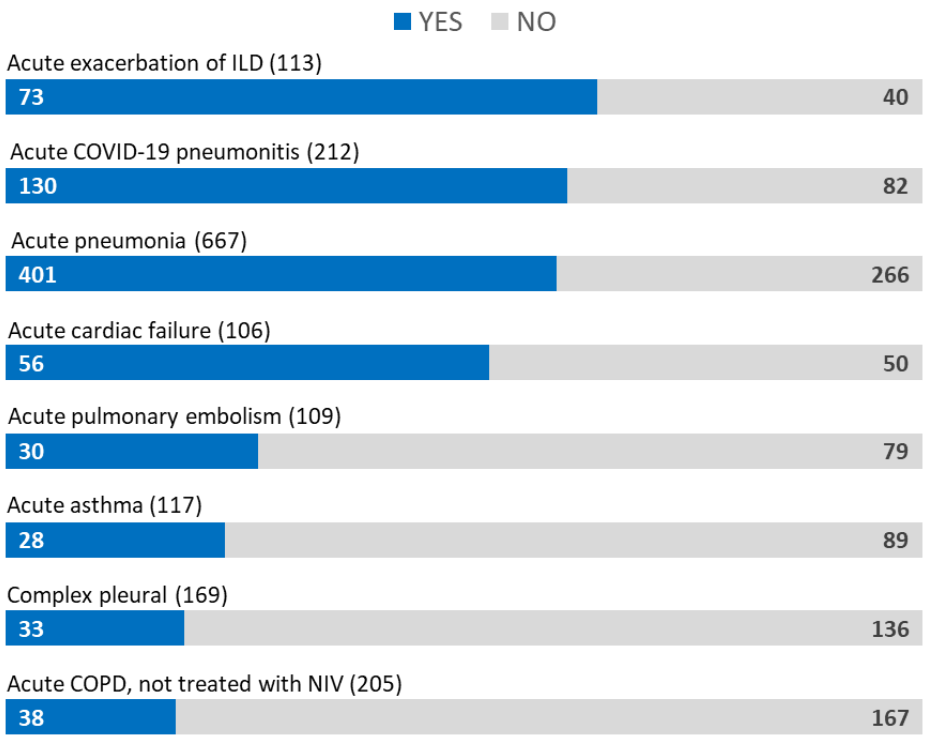

Figure 2: Use of HFT according to diagnostic category (all patients, excluding those whose primary support was acute NIV)

Where Was RSU-level Care Provided?

The distribution of ward locations where patients received MOST of their RSU-level care was as follows:

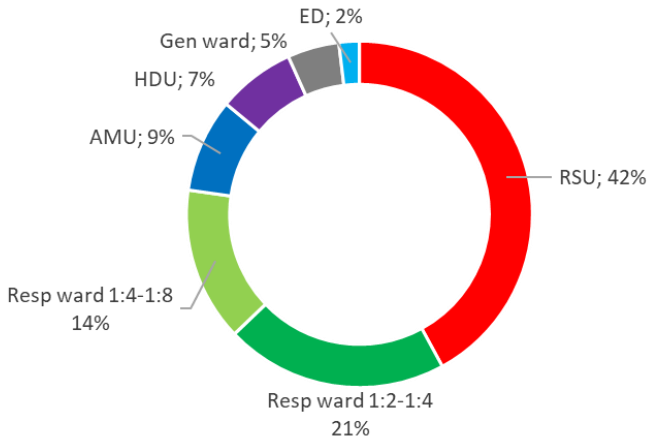

Figure 3: Primary locations where patients (n=4,136) received most of their 'RSU-level' care

Designated RSUs comprised 42% of whole cohort activity. Care took place in multiple types of clinical areas, some of which provided enhanced staffing models. These included 7% of patients treated in HDU, and 21% in respiratory ward areas staffed at 1:2-1:4 (likely originally designated for acute NIV and not named as an RSU area, yet providing an enhanced nursing staffing model). Taken together, up to 70% of patients were treated in a setting with an enhanced nursing staffing model.

The organisational audit found that 40% of hospitals did not have an RSU. Data on RSU status were available for 4,047 (98%) patients, of which 2,675 (66%) submissions were from RSU-equipped hospitals and 1,372 were from hospitals that do not have an RSU:

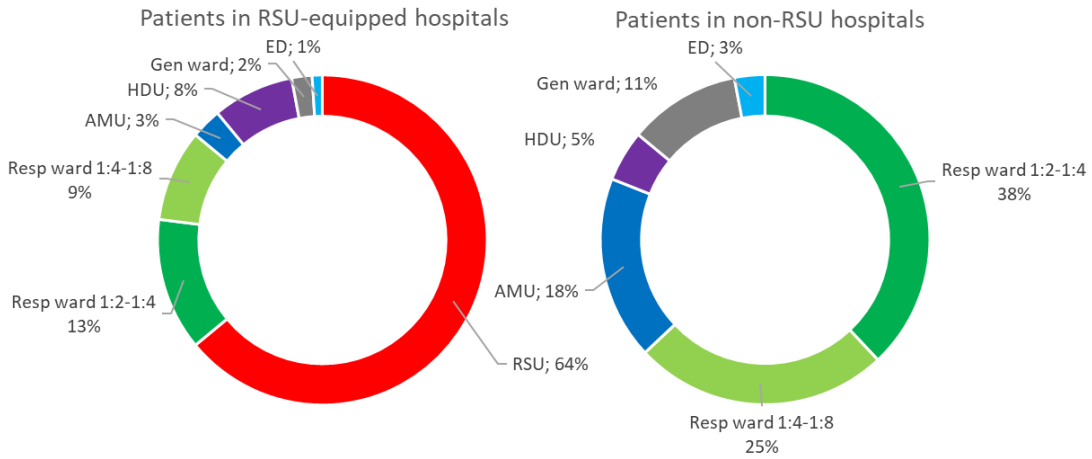

Figure 4: Distribution of locations of care with respect to hospital RSU status (RSU-equipped hospitals vs. non-RSU hospitals)

For RSU-equipped hospitals, 64% of patients were managed in an RSU, 13% in a respiratory ward staffed at 1:2-1:4, and a further 8% were managed in HDU (i.e. up to 85% received RSU care or similar).

For non-RSU Hospitals, 38% of patients were managed in a respiratory ward area with enhanced nursing staffing (1:2 or 1:2-1:4) and 5% were managed in HDU. As such, approximately 57% of RSU-level patients were managed in a standard ward setting.

Where Was Acute NIV Care Provided?

Combined NIV start and continued locations were available for 1,891 of 1,987 (95%) patients treated with acute NIV. Whole cohort data are shown in Figure 5. Respiratory wards (green) reflect activity delivered in areas staffed at 1:2-1:4 (i.e. likely designated NIV areas). Ward areas (grey) represent all ward areas with a standard staffing model (i.e. 1:4-1:8 and unable to flex to 1:2 for high-acuity patients):

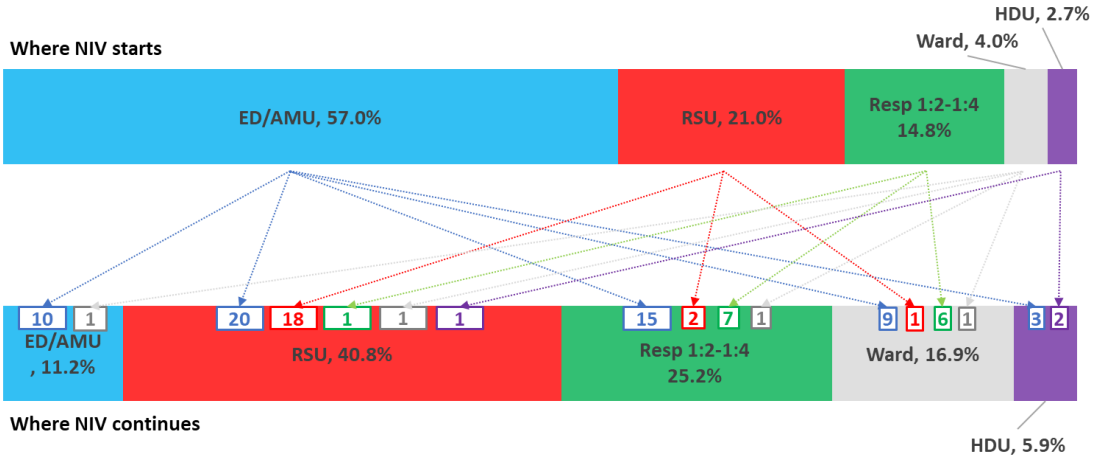

Figure 5: Locations where patients started and then continued acute NIV for AHRF (n=1,891)

The most common pathway was to start NIV in ED and then continue in an RSU or a respiratory ward area with 1:2-1:4 nursing support (likely NIV-designated area).

