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Respiratory Support Units: Guidance on development and implementation

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On behalf of the British Thoracic Society and the Intensive Care Society

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SUMMARY

The British Thoracic Society (BTS) and Intensive Care Society (ICS) have worked together to produce this document which provides guidance on the standards of care and infrastructure for Respiratory Support Units.

A Respiratory Support Unit (RSU) is an area of enhanced care that enables a higher level of monitoring and respiratory intervention than would be expected for a routine ward environment. Patients suitable for management in an RSU are those individuals who need more monitoring and/or intervention than can typically be provided in a ward, but do not currently require critical care. While RSUs have emerged due to the need to provide high quality acute non-invasive ventilation (NIV), there is a wider patient group likely to benefit.

This document has had wide stakeholder consultation and draws on previous guidance from a number of professional bodies, including the British Thoracic Society (BTS), Intensive Care Society (ICS), Faculty of Intensive Care Medicine (FICM), National Institute for Health and Care Excellence (NICE), Getting it Right First Time (GIRFT) and NHS England/Improvement (NHSE/I). The authors recognise that this is an evolving area, especially in light of ongoing learning during the COVID-19 epidemic.

SUMMARY OF KEY GUIDANCE

GOVERNANCE

- There should be designated operational management, medical, nursing and allied health professional (AHP) leads for the RSU.
- A robust monthly morbidity and mortality (M&M) process should be in place and outcome data should be collected nationally.

SERVICE MODEL

- Complex respiratory care should be co-located and delivered in an RSU environment.
- Infection control and isolation facilities should meet existing national guidance.
- Each bed space should have at least 2 terminal units for oxygen, 2 for medical air and at least one suction point.
- Lead clinicians must be aware of the effect of treatments on an RSU on the hospital oxygen supply and RSUs should be alerted in the event of significant increases in consumption of oxygen by the hospital.

WORKFORCE

- Consultants should all have experience and competence in the management of complex respiratory conditions.
- There should be 24/7 cover available from the same pool of consultants who deliver daytime work.
- A senior decision maker should be available to assess patients within 30 minutes of admission and deterioration.
- The nursing staff requirement of an RSU will be dependent on the number of beds within the unit and the complexity of each patient. Staffing ratios should reflect existing guidance where available.
- Nursing staff should be experienced and have demonstrable competence in the management of complex respiratory conditions.
- There should be 7 day physiotherapy cover.
- The RSU should have 7 day access to a pharmacist and microbiology advice.
- The RSU should have at least 5 day access to other services including; speech and language therapy, occupational therapy, dietetics, specialist palliative care teams and psychology.

PATIENT PATHWAYS

- There should be local admission protocols which should have consultant involvement.
- There should be local protocols for delivery of non-invasive forms of respiratory support including CPAP, NIV and HFNO.
- Monitoring (saturations, blood pressure, ECG) should be available at each bedspace and displayed centrally on the RSU.
- The RSU should have a tracheostomy management protocol.
- All RSUs should have immediate access to co-located blood gas monitoring.
- All units should have immediate access to an ultrasound machine for IV access and pleural procedures.
- Clinicians with skills in thoracic ultrasound should be available on an RSU. The RSU should also have access to bronchoscopy.
- Close collaboration with critical care is essential and there should be 24/7 access to critical care consultation.

INTRODUCTION

The demonstration that acute NIV could be delivered effectively as a ward-based service (1) has led to the evolution of dedicated ward areas for this therapy in numerous hospitals. However, successive national audits have shown wide variation in service infrastructure and patient outcomes. The National Confidential Enquiry into Patient Outcome and Death (NCEPOD) conducted a detailed review of UK NIV services. The 2017 publication, 'Inspiring Change,' (2) identified key areas where the organisation of NIV care required improvement and these recommendations were reinforced in 2018 by the publication of the BTS Quality Standards for acute NIV (3). These documents set out the necessary service infrastructure as it pertains to acute NIV.

The COVID-19 epidemic has seen significant increases in the use of respiratory and critical care services and the use of equipment such as Continuous Positive Airway Pressure (CPAP) and High Flow Nasal Oxygen (HFNO) at a higher volume than ever before. The increase in numbers of hospitalised patients with respiratory failure during COVID-19 surges has highlighted the importance of creating safe and efficient services to support patients requiring non-invasive respiratory support and the value of close working between respiratory services and critical care.

The epidemic has also reinforced that many respiratory patients requiring close monitoring and non-invasive respiratory support can be well managed by respiratory physicians outside the walls of the critical care unit. Existing NIV units were often deployed to provide acute CPAP and HFNO, with many achieving a significant expansion in service provision to meet demand. Recognising that critical care admissions comprised fewer than 10% of all patients who were hospitalised with COVID-19, these RSUs provided an important role in mitigating demand on ICU services. Alongside critical care capacity, the epidemic has drawn sharp focus on the under-provision of RSU beds.

