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Meta-analysis

Strategies to ensure continuity of nutritional care in patients with COVID-19 infection on discharge from hospital: A rapid review

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SUMMARY

Background & aims: The risk of malnutrition in people with COVID-19 is high; prevalence is reported as 37% in general medical inpatients, 53% in elderly inpatients and 67% in ICU. Thus, nutrition is a crucial element of assessment and treatment. This rapid review aimed to evaluate what evidence is available to inform evidence-based decision making on the nutritional care of patients hospitalised with COVID-19 infection.

Methods: Cochrane Rapid Reviews guidance was followed; the protocol was registered (CRD42020208448). Studies were selected that included patients with COVID-19, pneumonia, respiratory distress syndrome and acute respiratory failure, in hospital or the community, and which examined nutritional support. All types of studies were eligible for inclusion except non-systematic reviews, commentaries, editorials and single case studies. Six electronic databases were searched: MEDLINE, Embase, Cochrane Central Register of Controlled Trials, PubMed, CINAHL and MedRxiv.

Results: Twenty-six articles on COVID-19 were retrieved, including 11 observational studies, five guidelines and 10 opinion articles. Seven further articles on pneumonia included three RCTs, one unblinded trial, three observational studies, and one systematic review on rehabilitation post-ICU admission for respiratory illness. The evidence from these articles is presented narratively and used to guide the nutritional and dietetic care process.

Conclusions: Older patients with COVID-19 infection are at risk of malnutrition and addressing this may be important in recovery. The use of nutritional management strategies applicable to other acute conditions are recommended. However, traditional screening and implementation techniques need to be modified to ensure infection control measures can be maintained. The most effective nutritional interventions require further research and more detailed guidance on nutritional management post-discharge to support long-term recovery is needed.

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1. Introduction

COVID-19 infection continues to spread across the world with 239 million reported cases and almost 5 million deaths globally since the start of the pandemic (15/10/2021) [1]. In the UK, it has affected over 8 million people and resulted in 138,584 deaths so far (15/10/2021) [2].

COVID-19 affects certain groups disproportionately with higher risk of complications and death in people of black and

ethnic minority background, the elderly, overweight and obese, and those with underlying health conditions [3,4]. Oral intake is significantly impacted secondary to anorexia, gastrointestinal disturbances, dyspnoea and anosmia and in the most severe cases respiratory failure [5]. This combined with the heightened inflammatory response leads to rapid muscle wasting and a high risk of malnutrition [6]. Prolonged Intensive Care Unit (ICU) stay, post-extubation dysphagia, anorexia and weakness contribute towards a cycle of impaired nutrition and prolonged recovery [7].

The prevalence of malnutrition (as undernutrition) in people infected with COVID-19 is reported to be 37% in general medical inpatients [8], 52.7% in older inpatients [9] and 66.7% in patients admitted from ICU [10]. The average length of hospital stay varies from less than a week to nearly two months and stay in ICU from one to three weeks [11]. Length of hospital stay for malnourished patients with COVID-19 has been shown to be significantly higher (almost double) than that of non-malnourished patients [12]. This supports recommendations that nutrition support should be initiated as soon as possible for hospitalised patients [13].

Nutrition support, including oral nutritional supplements (ONS), enteral and parenteral nutrition, plays an important role in meeting nutritional requirements and aiding recovery [14]. Nutritional inadequacy during hospitalisation exacerbates the risk of malnutrition, increasing the likelihood that any deficiency may persist beyond discharge with potentially long-term effects on functionality and health [14]. Continuity of nutritional care has a vital role in ameliorating these effects.

Benefits of nutritional support and follow-up post discharge have been reported in other conditions, including the use of individualised nutrition plans, nutritional supplementation and optimisation of protein intake in patients [15–17]. A recent review of nutrition support guidelines [18] identified multiple themes essential to rehabilitation pathways for COVID-19 recovery including screening for malnutrition, care plans for nutrition support and continuity of nutritional care between settings. However, there is no clear evidence for post-discharge nutritional support in patients hospitalised with COVID-19 infection.

This rapid review aims to examine the evidence on nutritional management of patients infected with COVID-19 in hospital and on discharge to the community. The review question is: in patients hospitalised with COVID-19 infection, what is the best way of ensuring continuity of nutritional care post hospital discharge to minimise the nutritional consequences of infection and optimise recovery?

2. Methods

This review was conducted in accordance with the Cochrane Rapid Reviews guidance [19], and the protocol was registered on PROSPERO (registration number CRD42020208448).

2.1. Inclusion criteria

Studies were selected using defined eligibility criteria (Table 1). Due to limited research available on nutritional care in COVID-19 infection, the search criteria were widened to include pneumonia, respiratory distress syndrome and acute respiratory failure as potential complications of COVID-19 infection. To fully explore the focus of research, all types of studies were eligible for inclusion except non-systematic reviews, commentaries, editorials and single case studies.

Table 1
Eligibility criteria based on PICOS.

PICOS	Inclusion Criteria
Population	Patients admitted to hospital with symptoms of COVID-19 infection, pneumonia, acute respiratory distress disorder, respiratory failure (ICU or acute) and then step-down or discharged OR Patients discharged from hospital with a confirmed diagnosis of COVID-19 infection, pneumonia, acute respiratory distress disorder or respiratory failure OR Patients in the community with a confirmed diagnosis of Covid-19 infection, pneumonia, acute respiratory distress disorder or respiratory failure Adults (18 years or more).
Intervention	Nutritional support to optimise dietary intake e.g. via artificial nutritional support (tube feeding or parenteral nutrition), oral nutritional supplements, dietary counselling, (nutritional), nutritional rehabilitation (not micronutrient or fatty acid or amino acid supplementation)
Control or Comparison Outcomes	Usual care Mortality, length of hospital stay, readmissions, quality of life, activities of daily living, nutritional status, weight change, handgrip strength, dietary intake, return to baseline functional status, reversal of COVID-19 associated symptoms e.g. poor appetite, loss of senses of smell or taste.
Type of Study	RCTs, cohort studies, cross sectional studies, systematic reviews, guidelines and pathways, audits and service evaluations, protocols

2.2. Search strategy and study selection

Six electronic databases were searched: MEDLINE (Ovid), Embase (Ovid), Cochrane Central Register of Controlled Trials, PubMed, CINAHL and MedRxiv preprint database. A search strategy was developed to combine key concepts (Table 1) (example in supplementary information). Search terms were combined with suggested MeSH terms wherever possible. Only articles published in English between 1st November 2019 and 20th March 2021 and including adults ≥ 18 years were accepted. The search strategy for Medline was reviewed by an information specialist (LB) using the Peer Review of Electronic Search Strategies (PRESS) checklist [20]; suggested revisions were applied.

All identified studies were transferred into Endnote X8 (Clarivate, PA, USA), duplicates were removed and then data were transferred to Rayyan (QCRI, Doha, Qatar) [21] for screening. One author (JL) used the inclusion criteria to screen titles and abstracts. The decisions were checked by a second author (CEW or MH) who screened 20% of the included, and 100% of the excluded abstracts, resolving disagreements via discussion. Full text of each included article was re-assessed independently (JL and CEW), and a third author (MH) adjudicated on disagreements. Articles from critical care settings were included if nutritional care continued beyond ICU. Articles were excluded if they did not include outcomes of interest or where the focus was micronutrient supplementation, specific amino acids or fatty acids. Authors of articles with non-English full text were contacted for a translated version. Authors of protocols were contacted for preliminary data if available.

Further studies were identified by JL through hand-searching the reference lists of included studies, and the British Dietetic Association (BDA) and British Association for Parenteral and Enteral Nutrition (BAPEN) websites were checked for any potentially relevant articles. Identified articles were included following discussion with two other authors (CEW and MH).

