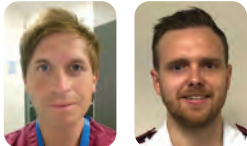


# The Nutritional Management of COVID-19 Patients in the Intensive Care Unit



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The outbreak of Coronavirus Disease 2019 (COVID-19) has resulted in an unprecedented strain upon healthcare systems globally,<sup>1</sup> with the World Health Organisation declaring a global pandemic on 12<sup>th</sup> March 2020.<sup>2</sup> Around the world, the demand on healthcare facilities has resulted in many reaching capacity, especially intensive care units (ICU). On top of this, national shortages of vital healthcare equipment have been seen, alongside a rapid increase in mortality rates. Following the example of other European countries, the UK introduced a range of strict social distancing measures to prevent an unprecedented, unmanageable peak in admissions to hospital.

ICU dietitians play an essential role in the management of patients with COVID-19. This article aims to share experiences from the Royal Stoke University Hospital (RSUH) on the dietetic management of COVID-19 patients in the ICU, including the practicalities of working within newly formed ICU teams and methods used to minimise risk of infection transmission within the hospital.

## Background

COVID-19 is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), resulting in various symptoms and respiratory compromise (see **Table 1**). The associated complications – severe pneumonia characterised by fever, tachypnoea, hypoxia and acute respiratory distress syndrome – may require the non-invasive ventilation of patients, or the mechanical ventilation of those with more severe cases.<sup>3</sup>

## Preparation

The RSUH is a large teaching hospital. It is one of 11 regional adult major trauma centres within the UK, with a 48-bedded adult ICU and an infectious disease team. The adult ICU is split into 6 'pods' – 2 for cardiothoracic patients and 4 for general ICU patients. To increase ICU capacity to meet the demands of COVID-19, large organisational changes were made, including converting the paediatric ICU and the theatre recovery hub to adult ICU wards, and staff were upskilled. This increase in ICU capacity meant that a potential 160 ventilated ICU patients could be accommodated and cared for.

To prepare for the potential, rapid increase of COVID-19 patients being admitted to the RSUH, the nutrition and dietetic department team worked tirelessly to ensure supplies of enteral feed, oral nutritional supplements, feeding pumps and giving sets were readily available.

Urgent supplies of gravity feeding sets were sourced to ensure all patients could be fed if ICU capacity was reached. Feeding pumps were uplifted from ward areas where they were not being used and moved to a central location. The home enteral feeding team contacted patients using continuous pump feeding regimens at home and, where appropriate, patients were converted to bolus feeding regimens with consent and feeding pumps uplifted.

**Table 1: Symptoms Associated with COVID-19<sup>4</sup>**

Rarely reported symptoms	Commonly reported symptoms	Serious symptoms
<ul style="list-style-type: none"><li>• Sore throat</li><li>• Headache</li><li>• Chills</li><li>• Loss of taste smell</li><li>• Nasal congestion</li><li>• Nausea and vomiting</li><li>• Diarrhoea</li></ul>	<ul style="list-style-type: none"><li>• Fever</li><li>• Fatigue</li><li>• Dry cough</li><li>• Loss of appetite</li><li>• General aches</li><li>• Shortness of breath</li><li>• Mucus or phlegm</li></ul>	<ul style="list-style-type: none"><li>• Trouble breathing</li><li>• Constant chest pain</li><li>• Changes of colour in lips or face</li><li>• Sudden confusion</li></ul>

## The ICU dietetic team

Prior to the COVID-19 outbreak in the UK, the RSUH had a team of four ICU dietitians providing services Monday to Friday. At the start of the COVID-19 outbreak there were two vacancies within the ICU team due to maternity and sick leave, and as a result only two ICU dietitians were in place. Members of the acute dietetic team with previous experience in critical care, surgery and artificial nutritional support volunteered to help manage the caseload. The volunteer dietitians had their caseloads covered by colleagues, and patients were also prioritised to help alleviate those caseloads. In-house training was arranged to ensure that all members of the newly formed ICU team had the appropriate skill-mix. The British Dietetic Association (BDA) produced clinical recommendations and webinars regarding the nutritional and dietetic management of COVID-19 patients and internal training was also used to prepare staff prior to working on the ICU.<sup>5</sup>