Whilst acute NIV service specifications may be encompassed within an RSU, there are other groups of patients who may benefit from its enhanced care infrastructure. These may include, but are not limited to, other patients receiving or considered for other non-invasive respiratory support (such as acute CPAP and HFNO therapies), patients at higher risk of abrupt deterioration (for example acute severe asthma or acute community acquired pneumonia), and patients with interventions that may require enhanced monitoring (for example management of patients with chest drains). These patients are already on respiratory wards but an RSU environment will concentrate the skills required to look after them.

Enhanced Care has been proposed as a means of bridging the gap in service delivery between ward care and critical care. Guidance from the FICM and RCP issued in 2020 makes key recommendations relating to Personalised Care, Governance, Service Models and Patient Pathways mapped to one of the five domains of the Care Quality Commission (CQC) inspection framework (4). Since publication of this over-arching guidance, specialty specific guidance has been developed for enhanced perioperative care services aimed at the higher risk surgical patient (5). Similarly, this guidance on RSUs provides support for developing and implementing RSUs, which can provide this type of enhanced care for patients diagnosed with, or at risk of respiratory deterioration, but not requiring critical care admission.

This document provides standards of care and guidance for development and implementation of RSUs during and outside of surges in requirement for respiratory care. It also provides guidance for development of existing RSUs. It brings together existing information from BTS, ICS, FICM, NICE and NHSE released both during and prior to the COVID-19 epidemic.

AUDIENCE

This guidance should be read by all healthcare professionals working as part of an RSU. It may also be of interest to those who collaborate with RSU teams, in particular colleagues working in critical care and outreach services, and non-respiratory colleagues who contribute to the care of acute medical admissions

SCOPE

This guidance considers the clinical needs for adult patients and does not cover requirements for patients under 16 years of age. It is not intended to describe the service or care standards for patients who require critical care.

METHODOLOGY

The British Thoracic Society has previously produced guidelines and quality standards regarding the use of NIV in RSUs (6). In response to the new challenges encountered during the COVID-19 epidemic, the British Thoracic Society has recently developed a set of rapidly produced clinical guidance on a range of respiratory conditions.

Brief guidance was published in December 2020 setting out a respiratory support pathway for patients with acute hypoxaemic respiratory failure associated with COVID-19 (7). It provided recommendations for health care professionals responsible for patients who could be looked after in non-critical care settings and outlined the criteria that should be used for escalation to areas with higher acuity treatments.

To provide more detailed guidance for developing and implementing RSUs, the British Thoracic Society and the Intensive Care Society convened a joint working group, chaired by Dr Ben Messer. Membership was drawn from respiratory medicine, critical care, nursing, and physiotherapy. The overall content of the brief guidance and this longer document was developed to reflect the scope of RSUs which had previously been published in the NHSE/I documents “Advice on acute sector workforce models during COVID-19” (8) and the GIRFT document “Clinical practice guide for improving the management of adult COVID-19” (9) .

The document was produced by the joint working group, and reviewed by the BTS COVID-19 Rapid Review Group. Rapid consultation took place with representatives from BTS, ICS, the Royal College of Physicians, London, the Faculty of Intensive Care Medicine (FICM) and others (listed in Acknowledgements). The final document was approved for publication by BTS and ICS officers, and published in June 2021.

Given the rapidly changing environment in relation to the COVID-19 epidemic, the content of this document will be regularly reviewed. The first formal review will take place at 12 months from publication, or earlier if appropriate.

RESPIRATORY SUPPORT UNITS

PURPOSE

The RSU should:

- provide a safe and effective environment to manage patients with complex respiratory disease or patients at risk of deterioration with acute respiratory disease;
- allow patients with complex respiratory disease or at risk of deterioration to be co-located to facilitate concentration of multiprofessional skills;
- bring multi-professional skills and experience together to bridge the gap between ward level care and critical care for patients with significant respiratory disease;
- facilitate the early recognition and treatment of new changes in the clinical condition of patients who are acutely unwell with respiratory disease;
- facilitate robust governance processes for such patients, with the overarching aim that improved infrastructure, staffing, and monitoring may result in improved patient outcomes.

PATIENT COHORT

The patient populations who are most likely to benefit from RSU care include:

- Patients receiving acute NIV for acute acidaemic hypercapnic respiratory failure
- Patients receiving acute non-invasive CPAP for hypoxaemia of respiratory cause
- Patients receiving acute HFNO for hypoxaemia
- Patients receiving Long Term Ventilation who are admitted acutely
- ICU step down patients with ongoing single organ respiratory failure including continued requirement for tracheostomy/laryngectomy management and patients receiving Mechanical Insufflation-Exsufflation (MI-E) therapy
- Patients with severe respiratory disease in association with Learning Disabilities
- Medical patients with intercostal drains
- Patients with acute asthma
- Patients with acute severe pneumonia
- Patients with massive pulmonary embolus (PE)

EXCLUSIONS

The patient population this guidance does not cover include:

- Patients receiving advanced respiratory support via an endotracheal tube
- Patients receiving advanced respiratory support via a tracheostomy or laryngectomy unless usually invasively ventilated in the community
- Patients receiving cardiovascular support
- Patients receiving acute renal replacement therapy
- Patients with non-respiratory organ support needs
- Medical patients with monitoring requirements for non-respiratory systems

These patients should be managed in a critical care or other appropriate setting.