2.3. Risk of bias and quality of evidence

Risk of bias was assessed independently by JL and judgements were verified by a second author (CEW or MH). The Cochrane Collaboration’s Risk of Bias tool [22] was used for randomised controlled trials (RCT), Joanna Briggs Institute (JBI) critical appraisal tools [23] for cohort and cross-sectional studies and the Appraisal of Guidelines for Research & Evaluation tool (AGREE II) [24] was used for clinical guidelines. The JBI Checklist for Text and Opinion [25] was used to make decisions regarding inclusion or exclusion of the remaining articles but was not used for quality appraisal.

RCTs, observational, cohort and cross-sectional studies, were quality rated according to the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) criteria [26]. RCTs were initially deemed high quality and downgraded or double downgraded for high risk of bias or indirectness of evidence; observational studies were initially deemed low quality and downgraded for high risk of bias.

Three reviewers (JL, MH and AJ) assessed the guidelines independently against the AGREE II tool organized into six domains (Scope and Purpose, Stakeholder involvement, Rigour of Development, Clarity of Presentation, Applicability, and Editorial Independence). Based on review authors’ consensus it was agreed that guidelines scoring >60% for all six domains were considered high quality, those scoring >60% for three to five domains were moderate quality, >60% in only two domains were low quality and only one domain were very low quality.

2.4. Data extraction, data synthesis and statistical analysis

Data on population, intervention, duration and follow-up, comparator, outcomes and results were extracted wherever possible and displayed in a table (Table 2). A second author (CEW) checked the data for accuracy and completeness. All data were synthesised narratively by one author (JL) and checked by two others (CEW and MH). Data were grouped and reported according to the six steps of the Nutritional and Dietetic Care Process [27] (assessment, diagnosis, treatment strategy, implementation, monitoring and review, and evaluation).

3. Results

3.1. Study selection

Figure 1 shows the PRISMA diagram of the selection and screening process. In total, 34 articles were included in this review

with 26 focussing on the nutritional care of patients with COVID-19 infection, seven on pneumonia and one on rehabilitation post-ICU admission for respiratory illness. No RCTs or intervention studies were identified for nutrition and COVID-19, therefore this review focussed on assessing the guidance on nutritional management of COVID-19 infection and extrapolating indirect evidence from studies on respiratory illness.

Statistical pooling of data was not possible due to the heterogeneous nature of the articles identified. Variations in interventions, subjects and outcomes, as well as risk of bias, prevented meta-analysis. Therefore, the results are described qualitatively.

For this review, guidelines were defined as systematically developed recommendations produced to direct the management of patients [28]. All other papers (excluding systematic reviews, RCTs and observational studies) were referred to as opinion articles.

3.2. Characteristics of included studies

Table 2 provides details on study characteristics, extracted data and quality assessment. The 26 articles on COVID-19 included 6 observational studies [29–34], four abstracts of observational studies [35–38], one cross sectional survey [39], five guidelines [40–44], nine opinion articles [45–53], and one abstract of opinion article [54]. The guidance provided by guidelines and expert-opinion articles is presented in the supplementary information.

The seven articles on pneumonia included three RCTs [55–57], one trial abstract [58] and three observational studies [59–61]. The rapid systematic review [62] presented evidence on rehabilitation in patients post-ICU admission for respiratory illness. The evidence from these papers will be presented together and used to produce guidance on the nutritional and dietetics care process.

3.3. Quality assessment

GRADE quality appraisal was applied to the systematic review, RCTs, and observational studies. The systematic review and the three RCTs were judged to be of low quality mainly due to indirectness of evidence. Of the observational studies, four were judged to be low quality while the remaining six were very low quality (see Table 2 for reasons). There was insufficient information to allow quality assessment of the six abstracts.

The five guidelines were assessed using the AGREE II tool, which requires users to produce an overall assessment and recommendation for use. Table 3 shows the final scaled domain scores for the

Table 2
Agree II quality assessment - standardised scores of each domain for guidelines.

Column1	Barazzoni et al., 2020	Chapple et al., June 2020	Aytür et al., 2020	Chen et al., 2020	Jin et al., 2020
Domains	Scaled domain scores (%)				
1. Scope and purpose	100	98	100	72	87
2. Stakeholder involvement	44	70	69	43	74
3. Rigour of development	30	41	61	25	73
4. Clarity of presentation	83	94	80	48	50
5. Applicability	46	83	50	42	56
6. Editorial independence	78	78	100	75	100
R1: overall quality [1–7]	4	6	4	3	5
R1: recommendation for use	Y + mod	Y + mod	Y + mod	N	Y + mod
R2: overall quality [1–7]	4	5	5	3	6
R2: recommendation for use	Y + mod	Y + mod	Y + mod	N	Y
R3: overall quality [1–7]	4	6	5	3	6
R3: recommendation for use	Y + mod	Y	Y + mod	N	Y
Overall recommendation	Y + mod	Y + mod	Y + mod	N	Y
Overall quality judgement ^a (Very low, Low, Moderate, High)	Moderate	Moderate	Moderate	Low	Moderate

R - reviewer; Y - yes; mod - modifications; N - no;

^a Based on 60% threshold.

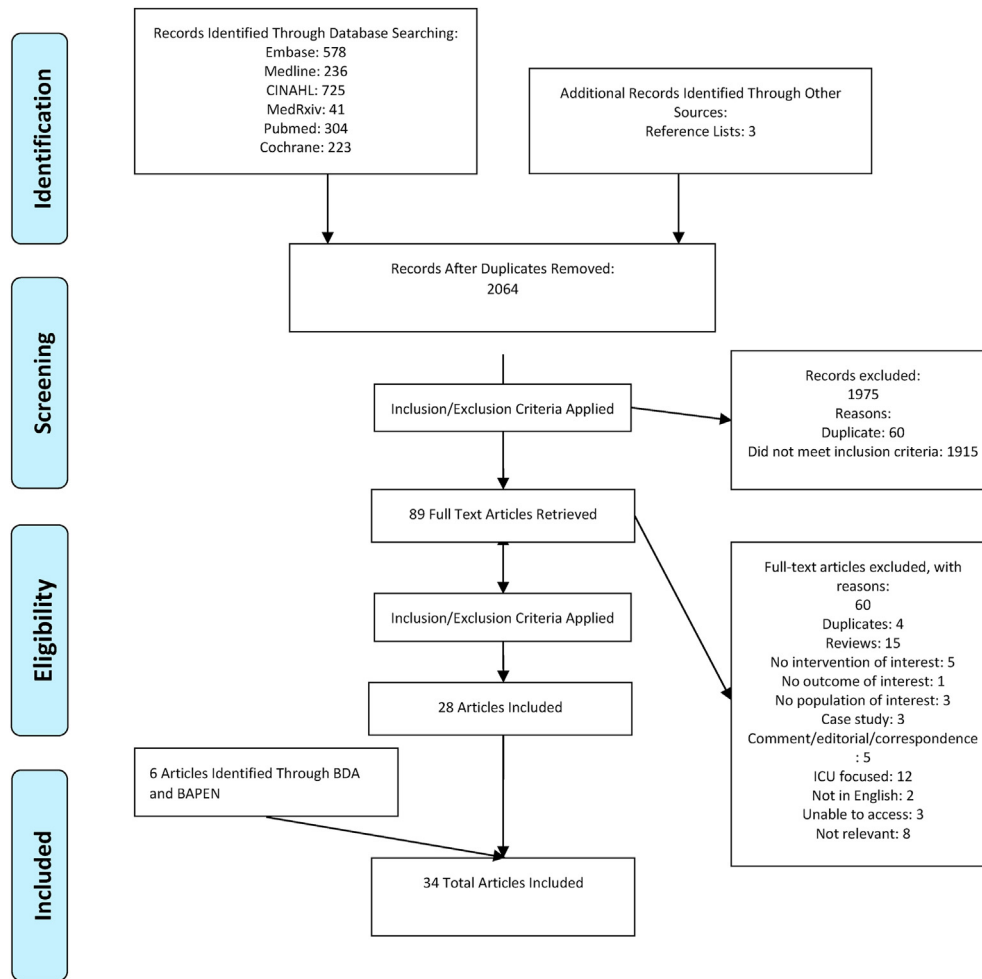


Fig. 1. Prisma flow diagram of search and selection process.

