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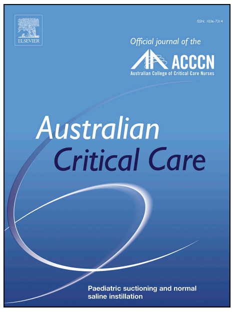

Nutrition care processes across hospitalisation in critically ill patients with COVID-19 in Australia: A multicentre prospective observational study

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Title:

Nutrition care processes across hospitalisation in critically ill patients with COVID-19 in Australia: A multicentre prospective observational study

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Three authors (Ridley, Marshall, Udy) hold leadership positions with Australian Critical Care. EJ Ridley is an Editor, AP Marshall is the Editor-in-Chief, and AU Udy is a member of the Editorial Board. Consistent with ACC policies the authors are excluded from any decision-making processes in relation to this submission. The manuscript was managed from submission through to final decision by Assoc Prof Tom Buckley, Editor.

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Abstract

Background: The COVID-19 pandemic highlighted major challenges with usual nutrition care processes, leading to reports of malnutrition and nutrition-related issues in these patients.

Objectives: To describe nutrition-related service delivery practices across hospitalisation in critically ill patients admitted to Australian intensive care units (ICU) with COVID-19 in the initial pandemic phase.

Methods: Multi-centre (nine site) observational study in Australia, linked with a national registry of critically ill patients with COVID-19. Adult patients with COVID-19 who were discharged to an acute ward following ICU admission were included over a 12-month period. Data are presented as n (%), median (interquartile range [IQR]), Odds Ratio (95% Confidence Interval (CI).

Results: A total of 103 patients were included. Oral nutrition was the most common mode of nutrition (93 (93%)). In the ICU there were 53 (52%) patients seen by a dietitian (median 4 [2-8] occasions) and malnutrition screening occurred in 51 (50%) patients most commonly with the Malnutrition Screening Tool (MST), (50 (98%)). The odds of receiving a higher MST score increased by 36% for every screening in ICU (1^{st} to 4^{th}, OR 1.39 (95% CI: 1.05-1.77) P=0.018) (indicating increasing risk of malnutrition). On the ward, 51 (50.5%) patients were seen by a dietitian (median time to consult 44 [22.5-75] hours post ICU discharge). The odds of dietetic consult increased by 39% every week while on the ward (OR 1.39 (1.03-1.89), p=0.034). Patients who received mechanical ventilation (MV) were more likely to receive dietetic input than those who never received MV.

Conclusions: During the initial phases of the COVID-19 pandemic in Australia, approximately half of the patients included were seen by a dietitian. Increased number of malnutrition screens were associated with a higher risk score in ICU and likelihood of dietetic consult increased if patients received MV and as length of ward stay increased.

Key words:

COVID-19, critical illness, intensive care, nutrition, malnutrition

Introduction:

The potential impact of the 2019 Coronavirus Disease (COVID-19) pandemic on the critical care medical and nursing workforce, and availability of critical care equipment in Australia and New Zealand were quickly and extensively quantified. [1] However, data providing insight into the same projections for Allied Health is lacking.[1,2] Projection of nutrition care work process is important due to the potential for significant disruption to these processes during the COVID-19 pandemic. Initial concerns related to staff safety and pressure on the hospital system required urgent and rapid identification of necessary resources.[1,3] As the pandemic has progressed, concerns have changed to the management of high rates of staff sickness, burnout, and continued pressure on the hospital system as usual operating processes return.[4,5]

Nutrition is a universal aspect of care provided for hospitalised patients, including the critically ill. As with many aspects of healthcare, standard care nutrition processes were scrutinised for potential transmission risk to patients and staff, including food service delivery, a reduction in face-to-face contact with patients and measurement of gastric residual volumes (GRVs) due to possible risk of virus within gastric aspirate. [6] There were also concerns about symptoms at presentation with COVID-19 that might impact ability to provide nutrition including diarrhoea and vomiting.[6] Remote nutrition consultations were increased, major challenges were uncovered in food service delivery and major stock shortages of many medical nutrition products and equipment required for nutrition provision were experienced.[6] Globally, these issues have led to increased reports of malnutrition and nutrition-related issues in hospitalised and critically ill patients with COVID-19.[7,8]

While there have been efforts to provide guidance around clinical staffing and workforce management during the pandemic, the provision of nutrition care has not been quantified in Australia.[3,9] The aim of this paper was to describe nutrition-related service delivery processes across hospitalisation in critically ill patients admitted to Australian ICUs with COVID-19 in the initial phases of the pandemic.