As shown, NIV occasionally started in a designated area (RSU or 1:2-1:4 NIV area) and then continued in a non-designated area (e.g. general ward), likely reflecting triage for capacity management.

Patient flow was assessed according to hospital RSU status. Data on NIV start and continuation location were available for 1,241 patients in RSU-equipped hospitals and 667 patients in non-RSU hospitals (including 17 with an unknown start location). Respective patient flow for RSU and non-RSU hospitals are shown in Figure 6:

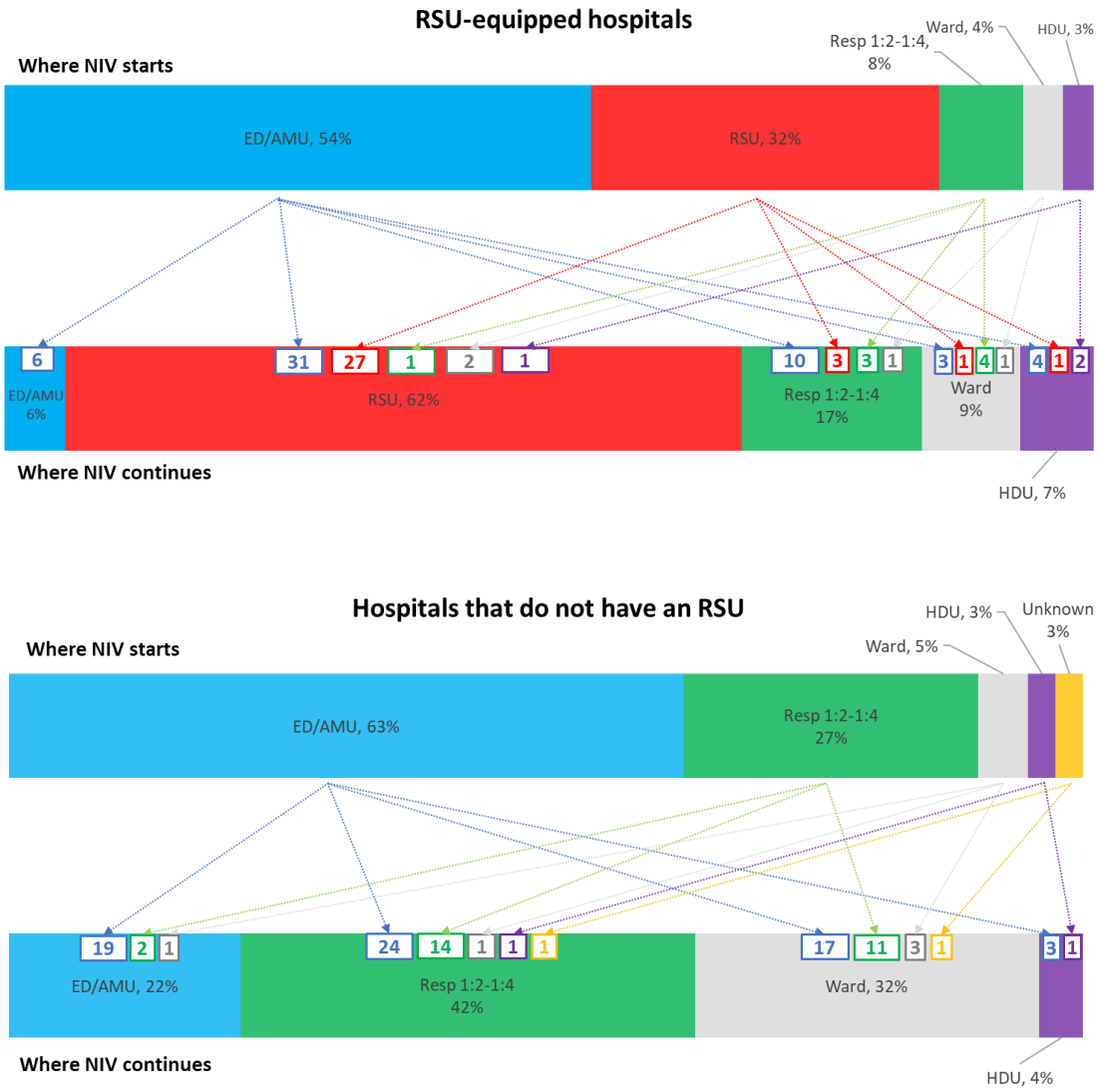

Figure 6: Locations where acute NIV was started and then continued for RSU-equipped hospitals (top, n=1,241) and non-RSU hospitals (bottom, n=667)

NIV usually started in an ED or a Respiratory ward area that had an enhanced staffing ratio in both RSU-equipped and non-RSU hospitals.

For patients treated in non-RSU hospitals, NIV was more likely to continue in a general ward area or acute medical unit with only 42% of patients receiving most of their NIV care in an enhanced respiratory ward area. Despite fewer enhanced care beds at ward level, HDU admission represented a smaller proportion of patients in non-RSU hospitals (4% vs. 7%).

Where Was HFT Therapy Used?

HFT was used for 921 of 4,136 (22%) patients, with ward distribution as follows:

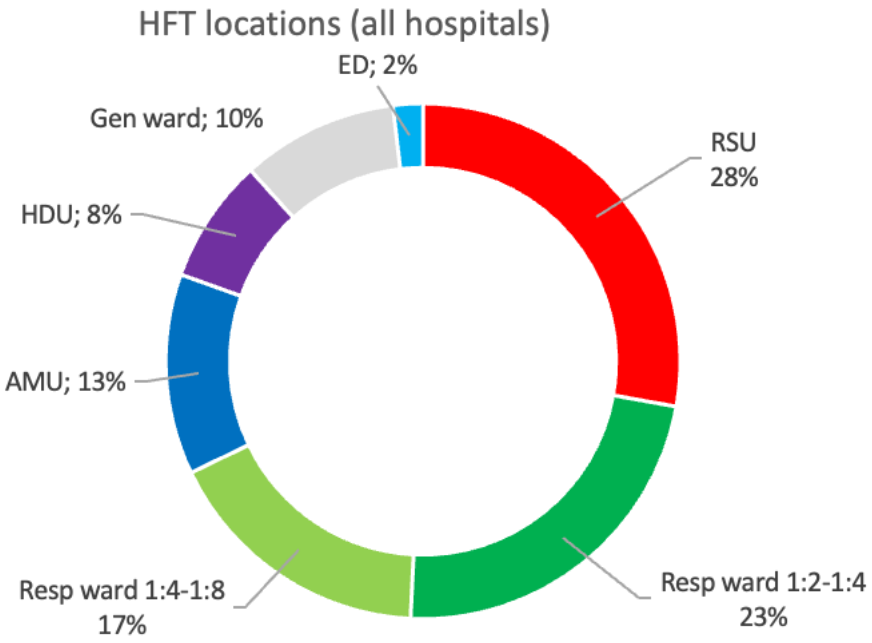

Figure 7: Distribution of ward locations for patients treated with HFT (n=922)

