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ORIGINAL RESEARCH

Barriers to Delivery of Enteral Nutrition in Intensive Care Settings in Saudi Arabia: A Comparative Study of the Perceptions of Health Care Providers Working in Adult and Paediatric ICUs

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Background and Aims: Achieving optimal nutrition prescription is challenging in critically ill patients. Many factors can hinder the adequate delivery of enteral nutrition (EN) in intensive care units (ICUs). In this study, we aim to describe EN barriers and compare the perceptions of health care practitioners working in adult and paediatric ICUs regarding these barriers.

Methods: In this cross-sectional study, data were collected via online survey. All physicians, dietitians, and nurses working in adult or paediatric ICUs across Saudi Arabia were eligible to participate. The survey contained 24 potential EN barriers and participants were asked to rate their importance on a scale from 1 to 5. A total Likert rating score of the 24 items was later calculated.

Results: We recruited 244 health care providers working in adult and paediatric ICUs. The most important perceived barriers were "Delay in physician ordering EN initiation" (3.33 ±1.32), and 'Waiting for dietitians to assess patients' (3.22 ±1.20). There was a statistical difference between the responses of health care providers based on their work settings for the following items; "Nurses failing to progress feeds according to feeding protocol" (p=0.006) and 'Feeding being held too far prior procedures or operating-room visits' (p=0.021). Profession significantly influenced the total Likert rating score of the 24 items (r=−0.234, p=0.001).

Conclusion: This study identified some barriers of EN delivery in ICUs and showed that participants' perceptions regarding these barriers were influenced by their roles. These findings shed light on the nutritional practices in Saudi hospitals and identify areas of improvement in EN practice and advancements in the field of critical care nutrition in the region.

Keywords: enteral nutrition, EN barriers, PICU, ICU

Introduction

Nutrition therapy is a vital element of the care process of critically ill adult and paediatric patients. The prognostic impact of nutrition therapy in the critically ill population has previously been documented in the literature;[1–5] however, achieving optimal nutrition remains a challenge in this population. Although nutrition support either enterally or parenterally has substantially improved the patient's nutritional intake, underfeeding continues to be documented in intensive care settings worldwide.[6–8]

Underfeeding is determined when a patient receives less than 70% of their prescribed requirements during the first 7 days of intensive care unit (ICU) admission.[9,10] The current international nutrition guidelines uniformly recommend the preferential use of enteral nutrition (EN) for critically ill patients where possible.[11,12] The development of EN and implementation of feeding protocols have markedly improved nutrient delivery in the hospitalised critically ill population.[13,14] However, there are a substantial number of critically ill children and adults worldwide who still cannot achieve adequate nutritional intake via the enteral route for many reasons.[7,8,15,16] These include: delayed initiation of EN,

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under-prescription of the requirements by physicians, and frequent interruption of EN due to fear of aspiration, high residual volume, or diarrhoea;[17–19] some of these reasons might be preventable.[17–19]

Although many international studies have investigated feeding practices in ICUs, this field is new in the Middle East and limited research has been conducted in this area. Therefore, there is an urgent need for nutrition-based studies to advance the field of critical care nutrition in the region. Previous data in the region recorded a high incidence of underfeeding among critically ill adult patients, and we have shown that the time of EN initiation plays a key role in determining the time to achieving full requirements.[7] In this study, we aim to describe in detail other barriers of EN delivery in critically ill adult and paediatric patients as perceived by physicians, dietitians, and nurses working in intensive care settings. Furthermore, we aim to compare the perceptions of health care providers working in adult and paediatric ICUs regarding the barriers of EN.

Methods

Study Design and Participants

In this cross-sectional study, all physicians, dietitians, and nurses working in adult or paediatric ICUs across Saudi Arabia were eligible to participate. The study was conducted in accordance with the Declaration of Helsinki and approved by the ethics committee at Taibah University (Certificate no. 2020/57/204/CLN). A participant information sheet was included in the first page of the online survey. Participants' consent was obtained by including a mandatory question confirming that they agreed to participate in the study.

Data were collected via online survey, which was promoted on various social media platforms (eg, Twitter and WhatsApp). Chain-referral sampling was then performed where the head of ICU departments were contacted to achieve adequate convenience sampling of medical staff working in adult and paediatric ICUs across the kingdom of Saudi Arabia. Data collection was initiated on 15 October 2021 and continued for 3 months.