three reviewers (JL, MH and AJ) and details of how each item within the domains scored. The scope and purpose, editorial independence and clarity of presentation scored highly in most guidelines, however stakeholder involvement was limited, partly due to a lack of information provision, but also because many of the wider healthcare team were not consulted. No patients were consulted in any guideline. This latter limitation was recognised by some guideline authors and perhaps understandable given the nature of the pandemic. The lowest scoring domains were rigour of development and applicability. Limits to the rigour of development reflect the urgency with which these guidelines were produced, and the lack of published data on the management of COVID-19. The applicability domain refers to advice on how the recommendations should be applied in practice, and low scores here also reflect the limited experience of COVID-19 and the rapid production of the guidelines. We do not recommend the guideline by Chen et al. (2020) because of shortcomings in most domains, however we do recommend the use of the other guidelines.

3.4. Nutritional and dietetic care process

3.4.1. Assessment

3.4.1.1. *Studies on COVID-19.* Six studies [30–32,34,37,38] including two abstracts [37,38] suggest a significant proportion of patients with COVID-19 are at high risk of malnutrition. A variety of screening and diagnostic tools or criteria were used including NRS-2002 [30,38], MNA [32], Modified NRS-2002 tool [34], GLIM criteria [34,38], and low BMI with or without weight loss [31], as indicators of risk. Risk of malnutrition or undernutrition ranged from 74% to 92% [30–32, 34,38]. Weight loss was variable; 61% patients in one study [32], 24–53% patients with ≥ 5 –10% weight loss in others [32,34]. Prevalence of low BMI ranged from 9 to 15% [32,34] and patients with severe COVID-19 were more prone to have low BMI, higher weight loss and greater nutritional risk [31]. Only one study [30] reported weight loss was seen in ‘only a few patients’ and only 4% had a BMI ≤ 18.5 kg/m², thus other factors were driving malnutrition risk.

Table 3
Nutritional care process strategies from guidelines and opinion articles.

Nutritional care process	Strategies	References
Identification and assessment	Nutrition screening and assessment should be undertaken using validated tools e.g. MUST, NRS-2002, Subjective Global Assessment, Mini Nutritional Assessment for geriatric patients, NUTRIC score for ICU patients, GLIM criteria, MNA-SF, or a local validated tool	[9,10,12,14–16,18–20]
	Estimation of risk by assessing oral intake and potentially impacting symptoms Consider at nutritional risk if BMI <22 kg/m ² and/or weight loss in the last three months and/or reduced food intake Alternative measures (in the absence of measurements of weight and/or height): <ul style="list-style-type: none"> • patient or family reported values of height, previous weight and weight loss • measurement of ulna length and mid arm circumference • subjective criteria e.g. loose clothing, history of decreased food intake, reduced appetite, reported dysphagia or underlying psycho-social or physical disabilities • Patients Association Nutrition Checklist (based on self-report) Discharge: <ul style="list-style-type: none"> • Reassess nutritional risk on discharge and handover to community • Ongoing dietary counselling and individualised nutrition plans in nutritionally high risk, frail, sarcopenic, post ICU or critical care recovery patients • Ongoing assessment of muscle mass 	[17] [21] [15,17–19] [36] [15–18]
Diagnosis	Identify malnutrition: <ul style="list-style-type: none"> • Focus on immunocompromised, older adults, poly-morbid, malnourished individuals, people with underlying long term conditions (diabetes), ICU patients, patients who are unable to eat • Identify dysphagia – particular attention to patients discharged from ICU (post-extubation dysphagia) • Identify refeeding syndrome 	[9,10,14,16,17,19,20]
Treatment strategies	Use protocols, algorithms, existing local policies or pathways to direct nutritional support once nutrition risk status is established. Link with existing pathways e.g. NICE rehabilitation pathway or community malnutrition pathway Ward-based strategies: <ul style="list-style-type: none"> • High energy, high protein, easy to chew menu options • Snack boxes • Snack rounds • Symptom relief • Taste or smell changes - Strong-flavoured foods • Dry mouth - sugar-free fruit sweets ICU stepdown: <ul style="list-style-type: none"> • Maintain enteral nutrition until review by a dietitian • Use supplemental enteral feeding or ONS if required • Offer ONS after rehabilitation • Educate ward staff about optimising nutrition • Enteral feeding regimens structured around physiotherapy sessions ONS criteria: Hospital: <ul style="list-style-type: none"> • Early high protein nutritional supplementation (20 g/day) in all nutritionally high-risk patients • To meet nutritional targets • Poor appetite and inadequate eating • Dysphagia • Dysphagia – texture adapted diets according to advice of SLT Community: <ul style="list-style-type: none"> • Food intake (including food fortification) does not meet nutritional goals and if there is significant unplanned weight loss, and where the UK ACBS criteria are met • Consider self-purchase and use of powdered ONS options (consider patient's ability to manage preparation at home) • Assess level of independence including access to food and availability of help from family or neighbours Energy and protein provision: <ul style="list-style-type: none"> • 400–600 kcal/day, ≥30 g protein/day from ONS • 600–900 kcal/day, 35–55 g/d protein from ONS Give protein in periodic doses Artificial nutrition: Consider EN if oral intake: <ul style="list-style-type: none"> • <half of energy and protein requirements met orally for 3–7 days • <65% for malnourished patients • <50–60% for 3 days • where ONS intake is less than two bottles on two consecutive days • Consider PN if EN not tolerated Nutritional requirements: Energy: <ul style="list-style-type: none"> • 25–30 kcal/kg/day Protein: <ul style="list-style-type: none"> • 1–2 g/kg body weight Adjust according to nutritional status, physical activity level, disease status, comorbidities, and tolerance Caution for refeeding syndrome On discharge:	[10,16,17,19,21] [16,17,19] [37] [16] [16,17] [9,10,12] [21] [17] [11] [20] [9,20] [15] [14,16,19] [15] [9,10] [21] [17] [9,10,20] [10] [20] [21] [9,10,12,17,20,21] [9,10,12,16,20,21] [9,12,20,21] [9,20] [9,10,16] [14]

Table 3 (continued)

Nutritional care process	Strategies	References
	<ul style="list-style-type: none"> • Provide resources e.g. BDA Older Adults Factsheets and Guide to Nutrition and Hydration in Older Age • Continue ONS if intake severely impacted, ongoing breathlessness, fatigue or if using a mask or nebulisers, or medium/high risk of malnutrition • Review by a dietitian to establish need for ongoing ONS and to ensure prescriptions meet the UK ACBS indications • Arrange community dietitian or GP review and communicated in writing • Artificial nutrition if patient has ongoing severe swallowing dysfunction, neurological dysfunction, or gastrointestinal dysfunction 	[9,16,19]
Implementation	MDT working: <ul style="list-style-type: none"> • Team could include clinical psychologists, speech and language therapists, physiotherapists, occupational therapists, and dietitians • Nurses for patients at risk of pressure ulcers • Podiatrists for diabetic foot injuries • Falls prevention • Mental health services 	[9,10,14,15,17,19,20] [9,14,15,17,19,20]
Monitoring and review	Body weight, BMI, food intake, compliance to dietary advice and ONS, blood tests, clinical condition, and functional tests (such as sit to stand), self-reported activity, progress towards agreed goals and ability to undertake activities of daily living. Monitor prescription compared to delivery of EN and PN; avoid under and overfeeding. Prescription of ONS for at least one month (post discharge) and regular monitoring if compliance is in question Frequency: During hospitalisation: <ul style="list-style-type: none"> • weekly for low to moderate nutrition risk • every 2–7 days for high risk Community: <ul style="list-style-type: none"> • 1 week to 3 months intervals No guidance	[15,19,20] [17] [9] [10]< [19]
Evaluation		

NICE: National Institute for Health and Care Excellence; ACBS: Advisory Committee on Borderline Substances; BAPEN: British Association of Parenteral and Enteral Nutrition; BDA: British Dietetic Association; BMI: Body Mass Index; EN: Enteral Nutrition; ICU: Intensive Care Unit; MNA-SF: Mini-Nutritional Assessment-Short Form; MUST: Malnutrition Universal Screening Tool; NRS-2002: Nutrition Risk Score 2002; ONS: Oral Nutritional Supplements; PN: Parenteral Nutrition; GLIM: Global Leadership Initiative on Malnutrition; NUTRIC: Nutrition Risk in Critically ill; MDT: multidisciplinary team; SLT: Speech and language therapy.