Average pre-HFT oxygen requirement was 65% and the most common indication was acute pneumonia. Despite this, patients on HFT were less likely to be admitted to HDU or RSU compared to the wider audit population (36% of HFT group vs. 49% whole cohort). HFT usage was proportionately higher in non-RSU hospitals (36% of their cohort) than RSU hospitals (16% of their cohort). The reasons are unclear, though may reflect a case-finding effect; in a non-RSU hospital, it is probably easier to identify RSU-level patients in a general ward setting via their need for respiratory support as opposed to a need for continuous monitoring. Nevertheless, the findings are consistent with a previous survey of UK and Canadian practice.[9] Data on the locations of HFT therapy was available for 906 patients, with distribution according to RSU status shown below:

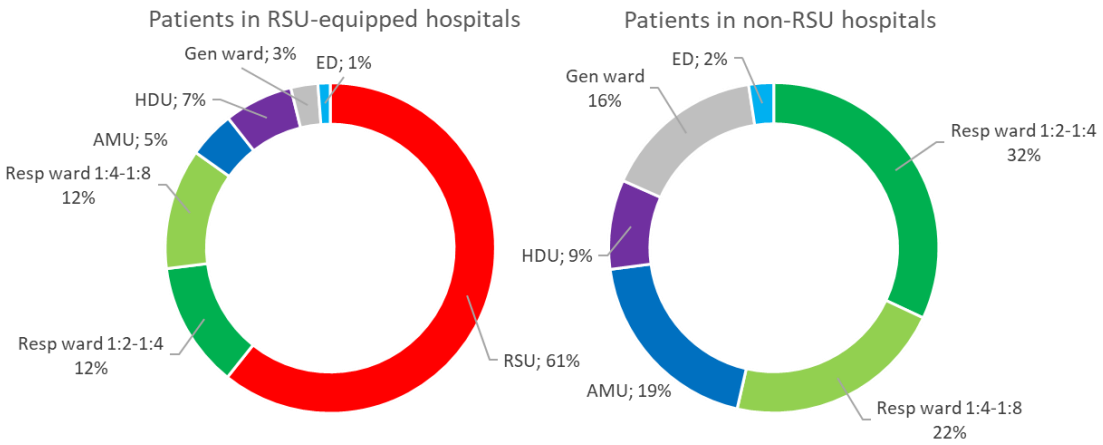

Figure 8: HFT distribution for patients in RSU-equipped (n=415) and non-RSU (n=491) hospitals

Outcomes

Median hospital stay was 9.5 days (IQR 5-18), including 5 days (IQR 2-9) of RSU-level care. Status on discharge from RSU-level care was as follows:

Status on discharge from enhanced ward care	Number	%
Discharge direct to home/community setting	1,722	42
Step-down to ward	1,208	29
Died during RSU/enhanced care stay	886	21
Transfer to Critical Care	108	3
Transfer to another hospital	81	2
Unknown/other	131	3
Total	**4,136**	

Table 3: Status at discharge from RSU-level care (whole cohort)

Given that some patients were never transferred to enhanced respiratory areas, we assessed the cohort of patients who were admitted to designated RSUs (n=1,720):

Status on discharge from RSU	Number	%
Discharge direct to home/community setting	766	45
Step-down to ward	598	35
Died during RSU/enhanced care stay	284	17
Transfer to Critical Care	29	2
Transfer to another hospital	29	2
Unknown/other	14	1
Total	**1,720**	

Table 4: Status at discharge from RSU (patients admitted to an RSU)

These data confirm a relative lack of ward step-down, even for patients who received their RSU-level care in a designated RSU. Discharge directly home was more common than ward step-down. This suggests a lack of ward capacity, but contrasts with HDUs or critical care, where ward step-down is routine after successful care.

As shown, mortality rates at the time of RSU-level care discharge appeared lower for patients admitted to RSUs (17%) compared to the overall cohort (21%).

In keeping with prior NIV audits, hospital mortality is used as the primary survival outcome in this report unless otherwise stated. For this metric, overall hospital (inpatient) mortality for all patients was 28% (1,137 of 4,136 patients), with most of the additional deaths occurring after step-down to the ward.

Again, hospital mortality varied according to the location of care. Excluding the small number of patients who received only a brief period of RSU-level care in ED (n=77), hospital mortality was 31% if care was delivered outside an RSU (691 of 2,250). In contrast, hospital mortality was 23% (392 of 1,720) for patients treated in designated RSUs. Mortality outcomes with respect to individual locations of care are reviewed in detail later.

Another notable finding from the whole cohort data was the very low proportion of patients who escalated to critical care, even if their RSU-level care were provided in a standard (unenhanced) ward setting. Despite high hospital mortality rates, only 108 (2.6%) of the whole cohort were

transferred to critical care. Demographic details are shown in Table 5 with whole cohort data alongside for comparison:

	Critical Care transfers	Whole cohort
Number	108	4,136
Age (median, years)	65	71
Gender (% female)	48	50
Median frailty score (IQR)	3- Managing well	5 – Mildly frail
Median LOS in RSU-level area	2	5
Main diagnostic groups (%)		
Acute pneumonia	34	16
AHRF treated with acute NIV	28	48
Acute COVID-19	10	5

Table 5: Status at discharge from RSU-level care (whole cohort)

Patients transferred to critical care tended to be younger and fitter than the general population. They were more likely to have conditions marked by worsening hypoxaemic respiratory failure, such as acute pneumonia. Conversely, patients presenting with acute hypercapnic respiratory failure were less likely to be transferred to critical care, even if they experienced early treatment failure of non-invasive respiratory support. For example, 70 patients with low or medium risk COPD (NIVO score <5) experienced NIV failure within 2 days of starting it (mean NIVO score 2.3); of these, 83% were not discussed with critical care, 4% were reviewed but not transferred, and 13% were transferred to critical care.

Of the 108 patients who transferred to critical care in total, 64% survived to hospital discharge. Median total inpatient stay was 4 days longer than the overall patient cohort (median 13 days, IQR 7-20 days), suggesting that prolonged critical care admission was not a feature of this patient group.

The audit did not explore factors influencing critical care referral. However, data were available for patients who did not achieve physiological correction of acidaemia on NIV ('NIV failure,' n =292). Of these, 239 were not considered for escalation to critical care and therefore not discussed with critical care, 27 transferred to critical care (median duration of prior NIV 1 day), and 26 were discussed with critical care but not transferred (NIV duration 2.5 days). Median duration of NIV in the non-escalation group was 1 day, with 69% of patients discontinuing NIV therapy within 48 hours. Only 8% of patients who experienced 'NIV failure' within 48 hours of starting were discussed with critical care.