Survey Development

The survey tool was adapted from Cahill et al (2016)[20] and was reviewed and modified by the researcher, including adding more questions about the demographics of the participants and rewriting some of the questions to improve clarity. The survey was then pilot tested on 10 dietitians, 5 doctors, and 5 nurses, and was adjusted accordingly. The data of the 20 participants used in the pilot testing were excluded from the analysis. The survey collected information about the participants' demographic information and barriers to adequate EN delivery as perceived by physicians, dietitians, and nurses working in adult and paediatric ICUs. The questionnaire contained 24 items, and the respondents were asked to rate the items' importance as barriers to delivery of EN in their ICUs from 1 (not at all important), 2 (slightly important), 3 (important), 4 (Fairly important) to 5 (very important). The barriers of EN were categorised into 5 domains: Domain 1 included 2 questions about guidelines and recommendations, Domain 2 included 7 questions about EN delivery to patients, Domain 3 included 3 questions about ICU and paediatric ICU (PICU) resources, Domain 4 included 7 questions about critical care providers' attitudes and behaviours, and Domain 5 included 5 questions about dietitian resources in intensive care settings. The Cronbach's alpha obtained indicated an excellent internal reliability of the instrument (0.944).

Statistical Analysis

Data were downloaded and analysed using the Statistical Package for Social Sciences software version 23 (SPSS Inc.) (SPSS 23, SPSS Inc., Chicago, IL, USA). The Shapiro–Wilk test was used to assess the normality of continuous variables. Continuous variables were presented as mean ± standard deviation (SD) and median (interquartile range [IQR]). Frequencies and percentages were also presented to describe the data. Mean (±SD) and median (IQR) were calculated to determine the most and least important barriers to EN in adult and paediatric ICUs. Cronbach's alpha test of reliability was used to assess the reliability of the measured enteral feeding barriers in the questionnaire. A total Likert rating score of the 24 items was calculated for each participant for use in the statistical analysis.

The Kruskal–Wallis test was performed to compare the median Likert rating scores of the 5 domains. The Mann–Whitney *U*-test was performed to compare the perceptions of health care providers working in adult ICUs and those working in PICUs regarding the importance of each item as a barrier to EN delivery.

A stepwise linear regression analysis was performed to identify factors that influenced the perceptions of the health care providers regarding the barriers of EN in ICU settings. The calculated total score (120) for each participant was used as the outcome variable in the regression models. The independent variables used in the models were gender (female coded as 1 and male coded as 2), education level (diploma coded as 1, intern coded as 2, Bachelor's coded as 3, Master's coded as 4, residency coded as 5, fellowship coded as 6, and doctorate coded as 7), years of experience as a numerical variable, type of health care facility (medical city coded as 1, military hospital coded as 2, ministry of health hospital coded as 3, national guard hospital coded as 4, private hospital coded as 5, specialised hospital coded as 6, and university teaching hospital coded as 7), region (Central coded as 1, Eastern coded as 2, Northern coded as 3, Southern coded as 4, and Western coded as 5), profession (dietitians coded as 1, nurses coded as 2, and doctors coded as 3), and setting (adult ICU coded as 1 and PICU coded as 2).

Results

A total of 244 health care providers working in adult and paediatric ICUs across Saudi Arabia participated in this study; 47 were physicians, 61 were dietitians, and 136 were nurses. Most of the participants were females (n=177, 72%). Most of the responses were received from the Western region, and their mean years of experience in intensive care settings was 5 ± 3.7 years. The characteristics of the study participants are presented in Table 1.

We calculated the mean (±SD) and the median (IQR) to determine the most and least important barriers to EN in adult and paediatric ICUs. The results showed that the most important barrier was "Delay in physician ordering initiation of enteral nutrition" [3.33 ±1.32, 3 (2–5)]which was included in the "delivery of EN" domain. The mean score of this item as indicated by the dietitians was [3.9 ±1.4, 5 (3–5)], by physicians was [3.09 ±1.1, 3 (2–4)] and by nurses was [3.06 ±1.3, 3 (2–4)]. The second most important barrier was "Waiting for the dietitian to assess the patients" [3.22 ±1.2, 3 (2–4)] which was included in the "dietitian support" domain. The mean score of this item as indicated by the dietitians was [3.5 ±1.4, 4 (2–5)], by physicians was [3.2 ±1.1, 3 (2–4)] and by nurses was [2.79 ±1.1, 3 (2–3)].The least important barriers were "Non-ICU physicians requesting patients not be fed enterally" [3.01 ±1.2, 3 (2–4)] preceded by "General belief among ICU team that provision of adequate nutrition does not impact on patient outcome" [3.03 ±1.3, 3 (2–4)]; both barriers were included in the "critical care providers attitude and behaviour" domain. A Kruskal–Wallis test was performed to compare the median Likert ratings of the 5 domains, and no significant differences were observed between the domains (Table 2).