A summary of care provided on an RSU and Level 2 is provided in Table 1.

Table 1: Acute Respiratory Support

	RSU	Level 2
Single organ acute respiratory support with CPAP, NIV, HFNO	Yes	Yes
Continuous saturation and ECG monitoring, intermittent non-invasive blood pressure (NIBP) monitoring, hourly urine output monitoring	Yes	Yes
Regular Blood Gas monitoring	Yes	Yes
Mechanical Insufflation-Exsufflation device use	Yes	Yes
Management of acute PE including thrombolysis	Yes	Yes
Tracheostomy care	Yes	Yes
Chest drain insertion and management	Yes	Yes
Invasive blood pressure monitoring	No	Yes
Central venous pressure monitoring	No	Yes
Postoperative acute respiratory failure requiring CPAP/NIV/HFNO	No	Yes
Acute respiratory failure requiring CPAP/NIV/HFNO plus renal or cardiovascular failure requiring close fluid balance, regular ABG or venous blood sampling for monitoring	No	Yes

GOVERNANCE

MANAGEMENT OF RSUs

RSUs should have a clear place within the overall management structure of an organisation. There should be designated operational management, medical, nursing, pharmacy and AHP leads for the RSU. Regular meetings should take place between the RSU leads. Where possible, creation of a separate RSU business reporting line is recommended to facilitate its day to day running, and there should be clear lines of reporting within the management structure of the healthcare provider. Larger RSUs are expected to function as a separate business unit.

Commissioning arrangements for RSUs is beyond the scope of this document. It is envisaged that local business plans be developed which will be informed by the guidance in this document.

RESEARCH AND QUALITY IMPROVEMENT

Research should be embedded within an RSU and current unit research should form part of the daily safety briefing. Where there are high levels of research demands RSU should aim to access research nurse support at least five days a week.
RSUs should engage in national quality improvement and safety projects such as patient deterioration, sepsis and nosocomial infections. National care quality indicators for RSUs should be identified and form part of the reported outcomes of RSUs.

SAFETY

A twice daily safety briefing using an appropriate safety checklist (see Appendix 1) should be usual practice. These are routinely used in a theatre and critical care setting and can be adapted for use on an RSU.

MORTALITY REVIEW

A robust monthly morbidity and mortality (M&M) process should be in place including rapid case note review of inpatient deaths of patients treated with (or considered for) acute NIV/CPAP/HFNO and other complex respiratory conditions.

Rapid case note reviews should report back to respiratory M&M meetings but also into critical care and emergency department M&M where appropriate.

Respiratory and critical care medicine should have an aligned process for such patients to ensure shared learning. There should be full representation from the extended MDT at these meetings.
All incidents relating to enhanced respiratory care should be reported via local reporting guidelines and discussed regularly at M&M meetings.

DATA COLLECTION

Local outcomes should be continuously monitored. National data collection will be important for outcome evaluation, mortality prediction and research. Entry of data into national data collection and clinical audit tools for RSUs should be encouraged and job plans should be developed to ensure that there is time for this.

ADMINISTRATIVE SUPPORT

Appropriate administrative support is essential to maximise patient contact for clinical staff. Duties will include reception, admission and discharge documentation and data collection.

SURGES IN DEMAND / VIRAL EPIDEMICS

The COVID-19 epidemic has focussed the respiratory community on estates, infection control, PPE, oxygen usage and equipment set up for NIV and CPAP. Whilst the principles of RSU set up will broadly apply, there are several important considerations during viral epidemics and other surges in demand. These are summarised in Appendix 2.

There should be designated operational management, medical, nursing and AHP leads for the RSU.

A robust monthly M&M process should be in place and outcome data should be collected nationally.

SERVICE MODEL

PHYSICAL INFRASTRUCTURE

Estates / Infection control

There are advantages to co-location of patients requiring complex respiratory care in RSUs in terms of staff expertise, monitoring and equipment. However, it is recognised that complex respiratory care may begin in other parts of the hospital. In all cases, appropriately trained staff should be available to assess patients, initiate and deliver treatments and remain with patients during delivery of care wherever this is. The same standard of care as available on an RSU should be provided. Transfer to a designated RSU should occur within 4 hours of initial review. This is often the role of critical care outreach teams and highlights the importance of close liaison between RSU and critical care teams. RSUs may also develop their own outreach teams to meet this demand.

The number of RSU beds required will depend upon local requirements. Successive BTS national audits, NCEPOD, and GIRFT all confirm that most trusts lack sufficient RSU beds to meet demand. A minimum of 10 beds per 250,000 population would provide sufficient capacity for many, though some will require more. Local modelling should take place to determine actual capacity to ensure sufficient beds for all patients requiring complex respiratory care to be managed in the RSU and accommodate winter pressures. Modelling should include future epidemic surge planning, ideally at both trust and regional network levels.