Methods:

This multi-centre observational study was conducted at nine sites in Australia and linked data from an existing observational study investigating clinical care of patients with COVID-19 (Short Period Incidence Study of Severe Acute Respiratory Infection (SPRINT-SARI) (https://www.anzics.com.au/current-active-endorsed-research/sprint-sari/). Patients were included if they were an adult (≥18years) with a confirmed COVID-19 diagnosis (PCR positive), admitted to the intensive care unit (ICU) for >24h, and discharged to an acute ward (with the exception of palliative care) over a 12-month recruitment period from 1 March 2020 until 1 March 2021. Ethics approval was obtained from The Alfred Health Human Research Ethics Committee under the National Mutual Acceptance scheme for single ethical review for multi-centre studies (Approval number 63512) and individual site governance was obtained. The study was deemed low risk and consent was not required. During the data collection period, 525 patients with COVID-19 were discharged alive from ICU in Australia from all participating sites (SPRINT-SARI Australia). From the nine SPRINT-SARI sites who also collected data for this study, there were 134 patients discharged alive (representing 77% data capture). Participating sites are listed in supplementary files.

The *apriori* defined objectives of this study were:

1. Report nutrition service elements within ICU dietetic consultations, route of nutrition and malnutrition screening processes
2. Report on nutrition practices in the prone position including management of gastric intolerance (due to the early reports of gastric tolerance issues with COVID-19)
3. Report on nutrition service elements on the ward following ICU discharge such as dietitian consultations, malnutrition screening and discharge processes.

Due to the number of patients who never received mechanical ventilation (MV) in our population, the investigators decided post-hoc to compare nutrition service process between patients who never received MV and those who did.

Data collection:

Data obtained from the SPRINT-SARI database are listed in the supplementary files. For each patient, additional data were collected at each site at the following timepoints: once in ICU; weekly on the ward; and once at ICU and hospital discharge. Data variables collected in ICU included the use of prone positioning, associated nutrition management strategies for enteral nutrition (EN) intolerance and details around gastric residual volume (GRV) limits for patients without COVID-19 and for those with COVID-19 to allow for comparison of any differences. Variables collected both in ICU and on the ward included: frequency of dietetic review; malnutrition screening and assessment; modes of nutrition used; and interventions at hospital discharge as documented in the patient record. Sites were not provided with any guidance regarding their practice, with data collected representing clinical practice within the available resources at the time.

Statistical analyses:

Continuous data are summarised using mean ± standard deviation (SD) or median [Interquartile range (IQR)] according to data type and distribution. Categorical data are presented as counts (n) and percentages (%). The odds of dietetic consult over time was determined using logistic regression, whereas the odds of receiving a higher MST score over screening occurrence was assessed by ordinal logistic regression, with results reported as odds ratios (OR) and 95% confidence intervals (95% CI). Changes in upper GRV between COVID-19 positive and non-COVID-19 positive patients were assessed using paired t-test. Comparisons in some variables were made between those who had received MV at any time to day 14 to those who never received any MV in ICU for dietetic input, malnutrition screening and nutrition handover and discharge process. A two-sided p value <0.05 indicated statistical significance. All analyses were performed with SAS software version 9.4 (SAS Institute, Cary, NC, USA).

Results:

A total of 103 patients were included (73 (71%) male) with a mean age of 58±14 years and mean BMI of 30±7 kg/m^2 (Table 1). Oral nutrition (n=93; 93%) was the primary mode of nutrition in ICU, 43 (42%) patients received EN via a nasogastric tube either alone or combined with oral intake, and 2 (2%) received parenteral nutrition (PN) during the ICU admission.

Nutrition service within the ICU

In ICU, 53 (52%) patients were seen by a dietitian on a median of 4 [2-8] occasions. There were 23 (22.5%) patients placed in the prone position during ICU stay. Of these, 15 (65%) were fed enterally, and 7 (47%) experienced raised GRVs. The mean GRV limit used in patients with COVID-19 was 316 (93) ml, with a mean difference of 65 (95% CI 29-102) ml between the usual limit for those without COVID-19 and the limit used for those with COVID-19, *p*=0.002 (Figure 1). Table 2 details nutrition management strategies during the prone position. On the day of ICU discharge, oral nutrition was the primary route of delivery for 83 (81%) patients and EN was the primary route for 19 (19%). Documentation of nutrition progress in nursing and/or medical handover at ICU discharge occurred most frequently in the nursing handover (35 (34%)), compared to combined medical and nursing handover (19 (19%)) or medical handover (13 (13%)), and was not mentioned for 35 (34%) patients.