To compare the perceptions of health care providers regarding the importance of each item as a barrier to EN based on their work setting (adult or paediatric ICU), a series of Mann–Whitney *U*-tests were performed. No significant differences were recorded between the responses of health care providers working in adult ICUs and those working in PICUs for most items, $p > 0.05$. However, a significant difference was recorded in the responses of the participants based on their work settings for the following items: "Nurses failing to progress feeds as per the feeding protocol" ($p=0.006$) and "Feeding being held too far in advance of procedures or operating room visits" ($p=0.021$). The results showed that "Nurses failing to progress feeds as per the feeding protocol" was perceived as more important EN barrier by participants working in adult ICU [3.34 (±1.3)] compared to those working in PICUs 2.88(±1.3). Similarly, "Feeding being held too far in advance of procedures or operating room visits" was also perceived as more important EN barrier by participants working in adult ICU [3.39 (±1.2)] compared to those working in PICUs 3.01(±1.3) (Table 3).

We then calculated the total Likert rating scores of the 24 items for each participant. The results showed that physicians had a median (IQR) Likert rating score of 71 (55–81), while dietitians scored 87 (69–102), and nurses scored 76 (65–88). A statistical difference was recorded between the total scores of different health care professions; the dietitians had statistically higher scores than the physicians and nurses ($p<0.001$).

The median (IQR) total Likert rating score of the 24 items was 78 (68–90) for health care providers working in adult ICUs and 72 (59–88) for those working in PICUs. No statistical difference was observed in the total scores between participants based on their work settings (adult vs paediatric ICU) ($p=0.059$).

Table 1 General Characteristics of the Study Participants

		Adult ICU (n=155)			Paediatric ICU (n=89)		
		Physicians (n=27)	**Dieticians (n=45)**	**Nurses (n=83)**	**Physicians (n=20)**	**Dieticians (n=16)**	**Nurses (n=53)**
Region	*Western region*	13 (48.1%)	23 (51.1%)	44 (53%)	8 (40.0%)	10 (62.5%)	34 (64.2%)
	Eastern region	6 (22.2%)	6 (13.3%)	8 (9.6%)	5 (25.0%)	3 (18.8%)	6 (11.3%)
	Central region	5 (18.5%)	7 (15.6%)	23 (27.7%)	5 (25.0%)	3 (18.8%)	8 (15.1%)
	Southern region	1 (3.7%)	6 (13.3%)	4 (4.8%)	1 (5.0%)	0	4 (7.5%)
	Northern region	2 (7.4%)	3 (6.7%)	4 (4.8%)	1 (5.0%)	0	1 (1.9%)
Education and training	*Intern*	1 (3.7%)	10 (22.2%)	1 (3.7%)	1 (5.0%)	1 (6.3%)	2 (3.8%)
	Bachelor's	7 (25.9%)	30 (66.7%)	7 (25.9%)	2 (10.0%)	14 (87.5%)	48 (90.6%)
	Residency	9 (33.3%)	0	9 (33.3%)	3 (15.0%)	1 (6.3%)	1 (1.9%)
	Fellowship	3 (11.1%)	0	3 (11.1%)	10 (50.0%)	0	0
	Board	0	0	0	0	0	0
	Master's	6 (22.2%)	5 (11.1%)	6 (22.2%)	1 (5.0%)	0	0
	Doctorate	1 (3.7%)	0	1 (3.7%)	3 (15.0%)	0	0
	Other (diploma)	0	0	0	0	0	2 (3.8%)
Type of health care facility	*University teaching hospitals*	1 (3.7%)	0	2 (2.4%)	0	0	1 (1.9%)
	Specialized hospitals	1 (3.7%)	1 (2.2%)	4 (4.8%)	3 (15.0%)	2 (12.5%)	1 (1.9%)
	Private hospitals	7 (25.9%)	6 (13.3%)	9(10.8%)	1 (5.0%)	3 (18.8%)	2 (3.8%)
	National guard hospitals	1 (3.7%)	4 (8.9%)	1 (1.2%)	2 (10.0%)	0	0
	Ministry Of Health (MOH) hospitals	15 (55.6%)	27 (60%)	57 (68.7%)	9 (45.0%)	10 (62.5%)	43 (81.1%)
	Military hospitals	1 (3.7%)	6 (13.3%)	7 (8.4%)	4 (20.0%)	0	3 (5.7%)
	Medical cities	1 (3.7%)	1 (2.2%)	3 (3.6%)	1 (5.0%)	1 (6.3%)	3 (5.7%)
Years of experience	**Mean ±SD**	2.5 ±2.4	4.8 ±3.9	5.7 ±3.6	3.6 ±2.7	7 ±3.5	6.5 ±3.6
	Median (IQR)	4 (6–2)	2 (3–1)	2 (6–1)	3.5 (7–3)	3 (4–1)	5 (7.7–3)
	1–5 years (n)	15 (55.5%)	42 (94%)	50 (60%)	9 (45%)	13 (81%)	22 (41.5%)
	5–10 years (n)	7 (26%)	2 (4%)	19 (23%)	5 (25%)	2 (12.5%)	14 (26%)
	10+ (n)	5 (18%)	1 (2%)	14 (17%)	6 (30%)	1 (6%)	17 (32%)

Note: Data presented as numbers and percentage.