Detailed guidance on the design and standards of an isolation facility used for the treatment of patients with airborne pathogens is included in the *Health Building Note 04-01 Supplement 1 Isolation facilities for infectious patients in acute settings* (10). New units should be designed to follow those principles, with rooms having either negative pressure ventilation or neutral pressure room with a positive pressure ventilated lobby. Existing facilities can be converted to follow the same standards set out in the guidance with the main focus being air exchange rate and pressure differentials to ensure rooms remain at negative pressure from the corridors. Given the potentially high acuity of care required for patients on RSUs, a mixture of bays and cubicles may be more practicable to deliver care whilst retaining the ability to isolate patients. In this case the same design principles should be observed. Specific ventilation requirements can be found in HTM 03-01 Heating and ventilation of health sector buildings (11). The overall ventilation quality of a unit will depend upon the air exchange rate, the flow of air and the filtration of air. Estates, Microbiologists and Infection Prevention and Control teams must be engaged from the early stages of design of any refurbishment project in order to ensure optimisation of ventilation systems in line with the proposed clinical use.

Staff should wear appropriate PPE which should take into account the presence of epidemic viruses, the community incidence of viral infection and the requirement for Aerosol Generating Procedures. Existing PHE guidance should be followed (12).

Complex respiratory care should be co-located and delivered in an RSU environment.

Infection control and isolation facilities should meet existing national guidance.

Oxygen supply and other terminal units

Collaboration between medical gas committee, estates engineering, pharmacy and clinical teams is essential before establishing an RSU. Specific medical gases requirements can be found in HTM 02-01 Medical gas pipeline systems (13). The limitations of oxygen delivery to any ward will depend on both the maximum potential outflow from the Vacuum Insulated Evaporator (VIE), and the specifics of the pipework supplying that specific ward or area. The maximum output of the hospital's VIE should be assessed as well as any reserve supply which may be required during viral epidemics. Close liaison with the hospital's medical gas committee is essential to evaluate any possibility of improving the supply of oxygen. During surges in demand ensure oxygen availability in terms of pipeline and VIE capacity have been accurately assessed.

Each bed space should have at least 2 terminal units for oxygen and 2 for air with pipeline pressure of 400kPa (13). Each bed space should have at least one suction point. Staff should be aware of the safe use of medical air terminal units (14). If the use of HFNO therapy is proposed on the unit, the bed spaces will require at least 60L/min oxygen delivery capability. Overall, the unit should be capable of delivering an average of at least 10L/min of oxygen per bed space.

Clinicians working on an RSU should be aware of the effect treatments given in an RSU have on the hospital oxygen supply and consideration must be given to the number and type of high flow devices which can be used

within a RSU and how this might impact on oxygen supply in other parts of the ward. Clinicians working on an RSU should be alerted at times of increased hospital oxygen demand.

Multiple open respiratory circuits can increase ambient oxygen concentrations and consideration should be given to fire risk. There are national guidelines for fire safety and emergency evacuation for intensive care units (15). The general principles of these guidelines are also applicable to RSUs.

Each bed space should have at least 2 terminal units for oxygen, 2 for medical air and at least one suction point.

Lead clinicians must be aware of the effect of treatments on an RSU on the hospital oxygen supply and RSUs should be alerted in the event of significant increases in consumption of oxygen by the hospital.

WORKFORCE

A service lead should be identified each for medicine, nursing, pharmacy, physiotherapy and other AHP. They should have evidence of competence and experience in the management of complex respiratory conditions. Administrative time should be available within job plans for service development, quality improvement and regular meetings between service leads. A clear handover policy for all staff groups should be established.

Medical

Each patient on an RSU should be reviewed twice a day by a competent senior decision maker. At least one of these reviews must be by a consultant or equivalent and depending upon the acuity of the patients, both of these reviews may need to be consultant-delivered. RSU Consultants should all have experience and competence in managing patients on both acute and long-term non-invasive respiratory support and current experience in the management of complex respiratory conditions. They may include consultants in respiratory medicine, general medicine and intensive care medicine. They may also include non-medical consultant workforce (such as nurse and physiotherapist consultants). Consultants should not have other clinical commitments during their duties on an RSU which would prevent them attending the RSU urgently. Out of hours cover should be from the same pool of experienced consultants as daytime cover.

Doctors in training from respiratory, acute internal medicine and critical care programmes will benefit from rotation through an RSU. A separate rota should be considered depending upon local numbers of patients, trainees and middle grades. Specific competencies on respiratory medicine, critical care and acute medicine syllabuses can be gained during rotations through an RSU. A senior decision maker (ST3 equivalent and above) with the required competencies should be available to assess patients within 30 minutes of admission or deterioration and in accordance with NEWS2 protocols.

Advanced Care Practitioners (ACPs) have been a valuable part of critical care workforce for the last decade, as have physician/anaesthesia associates (PAs/AAs) in medicine and anaesthesia. Depending upon medical staffing availability and rotas, ACPs or PAs may have a similar role on RSUs.