Nutrition service on the post-ICU ward

On the post-ICU ward, 51 (50.5%) patients were seen by a dietitian (median time to consult 44 [22.5-75] hours post ICU discharge). The odds of dietetic consult increased by 39% for every week on the ward (OR 1.39 [1.03-1.89, *p*=0.034] (Table 2). At hospital discharge 29 (28%) patients received dietetic input with the most frequent intervention being 'dietary education' (18 (62%)), followed by community dietitian referral (12 (41%)) and discharge supply of oral nutrition support (11 (38%)).

Malnutrition screening and assessment in ICU and post-ICU

In ICU, malnutrition screening occurred in 51 (50%) patients with the Malnutrition Screening Tool (MST) being the most common tool (50 (98%)) (median score 1 [0-2], indicating a low risk of malnutrition). However, the odds of receiving a higher MST score, indicating higher risk, increased by 36% for every screening in ICU (1st to 4th ; OR 1.39 (95% CI: 1.05-1.77) *p*=0.018). On the ward, malnutrition screening occurred for 51 (50%) patients, using the MST (45 (88%)) and Malnutrition Universal Screening Tool (MUST) (6 (12%)). Odds of receiving a higher MST score did not increase over screening occurrence on the ward (OR 1.04 (95% CI: 0.72-1.49) *p*=0.85).

In ICU, the assessment of malnutrition was conducted in 23 (22.5%) patients using the Subjective Global Assessment (SGA) on all occasions with 1 (4%) patient noted as 'mildly malnourished (B)' and 22 (96%) noted as well-nourished on the 1st SGA screen. On the ward, malnutrition assessment occurred in 14 (14%) patients. Five patients (36%) were noted to be 'mildly malnourished' and 2 (14%) 'severely malnourished' and all remaining patients well nourished. Table 3 displays results and occasions of malnutrition screening and assessment in ICU and on the ward.

Comparison between patients MV to those not

In ICU, patients who were MV received more dietetic input compared to those who were never ventilated. This included completion of a malnutrition assessment tool (17 (39.5%) vs 6 (10%), p<0.0001), being reviewed by a dietitian (40 (93%) vs 13 (22%), p<0.0001) and dietetic occasions of service per patient (5 [2.5-8.5] vs 2 [1-4]), p<0.0001). Patients who were MV in ICU were more likely to have a handover to the dietitian on the ward (36 (84%) vs 13 (22%), p<0.0001) and also saw a dietitian more often (39 (91%) vs (14 (24%), p<0.0001). Over the study period, 38 (88%) patients who were MV in ICU saw a dietitian compared to 13 (22%) who were not, p<0.0001, median occasions of service 3 [2-6 vs 2 [1-2], p=0.003. Table 4 shows additional data in relation to nutrition practice.

Discussion

This is the only paper to describe nutrition care process across hospitalisation for survivors of COVID-19 admitted to the ICU in Australia and one of few published internationally to provide specific data on the post-ICU period. In ICU, half of patients were seen by a dietitian and half were screened for malnutrition in ICU, with the risk of malnutrition increasing by the number of screens. Those who received MV at any timepoint were more likely to receive dietetic input than those who never received MV and a quarter of patients were placed in the prone position; the GRV limit was lower in patients with COVID compared to those without and EN delivery issues were frequent. On the ward, patients were more likely to be seen by a dietitian as weeks progressed and half of the patients were screened for malnutrition but risk did not increase as screens increased. More patients were noted to be malnourished on the ward compared to ICU despite the fact that fewer ward patients underwent a nutritional assessment.

