

# Advance knowledge of Physician about Total Parenteral Nutrition in Saudi Arabia

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## ABSTRACT

**Objectives:** To explore the physician's advanced knowledge about Total Parenteral Nutrition in Saudi Arabia. **Materials and Methods:** It analyzes a cross-sectional survey that discussed the physician's basic knowledge of some items for Total Parenteral Nutrition services (TPNs) in Saudi Arabian. The survey consisted of respondents' demographic information about Physician knowledge of Total Parenteral Nutrition services (TPNs) calculations. Besides, the physician's understanding of Total Parenteral Nutrition services (TPNs) adjusts based on diseases, Physician knowledge of Total Parenteral Nutrition services (TPNs) components for various populations. The 5-point Likert response scale system was used with closed-ended questions. The survey was validated through the revision of expert reviewers and pilot testing. Besides, various tests of the reliability of McDonald's  $\alpha$ , Cronbach alpha, Gutmann's  $\lambda_2$ , and Gutmann's  $\lambda_6$  were done with the study. Furthermore, the data analysis of the Pharmacist practice of Cardiopulmonary Resuscitation (CPR) medications is done through the survey monkey system. Besides, the Statistical Package of Social Sciences (SPSS), Jeffery's Amazing Statistics Program (JASP), and Microsoft Excel sheet version 16. **Results:** A total number of 409 physicians responded to the questionnaire. Of them, almost one-half responded from the Northern region (186 (45.48%)), and one Quarter responded from the central area (106 (25.92%)), with statistically significant differences between the provinces ( $p=0.000$ ). Females responded more than males (268 (65.53%)) versus 141 (34.47%), with statistically significant differences between all levels ( $p=0.001$ ). Most of the responders were in the age group of 36-45 years (198 (48.41%)) and 46-55 years (109 (26.65%)), with statistically significant differences between all age groups ( $p=0.000$ ). Almost one-half of responders, 176 (43.03%), worked at an organization that had Parenteral Nutrition services (TPNs) services, with only 86 (21.03%) had been ever requested any Parenteral Nutrition services (TPNs) with statistically significant differences between all answers ( $p=0.000$ ).

The average score of knowledge calculation of Total Parenteral Nutrition services components was (3.41). The element "Total daily requirement of the protein" obtained the highest score (3.81). The aspect "Total daily requirement of the electrolytes" was (3.77). The average score of knowledge the Total Parental Nutrition services (TPNs) adjust with various diseases was (3.70). The element "Hepatic Failure" obtained the highest score (4.30). The aspect "Renal failure" was (4.22). **Conclusion:** The advanced knowledge of physicians about parenteral nutrition calculations or adjusting parenteral nutrition based on the current disease was inadequate. Therefore, targeting undergraduates and postgraduate education and training is highly in the medical care.

**Keyword:** Advance, Knowledge, Total Parenteral Nutrition, Physicians, Saudi Arabia.

## INTRODUCTION

Various types of patients (adults, pediatrics, neonates, and geriatric) admit to the hospital with different cor morbidity conditions such as cardiovascular problems, hepatic disorders, or kidney problems.<sup>[1]</sup> Those patients are sometimes admitted to the hospital for surgical procedures, have complications of their disease, or have any concern that leads to stopping feeding by regular diet by month.<sup>[2]</sup> The testing doctor will switch them to enteral feeding. If he fails, they switch to parenteral feeding, called partial parenteral nutrition, which can give part of their feeding by intravenous administration.<sup>[2,3]</sup> Sometimes the patient needs complete nutrition provided by intravenous administration called total parenteral nutrition.<sup>[2,3]</sup> Various nutritional societies set up the contents of TPN.

Such as fluid, carious, carbohydrates, protein, lipids, electrolytes, multivitamins, and trace elements.<sup>[4,5]</sup> Every component had specific calculations for neonates, pediatricians, adults, and geriatricians.<sup>[4,5]</sup> Furthermore, if the patient had additional medical concerns such as hepatics or renal problems, each component should have been adjusted accordingly to guidelines. Any health care professionals, including physicians, pharmacists, nurses, and nutritionists who deal with such patients, should be familiar with all related parenteral nutrition. That knowledge of parenteral nutrition and it assumed as advanced knowledge of parenteral nutrition. Few studies have been conducted about advanced knowledge of parenteral nutrition internationally.<sup>[6-10]</sup> The authors are not familiar with any studies locally or in Gulf and Arabic countries published about the current topic.<sup>[11,12]</sup> The present study

aims to demonstrate the physician's advanced knowledge of parenteral nutrition in Saudi Arabia,