All members of the dietetic ICU team underwent mask fit training alongside 'donning' and 'doffing' to minimise contamination. Efforts were made to assign dietitians to positive and negative ward areas to minimise the risk of virus transmission. Remote working was also utilised through the online medical noting system. Office restrictions were introduced in line with social distancing guidelines to minimise the risk of disease transmission.<sup>6</sup>

Communication between members of the newly formed dietetic ICU team was essential to ensure that all patients were assessed and followed-up in a timely manner, and that personal protective equipment was used efficiently. The ICU caseload is tracked through a password protected spreadsheet, which all members of the team have access to and is updated daily.

## Referrals

All ICU patients are referred to dietetic team as part of standard procedure. As part of the admission proforma, weight and height are recorded. Out-of-hours referrals for enteral feeding have their feeding initiated by the admitting consultant following a simple proforma, which has been designed to avoid any complications or delays in feed initiation (Figure 1). RSUH does not currently use an ICU specific screening tool, but the Malnutrition Universal Screening Tool ('MUST') is used trust wide to identify patients at risk of malnutrition.

## COVID-19 cohort

Patients admitted to the RSUH typically present after a period of self-isolation, ranging from two days to two weeks, before they were unable to cope at home with respiratory distress. Initial data collection at RSUH suggests that the majority of patients that have been admitted to ICU are over-weight or obese, middle-aged, men with other co-morbidities, such as diabetes, hypertension and/or respiratory diseases. Obesity in combination with hypertension has to date been the most commonly observed at RSUH. At present, it is unclear why higher proportions of men are contracting COVID-19. The high incidence of obesity could suggest lifestyle risk factors.

As the presentation of patients diagnosed with COVID-19 the ICU has been variable, we have simplified this into three discrete categories:

- **Category 1**

Individuals requiring oxygen, including via a nasal cannula or high flow oxygen therapy. They are usually able to move from bed to chair and may be employing self-proning to help oxygenation status. Oxygenation presents no physical barrier to eating and drinking, and these patients have generally better intakes than patients requiring greater respiratory support. This category of patients has mostly required dietary advice on snacks and nourishing drinks, with or without the use of oral nutritional supplements (ONS) to meet nutritional needs.


- **Category 2**

This category refers to individuals needing non-invasive ventilation (NIV), including continuous positive airway pressure (CPAP) and bilevel positive airway pressure (BIPAP). These ventilation methods vary in function but are designed to force oxygen to the bottom of the lungs to improve oxygenation but can also cause fatigue. The mask used restricts a patient's ability to eat and drink. These patients therefore can have compromised intakes and may require oral nutritional support. The food first approach has remained preferential, however ONS and supplementary feeding using nasogastric (NG) tubes has been used where indicated.

- **Category 3**

Individuals requiring sedation and mechanical ventilation. Initially ventilation is via an endotracheal tube (ETT), alongside sedation with or without the use of paralysis. These patients will be exclusively fed via feeding tubes. Where nutritional requirements cannot be met via the enteral route, parenteral nutrition (PN) has been recommended.<sup>7</sup> Patients with prolonged respiratory weans may have ETTs replaced with a tracheostomy, which means that sedation can be stopped but oxygenation levels maintained. Oral intake can be introduced with tracheostomy tubes; however, from experience, intake is variable and the majority of patients may still require enteral feeding. Diet with a tracheostomy is likely to require texture modification and require Speech and Language Therapy (SLT) input. SLT will assess swallow ability and recommend suitable diet and fluid modification in line with the International Dysphagia Diet Standardisation Initiative Framework (<https://iddsi.org>).<sup>8</sup> In severe cases, sole artificial enteral nutrition may still be required due to dysphagia.