Two studies reported patients with COVID-19 have reduced oral intake: consuming <50% nutritional requirements in 39–56% patients [31,34]. The risk of weight loss and sarcopenia post ICU discharge was also reported [37]. One study [30] reported nutritional risk linked to mortality; higher NRS scores had significantly higher mortality and a longer stay in hospital. The importance of the acute disease effect (defined as no, or unlikely to have, adequate nutritional intake for more than five days) in assessing nutritional risk in patients with COVID-19 infection was emphasised [30].

3.4.1.2. Studies on pneumonia. Shirado et al. [60] compared patients with low energy intakes to those with adequate intakes, finding lower energy intake was associated with higher mortality, higher pneumonia recurrence rate during hospitalization, and lower discharge home rate suggesting assessment of energy intake is relevant.

Eekholm et al. [59] reported 6-month consecutive prospective data on 15 patients with community-acquired pneumonia and found discrepancies in clinical practice compared to evidence-based recommendations for nutritional care: only 53% of patients were screened on admission (only 27% within 24-h); nutrition plans were developed for 55% of nutritionally at-risk patients which were ‘incomplete and unsystematic’ and not developed according to evidence-based guidelines; incomplete documentation meant patients’ intake and adherence to recommendations for nutrition support could not be assessed. The nutritional care of patients with COVID-19 may be similarly hampered by the difficulties highlighted.

3.4.1.3. Guideline and opinion articles. All guidelines agreed that screening using a validated tool was an important initial step in the process and a variety of tools were recommended (Table 3).

The practical difficulties in obtaining measurements for a nutrition risk assessment e.g. body weight, were widely acknowledged and alternatives suggested. Limitations of these alternative measures due to access restrictions or infection control policies were acknowledged [45,49].

3.4.1.4. Other articles. Lawrence et al. [39] carried out a survey of nutritional care pathways on COVID-19 in the UK and reported that the majority of the pathways included MUST for screening (Table 2). For assessment, the focus was on COVID-specific symptoms (hunger or skipping meals, poor appetite and taste changes) and physical symptoms (weight loss, energy levels, weakness, shortness of breath and muscle loss) while emotional or psychological symptoms were included in only 32–63% of pathways. The outcomes most frequently monitored routinely were weight and food intake while patient specific goals including Activities of Daily Living (ADLs), physical function and handgrip strength were monitored less frequently. Management of COVID-19 symptoms included mainly advice or resources for eating and drinking with breathlessness, managing a dry mouth and loss of taste and smell or prescription of ONS. A few dietitians reported including advice on purchasing nutritional supplement drinks and managing gastrointestinal issues.

3.4.2. Diagnosis

None of the studies provided guidance directly on diagnosis. However two guidelines [41,42] and five opinion articles [46,48,49,51,52] on COVID-19 described conditions associated with higher nutritional risk, poorer outcomes and higher mortality: immune-compromised individuals, older adults, polymorbid individuals, malnourished people, those with underlying conditions (e.g. diabetes), and patients in ICU. One study [41] noted the potential “double burden” of over- and under-nutrition which

exacerbates severity of infection and recommended that general guidance on the prevention and treatment of malnutrition is fully applicable to COVID-19 infection.

3.4.3. Treatment strategy

This evidence comes from six observational studies (four as abstracts only) [31,34–38], five guidelines [40–44] and eight opinion articles [45–52] on COVID-19, and three RCTs [55–57], one unblinded trial (abstract) [58], two observational studies [30,61] on pneumonia, and one systematic review [62] on severe respiratory illness post-ICU.

3.4.3.1. Systematic review. Evidence for the efficacy of rehabilitation interventions in patients with severe respiratory illness post-ICU was assessed [62]. Only two of the included studies tested nutritional interventions; one tested an individualised expert programme (lectures, counselling, fortified foods, oral nutritional supplements or parenteral or enteral nutrition plus physical rehabilitation), and one simply reported as ‘nutritional care’. The meta-analysis showed significant improvements in ADLs. This could be generalizable to COVID-19.

3.4.3.2. Studies on pneumonia. The combined evidence from two RCTs [55,57] on pneumonia suggests long-term benefits of dietitian led individualised nutrition support during admission and 6 months post discharge in older adults, including significant improvement in daily energy and protein intakes. This intervention combined with patient and caregiver education [55] resulted in further benefits to malnutrition risk through significant improvement in MNA-SF scores, and lower readmission rate in the intervention group.

The combined evidence from one RCT [56] and one retrospective cohort study [61] suggests benefits of enteral nutrition (nasogastric feeding) during hospital admission in older adults including to nutritional status through improved arm muscle circumference, shorter length of stay (LOS) and fewer adverse events. Compared to parenteral nutrition (PN), patients who received nasogastric feeding had lower hospital mortality and complication, and more discharges home [61].

Overall these studies suggest nutrition support combined with rehabilitation may improve performance of ADLs in older adults.

3.4.3.3. Studies on COVID-19. Six observational studies (including three abstracts) [30,31,34–36,38] ($n = 724$) reported data on nutritional support requirements. The number of patients requiring ONS ranged from 6 to 74% [30,34–36,38], and patients at nutritional risk received more frequent ONS than patients without [31]. The number of patients requiring EN ranged from 6 to 15% [30,34,35], PN ranged from 5 to 12% [30,34] and patients requiring both EN and PN 8% [30]. Zhao et al. [30] reported that critically ill (please refer to Table 2 for definition) patients were more likely to receive nutritional support than severely ill (please refer to Table 2 for definition) patients and had higher mortality and longer hospital stays.

The presence of dysphagia was high at 52% [38] and the number of patients requiring texture modified diets ranged from 55 to 89% [35,38], the majority because of post-extubation dysphagia, 45% [37].

3.4.3.4. Guidelines and opinion articles. All recommendations were based on opinion and no data were presented to support these strategies, which are reproduced in Table 3. The recommendations reflected the usual management of malnutrition with consideration

for the additional restrictive working practices needed for infection control. All guidelines and opinion articles on COVID-19 [40–52] provided guidance on dietary interventions and agreed on the optimisation of oral intake as the first line intervention. Six articles offered different strategies for this including the use of dietary counselling and individualised nutrition from an experienced professional [41,42], and standardized health education and training for patients and families [43,46,48,49]. Food fortification was advised by four papers, as a general strategy [41], in the community [47,51] or at home [43].

Recommendations for ward-based strategies are listed in Table 3. In underlying conditions e.g. diabetes, relaxation of previous dietary restrictions may be temporarily necessary in the presence of a poor appetite or unintentional weight loss [51].