## MATERIALS AND METHODS

It analyzes a cross-sectional survey discussing physicians' advanced knowledge of Total Parenteral Nutrition services (TPNs) in Saudi Arabia. It self-reported an electronic survey of the physician, including a physician from internship to consultant, physician specialties, and Saudi Arabia. All non-physician or students, non-completed, non-qualified surveys will be excluded from the study. The survey consisted of respondents' demographic information about the physician's knowledge of Total Parenteral Nutrition services (TPNs) calculations. Besides, the physician's understanding of Total Parenteral Nutrition services (TPNs) adjusts based on diseases. Physician knowledge of Total Parenteral Nutrition services (TPNs) components for various populations.<sup>[6-10,13]</sup> The 5-point Likert response scale system was used with closed-ended questions. According to the previous literature with an unlimited population size, the sample was calculated as a cross-sectional study, with a confidence level of 95% with a z score of 1.96 and a margin of error of 5%, a population percentage of 50%, and drop-out rate 10%. As a result, the sample size will equal 380-420 with a power of study of 80%.<sup>[14-16]</sup> The response rate required for the calculated sample size is at least 60-70% and above.<sup>[16,17]</sup> The survey was distributed through social media of what's applications and telegram groups of a physician. The reminder message had been sent every 1-2 weeks. The survey was validated through the revision of expert reviewers and pilot testing. Besides, various tests of reliability McDonald's  $\omega$ , Cronbach alpha, Gutmann's  $\lambda_2$ , and Gutmann's  $\lambda_6$  been done with the study. The data analysis of the physician practice of some items for Total Parenteral Nutrition services (TPNs) at the institution is done through the survey monkey system. Besides, the Statistical Package of Social Sciences (SPSS), Jeffery's Amazing Statistics Program (JASP), and Microsoft Excel sheet version 16. It included a description and frequency analysis, good of fitness analysis, and correlation analysis. Besides, inferential analysis of factors affecting Physician knowledge of Total Parenteral Nutrition services (TPNs) calculations, Physician knowledge of Total Parenteral Nutrition services (TPNs) adjust based on diseases with linear regression. The STROBE (Strengthening the Reporting of Observational Studies in Epidemiology Statement: Guidelines for Reporting Observational Studies) guided the reporting of the current study.<sup>[18,19]</sup>

## RESULTS

A total number of 409 physicians responded to the questionnaire. Of them, almost one-half responded from the Northern region (186 (45.48%)), and one Quarter responded from the central region (106 (25.92%)), with statistically significant differences between the provinces ( $p=0.000$ ). Most of the responders were from National Guard Hospitals (90 (22.00%)), Military hospitals (79 (19.32%)), Ministry of Health (MOH) hospitals (53 (12.96%)), and University Hospitals (51 (12.47%)), with a statistically significant difference between working sites ( $p=0.000$ ). Females responded more than males (268 (65.53%)) versus 141 (34.47%), with statistically significant differences between all levels ( $p=0.001$ ). Most of the responders were in the age group of 36-45 years (198 (48.41%)) and 46-55 years (109 (26.65%)), with statistically significant differences between all age groups ( $p=0.000$ ). Most of the pharmacists were residents (133 (32.52%)) and General practitioners (110 (26.89%)), with statistically significant differences between all levels ( $p=0.000$ ). Most of the responders worked as Assistant directors of the medical unit (228 (55.75%)) and Medical Directors (90 (22.00%)), with a statistically significant difference between positions ( $p=0.000$ ). Most physicians had a work experience of 1-3 years (176 (43.03%)) and 4-6 years (137 (33.50%)), with a statistically significant difference between years of experience ( $p=0.000$ ). Most of physician's specialties was emergency (86 ((20.05%)), Surgery (79 ((19.32%)), Psychiatry (78 ((19.07%)), and Obstetrics and Gynecology (74 ((18.09%)) with statistically significant differences between all specialties ( $p=0.000$ ). Almost one-half of responders, 176 (43.03%), worked at an organization that had Parenteral Nutrition services (TPNs) services, with only 86 (21.03%) had been ever requested any Parenteral Nutrition services (TPNs) with statistically significant differences between all answers ( $p=0.000$ ). There are non-statistically significant correlations between all demographic variables ( $p>0.05$ ) (Tables 1 and 2). The average score of knowledge calculation of Total Parenteral Nutrition components was (3.41). The element "Total daily requirement of the protein" obtained the highest score (3.81). The aspect "Total daily requirement of the electrolytes" was (3.77). In contrast, the lowest score was obtained for the element "Total daily requirement of the fluid" (2.83). The score for the component "Total daily requirement of the trace elements" was (2.94), with a statistically significant difference between the responses ( $p<0.000$ ). All aspects of the knowledge calculation of Total Parenteral Nutrition

components were statistically significant between responses ( $p<0.000$ ) (Table 3). The average knowledge score for Total Parenteral Nutrition services (TPNs) with various diseases was (3.70). The element "Hepatic Failure" obtained the highest score (4.30). The aspect "Renal failure" was (4.22). In contrast, the lowest score was obtained for the element "Diabetes Mellitus" (3.13). The score for the element "Burn patients" was (3.20), with a statistically significant difference between the responses ( $p<0.000$ ). All aspects of the knowledge adjust the Total Parenteral Nutrition services (TPNs) with various diseases were statistically significant between responses ( $p<0.000$ ) (Table 4). The average score of knowledge calculation of Total Parenteral Nutrition services components in various populations was (3.41). Most physicians can calculate of Total daily requirement of the fluid for Geriatrics 246 (60.15%) and Pediatrics 222 (54.28%). Most physicians can calculate the total daily energy need for Adults 229 (55.99%) and Geriatrics 164 (40.10%). Most physicians are familiar with Geriatrics 229 (55.99%) and Adults 164 (40.10%) in calculating the total daily energy requirement. In calculating the entire daily requirement of the protein, most physicians knew that for adults, 189 (48.41%) and geriatrics, 185 (45.23%). Most physicians knew the total daily lipid requirement calculation for adults 200 (48.90%) and 172 (42.05%) geriatrics. The majority of physicians do not know the calculation of the Total daily requirement of electrolytes 231 (56.48%), followed by knowledge for adults 155 (37.90%) and geriatrics for adults 153 (37.41%). In calculating the total daily requirement of the Vitamins, most physicians knew Adolescents 213 (55.76%) and geriatrics 149 (39.01%). Most physicians knew the calculation of the Total daily requirement of the trace elements for adults 285 (69.68%) and adolescents 203 (49.63%) (Table 5). The score for single-test reliability analysis of McDonald's  $\omega$  was 0.661, Cronbach's  $\alpha$  was 0.691, Gutmann's  $\lambda_2$ , 0.731, Gutmann's  $\lambda_6$  was 0.956, and Greater Lower Bound was 0.989 with statistically significant ( $p<0.05$ ).