Figure 1: Example of Out of Hours Enteral Feed Regimen



**COVID19**

**ENTERAL FEEDING REGIME FOR CRITICAL CARE PATIENTS**

WEIGHT (Kg)	High-protein tube feed with fibre 1.3 kcal/ml	Tube feed with fibre 1.2 kcal	1.0 kcal/ml, high-protein tube feed	1.5 kcal/ml tube feed with fibre	2.0 kcal/ml tube feed
40-47	36	39	49	31	23
48-52	40	43	52	35	26
53-57	44	48	57	38	29
58-62	48	52	62	42	31
63-67	52	56	67	45	34
68-72	56	61	72	49	36
73-77	60	65	77	52	39
78-82	64	69	82	56	42
83-87	68	74	87	59	44
88-92	72	78	92	63	47
93-97	76	83	97	66	50
98-100+	80	87	100	69	52

PLEASE START WITH HIGH-PROTEIN TUBE FEED WITH FIBRE AND IF UNAVAILABLE PLEASE USE THE NEXT FEED ON THE CHART

Commence feed at 20 mls/hr and continue at this rate for 48 hours, after 48 hours increase rate by 10 mls every 12 hours until final rate reached

Patients should receive enteral feed for 24 hrs each day unless receiving enteral medications requiring a break in feed, e.g phenytoin seek advice from dietetics/pharmacy

Theatre Recovery team Enteral feeds/Freego giving sets/enteral syringes 60 mls (purple) can be located from pod1/2, pod 4, Pod 6

PICU team please order the Enteral feeds/giving sets/enteral syringes via supplies

Feeding pumps (Freego) can be obtained from medical equipment library ext xxxxx

Please contact Dietitians on ext xxxxx or pager 1 xxxxx/xxxxx for any queries

The dietetic team will aim to see all patients that are receiving artificial nutritional support

The majority of patients treated for COVID-19 on the ICU at RSUH have been NG tube fed, due to invasive ventilation and sedation. When feeding an ICU patient, additional considerations should be addressed to ensure efficient and safe feeding. This includes noting: pharmacology used, gastric residual volumes obtained, multi-organ failure present, any feed tolerance issues, and the position of the patient during feeding (for example proning).

Nutritional requirements are based on admission body weight taken from weigh beds. Occasionally we find that an actual body weight is not available and previous weights are used from medical correspondents, an estimated weight used, or ideal body weight estimated from an alternative measure such as ulna length. Where body mass index (BMI) exceeded 30 kg/m<sup>2</sup>, ideal body weight has been used to avoid potential complications of overfeeding.<sup>9</sup> Estimated calorie requirements are based upon Parenteral and Enteral Nutrition Group of the BDA guidance. Those with BMIs <30 kg/m<sup>2</sup> have been fed at 20-25 kcal/kg/day during acute illness progressing to 25-30 kcal/kg/day in rehabilitation.<sup>10</sup> Protein targets range from 1.2-2.0 g/kg/day, with up to 2.5 g/kg/day for those on continuous renal replacement therapy.