Comparing Outcomes: Frailty And Escalation Status

Noting that escalation decisions exert a major impact on decisions to discuss with critical care, we examined escalation decisions and hospital survival with respect to frailty. Increasing frailty was associated with a decreasing proportion of patients for escalation and decreasing likelihood of hospital survival. However, survival decreased only gradually in the absence of very severe frailty, whereas for escalation decisions declined sharply from minimal frailty onwards, leading to widening differences between survival (high) and 'for escalation' decisions (low) (Figure 9):

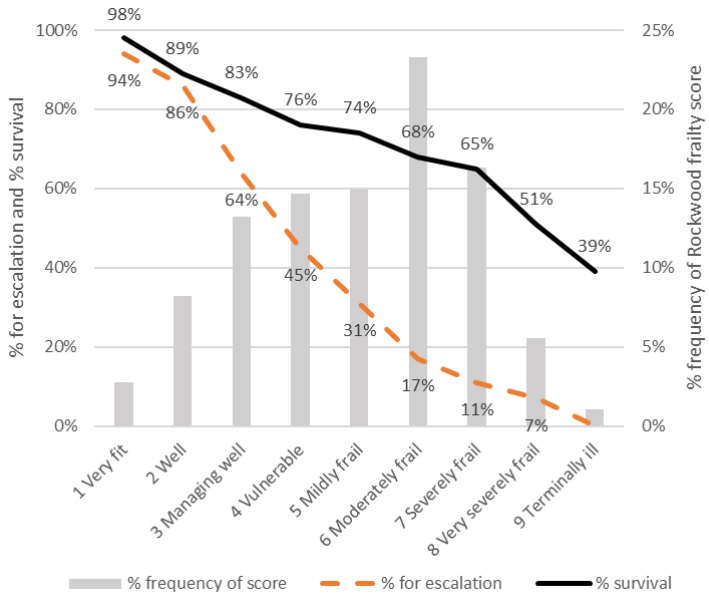

Figure 9: Relationship between escalation decision and survival according to frailty score

The relative preservation of survival with increasing frailty is a positive and encouraging finding. Equally, however, the high proportion of patients deemed unsuitable for escalation may act as a barrier to critical care when, in fact, they may have benefitted from further discussion. As noted earlier for low and medium risk patients with COPD, early decisions against escalation could lead to missed opportunities to provide effective therapy within critical care if RSU treatment unexpectedly fails soon after starting.

It is important to stress that the audit was not configured to explore such aspects in detail and at most serves to provide insight and stimulus for future research.

Comparing Outcomes: Diagnostic Groups

Hospital survival was highest for patients with acute asthma and was lowest for patients with acute exacerbation of interstitial lung disease. It should be noted, of course, that these data reflect the outcomes of patients who required RSU-level care, not a wider ward cohort of hospitalised patients.

Figure 10 below shows hospital survival according to diagnostic group and the respective proportion of patients who were considered FOR escalation within each cohort:

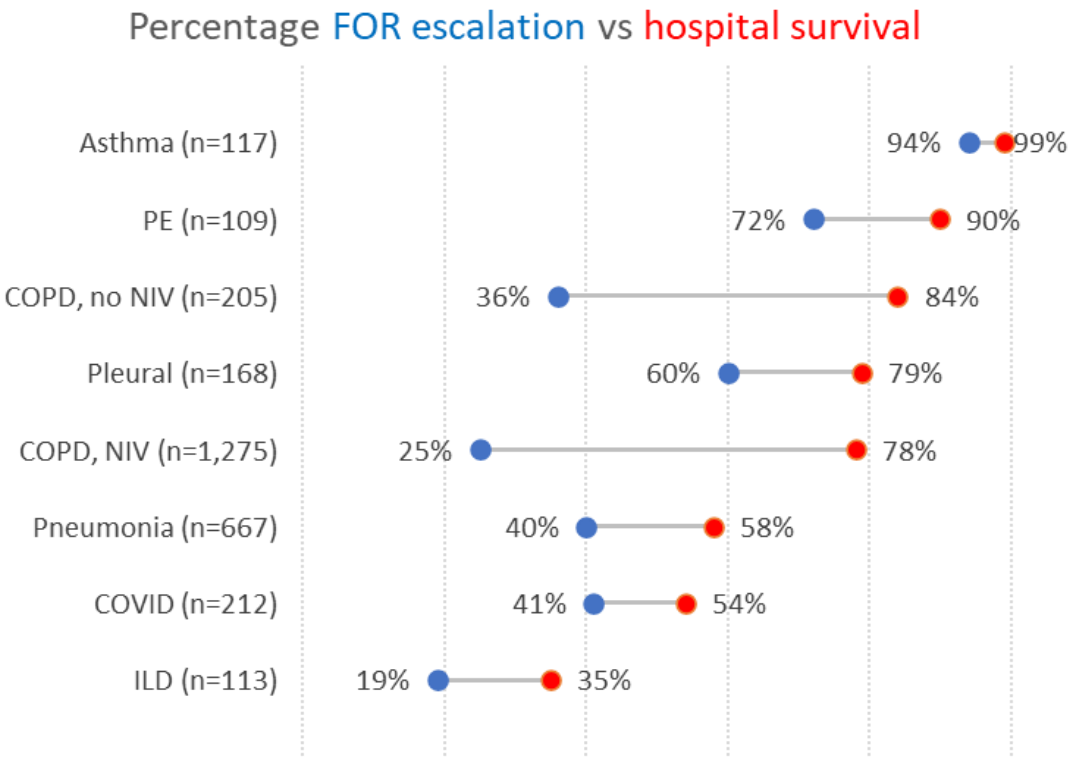

Figure 10: Relationship between FOR escalation decisions, hospital survival and diagnosis

Patients with COPD showed the largest differences between the proportion considered for escalation to critical care and actual outcome. Prior studies have highlighted that clinician-assessed prognosis tends to pessimism with respect to patients admitted with severe acute exacerbations of chronic obstructive lung disease.[10] These audit data suggest a greater degree of pessimism in COPD compared to other respiratory conditions. Equally, however, the factors contributing to a low proportion of patients with COPD for escalation with respect to survival are likely to be complex and may be entirely clinically appropriate. It is an area for further study.

Further data relating to the individual diagnostic groups described above are provided in Appendix 3.

Comparing outcomes: RSU-Equipped Vs. Non-RSU Hospitals

Demographic details comparing the RSU-equipped from non-RSU hospital cohorts are described in Appendix 1. Briefly, patients in non-RSU hospitals were slightly older (73 vs. 70 years). Diagnostic categories were similar, except that a higher proportion of patients in RSU-equipped hospitals were admitted solely due to overflow or capacity constraints (8% of total). Frailty distribution was similar.

Data were available for 4,047 patients. All-cause hospital mortality was 35% (486 of 1,372) for hospitals lacking an RSU, compared to 23% (628 of 2,675) for patients treated in RSU-equipped hospitals (or 24% if excluding the non-respiratory overflow patients).

Figure 11 shows hospital mortality rates according to RSU-status for the four most common diagnostic categories, namely acute hypercapnic respiratory failure (acute NIV), acute pneumonia, acute COVID-19, and acute exacerbation of COPD not requiring acute NIV:

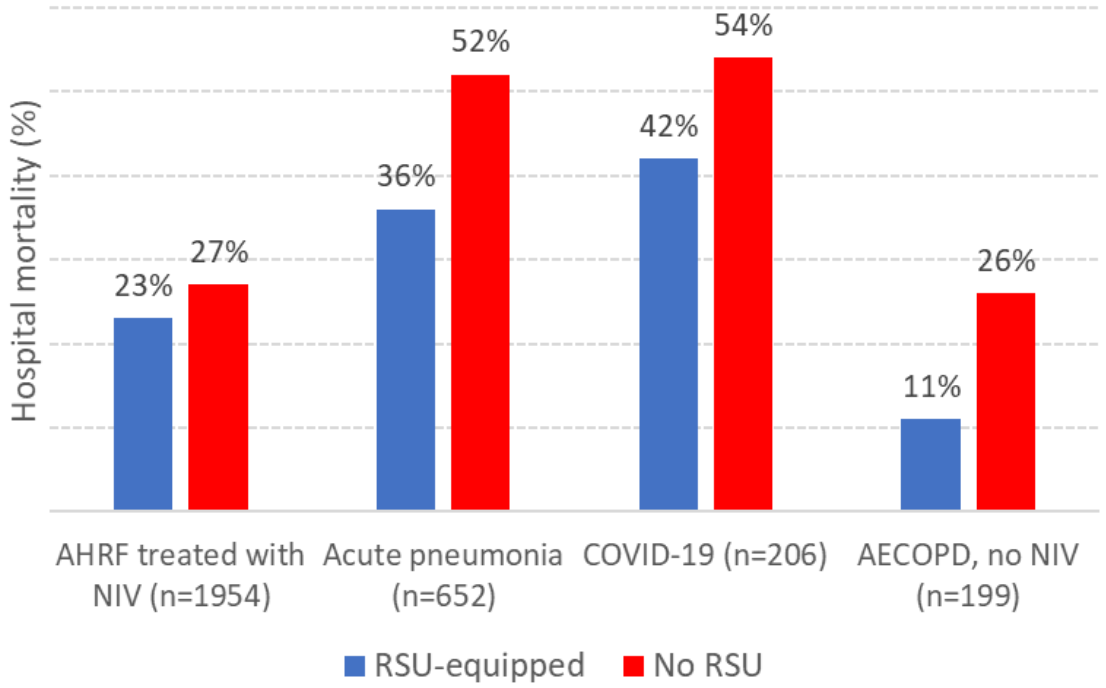

Figure 11: Hospital mortality with respect to diagnostic category and whether care was delivered in RSU-equipped or non-RSU hospital settings