### Factors affecting the physician's advanced knowledge of Total Parenteral Nutrition services (TPNs) calculations

Factors affecting the perception were analyzed. We adjusted the significant values using the independent samples Kruskal-Wallis test and the Bonferroni correction for multiple tests. **physician knowledge of Total Parenteral Nutrition services (TPNs) calculations** includes location, worksite, gender, Physician qualification, Physician specialties, years of experience, current position, Present of the

Table 1: Demographic, social information.			
Nationality	Response Count	Response Percent	p-value (X2)
Central area	106	25.92%	0.000
North area	186	45.48%	
South area	68	16.63%	
East area	36	8.80%	
West area	13	3.18%	
Answered question	409		
Skipped question	0		
Site of work	Response Count	Response Percent	p-value (X2)
MOH Hospitals	53	12.96%	0.000
Military hospitals	79	19.32%	
National Guard Hospital	90	22.00%	
Security forces hospitals	39	9.54%	
University Hospital	51	12.47%	
MOH primary care centers	12	2.93%	
Private hospitals	30	7.33%	
Private ambulatory care clinics	47	11.49%	
Private primary healthcare center	7	1.71%	
Community pharmacy	0	0.00%	
University (academia)	1	0.24%	
Answered question	409		
Skipped question	0		
Gender	Response Count	Response Percent	
Male	141	34.47%	0.000
Female	268	65.53%	
Answered question	409		
Skipped question	0		
Age	Response Count	Response Percent	p-value (X2)
24-35	63	15.40%	0.000
36-45	198	48.41%	
46-55	109	26.65%	
> 55	39	9.54%	
Answered question	409		
Skipped question	0		

Parenteral Nutrition services (TPNs) at the institution, Requisitions of any Parenteral Nutrition services (TPNs) before, Number of TPN orders, and Number of patients needed for TPN. The Eastern region showed the lowest scores (2.9127), with statistically significant differences between regions ( $p=0.000$ ). Ten worksites affected the *physician's knowledge of Total Parenteral Nutrition services (TPNs) calculations*. The lowest scores (3.1213) were obtained from MOH hospitals with statistically significant differences among all sites ( $p=0.000$ ). The female (3.4670) affected the *physician knowledge of Total Parenteral*

*Nutrition services (TPNs) calculations* more than the male (3.3283) with a statistically significant difference ( $p=0.001$ ). The age of the responders affected the *physician's knowledge of Total Parenteral Nutrition services (TPNs) calculations*. Physicians aged >55 showed the lowest score (2.8681), with a statistically significant difference between all age groups ( $p=0.000$ ). Five levels of academic qualifications affected the *physician's knowledge of Total Parenteral Nutrition services (TPNs) calculations*. The lowest score (3.0654) was obtained for the consultants, with a statistically significant difference between all

levels ( $p=0.000$ ). Nine levels of the physician specialties affected the *physician knowledge of Total Parenteral Nutrition services (TPNs) calculations*, with the lowest score (3.0124) obtained for the pediatrics with a statistically significant difference between all levels ( $p=0.000$ ). Six work experience levels affected the physician's *knowledge of Total Parenteral Nutrition services (TPNs) calculations*. The lowest score (3.0816) was obtained for those with work experience of >12 years, with a statistically significant difference between all levels ( $p=0.008$ ). Five levels of the position did not affect the *physician's knowledge of Total Parenteral Nutrition services (TPNs) calculations*, with the highest score (3.7619) of physician staff with a statistically significant difference between all levels ( $p=0.000$ ). The presence of the Parenteral Nutrition services (TPNs) at the institution with the highest score (3.5244) affected *physician knowledge of Total Parenteral Nutrition services (TPNs) calculations*, with a statistically significant difference between all answers ( $p=0.000$ ). The physician did not request any Parenteral Nutrition services (TPNs) before, with the highest score (3.5674) affected *physician knowledge of Total Parenteral Nutrition services (TPNs) calculations*, with a statistically significant difference between all answers ( $p=0.000$ ). The total number of patients needed for TPN orders (81-100) daily had the highest score (3.5608), which affected *physician knowledge of Total Parenteral Nutrition services (TPNs) calculations*, with a statistically significant difference between all answers ( $p=0.000$ ). The total number of TPN orders (16-20) and (6-10) daily had the highest scores (3.8413) and (3.5868), respectively, affected *physician knowledge of Total Parenteral Nutrition services (TPNs) calculations*, with a statistically significant difference between all answers ( $p=0.000$ ).<sup>[20-22]</sup> (Table 6).

The relationship between the physician knowledge of Total Parenteral Nutrition services (TPNs) calculations and factors such as location, worksite, age (years), gender, qualifications, specialties, years of experience, position held, Present of the Parenteral Nutrition services (TPNs) at the institution, Requisitions of any Parenteral Nutrition services (TPNs) before, Number of TPN orders, and Number of patients needed for TPN. The multiple regression analysis considered perception as the dependent variable and factors affecting it as an expletory variable. There was a medium relationship ( $R=0.687$  with  $p=0.000$ ) between the physician's knowledge of Total Parenteral Nutrition services (TPNs) calculations and its factors. Five factors (age, experience, position, Present of the Parenteral Nutrition services