Four guidelines [41–44] and seven opinion articles [46–52] provided guidance on oral nutritional supplements although the criteria for their use varied. Nutritional treatment should continue with ONS [41,46,51] in cases where required. Guidance for initiation of ONS in the community was also provided by four papers [46–48,51]. ONS should be stopped when goals have been met and malnutrition risk is resolved [51]. Three guidelines [41,42,44] and three opinion articles [49,50,52] provide guidance on artificial nutrition. The criteria for escalation to EN varied [41,42,50,52] but all articles advised consideration of PN if EN is not tolerated. Two opinion articles [50,52] stated a preference for PN in patients with expected respiratory complications.

Three guidelines [41,42,44] and three opinion articles [46,50,52] provided advice on nutritional requirements, of which five [41,44,46,50,52] advised broadly similar energy targets ranging from 25 to 30 kcal/kg/day with adjustment according to nutritional status, physical activity level, disease status, tolerance and refeeding risk, and one [42] focused on ICU.

Optimisation of protein intake was emphasised by two guidelines [41,44] and six opinion articles [46,47,49–52], with individual adjustment for various groups. The changing nutritional needs during different phases of recovery were acknowledged by only one article [49], suggesting the possible need for up to 35–40 kcal/kg and 1.5–2 g/kg protein for several months post discharge to optimise recovery. These authors cautioned against the provision of extra nutrition in the later stages of recovery to prevent fat rather than muscle gains and advised individualised dietary counselling and increased physical activity.

Three opinion articles [46,47,51] made recommendations on goal setting. The BDA [51] advised patient-centred goals should be discussed and agreed. In hospital appropriate goals include improved intake, weight maintenance, preservation of muscle mass and function [46]. During acute illness goals may be to minimise weight loss, muscle mass and strength [51]. During recovery, goals may be to gain muscle strength, return to a desirable weight, resume hobbies or to improve stamina [51].

3.4.4. Implementation

The only evidence on implementation comes from two guidelines [41,42] and five opinion articles [47–49,51,52]. Collaboration between healthcare professionals, catering and family was recommended by all articles to provide integrated care and minimise face-to-face contact (Table 3).

3.4.5. Monitoring, review and evaluation

The following evidence comes from two observational studies [29,33], three guidelines [40,42,44] and six opinion articles [46–49,51,52] all on COVID-19.

3.4.5.1. Studies on COVID-19. Two studies [29,33] (n = 1976) reported on rehabilitation needs of patients post COVID-19 infection in predominantly older people. Li et al. [29] used a self-designed questionnaire and reported ongoing physical and psychological dysfunction during recovery including sleep disorders (64%), anxiety (62%), decreased activity endurance (61%), respiratory dysfunction (58%) and loss of appetite (55%). Up to 40% patients indicated the need for dietary instructions.

Leite et al. [33] used data from a post-discharge tele-rehabilitation programme following COVID-19 infection to identify self-reported disability and rehabilitation needs of mainly ICU patients. Patients in ICU presented longer hospital stay, lower independence for activities of daily living, greater prevalence of weight loss with lack of appetite, more oxygen therapy, more shortness of breath during routine and non-routine activities and greater difficulty standing up for 10 min.

Together these data indicate patients hospitalized due to COVID-19 present high levels of physical and psychological disability which is exacerbated in those admitted to the ICU.

3.4.5.2. Guideline and opinion articles. Three opinion articles [47,51,52] suggested monitoring of anthropometric, nutritional, clinical and functional measures (Table 3).

One guideline [42] recommended frequency of monitoring during hospitalisation based on the degree of nutritional risk and another [51] advised regular monitoring built into clinical reviews by community healthcare professionals following hospital discharge.

Two guidelines [40,44] and three opinion articles [46,48,49] recommended remote working and virtual monitoring of patients during hospitalisation and as part of rehabilitation teams post discharge [44]. The BDA advised further discussion to support individuals unable to access or interact with technology or telephone consultation [48].

4. Discussion

This rapid review aimed to answer the following question: in patients hospitalised with COVID-19 infection, what is the best way of ensuring continuity of nutritional care post-hospital discharge to minimise the nutritional consequences of infection and optimise recovery? We did not identify any RCTs or intervention studies relating to COVID-19, but eleven observational studies provided new information. The remaining papers were guidelines and opinion articles produced rapidly at the start of the pandemic (around February–June 2020). We also found four intervention studies, three observational studies and a systematic review examining nutrition and pneumonia or respiratory illness recovery, which provided useful data to support nutritional interventions for COVID-19.

The observational studies involving patients with COVID-19 infection were of low quality and were predominantly hospital based. Two examined patient-reported nutritional needs post COVID-19 infection [29,33], and the others evaluated the nutritional characteristics of patients with COVID-19 infection and the relationship between these factors and clinical outcomes [30–32,34–38]. They reported wide-ranging symptoms, a need for dietary information, high prevalence of risk of malnutrition, substantial use of artificial feeding and nutritional support, and higher mortality and longer hospital stay in those at higher risk of malnutrition. This reinforces what we already know about the influence of malnutrition on clinical outcomes; it is well established that those at higher nutritional risk have longer hospital stays leading to higher healthcare costs and higher mortality [63]. These data show that older patients with COVID-19 infection are

potentially a high-risk population for malnutrition, particularly those with ICU admission, with a requirement for dietetic input and nutrition support.

The data on pneumonia included three RCTs [55–57] (low quality), the unblinded trial [58], and the retrospective cohort study [61] (low quality) which suggested that individualised dietetic-led care during and after hospitalisation, and enteral nutrition during hospitalisation could improve both nutritional and clinical outcomes. This provides some evidence to support the effectiveness of ward-based strategies to meet nutritional requirements in patients with acute lung infections. Previous research highlights the effectiveness of nutrition support in improving clinically important outcomes [64–66] and this can lead to net savings in healthcare costs [63]. The cross-sectional study in hospitalised older patients with pneumonia [59], although very low quality, suggests that older adults with lung infections are at risk of readmission and nutritional care does not appear to be prioritised.

The five guidelines referenced the increased risk of malnutrition in patients with COVID-19 infection. Nutrition screening was consistently recommended, and all provided guidance on dietary interventions according to stage of disease, care setting or nutritional status of the patient. Only two guidelines [41,44] recommended specific energy and protein targets for ward-based care, and only one [41] addressed the issue of dysphagia. Two guidelines [41,42] considered goals and monitoring, and three [40,41,44] looked at continued and community-based care. Only one guideline [42] detailed the difficulties in obtaining access to patients with COVID-19 infection and proposed strategies to minimise contact whilst striving for optimum nutrition. Although nutritional management based on other clinical conditions can be applied to COVID-19, implementation must be given careful consideration for them to be effective. The quality of four guidelines [40–42,44] was moderate based on consensus judgement and the reviewers were able to recommend the use of three with modifications [40–42] and one as it stands [44]. These are useful sources of advice for practicing dietitians. However, given their production at beginning of pandemic practitioners should be aware of the limitations of the guidance and the need for them to be reviewed and updated once further evidence has been generated.

The remaining papers were opinion articles, which offer further advice based on experience, most extrapolating from knowledge of lung disease and/or malnutrition. These address many of the same areas as the guidelines, with an emphasis on identification of nutritional risk and general advice on treatment. They also covered post-discharge procedures and ongoing community care in much more detail. Like the guidelines, advice on monitoring was limited.

The systematic review [62] suggested a benefit of multidisciplinary rehabilitation in combination with nutrition support, on functional outcomes in older adults. Multi-disciplinary working, in both community and hospital settings, was a recurring theme in most of the guidelines and opinion papers. This is especially relevant as evidence [67] from similar coronavirus infections shows that the long-term effects in hospitalised patients, or those that required ICU, persisted beyond 6 months post-discharge. Effects included psychological conditions (Post-traumatic stress disorder, depression, anxiety), lung function abnormalities and reduced exercise capacity. Given this mixed presentation, multi-component rehabilitation could help optimise recovery [68]. The benefits of a nutrition component are well recognised in other services including cancer [69] and pulmonary rehabilitation [70] and should be considered for patients recovering from COVID-19 infection [68].