Despite the uncontrolled nature of audit populations, the RSU-equipped and non-RSU patient populations appeared very similar for the AHRF and COVID-19 cohorts such that their differences in outcome according to location of care were not explained by patient demographic factors (similar distributions of age, gender, escalation status, and Rockwood score).

Patients in the acute pneumonia group in non-RSU hospitals were older (median age 76 vs. 73 years) and a higher proportion used HFT (76% vs. 51%), and there was a similar pattern for AECOPD (age 73 vs. 70 years, HFT use 38% vs. 9%). These factors may account for part of the differences seen.

Outcome data for patients treated with HFT were available for 906 patients. For patients in RSU-equipped hospitals, mortality was 46% (191 of 415 patients) compared to 52% (254 of 491 patients) in non-RSU hospitals.

We then explored the impact of individual locations of care between the two models (RSU-equipped vs non-RSU hospitals). Data were available for 3,970 patients after excluding 77 patients who received only a short duration of enhanced respiratory care within ED. As shown below in Figure 12, there were quite marked differences in patient outcomes according to the location of care, notably if comparing RSU to non-RSU hospitals:

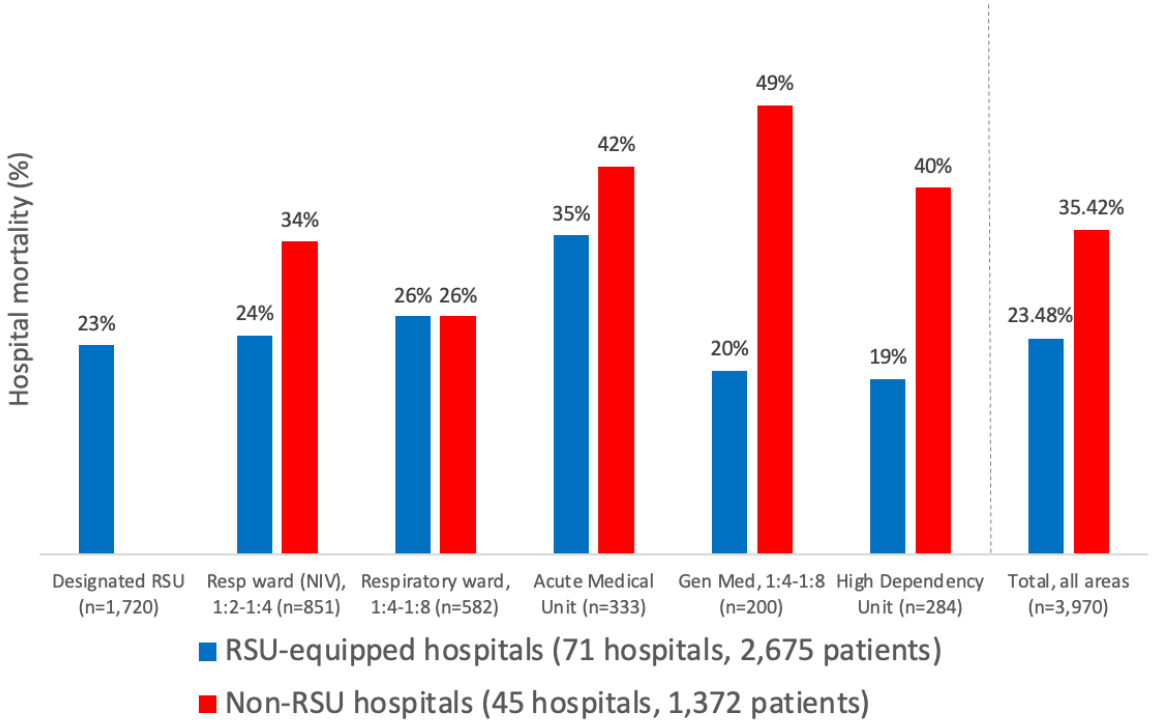

Figure 12: Relationship between area of main delivery of RSU-level care and hospital mortality

Again, it must be stressed that data were uncontrolled; patients managed in any specific area (e.g. HDU) were unlikely to be matched for case-mix and acuity, especially since 64% of the RSU-equipped hospitals cohort were treated in an RSU. Data from the NIV cohort showed that some patients transferred away from higher-intensity areas for their RSU-level treatment (e.g. 13% of patients who start NIV in an RSU continued their treatment elsewhere), implying triage on acuity grounds in the event of insufficient RSU capacity.

Nevertheless, even if accepting that higher acuity patients triage towards an RSU, patients treated in designated RSUs experienced lower rates of mortality than for any area in non-RSU hospitals, including HDU. For non-RSU hospitals, no single area demonstrated a lower patient mortality rate than its equivalent area in RSU-equipped hospitals.

Comparing Outcomes: RSU (Or Equivalent) Vs. Standard Ward

As described earlier (Figure 4), enhanced respiratory care was available in both RSU-equipped and non-RSU hospitals; 85% of patients in RSU-equipped hospitals and 43% of patients in non-RSU hospitals received care in an enhanced ward area (RSU, HDU, or NIV-designated area). We sought to compare the outcomes for patients who were managed in an enhanced care ward vs. standard ward.

Demographic details comparing the two groups are summarised in Appendix 2. Briefly, excluding patients who only received a brief period of RSU-level care within ED, 2,900 patients were managed in an enhanced ward area and 1,157 patients in a standard ward setting.

Hospital mortality was 25% (733 of 2,900) for patients in enhanced ward areas and 32% (372 of 1,157) for patients in a standard ward setting. As shown in Figure 12 earlier, this difference in survival rates for enhanced care settings appeared largely driven by patient outcomes in RSU-equipped hospitals, where HDU and NIV ward outcomes were superior to those seen in non-RSU hospitals.

To address the confounding issue of uncontrolled case-mix, the NIVO score was calculated for patients with COPD and treated with acute NIV.

Briefly, the NIVO score is a validated clinical prediction tool compiled from readily available measures at the time of presentation to hospital.[4] It was developed to aid prognostication decisions at the time of completion, though can also be used to benchmark observed outcomes against those expected from the score. The validation study was conducted in 10 separate UK centres selected to reflect the variety of care models for acute NIV such that some were equipped with enhanced respiratory care ward areas and some were not.

NIVO Score	Points
Consolidation	1
GCS <15	1
Atrial Fibrillation	1
pH <7.25	1
Time to Acidaemia >12 hours	2
eMRCD 5a	2
eMRCD 5b	3 /9

Table 6: NIVO score variables (higher scores indicate a lower likelihood of survival)

NIVO scores were available for 1,269 patients. Observed outcomes from the audit compared to expected outcomes were as follows:

NIVO Score	Number (n)	Observed Mortality (%)	Expected Mortality (%)
0	132	4.5	0
1	147	13.6	8.9
2	213	16.4	5.3
3	266	19.5	15.1
4	241	29.5	19.0
5	156	36.5	35.1
6	70	34.3	53.7
7	33	30.3	65.4
8	10	60	87.5
9	1	0	100

Table 7: Observed and expected hospital mortality according to the NIVO score

Patients were categorised according to the location of care. 922 patients were managed in an enhanced care area with 1:2 or 1:2-1:4 nursing staffing ratios, 313 patients were managed in a standard ward area (1:4-1:8), and 34 patients received only a brief trial of NIV within the ED. Hospital mortality was then assessed according to location of care and NIVO risk group; low risk (NIVO score 0-2), medium risk (3-4), and high risk (5-9).