Table 2: Demographic, social information.			
Physician Qualifications	Response Count	Response Percent	p-value (X2)
Intern	34	8.31%	0.000
Resident	133	32.52%	
General practitioner	110	26.89%	
Specialist	73	17.85%	
Consultant	59	14.43%	
<b>Answered question</b>	<b>409</b>		
<b>Skipped question</b>	<b>0</b>		
Position Held	Response Count	Response Percent	
Director of the medical unit	54	13.20%	0.000
Assistant director of the medical unit	228	55.75%	
Medical Director	90	22.00%	
Supervisor	1	0.24%	
Physician staff	36	8.80%	
<b>Answered question</b>	<b>409</b>		
<b>Skipped question</b>	<b>0</b>		
Years of experience in the medical career	Response Count	Response Percent	
< 1	9	2.20%	0.000
1-3	176	43.03%	
4-6	137	33.50%	
7-9	47	11.49%	
10-12	26	6.36%	
>12	14	3.42%	
<b>Answered question</b>	<b>409</b>		
<b>Skipped question</b>	<b>0</b>		
Physician Specialties	Response Count	Response Percent	
Critical Care	3	0.73%	0.000
Emergency	82	20.05%	
Medical	33	8.07%	
Surgical	79	19.32%	
Pediatrics	23	5.62%	
Anesthesia	36	8.80%	
Psychiatry	78	19.07%	
Obstetrics and Gynecology	74	18.09%	
Family medicine	1	0.24%	
<b>Answered question</b>	<b>409</b>		
<b>Skipped question</b>	<b>0</b>		
Do you have Parenteral Nutrition services (TPNs) at your institution?	Response Count	Response Percent	
Yes	176	43.03%	0.000
No	160	39.12%	
I do not know	73	17.85%	
<b>Answered question</b>	<b>409</b>		
<b>Skipped question</b>	<b>0</b>		
Have you ever requested any Parenteral Nutrition services (TPNs)?	Response Count	Response Percent	
Yes	86	21.03%	0.000
No	179	43.77%	
I do not know	144	35.21%	
<b>Answered question</b>	<b>409</b>		
<b>Skipped question</b>	<b>0</b>		

(TPNs) at the institution, Requisitions of any Parenteral Nutrition services (TPNs) before) out of twelve were non-significant differences ( $p>0.05$ ). However, multiple regression analysis confirmed that four factors (i.e., locations, physician qualifications, physician specialties, and the number of TPN orders) explained 43.8%, 26.6%, 23.7%, and 24.6%, respectively of the negative relationship to the variation in knowledge, with a statistically significant difference ( $p=0.000$ ), ( $p=0.000$ ), ( $p=0.000$ ) and ( $p=0.000$ ). The bootstrap model was also confirmed. Furthermore, the relationship was verified by the non-existence of multicollinearity with the five factors (age, experiences, position, Present of the Parenteral Nutrition services (TPNs) at the institution, Requisitions of any Parenteral Nutrition services (TPNs) before) with a Variance Inflation Factor (VIF) of 1.288, 1.178, 1.430 and 1.401 respectively less than three or five as an adequate number of VIF.<sup>[20-22]</sup> Besides, three factors (worksite, gender, and the number of patients needed for TPN) explained 20.8%, 32.3%, and 15.3% of the positive relationship to the variation in knowledge, with a statistically significant difference ( $p=0.000$ ) ( $p=0.000$ ), and ( $p=0.020$ ) respectively. The bootstrap model was also confirmed. Furthermore, the relationship was verified by the non-existence of multicollinearity with a Variance Inflation Factor (VIF) of 1.458, 1.359, and 1.799, respectively less than three or five as a sufficient number of VIF.<sup>[20-22]</sup> (Table 6).

#### *Factors affecting physician's knowledge of Total Parenteral Nutrition services (TPNs) adjust based on diseases*

Factors affecting the perception were analyzed. We adjusted the significant values using the independent samples Kruskal-Wallis test and the Bonferroni correction for multiple tests. *Physician's knowledge of Total Parenteral Nutrition services (TPNs) adjusts based on diseases*, including location, worksite, gender, Physician qualification, Physician specialties, years of experience, current position, Present of the Parenteral Nutrition services (TPNs) at the institution, Requisitions of any Parenteral Nutrition services (TPNs) before, Number of TPN orders, and Number of patients needed for TPN. The southern region showed the lowest scores (3.5789), with statistically significant differences between regions ( $p=0.000$ ). Ten worksites affected the *physician's knowledge of Total Parenteral Nutrition services (TPNs) adjusted based on diseases*. The lowest scores (3.4751) and (3.5843) were obtained from MOH hospitals and National Guard hospitals, respectively, with statically significant differences among all sites ( $p=0.000$ ). The female (3.7412) affected the *physician*

**Table 3: Physician knowledge of Total Parenteral Nutrition services (TPNs) calculations.**

No	Items	No knowledge		Little knowledge		Partial knowledge		Incomplete knowledge		Complete knowledge		Total	Weighted Average	p-value (X2)
1	Total daily requirement of the fluid?	8.56%	35	42.30%	173	22.98%	94	10.02%	41	16.14%	66	409	2.83	0.000
2	Total daily requirement of the energy?	2.93%	12	2.93%	12	65.77%	269	11.25%	46	17.11%	70	409	3.37	0.000
3	Total daily requirement of the protein?	0.24%	1	0.49%	2	34.47%	141	47.92%	196	16.87%	69	409	3.81	0.000
4	Total daily requirement of the lipid?	0.49%	2	2.45%	10	53.19%	217	25.00%	102	18.87%	77	408	3.59	0.000
5	Total daily requirement of the electrolytes?	2.93%	12	1.96%	8	40.83%	167	23.96%	98	30.32%	124	409	3.77	0.000
6	Total daily requirement of the Vitamins?	0.24%	1	13.69%	56	21.27%	87	53.06%	217	11.74%	48	409	3.62	0.000
7	Total daily requirement of the trace elements?	2.69%	11	15.16%	62	68.46%	280	12.47%	51	1.22%	5	409	2.94	0.000
	<b>Answered</b>											<b>409</b>		
	<b>Skipped</b>											<b>0</b>		