A stepwise linear regression analysis was performed to identify factors influencing the health care providers' perceptions regarding EN barriers in ICU settings. In the regression analysis, profession statistically influenced the total Likert rating scores of the participants (r=−0.234, p=0.001) (Table 4). In the sub-analysis of health care providers working in PICUs, gender statistically influenced the total Likert rating scores of the participants (r=−0.289, p=0.006) (Table 4).

Table 2 Description of Enteral Feeding Barriers as Perceived by the Medical Staff Working in Adults and Paediatric ICUs

Domain	Questions	Not at All Important	Slightly Important	Important	Fairly Important	Very Important	Mean (±SD) Likert Rating	Median (IQR) Likert Rating
		N (%)						
Domain 1 Guideline Recommendations and Implementation Strategies	***Current scientific evidence supporting some nutrition interventions is inadequate to inform practice.***	17 (7.0%)	48 (19.7%)	39 (38.1%)	32 (13.1%)	54 (22.1%)	3.24 (±1.201)	3 (2–4)
	Lack of feeding protocol in place to guide the initiation and progression of enteral nutrition in your institution.	21 (8.6%)	54 (22.1%)	79 (32.4%)	26 (10.7%)	64 (26.2%)	3.24 (±1.293)	3 (2–5)
Mean ±SD Likert rating for Domain 1	**3.23 ±1.24**							
Median (IQR) Likert rating for Domain 1	**3 (2–4)**							
Domain 2 Delivery of Enteral Nutrition to the Patient	***Delay in physician ordering initiation of enteral nutrition***	22 (9.0%)	51 (20.9%)	71 (29.1%)	31 (12.7%)	69 (28.3%)	3.3 (±1.32)	3 (2–5)
	Waiting for physician/radiology to read x-ray and confirm tube placement.	26 (10.7%)	52 (21.3%)	77 (31.6%)	29 (11.9%)	60 (24.6%)	3.18 (±1.31)	3 (2–4)
	Frequent displacement of feeding tube, requiring reinsertion.	25 (10.2%)	43 (17.6%)	78 (32.0%)	36 (14.8%)	62 (25.4)	3.27 (±1.297)	3 (2–5)
	Delays in initiating motility agents in patients not tolerating enteral nutrition (ie, high gastric residual volumes).	17 (7.0%)	47 (19.3%)	86 (35.2%)	36 (14.8%)	58 (23.8%)	3.29 (±1.221)	3 (2–4)
	Delays and difficulties in obtaining small bowel access in patients not tolerating enteral nutrition (ie, high gastric residual volumes).	23 (9.4%)	40 (16.4%)	79 (32.4)	43 (17.6%)	59 (24.2%)	3.31 (±1.264)	3 (2–4)
	In resuscitated, hemodynamically stable patients, other aspects of patient care still take priority over nutrition.	17 (7.0%)	49 (20.1%)	79 (32.4%)	39 (16.0%)	60 (24.6%)	3.31 (±1.238)	3 (2–4)
	Nutrition therapy not routinely discussed on patient care rounds.	27 (11.1%)	46 (18.9%)	85 (34.8%)	32 (13.1%)	54 (22.1%)	3.16 (±1.276)	3 (2–4)

(*Continued*)

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Table 2 (Continued).