Patients treated in enhanced ward areas experienced lower hospital mortality than those treated in a standard ward setting, with the difference widening as patient acuity increased. For the highest-risk patients, there was a 13% absolute difference in hospital mortality (39% relative difference):

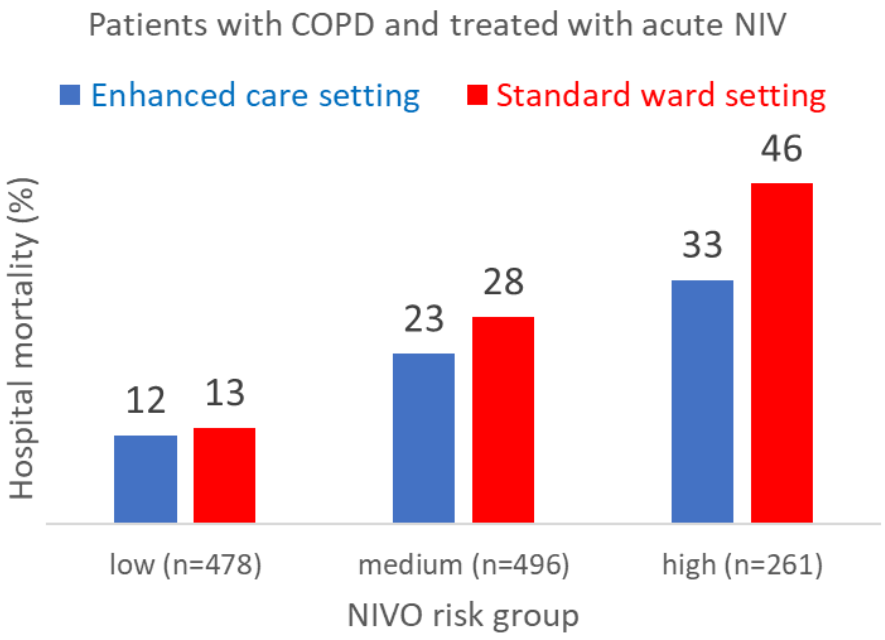

Figure 13: Case-mix standardised hospital mortality: Enhanced respiratory vs. standard ward care for patients with COPD and treated with acute NIV for AHRF

Conclusions

Acute lung disease is the most common reason for hospital admission during winter months and has increased at three times the rate of all other admissions in recent years.[11] Complexity of care is also rising, with contributory factors including an aging population, greater comorbidity, and increasingly complex therapies.

Prior national acute NIV audits confirmed better outcomes for patients managed in designated acute NIV areas compared to general ward areas, as evidenced by lower mortality and higher NIV success rates.[2] Recognising the capacity limitations of critical care,[12-13] multiple national guidance documents recommend the implementation of respiratory enhanced care areas to bridge the gap between critical care and normal acute ward care,[5-8,14] more recently expanding the concept to RSUs to include a broader group of respiratory patients than acute NIV alone.[3]

The 2023 BTS Respiratory Support audit provides an insight into the outcomes of all patients admitted to hospital with higher-acuity lung disease. It consisted of an organisational questionnaire (one response per centre) and a patient-level questionnaire (one response per patient) with over 4,000 patient submissions. We are extremely grateful to the clinical colleagues who contributed to create such a rich dataset. In keeping with the audit's aim, the patients were a high-acuity group characterised by a high proportion requiring acute non-invasive respiratory organ support.

The separate organisational audit report confirmed significant variability in the provision, staffing and infrastructure of RSU services. This report focuses on patient outcomes and the impact of organisational factors, such as location of care and staffing. Despite national guidance documents, there is little published evidence.

Firstly, the audit showed a consistent survival benefit for patients managed in RSUs or other enhanced respiratory ward settings compared to standard wards:

- Hospital mortality was lower for patients in RSU-equipped hospitals (23%) compared to those in non-RSU hospitals (35%). The survival benefit extended across all patient groups and was not well explained by minor differences in patient demographics between the two populations.

- Having an RSU was associated with better outcomes across the wider hospital ward footprint. This is consistent with improved ward-based triage in RSU-equipped hospitals, enabling the sickest patients to be treated in an enhanced ward area, especially given the extremely low utilisation of critical care for either model of care.

- Patients treated in enhanced respiratory care areas within RSU-equipped and non-RSU hospitals (RSU, HDU or acute NIV areas) had lower hospital mortality (25%) compared to those in standard wards (32%).

- Importantly, case-mix adjusted analysis using the NIVO score confirmed a lower mortality for patients with COPD treated with NIV in enhanced care settings. This mortality difference between enhanced and standard care widened with increasing acuity.

Secondly, there was an important lack of capacity for respiratory enhanced care, even for hospitals that had an RSU:

- Only 64% of RSU-level patients in RSU-equipped hospitals received their care in an RSU.

- In addition, 13% of patients who started acute NIV in an RSU were moved to a lower intensity ward area for most of their NIV therapy. This likely indicates appropriate clinical triage of lower risk patients, though it should be stressed that, if there were sufficient RSU capacity, then step-down to ward should occur after completion of NIV rather than for the main duration of therapy.

- At least 40% of patients treated with acute HFT were managed in a general ward environment with unenhanced staffing.

Despite insufficient RSU capacity, critical care use was rare (3% of all patients), suggesting missed opportunities for critical care admission, especially when compared to international series.[15] Key points include:

- Inappropriate use of acute NIV in standard wards: High-risk patients were routinely managed in standard wards, contrary to evidence and national guidance recommending enhanced care for such patients.

- Low escalation to Critical Care in the event of early treatment failure: Early treatment failure may be due to poor tolerance of non-invasive respiratory support. Conversion to invasive ventilation may be appropriate if reversible factors remain, in contrast to the poorer prognosis expected if treatment failure occurs at a later stage.[16]

- Prognostic pessimism: Few patients with COPD were considered for further escalation despite overall high survival rates. This may have been clinically appropriate, though intubation rates and survival remain lower than international benchmarks.[15] Excess pessimism hinders discussion about the merits of critical care escalation in the event of unexpected early treatment failure.

- Positive Critical Care outcomes: Outcomes for patients admitted to critical care were reasonable, with no evidence of prolonged hospital stays. This aligns with international studies indicating COPD does not predict prolonged weaning failure from invasive ventilation.[17]

Any argument for greater utilisation of critical care must acknowledge significant limitations in critical care capacity.[12-13] Nevertheless, our findings support the escalation to critical care for selected patients, particularly those with COPD and good prognosis indicators via the NIVO score, in the event of early treatment failure.

Further study is warranted to explore the factors influencing escalation decisions and the potential role of the NIVO score in guiding these decisions. The audit results support other areas for further study and suggestions are provided in Appendix 4.

However, the most compelling findings of the audit were the differential outcomes based on the type of ward care. Patients receiving RSU-level care in an RSU or equivalent environment had higher treatment success and survival rates compared to those managed in standard wards. Our data indicate that every acute hospital with unselected acute respiratory admissions should have an adequately resourced RSU and, equally, that high-risk patients should not continue to receive their care in a standard ward. Properly configured RSUs with sufficient capacity, staffing, and infrastructure could substantially improve hospital survival rates for patients with acute respiratory disease.