In ICU, we observed that oral nutrition was the route of nutrition most often provided, and those who were never MV (the majority of whom ate orally) received less dietetic input across ICU and the ward than those who did receive MV. Compared to a large UK dataset of 252 patients (including 58 on VV ECMO), EN was used as the mode of nutrition in our population less frequently.[10] On the ward and after ICU discharge, lower rates of dietitian assessment were observed in the post ICU period when compared to two recent UK datasets;[10,11] however, we did observe that assessment frequency increased in our study with a longer length of stay. Approximately 50% of patients in our study were screened for malnutrition in ICU and on the ward; this is similar to pre-pandemic screening rates in a study including 68 hospitals from 2008 where approximately 50% of patients were also screened for malnutrition.[12] Higher rates of dietetic referral at hospital discharge were also observed in both UK studies compared to our findings.[10,11] These differences may reflect a more acutely ill population, a difference in available services and staff during the pandemic according to location and changes in the model of care such as increased remote working. It may also represent historical practice in dietetic delivery where patients who eat orally within ICU and in the post-ICU period are not seen as a priority. Previous work in patients with traumatic brain injury has indicated that dietitians spend just 20% of their time managing patients that eat orally in the post-ICU period.[13] There is a growing body of evidence indicating that critically ill patients who receive only oral diets have lower energy and protein intakes compared to those who receive artificial nutrition therapy; it may be that more dietetic input is required in this population (not less) and this should be a focus for future research.[14-20]

There exists one Australian-based guideline to inform nutrition care for critically ill patients with COVID-19 which was rapidly developed early in the pandemic. Some aspects of care for which data were available in our study are in line with the recommendations within this guideline, whereas others were not aligned with recommendations.[6] This guideline recommends that malnutrition screening is maintained in patients who are considered at high nutrition risk and that nutrition assessment occurs within 48 hours of ICU discharge in those that are deemed at nutrition risk. In our dataset, malnutrition screening occurred in just 50% of the patients, while dietetic assessment occurred within this timeframe, at a median 44 [22.5-75] hours after ICU discharge. Internationally, six different guidelines for COVID-19 recommend malnutrition screening in patients with COVID-19.[13] Compared to other data, lower rates of malnutrition were observed in our population;[21] it is unclear if screening in our population did not occur due to inadequate staffing, a perception that it was not required, or other issues related to workforce (e.g. remote working). Due to the low rates of screening, it is possible that more patients were malnourished (pre-existing or developed in hospital) but this was not captured.

Future work should focus on preparation for further pandemics, including obtaining reliable and detailed data about the allied health workforce.[1-3] This should include a more detailed understanding of successful models of care, determination of ratios for Allied Health staff in critical care, and planning for equipment to ensure the sickest patients can continue to receive quality nutrition care in a pandemic situation.[1-3] Communication and the appropriate way to communicate with the multidisciplinary team regarding nutrition management during a pandemic should be determined; failure to communicate and adequately handover at key transition periods such as ICU to ward transfer has been shown in general critical care populations to be a barrier to optimal nutrition care.[15] Based on our observations, we recommend that critically ill patients with COVID-19 continue to be screened and assessed for malnutrition, with a focus on those who have a prolonged length of ICU stay who are likely to be at the greatest risk for the development of malnutrition. This is in keeping with current Australian-based guidelines for nutrition care of critically ill patients with COVID-19.[6]

Limitations to our work include that the data were collected in the initial phases of the pandemic in Australia, across a number of COVID-19 waves; patient numbers in subsequent waves have been larger, placing an increased burden on the healthcare system and the emergence of new COVID-19 variants mean clinical course and treatment may have changed.[22] The project was developed and conducted very rapidly due to the critical nature of the early pandemic; this means that some data, although important, could not be captured, such as quantification of nutritional intake and some variables may have been subjectively determined (although a data dictionary was provided). Moreover, we did not capture 100% of the patients eligible at participating sites and we are not able to determine why this may have occurred. It is possible that workload changes due to the pandemic and reduced staffing meant that some patients were missed and that aspects of care that normally happen could not happen and we were unable to capture this (eg, under reporting of malnutrition risk due to lack of screening). Interpretation of our data should occur with the knowledge that our study included only patients who survived their ICU admission and the observational nature of the data may lead to bias or confounders that can not be controlled for. Strengths of our work include the multi-centre design across a number of geographical regions in Australia, linkage with an existing dataset to reduce data burden on site clinicians and that it is the only Australian data available. These experiences may assist in developing service provision models for future pandemics.

Conclusion

During the initial phases of the COVID-19 pandemic in Australia, approximately half of ICU survivors were seen by a dietitian during their hospital admission. Increased number of malnutrition screens were associated with a higher risk score in ICU only, and the likelihood of dietetic consult increased with longer duration in hospital. Future work should focus on developing optimal models of nutrition care to inform future waves of COVID-19 and other emerging infectious diseases pandemics with a focus on those who receive an oral diet.