Domain	Questions	Not at All Important	Slightly Important	Important	Fairly Important	Very Important	Mean (±SD) Likert Rating	Median (IQR) Likert Rating
		N (%)						
Mean ±SD Likert rating for Domain 2	**3.3 ±1.27**							
Median (IQR) Likert rating for Domain 2	**3 (2–4)**							
Domain 3 ICU/PICU Resources	***Not enough nursing staff to deliver adequate nutrition.***	30 (12.3%)	44 (18.0%)	79 (32.4%)	36 (14.8%)	55 (22.5%)	3.17 (±1.303)	3 (2–4)
	Enteral formula not available on the unit.	34 (13.9%)	42 (17.2%)	83 (23.0%)	30 (12.3%)	55 (22.5%)	3.12 (±1.321)	3 (2–4)
	No or not enough feeding pumps on the unit.	34 (13.9%)	44 (18.0%)	76 (31.1%)	27 (11.1%)	63 (25.8%)	3.17 (±1.364)	3 (2–5)
Mean ±SD Likert rating for Domain 3	**3.15 ±1.32**							
Median (IQR) Likert rating for Domain 3	**3 (2–4)**							
Domain 4 Critical Care Provider Attitudes and Behaviours	***Non-ICU physicians (ie, surgeons, gastroenterologists) requesting patients not be fed enterally.***	30 (12.3%)	60 (24.6%)	79 (32.4%)	28 (11.5%)	47 (19.3%)	3.01 (±1.277)	3 (2–4)
	Nurses failing to progress feeds as per the feeding protocol.	31 (12.7%)	47 (19.3%)	75 (30.7%)	31 (12.7%)	60 (24.6%)	3.17 (±1.338)	3 (2–4)
	Feeds being held due to diarrhea.	32 (13.1%)	53 (21.7%)	86 (35.2%)	33 (13.5%)	40 (16.4%)	2.98 (±1.24)	3 (2–4)
	Fear of adverse events due to aggressively feeding patients.	32 (13.1%)	40 (16.4%)	93 (38.1%)	33 (13.5%)	46 (18.9%)	3.09 (±1.256)	3 (2–4)
	Feeding being held too far in advance of procedures or operating room visits.	20 (8.2%)	53 (21.7%)	76 (31.1%)	35 (14.3%)	60 (24.6%)	3.25 (±1.271)	3 (2–4)
	General belief among ICU team that provision of adequate nutrition does not impact on patient outcome.	40 (16.4%)	51 (20.9%)	70 (28.7%)	27 (11.1%)	56 (23.0%)	3.03 (±1.378)	3 (2–4)
	Lack of familiarity with current guidelines for nutrition in the ICU.	20 (8.2%)	50 (20.5%)	78 (32.0%)	33 (13.5%)	63 (25.8%)	3.28 (±1.276)	3 (2–5)

Mean ±SD Likert rating for Domain 4	**3.11 ±1.29**							
Median (IQR) Likert rating for Domain 4	**3 (2–4)**							
Domain 5 Dietitian Support	***Waiting for the dietitian to assess the patient.***	21 (8.6%)	50 (20.5%)	83 (34.0%)	34 (13.9%)	56 (23.0%)	3.22 (±1.251)	3 (2–4)
	Dietitian not routinely present on weekday patient rounds.	29 (11.9%)	44 (18.0%)	79 (32.4%)	38 (15.6%)	54 (22.1%)	3.18 (±1.293)	3 (2–4)
	Not enough dietitian time dedicated to the ICU during regular weekday hours.	26 (10.7%)	50 (20.5%)	82 (33.6%)	40 (16.4%)	46 (18.9%)	3.12 (±1.241)	3 (2–4)
	No or not enough dietitian coverage during evenings, weekends, and holidays.	25 (10.2%)	52 (21.3%)	77 (31.6%)	28 (11.5%)	62 (25.4%)	3.2 (±1.311)	3 (2–5)
	There is not enough time dedicated to education and training on how to optimally feed patients.	19 (7.8%)	57 (23.4%)	77 (31.6%)	39 (16.0%)	52 (21.3%)	3.2 (±1.235)	3 (2–4)
Mean ±SD Likert rating for Domain 5	**3.18 ±1.26**							
Median (IQR) Likert rating for Domain 3	**3 (2–4)**							
P value	**0.08**							

Notes: Data presented as numbers and percentage. Kruskal Wallis test was conducted to compare the median of the 5 domains. P value is statistically significant at < 0.05 level. Adapted from Cahill NE, Jiang X, Heyland DK. Revised Questionnaire to Assess Barriers to Adequate Nutrition in the Critically Ill. *JPEN J Parenter Enteral Nutr.* 2016;40:511–518.[20]

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Table 3 Comparison Between the Perception of Health Care Providers Working in Adult and Paediatric ICU Regarding the Importance of the Following Items as Barriers to Achieve Adequate EN