Consultants should all have experience and competence in the management of complex respiratory conditions.

There should be 24/7 cover available from the same pool of consultants who deliver daytime work.

A senior decision maker should be available to assess patients within 30 minutes of admission and deterioration.

Nursing

The nursing staff requirement of an RSU will be dependent on the number of beds within the unit and the complexity of each patient. Ensuring that the competencies and skill mix of ward staff (including nurses, allied health professionals and healthcare support workers) on every shift is tailored to the needs and acuity of patients on the unit is more important than specific nurse: patient staffing ratios, and can be supported by the Safer Nursing Care Tool (16). However, previous guidance (BTS/NCEPOD) has provided indicative ratios for different respiratory conditions and therapies including acute NIV for respiratory failure and can be used as a guide for calculating the establishment required to establish a respiratory support unit (2, 3). The minimum ratio recommended by the respiratory GIRFT report for an RSU is 1:4 but increased acuity will require additional staff. Specifically, a 1:2 nurse to patient ratio is mandated for delivery of acute NIV until the patient is weaned to nocturnal NIV (9). Safe staffing ratios must be maintained at nights and during weekends. Local competencies should be made for nursing staff with time in job plans to achieve them. An example is the national competency framework which has been developed for the recognition and management of the critically ill (17).

In addition to staff required for direct patient care, there should also be a senior member (band 6 or above) of trained staff present on each shift to provide leadership and coordination. This individual, alongside the duty consultant, will also be responsible for liaison with other services (e.g. ward, emergency department, critical care, bed management) and for overseeing data management for governance and audit purposes.

Each member of nursing staff should be competent in the equipment that will be used within the unit, such as NIV and CPAP machines, suction, HFNO, Mechanical Insufflation-Exsufflation therapy and monitoring equipment. Each hospital should have their own competency documents for this equipment. The nursing staff will also need to be competent in caring for patients that will be allocated to this unit, such as patients receiving ventilation and patients with tracheostomies. Therefore prior to being allocated patients, each member of staff within the unit should have sufficient funded and protected time to ensure they develop and can demonstrate competence in the delivery of the different types of treatment which have been designated for their hospital's RSU.

Each member of qualified nursing staff should be trained in obtaining blood gases, whether arterial or capillary and interpreting the results obtained. Alternatively, there should be appropriate team members available at all times to be able to complete this, such as Respiratory Clinical Nurse Specialists or the medical team.

The nursing staff requirement of an RSU will be dependent on the number of beds within the unit and the complexity of each patient. Staffing ratios should reflect existing guidance where available.

Nursing staff should be experienced and have demonstrable competence in the management of complex respiratory conditions.

Physiotherapy

Respiratory physiotherapists are essential members of the Multi-Disciplinary Team (MDT) when treating respiratory patients from acute admission, rehabilitation to discharge. Daily physiotherapy input is essential. A respiratory physiotherapist with expert knowledge of CPAP, HFNO, NIV and rehabilitation should be identified as a service lead to support RSUs and work with a lead consultant and senior nurse identified for the RSU. This should include AFC Band 7 and above and must demonstrate experience in the management of complex ventilation patients and training and support to other members of the MDT working on these wards. The initiation of CPAP, HFNO, NIV and airway clearance/MI-E should only be carried out by a physiotherapist with relevant training and may be dependent on individual trusts local policies. Specific competencies should be designed as such to ensure staff have the appropriate training and skill sets and funded and protected time should be made available to ensure staff can meet these requirements. Any redeployment of physiotherapists into the RSU during surges of COVID-19 or other epidemic infections should include careful consideration of competencies and skill sets and the impact on existing services.

Physiotherapy staffing ratios will depend on the acuity of the unit and may vary depending on this. RSUs will require more intensive physiotherapy staffing than other respiratory and medical wards. Flexible models should exist to meet the demand on workforce and available resource and may include extended days, twilight shifts, night shifts and 7 day working where appropriate. A roster should ensure that there is the ability to provide out of hours physiotherapy on-call and account for sickness.

There should be 7 day physiotherapy cover.

Wider Multi-professional team

Other members of the multi-professional team may include:

- Clinical Scientists
- Dieticians
- Microbiologists
- Occupational Therapists
- Palliative Care
- Pharmacists and Medicine Management Technicians
- Psychologists
- Speech and Language Therapists

These services are essential to provide safe and high quality care to patients on an RSU. Access to a pharmacist and microbiology advice is required 7 days of the week. At a minimum, 5 day access to the other

members of the multi-professional team should be a mandatory part of a business case for an RSU. Depending upon the local set up of an RSU, 7 day access to the other professionals may be required.

The RSU should have 7 day access to a pharmacist and microbiology advice.

The RSU should have at least 5 day access to other services including; speech and language therapy, occupational therapy, dietetics, specialist palliative care teams and psychology.

Multi-professional working

Multi-professional liaison should be routine and a MDT meeting after the morning ward round to prioritise urgent assessment and treatments should be embedded in the daily routine.