The COVID-19 crisis resulted in the rapid increase in the use of virtual clinics and telehealth through necessity. Some of the guidelines mentioned these technologies as useful in the

management of patients with COVID-19, but there was little evidence at the time to support their use. Wells Mulherin et al. [53] reported a benefit of virtual clinics and telehealth technology in provision of home enteral and parenteral nutrition, through patient education and training by MDT teams including dietitians. This is supported by observational evidence from a recent systematic review [71] which reported the convenience of telehealth in bringing together multiple healthcare professionals whilst minimising direct patient contact during the COVID-19 pandemic. Multiple expertise combined in this way can be an effective tool in tackling malnutrition as reported by a meta-analysis [72]; there was a significant improvement in protein intakes (2 studies; 200 participants) and quality of life (4 studies; 248 participants) in malnutrition focussed telehealth interventions when compared to usual care, in older adults living at home. However, limited practical guidance was provided by the papers in this review. MDT rehabilitation through telehealth requires co-ordination to ensure effective communication. Guidance is essential to ensure effective use of resources.

This review highlights the need for further research in effective nutrition support interventions for patients during and post-COVID-19. Recent data showing that up to 78% of patients required dietetic input during post-ICU rehabilitation [73], suggests a similar need for dietetic input post COVID-19. Our review adds to the evidence of knowledge gaps highlighted by Mechanick et al. [74] where an urgent need for well-designed research, particularly RCTs, was identified for nutrition support, registered dietitian nutritionist counselling (chronic or post-COVID-19), malnutrition and management (all stages) as well as enteral nutrition, protein-energy requirements, and home enteral and parenteral nutrition support (chronic or post-COVID-19).

Strengths of this review include adherence to relevant Cochrane guidelines [19], a peer reviewed search strategy and independent duplicate screening for most of the retrieved articles. The inclusion of BDA and BAPEN articles allowed post-discharge procedures and continuity of care to be explored in more detail. The use of a variety of relevant quality appraisal tools allowed appropriate assessment of the strength and relevance of the available evidence. Limitations include short timeframe and language restrictions. Indirect evidence from non-COVID-19 pneumonia may also be a limitation as some data suggest that COVID-19 can also specifically target the gastrointestinal tract, resulting in possibly more nutritional intolerance in COVID-19 patient compared to regular pneumonia [75]. Although some grey literature was explored through hand searching of reference lists, it was not extensive due to time restrictions.

In conclusion, this review highlights the lack of high quality evidence available on nutritional management of COVID-19 and we are unable to say with confidence the best way of ensuring continuity of nutritional care post hospital discharge. There were no dietary intervention studies for COVID-19 and most of the evidence was from opinion articles and guidelines. The observational evidence described here showed COVID-19 in older adults presents a risk of malnutrition and addressing this may be important in recovery. Indirect evidence from studies on pneumonia provides some support for the recommended use of nutritional management strategies applicable to other acute conditions in patients with COVID-19. However, traditional screening and implementation techniques need to be modified to ensure infection control measures can be maintained. More research is required on the most effective nutritional interventions, as well as more detailed guidance on nutritional management post-discharge to aid long-term recovery.

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conception and design of the review. JL undertook the searching, JL, MH, and CEW conducted the screening, data interpretation, and tabulation. JL, MH and AJ undertook the AGREE II analysis of the guidelines. JL, MH and CEW drafted the manuscript. All authors critically reviewed the content of drafts and have approved the final version of the manuscript submitted for publication.

Declaration of competing interest

The authors declare that they have no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.clnesp.2021.11.020>.

References

- [1] World Health Organisation (WHO). Situation reports: coronavirus disease (COVID-19) weekly epidemiological update and weekly operational update 2021. Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>. [Accessed 17 October 2021].
- [2] Public Health England. Coronavirus (COVID-19) in the UK: daily update 2021. Available from: <https://coronavirus.data.gov.uk/>. [Accessed 17 October 2021].
- [3] Richards-Belle A, Orzechowska I, Gould DW, Thomas K, Doidge JC, Mouncey PR, et al. COVID-19 in critical care: epidemiology of the first epidemic wave across England, Wales and Northern Ireland. *Intensive Care Med* 2020;46(11):2035–47.
- [4] Ferrando-Vivas P, Doidge J, Thomas K, Gould DW, Mouncey P, Shankar-Hari M, et al. Prognostic factors for 30-day mortality in critically ill patients with coronavirus disease 2019: an observational cohort study. *Crit Care Med* 2021;49(1):102–11.
- [5] Thibault R, Quilliot D, Seguin P, Tamion F, Schneider S, Dechelotte P. Nutritional care at hospital during the covid-19 viral epidemic: expert opinion from the French-speaking society for clinical nutrition and metabolism (SFNCM). *Nutr Clin Metab* 2020;34(2):97–104.
- [6] Thibault R, Coëffier M, Joly F, Bohé J, Schneider SM, Déchelotte P. How the Covid-19 epidemic is challenging our practice in clinical nutrition-feedback from the field. *Eur J Clin Nutr* 2020:1–10.
- [7] Merriweather J, Smith P, Walsh T. Nutritional rehabilitation after ICU – does it happen: a qualitative interview and observational study. *J Clin Nurs* 2014;23(5–6):654–62.
- [8] Rouget A, Vardon-Bouines F, Lorber P, Vavasasseur A, Marion O, Marcheix B, et al. Prevalence of malnutrition in coronavirus disease 19: the NUTRICOV study. *Br J Nutr* 2020 Dec 21:1–8.
- [9] Li T, Zhang Y, Gong C, Wang J, Liu B, Shi L, et al. Prevalence of malnutrition and analysis of related factors in elderly patients with COVID-19 in Wuhan, China. *Eur J Clin Nutr* 2020;74(6):871–5.
- [10] Bedock D, Bel Lassen P, Mathian A, Moreau P, Couffignal J, Ciangura C, et al. Prevalence and severity of malnutrition in hospitalized COVID-19 patients. *Clin Nutr ESPEN* 2020;40:214–9.
- [11] Rees EM, Nightingale ES, Jafari Y, Waterlow NR, Clifford S, Pearson Ca B, et al. COVID-19 length of hospital stay: a systematic review and data synthesis. *BMC Med* 2020;18(1):270.
- [12] Yu Y, Fau Ye J, Chen M, Fau Chen M, Jiang C, Fau Jiang C, Lin W, Fau Lin W, Lu Y, Fau Lu Y, Ye H, et al. Malnutrition prolongs the hospitalization of patients with COVID-19 infection: a clinical epidemiological analysis. *J Nutr Health Aging* 2021;25(3):369–73.
- [13] Gomes F, Schuetz P, Bounoure L, Austin P, Ballesteros-Pomar M, Cederholm T, et al. ESPEN guidelines on nutritional support for polymorbid internal medicine patients. *Clin Nutr* 2018;37(1):336–53.
- [14] Volkert D, Beck AM, Cederholm T, Cruz-Jentoft A, Goisser S, Hooper L, et al. ESPEN guideline on clinical nutrition and hydration in geriatrics. *Clin Nutr* 2019 Feb;38(1):10–47.
- [15] Weijs PJM, Mogensen KM, Rawn JD, Christopher KA-OX. Protein intake, nutritional status and outcomes in ICU survivors: a single center cohort study. *J Clin Med* 2019 Jan 4;8(1):43.
- [16] Neelemaat F, Fau Bosmans Je, Thijs A, Fau Thijs A, Seidell JC, Jc Fau Seidell, van Bokhorst-de van der Schueren MAE, van Bokhorst-de van der Schueren MA. Post-discharge nutritional support in malnourished elderly individuals improves functional limitations. *J Am Med Dir Assoc* 2011;12(4):295–301.