Domain	Questions	Mean ±SD Median (IQR) Health Care Providers Working in Adult ICUs	Mean ±SD Median (IQR) Health Care Providers Working in PICUs	P-value
Domain 1 Guideline Recommendations and Implementation Strategies	***Current scientific evidence supporting some nutrition interventions is inadequate to inform practice.***	3.21 ±1.1 3 (2–4)	3.28 ±1.2 3 (2–5)	0.780
	Lack of feeding protocol in place to guide the initiation and progression of enteral nutrition in your institution.	3.21 ±1.2 3 (2–4)	3.29 ±1.2 3 (2–5)	0.644
Likert rating for Domain 1		3.21 ±1.2 3 (2–4)	3.28 ±1.2 3 (2–5)	**0.780**
Domain 2 Delivery of Enteral Nutrition to the Patient	***Delay in physician ordering initiation of enteral nutrition.***	3.32 ±1.3 3 (2–5)	3.25 ±1.3 3 (2–5)	0.640
	Waiting for physician/radiology to read x-ray and confirm tube placement.	3.31 ±1.2 3 (2–5)	2.97 ±1.3 3 (2–4)	0.05
	Frequent displacement of feeding tube, requiring reinsertion.	3.38 ±1.2 3 (3–4)	3.09 ±1.3 3 (2–5)	0.093
	Delays in initiating motility agents in patients not tolerating enteral nutrition (ie, high gastric residual volumes).	3.36 ±1.2 3 (3–5)	3.17 ±1.2 3 (2–4)	0.254
	Delays and difficulties in obtaining small bowel access in patients not tolerating enteral nutrition (ie, high gastric residual volumes).	3.43 ±1.2 3 (3–5)	3.10 ±1.2 3 (2–4)	0.052
	In resuscitated, hemodynamically stable patients, other aspects of patient care still take priority over nutrition.	3.39 ±1.2 3 (3–5)	3.18 ±1.2 3 (2–4)	0.219
	Nutrition therapy not routinely discussed on patient care rounds.	3.10 ±1.2 3 (2–4)	3.27 ±1.2 3 (2–5)	0.424
Likert rating for Domain 2		3.33 ±1.3 3 (2–4)	3.26 ±1.3 3 (2–4)	0.640
Domain 3 ICU/PICU Resources	***Not enough nursing staff to deliver adequate nutrition.***	3.18 ±1.2 3 (2–4)	3.15 ±1.4 3 (2–5)	0.907
	Enteral formula not available on the unit.	3.12 ±1.3 3 (2–4)	3.13 ±1.3 3 (2–4)	0.942
	No or not enough feeding pumps on the unit.	3.23 ±1.3 3 (2–5)	3.06 ±1.3 3 (2–4)	0.319

(*Continued*)

Table 3 (Continued).

Domain	Questions	Mean ±SD Median (IQR) Health Care Providers Working in Adult ICUs	Mean ±SD Median (IQR) Health Care Providers Working in PICUs	P-value
Likert rating for Domain 3		3.18 ±1.2 3 (2–4)	3.16 ±1.4 3 (2–4)	0.907
Domain 4 Critical Care Provider Attitudes and Behaviours	***Non-ICU physicians (ie, surgeons, gastroenterologists) requesting patients not be fed enterally.***	3.10 ±1.2 3 (2–4)	2.83 ±1.2 3 (2–4)	0.084
	Nurses failing to progress feeds as per the feeding protocol.	3.34 ±1.3 3 (2–5)	2.88 ±1.3 3 (2–4)	0.006*
	Feeds being held due to diarrhea.	3.08 ±1.2 3 (2–4)	2.81 ±1.2 3 (2–4)	0.066
	Fear of adverse events due to aggressively feeding patients.	3.17 ±1.2 3 (2–4)	2.93 ±1.2 3 (2–4)	0.141
	Feeding being held too far in advance of procedures or operating room visits.	3.39 ±1.2 3 (3–5)	3.01 ±1.3 3 (2–4)	0.021*
	General belief among ICU team that provision of adequate nutrition does not impact on patient outcome.	3.06 ±1.3 3 (2–4)	2.98 ±1.4 3 (2–4)	0.550
	Lack of familiarity with current guidelines for nutrition in the ICU.	3.39 ±1.2 3 (2–5)	3.10 ±1.2 3 (2–4)	0.090
Likert rating for Domain 4		3.11 ±1.2 3 (2–4)	2.83 ±1.2 3 (2–4)	0.084
Domain 5 Dietitian Support	***Waiting for the dietitian to assess the patient.***	3.23 ±1.2 3 (2–4)	3.19 ±1.2 3 (2–4)	0.732
	Dietitian not routinely present on weekday patient rounds.	3.28 ±1.2 3 (2–4)	3.00 ±1.3 3 (2–4)	0.106
	Not enough dietitian time dedicated to the ICU during regular weekday hours.	3.18 ±1.2 3 (2–4)	3.02 ±1.2 3 (2–4)	0.310
	No or not enough dietitian coverage during evenings, weekends, and holidays.	3.28 ±1.3 3 (2–5)	3.08 ±1.3 3 (2–4)	0.251
	There is not enough time dedicated to education and training on how to optimally feed patients.	3.26 ±1.2 3 (2–4)	3.09 ±1.1 3 (2–4)	0.312
Likert rating for Domain 5		3.24 ±1.3 3 (2–4)	3.19 ±1.2 3 (2–4)	0.732