PATIENT PATHWAYS

ADMISSION

Admission to the RSU should be agreed between the RSU consultant and the relevant consultant(s) from emergency medicine, critical care, acute medicine, and/or other non-respiratory wards according to a local protocol. Beds on an RSU should be ring-fenced for respiratory patients with the conditions above and/or requiring the treatments listed above. In general, patients who would be suitable for escalation to an RSU should be transferred to an RSU when specific therapy (such as NIV, CPAP or pleural drains) is being considered or when patients require increased frequency of monitoring (such as acute asthma or pneumonia). Patients at risk of deterioration should be discussed with critical care and critical care outreach prior to RSU admission. Critical care outreach teams should be available to transfer patients where required both to an RSU and from an RSU to a critical care area.

Prior to admission to an RSU, all patients should have a consultant review of treatment goals and priorities. During RSU admission, a treatment escalation plan (TEP) should be discussed with patients and their next-of-kin, and clearly documented. All decisions should have patient and consultant involvement.

There should be local admission protocols which should have consultant involvement.

TREATMENT AND MONITORING

The RSU should have locally developed non-invasive respiratory support protocols (based on published best practice guides) uniformly applied across all areas including situations where these treatments are given outside of an RSU setting whilst awaiting transfer to an RSU. They should define guidance for the initiation, ongoing management and weaning/discontinuation of these therapies. If non-invasive respiratory support is delivered outside of an RSU, the same local protocols and standards of care should apply as in an RSU with senior involvement from experienced clinicians.

Chest imaging should be reviewed for the presence of pneumothorax in severe asthma and in all patients prior to initiation of CPAP/NIV.

Local protocols should be in place for the other treatments and conditions listed above.

RSUs should have robust protocols for tracheostomy and laryngectomy management including management of emergency blockage or dislodgement (18-21).

Local protocols will also define care pathways to identify and treat patients presenting with the requirement for acute NIV who may benefit from transition to long term ventilation. Early liaison with home NIV services is recommended for such patients and a network approach should be embedded within the service.

In patients who are highly NIV or CPAP dependent, nasogastric (NG) feeding is recommended and staff should be aware of national guidance (22).

Oxygen targets should be agreed locally. Variances can be used on NEWS2 charts should lower targets be more appropriate than those used in NEWS2 oxygen scale 1 (23). For patients at risk of hypoventilation a lower oxygen target of 88-92% should be used. These may include patients with COPD, obesity, scoliosis and respiratory muscle weakness secondary to neuromuscular disease, and all patients should be individually assessed for this risk.

Monitoring standards and frequency should follow BTS guidance for NIV (3) and those mandated by NEWS2 (23). Any deteriorating patient defined by NEWS2 should have continuous oxygen saturations. Monitoring (saturations, blood pressure, ECG) should be available at each bedspace and displayed centrally on the RSU.

Saturation monitors should be clearly visible to staff including when patients are in isolation rooms. Any patient receiving NIV who has not been weaned to nocturnal NIV should have continuous oxygen saturation monitoring. Locally agreed protocols should be used to define patients who can be taken off continuous oxygen saturation monitoring following improvement in their condition. Continuous ECG monitoring should be used during the first 24 hours of an acute exacerbation of COPD and in all patients when the pulse rate is greater 120 bpm, there is a new dysrhythmia or the patient is receiving intravenous beta-agonist/phosphodiesterase inhibitors. Local protocols should be in place to detect disconnection from CPAP and NIV and will include disconnection alarms on machines and defining the protocols for the frequency of nursing review especially for patients nursed in side rooms. Frequency of nursing review will depend upon conscious level and dependency on non-invasive respiratory support.

Consideration should be given to using continuous capnography as a monitor to detect disconnection of oxygen or ventilatory support. Correlation with $PaCO_2$ both absolute values and trends is poor and therefore it should not be used as a substitute for blood gas monitoring. End-tidal CO_2 ($ETCO_2$) monitoring should be used at all times during ventilation via a tracheostomy or laryngectomy although it envisaged that only patients ventilated in the long term via a tracheostomy would be admitted to RSUs.

There should be local protocols for delivery of non-invasive forms of respiratory support including CPAP, NIV and HFNO.

Monitoring (saturations, blood pressure, ECG) should be available at each bedspace and displayed centrally on the RSU.

The RSU should have a tracheostomy management protocol.

EQUIPMENT

Machines used for CPAP and NIV should be designed for this purpose. All machines should, at a minimum, have a disconnection alarm. Where patients are nursed in side rooms, the alarm should be audible from outside the room. Machines for the delivery of CPAP and NIV should have an uninterrupted power supply (UPS) both for mains power failure and to enable transfer e.g. to radiology. Staff should be aware of national patient safety alerts relating to interruption of HFNO during transfer (24). When delivering CPAP and NIV with machines which entrain room air, the dependence of FiO_2 on inspiratory flow should be understood by all staff. The use of machines with an oxygen blender should be strongly considered especially in hypoxaemic patients.