**Table 4: Physician knowledge of Total Parenteral Nutrition services (TPNs) components for various populations.**

No	Items	Neonates		Pediatric		Adolescent		Adults		Geriatrics		I do not know how to calculate it		Total
1	Total daily requirement of the fluid?	18.83%	77	54.28%	222	50.37%	206	53.79%	220	60.15%	246	47.92%	196	409
2	Total daily requirement of the energy?	3.18%	13	13.45%	55	34.96%	143	40.10%	164	55.99%	229	37.16%	152	409
3	Total daily requirement of the protein?	2.20%	9	21.52%	88	46.70%	191	48.41%	198	45.23%	185	30.32%	124	409
4	Total daily requirement of the lipid?	9.05%	37	23.72%	97	25.43%	104	48.90%	200	42.05%	172	23.96%	98	409
5	Total daily requirement of the electrolytes?	0.49%	2	24.45%	100	37.90%	155	35.21%	144	37.41%	153	56.48%	231	409
6	Total daily requirement of the Vitamins?	0.52%	2	20.16%	77	55.76%	213	35.86%	137	39.01%	149	36.91%	141	382
7	Total daily requirement of the trace elements?	5.62%	23	22.49%	92	49.63%	203	69.68%	285	41.81%	171	38.88%	159	409
	<b>Answered</b>													<b>409</b>
	<b>Skipped</b>													<b>0</b>

**Table 5: Physician knowledge of Total Parenteral Nutrition services (TPNs) adjusted based on diseases.**

No	Items	No knowledge		Little knowledge		Partial knowledge		Incomplete knowledge		Complete knowledge		Total	Weighted Average	p-value (X2)
1	Critical ill patients	5.62%	23	33.99%	139	11.49%	47	24.21%	99	24.69%	101	409	3.28	0.000
2	Renal failure	0.50%	2	2.01%	8	21.55%	86	27.07%	108	48.87%	195	399	4.22	0.000
3	Hepatic Failure	0.26%	1	9.21%	36	7.16%	28	27.11%	106	56.27%	220	391	4.30	0.000
4	Cancer patients	0.24%	1	0.49%	2	14.91%	61	71.88%	294	12.47%	51	409	3.96	0.000
5	Short bowel syndrome	0.25%	1	3.48%	14	26.12%	105	51.00%	205	19.15%	77	402	3.85	0.000
6	Home care patients	0.24%	1	11.49%	47	50.37%	206	29.34%	120	8.56%	35	409	3.34	0.000
7	Burn patients	2.48%	10	22.77%	92	33.66%	136	34.16%	138	6.93%	28	404	3.20	0.000
8	Surgical patients	3.18%	13	6.60%	27	25.67%	105	33.01%	135	31.54%	129	409	3.83	0.000
9	Crohn's Diseases	0.49%	2	0.00%	0	14.67%	60	56.48%	231	28.36%	116	409	4.12	0.000
10	Ulcerative Colitis	0.49%	2	8.31%	34	37.90%	155	40.10%	164	13.20%	54	409	3.57	0.000
11	Diabetes Mellitus	0.24%	1	15.89%	65	56.23%	230	26.16%	107	1.47%	6	409	3.13	0.000
	<b>Answered</b>											<b>409</b>		
	<b>Skipped</b>											<b>0</b>		

knowledge of Total Parenteral Nutrition services (TPNs) adjusted based on diseases than the male (3.6434) with a statistically significant difference ( $p=0.000$ ). The age of the responders affected the *physician's knowledge*

of Total Parenteral Nutrition services (TPNs) adjusted based on diseases. Physicians aged >55 showed the lowest score (3.5478), with a statistically significant difference between all age groups ( $p=0.000$ ). Five levels of academic

qualifications affected the *physician knowledge of Total Parenteral Nutrition services (TPNs) adjusted based on diseases*, with the lowest score (3.4838) obtained for the consultants with a statistically significant difference between all

Table 6: Multiple regression of Factors with the physician's knowledge of Total Parenteral Nutrition services (TPNs) calculations.

Model	R	R Square	F	Sig.	Unstandardized Coefficients		Standardized Coefficients		t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
					B	Std. Error	Beta				Lower Bound	Upper Bound	Tolerance	VIF
1 (Constant)	.687 <sup>b</sup>	.473	29.574	.000 <sup>b</sup>	3.784	.118			32.043	.000	3.552	4.016		
Location					-.191	.018	-.438		-10.581	.000	-.227	-.156	.776	1.288
Site of work					.039	.008	.208		4.722	.000	.023	.056	.686	1.458
Age (years)					.004	.026	.008		.153	.879	-.048	.056	.526	1.902
Physician gender					.301	.040	.323		7.601	.000	.223	.379	.736	1.359
Physician qualification					-.098	.015	-.264		-6.669	.000	-.127	-.069	.849	1.178
Physician specialties					-.047	.009	-.237		-5.435	.000	-.064	-.030	.699	1.430
Years of experience in a medical career					.025	.018	.060		1.331	.184	-.012	.061	.649	1.542
Position Held					.033	.020	.075		1.672	.095	-.006	.071	.665	1.504
The presence of Parenteral Nutrition services (TPNs) at the institution					-.052	.030	-.087		-1.760	.079	-.110	.006	.545	1.836
Requisitions of any Parenteral Nutrition services (TPNs) before					-.030	.025	-.050		-1.200	.231	-.079	.019	.773	1.293
Number of TPN orders					-.056	.010	-.246		-5.685	.000	-.075	-.036	.710	1.408
Number of patients needed for TPN					.040	.013	.153		3.129	.002	.015	.066	.556	1.799

a. Dependent Variable: physician knowledge of Total Parenteral Nutrition services (TPNs) calculations. Predictors: (Constant), location, worksite, gender, Physician qualification, Physician specialties, years of experience, current position, Present of the Parenteral Nutrition services (TPNs) at the institution, Requisitions of any Parenteral Nutrition services (TPNs) before, Number of TPN orders, and Number of patients needed for TPN.