Notes: Numbers presented in the table are Mean ±SD and Median (IQR). Mann–Whitney *U*-test was performed to compare the perception of staff working in adult ICU and those working in paediatric ICU. * P value is statistically significant at < 0.05 level. Adapted from Cahill NE, Jiang X, Heyland DK. Revised Questionnaire to Assess Barriers to Adequate Nutrition in the Critically Ill. *JPEN J Parenter Enteral Nutr.* 2016;40:511–518.20.

Finally, we allowed for free-text responses to record any barriers that were not mentioned in the survey, two participants indicated that the nurses fear of aspiration could be a potential barrier to initiate and advance EN.

Table 4 Regression Analysis to Identify the Factors Influenced the Perception of Health Care Providers Regarding the Barriers to Achieve Adequate EN in ICU Settings

Combined sample (Health care providers working in Adult ICUs and PICUs)			
Model 1	**R**	**R ^{2}**	**Adjusted R ^{2}**
Outcome variable: Total score			
	0.234	0.055	0.051
***Dependent variable* (n=244)**	***Beta***		***P* value**
Profession (dietitians, nurses, physicians) [a]	−0.234		0.001*
Work settings (adult ICU or PICU) [b]	−0.069		0.277
Gender [b]	−0.079		0.245
Educational level [b]	−0.125		0.082
Years of experience [b]	−0.037		0.57
Type of health care facility [b]	0.022		0.723
Region [b]	0.090		0.152
Health care providers working in Adult ICUs			
Model 2	**R**	**R ^{2}**	**Adjusted R ^{2}**
Outcome variable: Total score			
	0.307	0.940	0.820
***Dependent variable* (n=155)**	***Beta***		***P* value**
Profession (doctors, dietitians or nurses) [a]	−0.282		0.001*
Type of health care facility [a]	0.156		0.047
Gender [b]	0.004		0.966
Educational level [b]	−0.112		0.187
Years of experience [b]	−0.091		0.266
Region [b]	0.134		0.086
Health care providers working in PICUs			
Model 3	**R**	**R ^{2}**	**Adjusted R ^{2}**
Outcome variable: Total score			
	0.289	0.830	0.730
***Dependent variable* (n=89)**	***Beta***		***P* value**
Gender	−0.289		0.006*
Profession (doctors, dietitians or nurses) [b]	−0.042		0.718
Type of health care facility [b]	−0.152		0.142
Educational level [b]	−0.070		0.563
Years of experience [b]	0.085		0.415
Region [b]	−0.002		0.983

Notes: [a]Predictors: (constant). [b]Excluded variables. *P value is statistically significant at < 0.05 level.

Discussion

The current study is the first to investigate the perceived barriers to EN in both adult and paediatric ICUs across Saudi Arabia; it included all three professional groups responsible for EN delivery in intensive care settings. Overall, this study showed that delayed ordering of EN initiation by physicians and waiting for dietitians to assess patients were considered the most important barriers to EN delivery in both adult and paediatric ICUs. Furthermore, the current study indicated that the perceptions of health care providers working in adult ICUs regarding barriers to EN were similar to those working in PICUs. However, the participants' characteristics, such as profession (physicians, dietitians, and nurses) and gender, influenced their perceptions regarding EN barriers in intensive care settings.

The current study indicated that delayed ordering of EN initiation by physicians was perceived as the most important barrier to adequate delivery of EN by health care providers working in adult and paediatric ICUs. It has been previously reported that physicians were reluctant to initiate EN early; this is mainly because of the common perception that early EN is associated with increased risk of aspiration pneumonia.[21,22] In addition, it is likely that other procedures took priority over EN, which may have hindered the optimal delivery of enteral feeding. Physicians have a key role in improving nutrition care in intensive care settings as the physician usually commences the initial feeding order, and this is considered the first step of the nutrition delivery process. Studies have shown that the use of physician opinion leaders as agents of change has resulted in improvements in the patient care process.[23,24] Therefore, it is crucial that physicians understand the importance of nutrition in improving the clinical outcomes of critically ill adults and children. According to the participants from all disciplines included in this study, waiting for dietitians to assess patients was also considered a significant barrier to EN delivery in both adult and paediatric ICUs. Many studies have emphasised the role of the dietician in managing and minimising malnutrition in hospitalised patients, reducing the incidence of underfeeding, and improving the overall outcomes.[25–27] Furthermore, research has shown that the availability of dedicated registered dietitians in ICUs improves the compliance to EN orders and substantially improves protein delivery to critically ill patients.[26] Overall, these findings highlight the role of the multidisciplinary team in improving nutrition delivery in intensive care settings.