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Appendix 1: Demographic Details Of RSU-Equipped And Non-RSU Hospitals

Data on RSU status, whether an RSU was available in a hospital or not, was available for 116 of 119 hospitals that completed the patient-level submissions. This comprised 4,047 patients in total; 2,675 treated in RSU-equipped hospitals (though not necessarily in the RSU) and 1,372 patients in non-RSU hospitals.

Demographic details were as follows:

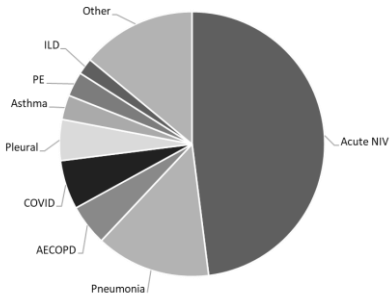
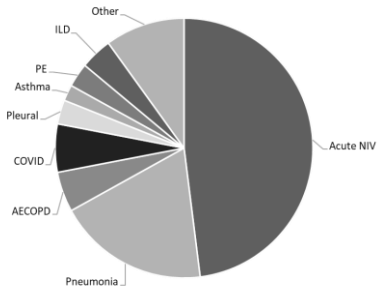
	RSU-equipped hospitals (n=2,675)	No RSU provision (n=1,372)
Age, median years	70	73
Gender, % female	49	50
Not for esc, %	60	65
Diagnostic categories		
Pre-NIV blood gas (median, kPa)		
pH	7.27	7.26
$PaCO_2$	9.9	10.0
PaO_2	8.3	8.4

Table A1: Comparison of demographics for patients treated in RSU-equipped hospitals and for hospitals that do not have an RSU

The 'other' category included non-respiratory patients admitted purely because of hospital overflow / capacity reasons.

Location of RSU-level care was as follows:

	RSU-equipped hospitals N (%)	No RSU provision N (%)
RSU	1,720 (64)	0 (0)
NIV area/Resp ward staffed at 1:2-1:4	335 (13)	516 (38)
HDU	209 (8)	75 (5)
AMU or ED	123 (4)	287 (21)
General ward (1:4-1:8)	288 (11)	494 (36)

Table A2: Distribution of patients in RSU-equipped hospitals and for hospitals that do not have an RSU

Frailty distribution according to Rockwood scores was as follows:

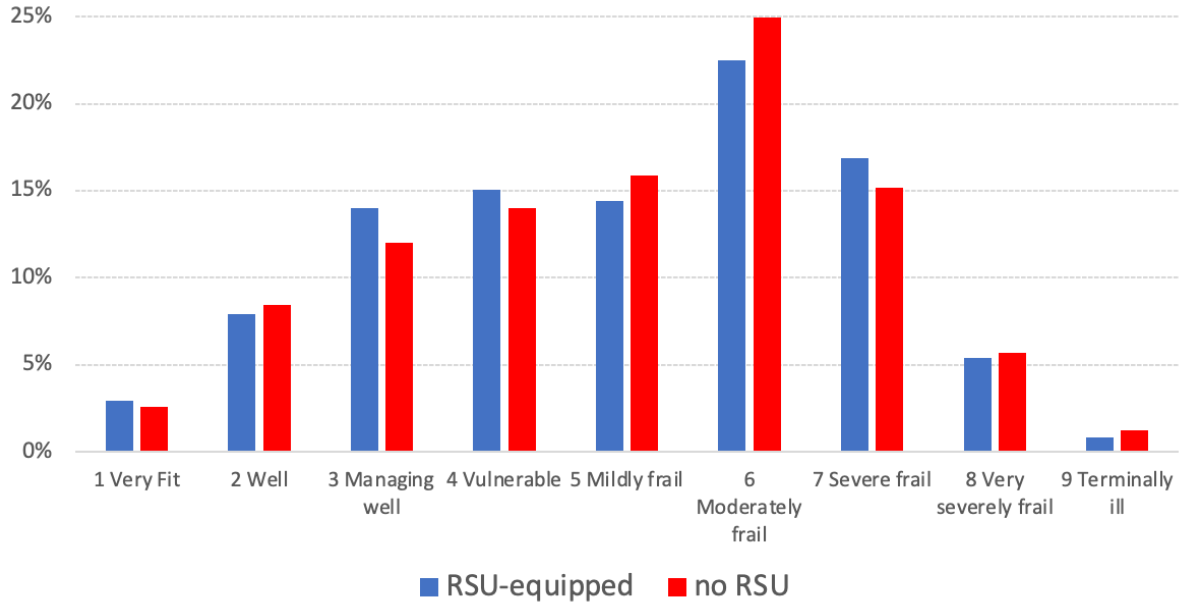


Figure A1: Frailty distribution comparing RSU-equipped and non-RSU hospitals

Appendix 2: Demographic Details For Patients Managed In Respiratory Enhanced Wards Vs. Standard Wards

The patient-level questionnaire included a question around ward placement and the routine nursing staffing for the ward location where most of the requirement for enhanced respiratory care was undertaken.

Of the 4,136 patients, 79 received only a brief period of RSU-level care within ED and are not considered further. In total, 2,900 patients were admitted to RSU, HDU, or another enhanced respiratory ward area (e.g. NIV unit). These were staffed to 1:2 or 1:2-1:4 nursing care (providing there was some flex to provide 1:2 for higher-acuity patients). The remaining 1,157 were treated in ward areas staffed to 1:4-1:8 and documented they had little or no flex to provide 1:2 nursing for higher-acuity patients.

Demographics and case-mix are shown below in Table 3:

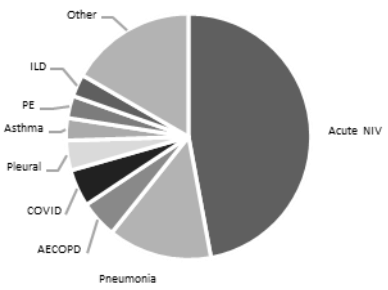
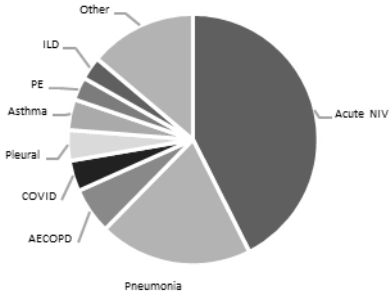
	RSU or equivalent (n=2,900)	Standard ward (n=1,157)
Age, median years	70	72
Gender, % female	51	48
Not for escalation, %	61	63
LOS, days	5	4
Diagnostic groups		

Table A3: Comparison of demographics for patients treated in an RSU (or equivalent) ward vs. patients treated in a standard ward

Patients in more intensively staffed areas were slightly younger and diagnostic categories showed a lower proportion of patients with pneumonia (14% vs. 20%) and a higher proportion of patients with acute hypercapnic respiratory failure treated with NIV (48% vs. 43%).

Frailty distribution was similar.

Appendix 3: Outcomes Relating To Individual Cohorts

The audit included all patients who are treated within an RSU environment or require enhanced respiratory monitoring and care. The ambition for this first national audit was to define and understand the patient pathways included in the delivery of RSU care.

In-depth questions were retained for patients treated with acute NIV to enable comparison to earlier audit series. This patient cohort will be reviewed separately. The questionnaire included a more limited dataset for other patient cohorts, mindful that most are more comprehensively covered in existing successful national audit programmes. Patient categorisation was based on clinician diagnosis. We did not seek to clarify case definitions, for example in acute pneumonia we did not specify community-acquired pneumonia only or require Chest X-Ray confirmatory changes.