Respiratory circuits for CPAP and NIV should be approved by the multi-professional team to ensure they are set up correctly to be compatible with the device and have appropriate parameters set.

Local policies should be in place to define the frequency of changes of equipment for infection control purposes examples are: viral/bacterial filter (24h), mask (7d), valve (7d) and tubing (7d).

All RSUs should have immediate access to co-located blood gas monitoring.

All units should have immediate access to an ultrasound machine for IV access and pleural procedures.

Clinicians with skills in thoracic ultrasound should be available on an RSU. The RSU should also have access to bronchoscopy.

DISCHARGE

In order to maintain efficient patient flow through the RSU, patients deemed ready for discharge should be prioritised by bed managers for ward level beds, in a similar manner to patients fit for critical care discharge.

Although most patients will be transferred to a lower acuity setting prior to discharge, some patients will be discharged home straight from an RSU. These patients should be discharged in accordance with local policies including: have a medication review prior to discharge, have follow up arrangements made and ensure adequate communication with GPs or the community team. Patients with complex rehabilitation requirements should be able to access the local services they require as assessed by the multiprofessional team during and following RSU admission.

COLLABORATIVE WORKING WITH CRITICAL CARE

Although RSUs will largely be run by respiratory teams, there is an important role for critical care. Access to critical care consultation, either via outreach teams and/or direct support from critical care senior decision makers should be available 24/7/365. There should be at least daily liaison between the RSU and critical care clinical teams focusing on patients who might require escalation or de-escalation in each setting. Patients who may benefit from de-escalation from critical care to an RSU are patients with ongoing single organ respiratory failure and patients with recently sited (at least 7 days previously) tracheostomies. RSUs should have access to the personnel and equipment required for intubation and stabilisation if a patient is not stable enough for transfer to critical care.

Depending on local service design and consultant job plans, there may be a role for routine Consultant Intensivist input to facilitate joint decision making and advanced care planning for deteriorating patients with a marginal chance of benefit from critical care. Treatment escalation plans using a recognised communication tool as should be made for all patients to ensure continued quality of care during times where care is not consultant-delivered. Templates such as ReSPECT (25) or similar should be used. Patients with chronic respiratory disease

should be supported in an outpatient setting in making an Emergency Healthcare Plan with time in clinicians' job plans to reflect this requirement.

Some RSUs, particularly those which include patients receiving long term ventilation, may care for patients with tracheostomies. Critical care services may have an important role in the advising on the management about these patients. This will include day-to-day management, decannulation decisions and upskilling RSU staff in tracheostomy management. Further guidance on safe management of tracheostomies is available (18-21).

Finally, critical care will be important in the governance structure of RSUs. This may include advice on equipment, protocols and a shared governance structure including joint mortality and morbidity meetings.

During times of surge requirements for RSU, there may be the need to expand critical care services. RSUs should ideally have the ability to flex to deal with surges in demand, including offering invasive ventilation which will require the import of appropriate staff and equipment. Under these conditions, clear protocols defining arrangements for management of non-critical care respiratory patients should be in place.

Close collaboration with critical care is essential and there should be 24/7 access to critical care consultation.

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DISCLAIMER

This document reflects the expert views of a group of convened by the British Thoracic Society and the Intensive Care Society. Production of this document did not involve a formal evidence review and has not been developed in accordance with clinical practice guideline methodology. This guidance document is not intended as a legal document or a primary source of detailed technical information.

APPENDIX 1

SAFER NIV/CPAP - A checklist for use in Pandemic Response and on Respiratory Support Units*
Complete on initiating NIV/CPAP and every shift change
DO NOT PROCEED WITH NIV/CPAP UNTIL ALL QUESTIONS ANSWERED YES
Where doubt exists, or where an answer is NO - give supplemental oxygen sufficient to prevent desaturation, and STAY WITH THE PATIENT.

	Tick
SYSTEM	
Has each team member read and understood the NIV machine quick start guide? (This guide should be laminated, and permanently attached within arms' reach of the machine)	
Has a suitable filter been fitted to the expiratory/exhaust pathway?	
Are all machine alarms on and set appropriately?	
Has the patient been reviewed as being at higher risk of deterioration?	
If higher risk, are they in the appropriate place on the ward (i.e. proximity to nurses' station etc)	
Is their Treatment Escalation Plan known, documented and handed over?	
AIRWAY	
Is the machine tubing as short, direct, and protected as possible? Confirm that no improvements can be made.	
Confirm that the patient cannot disconnect the oxygen supply by moving, rolling, or pulling?	
Can the machine tubing be better protected by loosely taping (masking tape) the tubing out of reach?	
Has operation of the mask bypass valve been checked as operational?	
Has each and every connection between the patient and the machine been checked for security, and then double checked?	
Has the mask fit been checked and there is minimal leak?	
FiO2	
Have you confirmed that the machine is attached to **oxygen** (**not** medical air)	
Are the target ranges for key observations documented?	
○ O_2 saturation	
○ RR	
Does the patient have continuous pulse oximetry with alarms set appropriately and within earshot of a staff member?	
ELECTRICITY SUPPLY	
Is the electricity supply to the NIV/CPAP machine as safe and protected as possible?	
Where the electricity supply cable must cross a walkway, has the cable been taped to the floor, using masking tape, or covered with a rubberised mat?	
Has the electricity supply cable been checked for pinch hazards?	
RESCUE	
Which named team member will respond to an alarm?	
Can this team member stay within earshot of machine/pulse oximeter alarm at all times?	
Do you know the location of the nearest fire extinguisher? Do you know how to use it to attack an oxygen fire?	
Which named BLS trained team member will respond in an emergency?	
Can this team member remain close to the patient at all times?	