- [17] Ingstad K, Uhrenfeldt L, Kymre IG, Skrubbeltrang C, Pedersen P. Effectiveness of individualised nutritional care plans to reduce malnutrition during hospitalisation and up to 3 months post-discharge: a systematic scoping review. *BMJ Open* 2020 Nov 3;10(11):e040439.
- [18] Cawood AL, Walters ER, Smith TR, Sipaul RH, Stratton RJ. A review of nutrition support guidelines for individuals with or recovering from COVID-19 in the community. *Nutrients* 2020;12(11):22.
- [19] Garrity C, Gartlehner G, Kamel C, King VJ, Nussbaumer-Streit B, Stevens A, et al. Cochrane rapid reviews: interim guidance from the Cochrane rapid reviews methods group. Available from: https://methods.cochrane.org/rapidreviews/sites/methods.cochrane.org/rapidreviews/files/public/uploads/cochrane_rr_-_guidance-23mar2020-final.pdf. [Accessed 20 April 2021].
- [20] McGowan J, Sampson M, Salzwedel DM, Cogo E, Foerster V, Lefebvre C. PRESS peer review of electronic search strategies: 2015 guideline statement. *J Clin Epidemiol* 2016 Jul;75:40–6.
- [21] Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. *Syst Rev* 2016;5(1):210.
- [22] Sterne JAC, Savović J, Page MJ, Elbers RG, Blencowe NS, Boutron I, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ* 2019;366:l4898.
- [23] Joanna Briggs Institute. Critical appraisal tools: JBI. Available from: <https://joannabriggs.org/critical-appraisal-tools>. [Accessed 20 April 2021].
- [24] Brouwers M, Kho ME, Browman GP, Burgers JS, Cluzeau F, Feder G, et al. Agree II: advancing guideline development, reporting and evaluation in healthcare. *Prev Med* 2010 Nov;51(5):421–4.
- [25] McArthur A, Klugarova J, Yan H, Florescu S. Innovations in the systematic review of text and opinion. *Int J Evid Base Healthc* 2015;13(3):188–95.
- [26] Higgins JPTGS. Handbook for systematic reviews of interventions version 5.1.0 [updated March 2011]. The Cochrane Collaboration; 2011.
- [27] British Dietetic Association. Model and process for nutrition and dietetic practice. Available from: <https://www.bda.uk.com/practice-and-education/nutrition-and-dietetic-practice/professional-guidance/model-and-process-for-dietetic-practice.html>. [Accessed 20 April 2021].
- [28] Woolf SH, Grol R, Hutchinson A, Eccles M, Grimshaw J. Clinical guidelines: potential benefits, limitations, and harms of clinical guidelines. *BMJ* 1999;318(7182):527–30.
- [29] Li Z, Zheng C, Duan C, Zhang Y, Li Q, Dou Z, et al. Rehabilitation needs of the first cohort of post-acute COVID-19 patients in Hubei, China. *Eur J Phys Rehabil Med* 2020;56(3):339–44.
- [30] Zhao X, Li Y, Ge Y, Shi Y, Lv P, Zhang J, et al. Evaluation of nutrition risk and its association with mortality risk in severely and critically ill COVID-19 patients. *JPEN - J Parenter Enter Nutr* 2021 Jan;45(1):32–42.
- [31] Allard L, Ouedraogo E, Molleville J, Bihan H, Giroux-Leprieur B, Sutton A, et al. Malnutrition: percentage and association with prognosis in patients hospitalized for coronavirus disease 2019. *Nutrients* 2020;12(12):3679.
- [32] Haraj NE, El Aziz S, Chadli A, Dafir A, Mjabber A, Aissaoui O, et al. Nutritional status assessment in patients with Covid-19 after discharge from the intensive care unit. *Clin Nutr ESPEN* 2020;41:423–8.
- [33] Leite VF, Rampim DB, Jorge VC, Correia de Lima MDC, Cezarino LG, da Rocha CN, et al. Persistent symptoms and disability after COVID-19 hospitalization: data from a comprehensive telerehabilitation program. *Arch Phys Med Rehabil* 2021 Jul;102(7):1308–16.
- [34] Pironi L, Sadedelli AS, Ravaoli F, Baracco B, Battaiola C, Bocedi G, et al. Malnutrition and nutritional therapy in patients with SARS-CoV-2 disease. *Clin Nutr* 2020;40(3):1330–7.
- [35] Alvarez Schettini MI, Vazquez LA, Cruz F, Garcia Gomez MC, Ramos L, Gonzalez A, et al. Nutritional inpatient care in geriatric population during covid-19 outbreak: some basics forgotten in the rush?. 42nd ESPEN Virtual Congress Clin Nutr ESPEN 2020. 0 (pp 583).
- [36] Formisano E, Ivaldi C, Sferrazzo E, Arieta L, Bongiovanni S, Panizzi L, et al. Nutritional management of non-critically ill hospitalized patients affected by Covid-19: the experience of dietitians in an Italian single center. 42nd ESPEN Virtual Congress Clin Nutr ESPEN 2020. 0 (pp 609).
- [37] Hoyois A, Ballarin A, Thomas J, Lheureux O, Preiser JC, Bogerd SP, et al. Nutritional evaluation and management in patients with Covid-19 following hospitalization in intensive care units. 42nd ESPEN Virtual Congress Clin Nutr ESPEN 2020. 0 (pp 503).
- [38] Ortega O, Arreola V, Nascimento W, Martin A, Costa A, Arus M, et al. Oropharyngeal dysphagia and malnutrition in patients with covid-19 at the consorci sanitari del maresme, catalonia, Spain: prevalence and needs of compensatory treatment. 42nd ESPEN Virtual Congress Clin Nutr ESPEN 2020: 618–9. 0.
- [39] Lawrence V, Hickson M, Weekes CE, Julian A, Frost G, Murphy J. A UK survey of nutritional care pathways for patients with Covid-19 prior to and post hospital stay. *J Hum Nutr Diet* 2021;18:18.
- [40] Aytür YK, Köseoğlu BF, Taşkiran ÖÖ, Ordu-Gökkaya NK, Delialioğlu SÜ, Tur BS, et al. Pulmonary rehabilitation principles in SARS-CoV-2 infection (COVID-19): a guideline for the acute and subacute rehabilitation. *Turk J Phys Med Rehabil* 2020;66(2):104–20.
- [41] Barazzoni R, Bischoff SC, Breda J, Wickramasinghe K, Krznaric Z, Nitzan D, et al. ESPEN expert statements and practical guidance for nutritional management of individuals with SARS-CoV-2 infection. *Clin Nutr* 2020;39(6):1631–8.
- [42] Chapple LAS, Fetterplace K, Asrani V, Burrell A, Cheng AC, Collins P, et al. Nutrition management for critically and acutely unwell hospitalised patients with coronavirus disease 2019 (COVID-19) in Australia and New Zealand. *Aust Crit Care* 2020;33(5):399–406.
- [43] Chen Q, Wang L, Yu W, Xi H, Zhang Q, Chen X, et al. Recommendations for the prevention and treatment of the novel coronavirus pneumonia in the elderly in China. *Aging Medicine* 2020;3(2):66–73.
- [44] Jin Y-H, Cai L, Cheng Z-S, Cheng H, Deng T, Fan Y-P, et al. A rapid advice guideline for the diagnosis and treatment of 2019 novel coronavirus (2019-nCoV) infected pneumonia (standard version). *Mil Med Res* 2020 Feb 6;7(1):4.
- [45] British Association of Parenteral and Enteral Nutrition: Malnutrition Action Group. Practical guidance for using 'MUST' to identify malnutrition during the COVID-19 pandemic Malnutrition Action Group (MAG) update. Available from: <https://www.bapen.org.uk/>. [Accessed 20 April 2021].
- [46] British Dietetic Association. Practical considerations for nutritional management of non-ICU COVID-19 patients in hospital. Available from: <https://www.bda.uk.com/>. [Accessed 20 April 2021].
- [47] British Dietetic Association. Nutritional considerations for primary care teams managing patients with or recovering from Covid-19. Available from, <https://www.bda.uk.com/>. [Accessed 20 April 2021].
- [48] British Dietetic Association. COVID-19 - recommendations for community action by dietitians for older and vulnerable people living in their own home. 2020. Available from: <https://www.bda.uk.com/>. [Accessed 20 April 2021].
- [49] British Dietetic Association, Critical Care Specialist Group. Guidance on management of nutrition and dietetic services during the COVID-19 pandemic. Available from, <https://www.bda.uk.com/>. [Accessed 20 April 2021].
- [50] Caccialanza R, Laviano A, Lobascio F, Montagna E, Bruno R, Ludovisi S, et al. Early nutritional supplementation in non-critically ill patients hospitalized for the 2019 novel coronavirus disease (COVID-19): rationale and feasibility of a shared pragmatic protocol. *Nutrition* 2020;74:110835.
- [51] Managing Adult Malnutrition. A community healthcare professional guide to the nutritional management of patients during and after COVID-19 illness. 2020. Available from: <https://www.malnutritionpathway.co.uk/>. [Accessed 20 April 2021].
- [52] Brugliera L, Spina A, Castellazzi P, Cimino P, Arcuri P, Negro A, et al. Nutritional management of COVID-19 patients in a rehabilitation unit. *Eur J Clin Nutr* 2020;74(6):860–3.
- [53] Wells Mulherin D, Walker R, Holcombe B, Guenter P. ASPEN report on nutrition support practice processes with COVID-19: the first response. *Nutr Clin Pract* 2020;35(5):783–91.
- [54] Bursi S, Esposito L, Anzolin F, Natale S, Morisi L, Tommesani G, et al. Early nutrition protocol during Covid-19 pandemic. 42nd ESPEN Virtual Congress Clin Nutr ESPEN 2020:511–2. 0.
- [55] Yang PH, Lin MC, Liu YY, Lee CL, Chang NJ. Effect of nutritional intervention programs on nutritional status and readmission rate in malnourished older adults with pneumonia: a randomized control trial. *Int J Environ Res Public Health* 2019 Nov 27;16(23):4758.
- [56] Yuanyuan H, Huayan X, Jing N, Danhua H, Yanjie S. Clinical effects of enteral nutrition support on nutritional status of elderly patients with severe pneumonia. *Acta Med Mediterr* 2020;36(1):477–82.
- [57] Baumgartner A, Hasenboehler F, Cantone J, Hersberger L, Bargetzi A, Bargetzi L, et al. Effect of nutritional support in patients with lower respiratory tract infection: secondary analysis of a randomized clinical trial. *Clin Nutr* 2021;40(4):1843–50.
- [58] Hansen NM, Faurholt-Jepsen D, Ryrso CK, Hegelund MH, Dungu AM, Sejdic A, et al. The effect of protein-based nutritional supplementation during and after hospital stay in patients with community acquired pneumonia. 42nd ESPEN Virtual Congress Clin Nutr ESPEN 2020:428–9. 0.
- [59] Eekholm S, Ahlstrom G, Kristensson J, Lindhardt T. Gaps between current clinical practice and evidence-based guidelines for treatment and care of older patients with Community Acquired Pneumonia: a descriptive cross-sectional study. *BMC Infect Dis* 2020 Jan 23;20(1):73.
- [60] Shirado K, Wakabayashi H, Maeda K, Nishiyama A, Asada M, Isse H, et al. Impact of energy intake at one week after hospitalization on prognosis for older adults with pneumonia. *J Nutr Health Aging* 2020;24(1):119–24.
- [61] Honda Y, Momosaki R, Ogata N. Nasogastric tube feeding versus total parenteral nutrition in older dysphagic patients with pneumonia: retrospective cohort study. *J Nutr Health Aging* 2020;24(8):883–7.
- [62] Goodwin VA, Allan L, Bethel A, Cowley A, Cross JL, Day J, et al. Rehabilitation to enable recovery from COVID-19: a rapid systematic review. *Physiotherapy* 2021:22.
- [63] Elia M. The cost of malnutrition in England and potential cost savings from nutritional interventions (full report). British Association for Parenteral and Enteral Nutrition and National Institute for Health Research Southampton Biomedical Research Centre; 2015.
- [64] Gomes F, Baumgartner A, Bounoure L, Bally M, Deutz NE, Greenwald JL, et al. Association of nutritional support with clinical outcomes among medical inpatients who are malnourished or at nutritional risk: an updated systematic review and meta-analysis. *JAMA Netw Open* 2019;2(11):e1915138–.
- [65] Schuetz P, Fehr R, Baechli V, Geiser M, Deiss M, Gomes F, et al. Individualised nutritional support in medical inpatients at nutritional risk: a randomised clinical trial. *Lancet* 2019;393(10188):2312–21.
- [66] Cawood AL, Elia M, Stratton RJ. Systematic review and meta-analysis of the effects of high protein oral nutritional supplements. *Ageing Res Rev* 2012;11(2):278–96.
- [67] Ahmed H, Patel K, Greenwood D, Halpin S, Lewthwaite P, Salawu A, et al. Long-term clinical outcomes in survivors of severe acute respiratory