Excluding acute NIV, the primary diagnostic groups were as follows:

Primary reason for enhanced respiratory care / RSU admission	Number
Acute pneumonia	667
Acute COVID-19 pneumonitis	212
Acute exacerbation of COPD (not requiring NIV)	205
Complex pleural management (fluid or pneumothorax)	168
Acute asthma	117
Acute exacerbation of interstitial lung disease	113
Acute pulmonary embolism	109
Acute cardiac pathology	106
Neuromuscular / secretion clearance (not requiring NIV)	68
Tracheostomy management	38

Table A4: Reasons for RSU admission, excluding NIV for acute hypercapnic respiratory failure

Demographic variables and outcomes for the most common groups were as follows:

	Pneumonia	Acute COVID	COPD, not req. NIV	Pleural	Asthma	ILD	PE
N	667	212	205	168	117	113	109
Age (median years)	74	74	71	67	46	76	70
Gender (% female)	44	38	57	43	71	28	53
For escalation (%)	40	41	36	60	94	19	72
Used HFT (%)	61	61	19	20	1	65	28
Used CPAP	10	27	-	-	-	-	-
RSU LOS (med. days)	5	6	4	6	2	6	4
Hospital mortality (%)	42	46	16	21	1	65	10

Table A5: Demographic and outcome data for patients admitted to RSU or requiring RSU-level care

These data are mainly provided to enable comparison to other datasets relating to each diagnostic group in the hope that it provides context with respect to the observed outcomes. By the nature of the audit, these were a selected population who were included based on their RSU requirement. Of note, the demographics and outcomes for the patients with COVID-19 appeared very similar to the (non-COVID) acute pneumonia group, consistent with a supposition that COVID now essentially behaves in a similar manner to other respiratory viruses.

Whilst perhaps unsurprising, this represents a significant change in patient profile and treatment selection compared to earlier series and studies. Use of acute respiratory support outside of a critical care environment became a necessity during the COVID-19 pandemic and for periods represented almost all the patients treated within an RSU, though has decreased since. Acute COVID represented 37% of the RSU population in the 2021 BTS pilot RSU audit[i] and has reduced to 5% of overall RSU-level activity in the current audit (same inclusion criteria).

Table A5 also shows a drift away from the published evidence base for acute COVID. The Recovery-RS trial showed that CPAP reduces the need for invasive mechanical ventilation in patients with acute COVID who were deemed for escalation to intubation, whereas HFT was not associated with benefit.[ii] It remains important to assess real-life practice and outcomes against the research findings, especially if the nature of disease presentations also change over time.

Data from the 2021 pilot and current (2023) audit are shown alongside the earlier Recovery-RS findings. Differences in groups should be stressed; Recovery-RS was a multicentre study of patients treated in critical care and non-critical care areas who were for intubation in the event of treatment failure, whereas the BTS audit included patients not for escalation. Notably, in keeping with the changing nature of COVID-19, average age and frailty have increased through the audit cycles and now differs substantially from the earlier Recovery-RS study. There has also been a recent drift away from CPAP usage and towards HFT:

	Recovery-RS study 2020-21 (CPAP arm)	**Recovery-RS Study 2020-21 (HFT arm)**	**RSU pilot audit 2021 COVID cohort**	**RSU audit 2023 COVID cohort**	**RSU audit 2023 Acute Pneumonia 2023**
N	264	308	278	205	667
Age (median years)	57	58	63	74	74
Female (%)	32	35	38	43	44
For escalation (%)	100	100	59	38	40
Most common Frailty Score	2 (well)	2 (well)	3 (managing well)	5 (mildly frail)	6 (moderately frail)
HFT use, incl. CPAP overlap (%)	15	100	53	61	60
CPAP use, incl. HFT overlap (%)	100	12	78	27	11
RSU Length of stay (median days)	6	6	6	5	5
Hospital survival (%)	84	81	60	54	58

Table A6: Demographic and outcome data for RSU-level patients with acute COVID (2020-23) compared to non-COVID acute pneumonia (2023)

The nature of COVID infection has undoubtedly changed over time and these data are presented to reflect that such evidence relates to the patient population included and the nature of the disease at the time, though equally to show the extent to which use of therapies may drift from the evidence.

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Appendix 4: Suggestions For Further Research Or Service Evaluation

Could the NIVO score be used to improve NIV weaning de-escalation decisions?

- The NIVO analysis showed a clear mortality benefit for medium and high-risk patients with COPD if treated in an enhanced respiratory care setting. This was less evident for low-risk patients, though this does not mean that RSU admission was not indicated. There is much more to the routine provision of effective NIV than audited mortality outcomes alone, including careful attention to mask fit and ventilator settings for patient comfort, the availability of sufficient staff to enable hydration and nutrition breaks from NIV, and the ability to respond quickly to changes in the patient's condition.

- Nevertheless, these data do suggest a potential role for the NIVO score to assist weaning and de-escalation decisions. More rapid weaning from NIV could improve RSU bed availability. A UK multi-centre study exploring accelerated weaning from NIV and standard care is already in progress (ISRCTN64639614) and we await the results with interest.

Could the NIVO score be used for non-COPD patient groups?

- Data completion for the NIVO score was excellent. Given the robust nature of the findings for patients with COPD, it would be of interest to assess its validity for patients treated with acute NIV who do not have COPD.

- The current audit included completion of the NIVO score for such patients and will be analysed.

What factors affect escalation decisions?

- Our findings suggested that higher frailty scores and the presence of certain diagnoses (e.g. COPD) were associated with a higher likelihood of 'not for escalation' decisions.

- Such decisions may be entirely clinically appropriate, and the audit was not configured to explore clinical decision-making and patient preference. Escalation decisions were documented within 24 hours of admission for almost all patients. This, of course, is good clinical practice. However, decisions may sometimes assume that the patient will be able to tolerate the treatment (e.g. NIV). If NIV failure occurs early because of poor mask tolerance or other factors associated with the application of ventilation, then conversion to invasive ventilation may be indicated to bridge the time required for other therapies to work. This is distinct from a later failure of NIV after good initial mask fit, settings and usage were successful; such circumstances usually confer a very poor prognosis.

- The national improvement target was included to encourage further consideration towards critical care escalation for lower risk patients who experience an adverse initial response to therapy (NIV In this case). The outcome data strongly imply that a higher proportion of patients may benefit from critical care, especially if compared to international data. However, whilst the NIVO score provides a prediction for NIV outcome, further study is needed to see if it can aid decisions about intubation/critical care escalation in the event of early, unexpected NIV failure.

Would ringfencing and more effective step-down from RSU beds assist their triage and function?

- Many patients in RSU hospitals were never admitted to the RSU. Despite this, at least 8% of RSU admissions were non-respiratory because of hospital overflow.
- Patients admitted to RSUs often went directly home rather than transitioning to ward-level care, even when their RSU requirement had ceased days earlier. These challenges intensify in high-demand winter months.
- Further study could, for example, assess models of patient flow more akin to critical care including ringfencing beds and more rigorous escalation and de-escalation from standard ward beds.

What is the optimal configuration for an RSU?

- The audit confirmed that an enhanced nursing model was associated with lower all-cause mortality compared to patients who received 1:4-1:8 staffing, though was not configured to explore other aspects of RSU staffing or infrastructure.
- Future study could assess whether a 1:2 model provides safer and more effective care compared to 1:2-1:4 and could also consider other aspects such as medical staffing or critical aspects of infrastructure, such as central monitoring.

How, when, where, and for whom should HFT be used?

- The audit data showed that HFT was used in ward locations that lack appropriate skill-mix and in conditions with little evidence supporting its use.
- Of note, there was a proportionately higher use of HFT in non-RSU hospitals (36% of total cohort) compared to RSU-equipped hospitals (16% of cohort). Differences in usage were especially evident for patients with acute pneumonia and AECOPD. Whilst as stated earlier, this likely reflects a case-finding effect at least in part. However, it could also represent an ‘availability’ effect; if HFT is available, whereas an RSU is not, then a clinician may be more likely to try HFT even if evidence to support its use is lacking. Further study is suggested.
- BTS has recently convened a group to produce a Clinical Statement on HFT. Based on the current audit data, a document that outlines the latest evidence and suggested clinical practice points is timely.