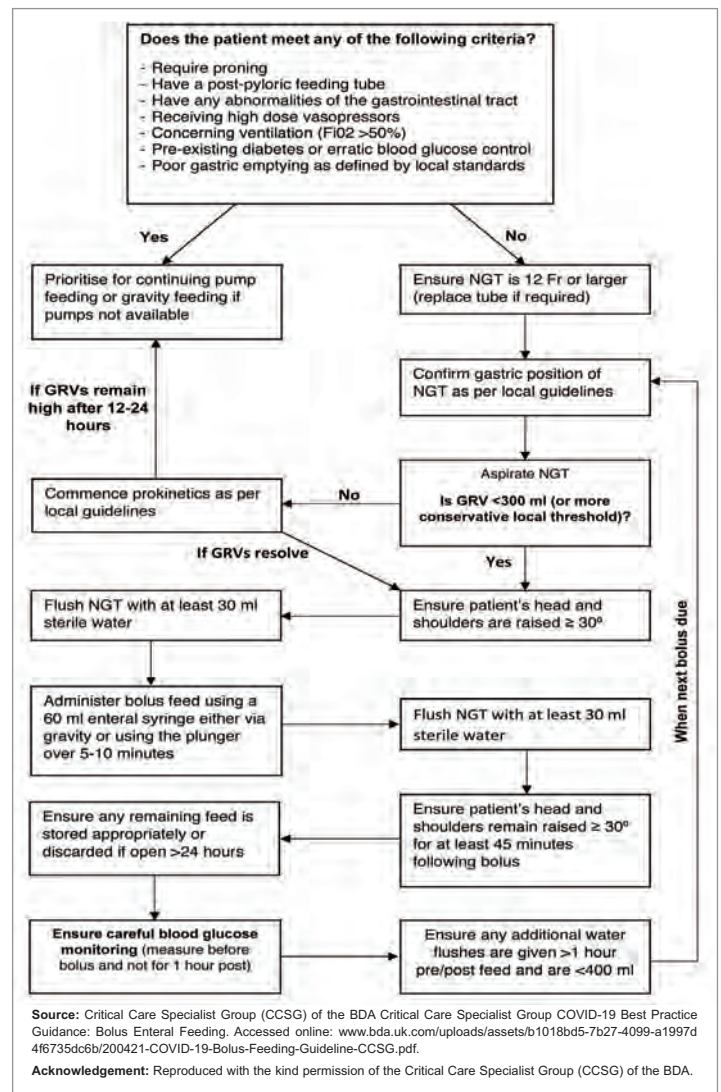
In the ICU, at RSUH, fine bore NG tubes are used as first line for feeding. In some instances, patients have developed high gastric residual volume (GRV) and are therefore progressed to post-pyloric feeding using fine bore nasojejunal (NJ) feeding tubes sited at the bedside.<sup>11</sup> GRV thresholds are reduced to 300 ml and taken every four hours during feeding. If aspirates exceed 300 ml, this is treated with the early use of prokinetics, such as metoclopramide and erythromycin, which may be used individually or in combination to minimise aspiration risk.<sup>11</sup> If this is ineffective, NJ feeding or progression to PN may be indicated. At the time of writing, RSUH has had no COVID-19 patients whom have required parenteral feeding. ICU enteral feeds are delivered continuously. Gravity drip feeding giving sets and bolus feeding have also not yet been used. Bolus feeding should only be considered in suitably assessed patients - see Figure 2.<sup>12</sup>

Non-nutritional calorie sources need to be accounted for to avoid potential overfeeding.<sup>11</sup> Common sources include propofol and intravenous glucose. Propofol is a lipid-based sedative agent. RSUH use 1% propofol, providing roughly 1 kcal/ml. It was observed early in the outbreak, how quickly patients can deteriorate and require mechanical ventilation and NG feeding. Therefore, when required, multiple feeding plans have been provided to account for changes in propofol rates. The aim of this is to improve time efficiency and minimise multiple reviews to save on PPE. Intravenous glucose is a sugar solution of varying strengths, which can be given as intravenous fluids or as a giving solution for medications. Protein supplementation has been used to meet protein requirements in the presence of non-nutritional calories.<sup>11</sup> At the time of writing, the majority of patients have received a 1.3 kcal/ml high protein feed to meet estimated requirements. Those patients who had intolerance issues were converted to semi-elemental feeds. A low electrolyte, calorie-dense, feed has been utilised for patients with renal failure to prevent hyperkalaemia and fluid overload.

## In summary

COVID-19 has challenged the organisation of Trusts across the UK. The role of dietitians in the nutritional management of patients admitted to ICU is paramount. The high ICU caseload turnover at the RSUH, coupled with working in a very different way within new teams, has been challenging. The challenges have been overcome through effective communication, dedication and willingness to undertake training to develop new skills. However, it is important to note that the work conducted by dietitians exceeds, simply, seeing patients to arrange suitable feeds and ONS prescriptions, and this has highlighted the unseen organisational work undertaken to prepare and manage the nutritional consequences of COVID-19. The future will focus on learning from these experiences and the data collection project (see details below), initiated by the RSUH ICU dietitians, will be influential in driving this.

Figure 2: ICU Bolus Feeding Chart



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## Data collection

The ICU team have started data collection regarding patient demographics, length of stay, intervention, outcome and anthropometric changes. The BDA have agreed to help with data collection and co-ordination. If you are interested in participating then please contact the authors on: [samuel.lucking@uhnm.nhs.uk](mailto:samuel.lucking@uhnm.nhs.uk) or [phil.johnston@uhnm.nhs.uk](mailto:phil.johnston@uhnm.nhs.uk).