Model	B	Bias	Bootstrap for Coefficients			
			Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
1 (Constant)	3.784	-.005	.213	.001	3.359	4.179
Location	-.191	-.002	.018	.001	-.227	-.157
Site of work	.039	-.002	.014	.009	.009	.065
Age (years)	.004	.003	.042	.926	-.078	.090
Physician gender	.301	.006	.063	.001	.188	.432
Physician qualification	-.098	-.001	.017	.001	-.132	-.067
Physician specialties	-.047	-.001	.011	.001	-.069	-.029
Years of experience in a medical career	.025	.004	.032	.470	-.034	.089
Position Held	.033	.003	.042	.440	-.042	.120
The presence of Parenteral Nutrition services (TPNs) at the institution	-.052	-.006	.049	.314	-.153	.039
Requisitions of any Parenteral Nutrition services (TPNs) before	-.030	-.001	.032	.365	-.095	.029
Number of TPN orders	-.056	.001	.016	.001	-.087	-.025
Number of patients needed for TPN	.040	.000	.019	.036	.006	.078

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

levels ( $p=0.000$ ). Nine levels of the physician specialties affected the *physician knowledge of Total Parenteral Nutrition services (TPNs) adjusted based on diseases*, with the highest score (3.8424) and (3.8166) obtained for the medical and pediatrics, respectively, with a statistically significant difference between all levels ( $p=0.000$ ). Six levels of work experience affected the *physician's knowledge of Total Parenteral Nutrition services (TPNs) adjusted based on diseases*. The lowest score (3.5783) was obtained for those with work experience of 4-6 years, with a statistically significant difference between all levels ( $p=0.000$ ). Five levels of the position affect the *physician's knowledge of Total Parenteral Nutrition services (TPNs) adjusted based on diseases*, with the lowest score (3.5796) from the medical director with a statistically significant difference between all levels ( $p=0.000$ ). The presence of the Parenteral Nutrition services (TPNs) at the institution with the highest score (3.8357) affected *physician knowledge of Total Parenteral Nutrition services (TPNs) adjusted based on diseases* with a statistically significant difference between all answers ( $p=0.000$ ). The physician's request for any Parenteral Nutrition services (TPNs) before did not affect the *physician's knowledge of Total Parenteral Nutrition services (TPNs) adjusted based on diseases* with non-statistically significant differences between all answers ( $p=0.799$ ). The total number of patients needed for TPN orders (81-100) daily had the lowest score (3.5310), affected *physician knowledge of Total Parenteral Nutrition services (TPNs) adjusted based on diseases*, with a statistically significant difference between all answers ( $p=0.000$ ). Conversely, the total number of TPN orders (6-10) daily had the highest score (3.8527), affected *physician knowledge of Total Parenteral Nutrition services (TPNs) adjusted based on diseases*, with a statistically significant difference between all answers ( $p=0.000$ ).<sup>[20-22]</sup> (Table 6).

The relationship between the physician's advanced knowledge of Total Parenteral Nutrition services (TPNs) adjusts based on diseases and factors such as location, worksite, age (years), gender, qualifications, specialties, years of experience, position held, Present of the Parenteral Nutrition services (TPNs) at the institution, Requisitions of any Parenteral Nutrition services (TPNs) before, Number of TPN orders, and Number of patients needed for TPN. The multiple regression analysis considered perception as the dependent variable and factors affecting it as an explanatory variable. There was a medium relationship ( $R=0.551$  with  $p=0.000$ ) between the physician knowledge of Total Parenteral Nutrition services (TPNs) adjusted based on

diseases and its factors. Six factors (location, age, experiences, position, Requisitions of any Parenteral Nutrition services (TPNs) before, and the number of patients needing TPN) out of twelve were non-significant differences ( $p>0.05$ ). However, multiple regression analysis confirmed that four factors (i.e., physician qualifications, physician specialties, Present of the Parenteral Nutrition services (TPNs) at the institution, and the number of TPN orders) explained 25.7%, 14.3%, 28.2%, and 19.5% respectively of the negative relationship to the variation in knowledge, with a statistically significant difference ( $p=0.000$ ), ( $p=0.004$ ), ( $p=0.000$ ) and ( $p=0.000$ ). The bootstrap model was also confirmed. Furthermore, the relationship was verified by the non-existence of multicollinearity with the four factors (physician qualifications, physician specialties, Present of the Parenteral Nutrition services (TPNs) at the institution, and the number of TPN orders) with a Variance Inflation Factor (VIF) of 1.178, 1.430, 1.836 and 1.408 respectively less than three or five as a sufficient number of VIF.<sup>[20-22]</sup> Besides, two factors (worksite and gender) explained 21.5%, and 18.6%, of the positive relationship to the variation in knowledge, with a statistically significant difference ( $p=0.000$ ), ( $p=0.000$ ), and ( $p=0.020$ ), respectively. The bootstrap model was also confirmed. Furthermore, the relationship was verified by the non-existence of multicollinearity with a Variance Inflation Factor (VIF) of 1.458 and 1.359, respectively, less than three or five as an adequate number of VIF.<sup>[20-22]</sup> (Table 7).