In the current study, the general responses of health care providers working in adult ICUs and PICUs regarding the barriers of EN were not significantly different for most items; however, there was a significant difference in their perceptions of certain barriers. The failure of nurses to advance feeding according to the feeding protocol was considered a more significant barrier to enteral feeding by health care providers working in adult ICUs than those working in PICUs. The discrepancy in the perceptions of health care providers based on their work setting could be related to the different levels of nutritional training provided to nurses in adult and paediatric ICUs. It is likely that nurses working in PICUs receive more nutritional training and therefore have better EN practices. For example, in the United Kingdom, nutrition training is a required for PICU nursing and medical staff.[28] In contrast, Morphet et al highlighted a significant EN knowledge deficit in nurses working in adult ICUs.[29]

Holding feeds for an extended time prior to medical procedures was perceived as a more significant barrier to enteral feeding by health care providers working in adult ICUs than staff working in PICUs. Prolonged periprocedural cessation of EN has frequently been reported in adult ICUs.[30,31] There are many reasons for the variation in the duration of delaying EN between different ICUs. For instance, lack of proper feeding protocols leads to a unnecessary feeding interruptions or delays in feeding restart after procedures.[30] Furthermore, the clinical load in adult ICUs in Saudi Arabia is likely heavier than in PICUs, which might affect the timing of the procedures and consequently impacts the feeding schedule. The prolonged period of EN cessation after procedures in ICU settings might also be due to insufficient staff awareness that this practice can prevent the delivery of the planned nutritional requirements.[31] Frequent and prolonged interruption of EN can be minimised by improving the nutrition knowledge of the health care practitioners who are responsible for making decisions regarding patient feeding in intensive care settings. To support and maintain good EN practices, regular nutritional education and training sessions should be provided to all health care providers involved in the nutrition care process.

Studies have shown that nutrition therapy is influenced by the practitioner roles due to competing priorities when caring for patients.[25,28,32] In the current study, dietitians assigned higher scores to all the questions, indicating that they were more aware than other professions of the importance of these items as barriers to EN delivery in ICUs. These

findings highlight the importance of involving all three professional groups in EN practice training and education. Although dietitians play a key role in assessing and providing the patient's nutritional requirements, they are nonetheless part of a multidisciplinary team. Therefore, effective communication between health care providers is crucial to ensure proper implementation of nutrition care plans.

There were some limitations to our study that should be highlighted. Our sample size was relatively small, and the response rate from some professions was low. It was challenging to obtained the desired number of participants as we needed a specific group in a specific setting. However, our sample size was close to that of other studies performed in ICU settings in other countries. In addition, we recruited participants from all the regions of the kingdom, providing a general representation of the perspectives of health care providers working in ICUs regarding the barriers of EN. The tool used in this study was validated for adult ICUs, and there might be other barriers specifically encountered in PICUs that were not explored in this study. For example, Rogers et al reported that fluid restriction was the main barrier to achieving adequate EN in children with congenital heart disease.[33] We allowed for free-text responses to record any barriers that were not mentioned in the survey. The survey-based nature of this study, as compared with direct prospective observation, was considered another limitation. However, most of the previously studies that investigated EN barriers in ICU settings worldwide collected their data through surveys.

Conclusion

This study highlighted the important of certain factors as barriers to EN delivery in intensive care settings as perceived by health care providers. The perceptions of the participants were influenced by their roles, mostly due to competing priorities when caring for patients. Highlighting and identifying EN barriers in intensive care settings will help to optimise nutrition care in this population. The standardisation of feeding protocols could minimise the discrepancies in the perceptions of health care providers regarding some avoidable barriers of EN, such as delaying EN initiation. Conducting educational sessions on preventable EN barriers should be included in the training of health care providers working in adult and paediatric ICUs to ensure best EN practices. The findings of this study shed light on the nutritional practices in Saudi hospitals and identify areas for improvement in EN practice, eventually helping to advance the field of critical care nutrition in the region. Future studies should focus on direct of observation of the factors hindering the delivery of EN in intensive care settings.

Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the ethics committee at Taibah University (Certificate no. 2020/57/204/CLN). A participant information sheet was included in the first page of the online survey. Participants' consent was obtained by including a mandatory question confirming that they agreed to participate in the study. Informed consent for publication was also obtained from participants.

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Author Contributions

The author made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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