Table 1: Baseline characteristics and clinical outcomes

	n	**Mean ± SD unless otherwise indicated**
Age*, years	103	58 ± 14
Sex* (F), n (%)	103	30 (29%)
Weight* (kg)	100	87 ± 22
Height* (cm)	99	170 ± 11
BMI* (kg/m^2)	99	30 ± 7
Respiratory support received at any timepoint to D14*, n (%)	103	
Mechanical ventilation		43 (42%)
High-flow nasal cannula oxygen therapy		54 (52%)
Non-invasive ventilation		4 (4%)
Nil respiratory support		37 (36%)
ICU length of stay* (days), median [IQR]	102	6 [3-17]
Hospital length of stay* (days), median [IQR]	101	16 [10-31]

*Data obtained from SPRINT-SARI

BMI: Body mass index, D: Day, ICU: Intensive care unit, IQR: Interquartile range, SD: Standard deviation

Table 2: Nutrition management and processes

	n	**n/N (%)**
Prone position in ICU		
Placed prone	102	23 (22.5%)
Enterally fed	23	15 (65%)
Raised GRV	15	7 (47%)
Nutrition management changes during prone position in ICU*	15	8 (53%)
Reduced EN rate		4 (27%)
Prokinetics		4 (27%)
Lower GRV threshold		2 (13%)
Total PN		1 (7%)
Supplemental PN		1 (7%)
Dietitian consults by week		
Week 1, n (%)	102	49 (49%)
Occasions of service, median [IQR]		2 [1-3]
Week 2, n (%)		19 (44%)
Occasions of service, median [IQR]		2 [1-3]
Week 3, n (%)		14 (58%)
Occasions of service, median [IQR]		1 [1-2]
Week 4, n (%)		9 (90%)
Occasions of service, median [IQR]		2 [1-3]

EN: Enteral nutrition, GRV: Gastric residual volume, ICU: Intensive care unit, IQR: Interquartile range, PN: Parenteral nutrition, SD: Standard deviation

** Multiple options could be selected*

Table 3: Malnutrition screening and assessment

	n	Report
Malnutrition screening in ICU		
Patients screened for malnutrition, n (%)	102	51 (50%)
MST		
Patients screened	51	50 (98%)
Number of screens per patient, median [IQR]		4 [3-4]
Result, 1st screen	50	0 [0-2]
Result, 2nd screen	46	1.5 [0-2]
Result, 3rd screen	40	2 [0-2.5]
Result, 4th screen	31	2 [0-3]
MUST		
Patients screened	1	1 (2%)
Number of screens per patient, median [IQR]	1	1 [1-1]
Result, 1st screen	1	1 [1-1]
Malnutrition assessment in ICU		
Patients assessed for malnutrition, n (%)	102	23 (22.5%)
SGA	23	23 (100%)
Result, 1st assessment	23	
A- Well nourished		22 (96%)
B- Mildly/moderately malnourished		1 (4%)
Result, 2nd assessment	3	
A- Well nourished		1 (33%)
B- Mildly/moderately malnourished		2 (66%)
Result, 3rdSGA assessment	2	
B Mildly/moderately malnourished		2 (100%)
Malnutrition screening on the ward		

Patients screened for malnutrition, n (%)	102	51 (50%)
MST		
Patients screened	51	45 (88%)
Number of screens per patient, median [IQR]		2 [1-3.5]
Result, 1st screen	44	0.5 [0-2]
Result, 2nd screen	25	1 [0-2]
Result, 3rd screen	14	0 [0-2]
Result, 4th screen	11	1 [0-2]
MUST		
Patients screened	51	6 (12%)
Number of screens per patient, median [IQR]		1 [1-1]
Result, 1st screen	6	1 [0-3]
Result, 2nd screen	1	2 [2-2]
Malnutrition assessment in on the ward		
Patients assessed for malnutrition, n (%)	102	14 (14%)
PG-SGA	2	
Result, 1st assessment		
B-Mildly/moderately malnourished		2 (100%)
SGA	12	
Result, 1st assessment		
A- Well nourished		7 (58%)
B- Mildly/moderately malnourished		3 (25%)
C- Severely malnourished		2 (17%)