- syndrome and Middle East respiratory syndrome coronavirus outbreaks after hospitalisation or ICU admission: a systematic review and meta-analysis. *J Rehabil Med* 2020 May 31;52(5):jrm00063.
- [68] NHS England. After-care needs of inpatients recovering from COVID-19. Available from: <https://gp.selondonccg.nhs.uk/wp-content/uploads/2020/06/C0388-After-care-needs-of-inpatients-recovering-from-COVID-19-5-June-2021.pdf>. [Accessed 20 August 2021].
- [69] Chasen MR, Bhargava R. A rehabilitation program for patients with gastroesophageal cancer—a pilot study. *Support Care Cancer* 2010;18(2):35–40.
- [70] Griffiths TL, Burr ML, Campbell IA, Lewis-Jenkins V, Mullins J, Shiels K, et al. Results at 1 year of outpatient multidisciplinary pulmonary rehabilitation: a randomised controlled trial. *Lancet* 2000;355(9201):362–8.
- [71] Monaghesh E, Hajizadeh A. The role of telehealth during COVID-19 outbreak: a systematic review based on current evidence. *BMC Publ Health* 2020 Aug 1;20(1):1193.
- [72] Marx W, Kelly JT, Crichton M, Craven D, Collins J, Mackay H, et al. Is telehealth effective in managing malnutrition in community-dwelling older adults? A systematic review and meta-analysis. *Maturitas* 2018 May;111:31–46.
- [73] Puthuchery Z, Brown C, Corner E, Wallace S, Highfield J, Bear D, et al. The Post-ICU presentation screen (PICUPS) and rehabilitation prescription (RP) for intensive care survivors part II: clinical engagement and future directions for the national Post-Intensive care Rehabilitation Collaborative. *J Intensive Care Soc.* 2021. <https://doi.org/10.11772/F1751143720988708>.
- [74] Mechanick JI, Carbone S, Dickerson RN, Hernandez BJD, Hurt RT, Irving SY, et al. Clinical nutrition research and the COVID-19 pandemic: a scoping review of the ASPEN COVID-19 task force on nutrition research. *JPEN - J Parenter Enter Nutr* 2021;45(1):13–31.
- [75] Kaafarani HMA, El Moheb M, Hwabejire JO, Naar L, Christensen MA, Breen K, et al. Gastrointestinal complications in critically ill patients with COVID-19. *Ann Surg* 2020 Aug;272(2):e61–2.