APPENDIX 2

Surges in demand/ viral epidemics

PPE

Staff should wear appropriate PPE which, during viral epidemics includes the use of FFP3/FFP2 masks for Aerosol Generating Procedures, following PHE guidelines (12). All staff must be fit tested to ensure they are provided with the appropriate fit mask that is protective. Occasionally masks are not suitable and alternatives such as hoods and other respirators must be explored. Fit-testing and PPE training must be supported by Infection Prevention and Control who would monitor changes to the guidelines and cascade information and training as appropriate.

INFECTION CONTROL

All patients should be risk stratified as per PHE guidance as low, medium or high risk of epidemic viruses. This will depend upon the background incidence of epidemic viruses in the community, the clinical presentation and rapid testing. Isolation requirements during NIV/CPAP should follow national PHE/BTS guidance.

NIV AND CPAP

Circuits for acute NIV/CPAP should be set up according to BTS guidance during COVID-19 surges (or other epidemic infections). Patients who have epidemic viruses or with a high clinical suspicion should have a non-vented mask with a viral filter between the patient and an exhalation port. Oxygen should be entrained further from the patient than the filter (26). Circuit set up outside of epidemic virus surges should follow local protocols and experience but in general a single limb circuit with an exhalation port is preferred.

During epidemic surges, patients who receive NIV at home should have their circuits altered according to NHS/BTS guidance (26). Patients who receive long term CPAP at home should have their requirement for this reviewed during acute admissions but where required, the circuit should follow NHS/BTS guidance (26). Upon discharge, the circuit should be changed back to the usual circuit and mask for that patient.

Mechanical Insufflation-Exsufflation and other airway clearance techniques form an important part of the acute treatment of patients with ventilatory failure, especially in the setting of weaning from mechanical ventilation and in patients with neuromuscular disease. Viral filters should be used at the patient side of the expiratory valve. They should be used with caution during viral epidemic surges due to concerns about aerosol generation. A risk assessment of individual patients should be undertaken to define the need for MI-E therapy.

OXYGEN

At times of surges in demand for oxygen, initiation of HFNO should be a consultant level decision. Replacement of high flow CPAP/NIV machines with lower flow machines may be possible at times of high demand on oxygen supplies. Where local expertise exists, a circuit with an active exhalation valve to deliver NIV or tracheostomy ventilation can reduce oxygen requirements.

When calculating oxygen requirements during CPAP/NIV using machines which entrain room air, it should be recognised that the high peak inspiratory flow rates seen during episodes of acute respiratory failure will result in dilution of FiO2 and increase demand on the oxygen supply. High peak flow rates during CPAP will result in FiO2 of approximately 0.3, 0.35 and 0.45 with 5, 10 and 15L/min of oxygen entrained respectively.

Consider ways of conserving oxygen such as:

- Turning off oxygen flow meters, nasal high flow and CPAP/NIV devices when not in use
- Staggering of interventions that may lead to sudden surges in oxygen demand between patient e.g., nebuliser use, switching from CPAP to HFNO to enable feeding
- Assessing and managing leaks from CPAP/NIV facemasks
- Awareness that turning oxygen flowmeters up to maximum can result in significantly more oxygen being delivered than the highest gradation on the flowmeter

Multiple open circuit devices may contribute to a higher than usual ambient oxygen concentration which may pose a potential fire hazard. Please see this CAS-ALERT for further information. There are also national guidelines for fire safety and emergency evacuation for intensive care units (15). The general principles of these guidelines are also applicable to RSUs.

Good environmental ventilation is required. Close liaison with the medical gas committee, Estates engineering team and the hospital Fire Officer is essential to undertake a risk assessment. A checklist to ensure minimisation of ambient oxygen concentrations should be used. (Appendix 1)

WORKFORCE

During acute surges in demand such as during subsequent waves of COVID-19 or other epidemic infections, staffing levels may have to be reduced to manage the overall hospital workload. As much as possible should be done to ensure that RSUs maintain the safe staffing levels above following the demonstration of the critical role these units have during surges in demand for respiratory support. During surges in demand, staff may be redeployed from other clinical areas. Care must be taken to ensure that they are well-supported by more experienced staff and that they have an induction and an intensive educational programme prior to redeployment. Examples of courses which have been used to train support critical care staff include the C19 SPACE course from the ESICM (27).

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