## DISCUSSION

The knowledge of parenteral nutrition is very comprehensive information.<sup>[2-5]</sup> It starts from the general basic understanding of the general requirements of parenteral nutrition from the IV admixture, nutrition support team, indication of parenteral nutrition, and patient assessment for malnutrition.<sup>[2-5]</sup> The next very critical step is calculating of daily requirements of the seven components of TPN. That included fluid, energy, carbohydrates, protein, lipid, electrolytes, vitamins, and trace elements. All those elements should be calculated according to patient conditions and comorbid diseases. Besides, the calculation of total requirements according to the types of patients neonates, pediatric, adults, and geriatric disorders.<sup>[4,5]</sup> All those knowledge elements are required for any clinician prescribing parenteral nutrition. The current cross-sectional study for physicians to assess the knowledge of parenteral nutrition explores the updated knowledge level of TPN calculation. The study had various ages, academic qualifications, experience, working

sites, and positions and jobs. That's reflected in the culture of the medical field. similar to previous studies.<sup>[6-8]</sup>

The study's findings showed that physicians' average score knowledge general calculation was medium similar to previous study.<sup>[8]</sup> Most physicians are familiar with the requirements of protein and electrolytes daily. That's related to the physicians dealing with general nutrition that needs protein and electrolytes. In contrast, the slightest knowledge of fluid and trace elements. The little knowledge of trace element calculation might be expected because they rarely used them in practice. In contrast, the lowest understanding of daily fluid was storage because most responders had an emergency and surgical specialties, which was essential knowledge.

The findings showed the average knowledge of calculating per population all components for the total parental nutrition average. Most physicians can calculate the daily energy, protein, and lipid for adults and geriatrics patients. That's related to whether physicians deal with surgery for adults and geriatrics, not pediatrics or neonates. However, most physicians are familiar with calculating daily fluid for geriatrics and pediatrics. That's related high demand for fluid during an emergency or surgical condition, and physicians deal more with fluid. Variable factors might affect the knowledge of adjusting TPN for specific diseases. Locations and the working site might affect the knowledge with the lowest level related non the availability of patient's needs for adjusting TPN or the facilities of TPN not existing. The female physician might deal with adjusting TPN for specific patients and gain more information than male. Older physicians with high academic qualifications, such as consultants who do not deal with comorbid conditions, require parental nutrition. Thus, the knowledge will decrease over time. In contrast, medical and pediatrics specialization might have more knowledge in adjusting TPN because they deal with patients suffering from hepatics or renal disorders and require parental nutrition. The experience within 4-6 years might have a lower understanding of adjusting TPN because they might need more different experience to be competent in adjusting TPN. The physician's position with the medical director had insufficient knowledge of adjusting TPN because they were busy with administrative duties. The presence of TPN services at the institution, a high number of TPN patients, and a medium number of TPN orders might increase the knowledge of adjusting TPN. The most dependable factors that impacted positively were working site and gender based on previously discussed

Table 7: Multiple regression of Factors with the physician's knowledge of Total Parenteral Nutrition services (TPNs) adjusted based on diseases.

Model	R	R Square	F	Sig.	Unstandardized Coefficients		Standardized Coefficients		t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
					B	Std. Error	Beta				Lower Bound	Upper Bound	Tolerance	VIF
1 (Constant)	.551 <sup>b</sup>	.303	14.362	.000 <sup>b</sup>	4.100	.100			40.800	.000	3.902	4.297		
Location					-.014	.015	-.043		-.910	.364	-.044	.016	.776	1.288
Site of work					.030	.007	.215		4.251	.000	.016	.044	.686	1.458
Age (years)					.024	.023	.061		1.061	.290	-.020	.068	.526	1.902
Physician gender					.128	.034	.186		3.808	.000	.062	.195	.736	1.359
Physician qualification					-.071	.013	-.257		-5.635	.000	-.095	-.046	.849	1.178
Physician specialties					-.021	.007	-.143		-2.857	.004	-.036	-.007	.699	1.430
Years of experience in a medical career					-.009	.016	-.030		-.573	.567	-.040	.022	.649	1.542
Position Held					-.012	.017	-.038		-.744	.457	-.045	.020	.665	1.504
The presence of Parenteral Nutrition services (TPNs) at the institution					-.125	.025	-.282		-4.959	.000	-.175	-.075	.545	1.836
Requisitions of any Parenteral Nutrition services (TPNs) before					-.017	.021	-.037		-.780	.436	-.058	.025	.773	1.293
Number of TPN orders					-.033	.008	-.195		-3.922	.000	-.049	-.016	.710	1.408
Number of patients needed for TPN					-.001	.011	-.004		-.069	.945	-.022	.021	.556	1.799

a. Dependent Variable: physician knowledge of Total Parenteral Nutrition services (TPNs) adjust based on diseases; Predictors: (Constant), Predictors: (Constant), location, worksite, gender, Physician qualification, Physician specialties, years of experience, current position, Present of the Parenteral Nutrition services (TPNs) at the institution, Requisitions of any Parenteral Nutrition services (TPNs) before, Number of TPN orders, and Number of patients needed for TPN.

Model	B	Bias	Bootstrap for Coefficients			
			Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
1 (Constant)	4.100	.030	.217	.001	3.684	4.566
Location	-.014	.000	.013	.316	-.039	.012
Site of work	.030	.001	.016	.051	.002	.060
Age (years)	.024	-.005	.043	.585	-.066	.108
Physician gender	.128	-.005	.060	.048	.010	.245
Physician qualification	-.071	-.001	.015	.001	-.102	-.040
Physician specialties	-.021	6.111E-05	.009	.019	-.038	-.004
Years of experience in a medical career	-.009	-.003	.029	.763	-.066	.049
Position Held	-.012	-.001	.039	.752	-.094	.062
The presence of Parenteral Nutrition services (TPNs) at the institution	-.125	.002	.051	.010	-.219	-.026
Requisitions of any Parenteral Nutrition services (TPNs) before	-.017	.001	.030	.593	-.083	.036
Number of TPN orders	-.033	.001	.015	.009	-.063	-.009
Number of patients needed for TPN	-.001	-.003	.021	.966	-.043	.040