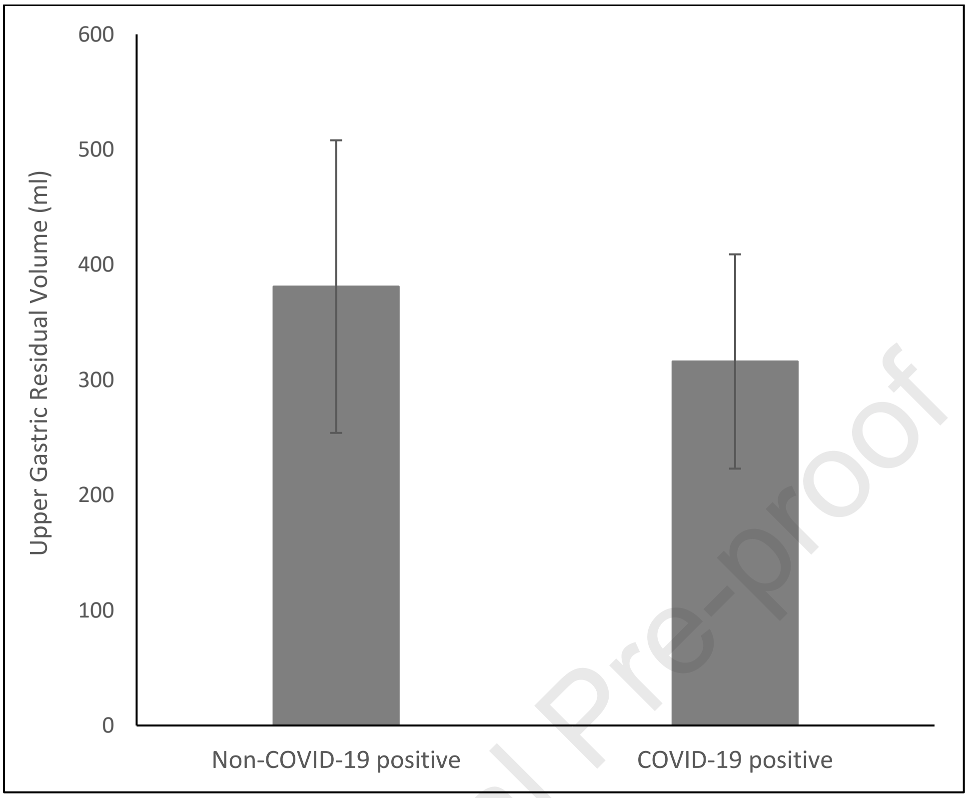
IQR: Interquartile range; MST: Malnutrition screening tool; MUST: Malnutrition universal screening tool; SGA: Subjective Global Assessment; PG-SGA: Patient Generated Subjective Global Assessment

Table 4: Comparison of nutrition practice between patients who were mechanically ventilated at any time point before day 14 in ICU to those who were never ventilated

	Never mechanically ventilated		Mechanically ventilated		p-value
	n		n		
Prone position					
Placed in prone position	59	5 (8.5)	43	18 (42)	<0.0001
Enterally fed in prone	5	0 (0)	18	15 (83)	<0.0001
Nutrition in the ICU handover	59		43		
Not present		13 (22)		51 (22)	<0.0001
Medical handover		5 (8.5)		8 (19)	0.13
Nursing handover		31 (52.5)		4 (9)	<0.0001
Medical and nursing handover		10 (17)		9 (21)	0.61
Dietitian consults by week					
Week 1	58	12 (21)	42	37 (88)	<0.0001
Occasions of service, median [IQR]	12	2 [1-2]	37	2 [2-4]	0.038
Week 2	19	2 (10.5)	24	17 (71)	<0.0001
Occasions of service, median [IQR]	2	2 [1-3]	17	2 [1-3]	0.94
Week 3	5	0 (0)	19	14 (73.7)	0.006
Occasions of service, median [IQR]	0	0	14	1 [1-2]	1.00
Week 4	0	0	10	9 (90)	1.00
Occasions of service, median [IQR]	0	0	9	2 [1-3]	1.00
Nutrition intervention at hospital discharge	59	6 (10%)	43	23 (53.5)	<0.0001

IQR: Interquartile range

Figure 1: Mean upper gastric residual volume limit (ml) used in ICU for non-COVID-19 positive and COVID-19 positive patients. Error bars represent standard errors



Difference in mean upper gastric residual volume = 65 ml

95% confidence interval: 29 ml to 102 ml

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