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples.



reasons. In contrast, as previously mentioned, some elements might negatively affect TPN knowledge, such as physician's qualifications, specialties, presence of TPN facilities, and the number of TPN orders. Thus, there is no previous investigation to compare with the current findings. In contrast, the highest knowledge of vitamins and trace elements for adolescents can deal with bariatric surgery done for patients. For example, it might be that the physician prescribed oral vitamins and traces element for adolescents who were knowledgeable about parental and proper oral dosage forms after surgery. In contrast, more than half of physicians can not calculate the electrolyte. That's related to difficulties estimating the requirement during deficiency, which is highly required for organized, systematic therapeutic guidelines. Thus, there is no previous investigation to compare with the current findings.

Various factors might affect TPN calculation knowledge for physicians. Such as location and working site. In the Eastern region, the lowest part of related knowledge might be untrained physicians, or they did prescribe TPN. The MOH hospital found the most deficient knowledge of TPN; that's expected because most of the MOH hospitals do have IV admixture and TPN services. Thus, most physicians working at MOH hospital did not have enough knowledge of TPN calculations. The female physician knew TPN calculation better than make that's might they deal with surgical patients who need TPN. Age and academic qualifications might affect the knowledge of TPN calculations. The higher age, consultant physicians, specialties, and experiences had inadequate knowledge that related might not or rarely prescribe TPN due to no patients demand availability, busy schedule, and dealing with administrative issues. The presence of TPN services, the high number of TPN Orders to appropriate or medium number of patients might have higher knowledge of TPN calculation knowledge. All those factors might encourage the physician to study TPN calculations and gain more understanding. However, not prescribing TPN might increase the calculation knowledge of TPN that might relate to new graduates with fresh knowledge not dealing much with patient's need for TPN. The most dependable factors that might positively affect knowledge calculation of TPN were working site, gender, and the number of patients needed for TPN; the same explained reasons before. In contrast, location, physician qualifications, physician specialties, and number of TPN Orders) that's related if the region does not have enough TPN resources, such as human resources and TPN facilities might negatively affect

the physician's knowledge. Furthermore, physician's qualifications and specialties, such as consultants, non-anesthesia, or non-surgeon who do not deal with TPN, affect the understanding of calculating because they do not prescribe TPN. The number of TPN orders might negatively affect calculation knowledge of TPN related to the inadequate practice of prescribing TPN. Thus, there is no previous investigation to compare with the current findings.

The findings showed the appropriate ability of TPN adjustments for various diseases. Most of the responder's physicians are familiar with adjusting TPT for hepatic and renal failure. However, the lowest knowledge for TPN changed for DM and Burned conditions. The answer was very stage because most TPN is not indicated for hepatics or renal failure. Unless the patient clearly indicated for TPN with a comorbid condition. In other words, most patients receiving TPN can develop hyperglycemia, or patients already suffering from DM needs adjustment of TPN. Besides, burn patients might be indicated, but it is not common in practice. Thus, the results overestimated knowledge of TPN in various diseases. Thus, there is no previous investigation to compare with the current findings.

Various factors might affect the adjusted TPN for different diseases. The location factor might affect the modified TPN knowledge. Such as, the southern region had the lowest knowledge related to insufficiently educated TPN physicians, non-availability of TPN services, no clinical pharmacist specialized in TPN, or the number of patients with comorbid conditions needing TPN. The working site factor might have affected the knowledge of adjusting TPN. For instance, the MOH hospitals and National Guard Hospitals might have related to un-available TPN services at most MOH hospitals and non-available patients required to adjust for TPN for National Guard hospitals. The female physician is more familiar with Adjusted TPN than the male physician; might the female physician more involved in patients requiring adjusted TPN. With the higher age and high academic qualifications, such consultants had the lowest knowledge of adjusting TPN. That might be related to most of them not prescribing TPN and specialists being more involved than consultants in adjusting TPN. The internal medicine and pediatrics had higher knowledge of adjusting TPN because most patients had comorbid symptoms treated by them. Not enough experience within 4-6 years had the lowest understanding of adjusting TPN because they were more experienced and educated to be experts in adjusting TPN. The availability of TPN in healthcare organizations

and the medium number of TPN had more knowledge than others that related to the daily practice of TPN increase the understanding of TPN. In contrast, a higher number of patients might affect the ability to adjust TPN because of workload and properly got mistakes in TPN. The knowledge of adjusting TPN did affect by the previous prescribing of TPN without clear reasons. As mentioned earlier, the most dependable factors that negatively affected the knowledge modified of TPN were physician qualifications, specialties, and the presence of TPN services. In contrast, working sites and gender might have been affected positively with the adjustment of TPN knowledge, as discussed before. Thus, there is no previous investigation to compare with the current findings.

### Limitaions

The current study showed beneficial information about physician's knowledge of calculation and adjustments of TPN for various patients. However, it included several limitations, such as non-randomized techniques used for sampling methods, Leads a wide range of demographic characteristics, and the reliability test reaching optimal level. Figure study with randomized sampling methods and high-reliability test scores were warranted.

### CONCLUSION

The average knowledge of physicians about parenteral nutrition calculation was insufficient. Some essential parts were more deficit knowledge, such as fluid and trace element calculations. In addition, the average understanding of adjusting TPN for various conditions was inadequate. For example, most physicians had a deficit of knowledge of changing calculations for people with diabetes and burn patients. Multiple factors, such as physician qualifications and specialties, might negatively affect the calculation knowledge and adjustment of TPN for disease. In contrast, other factors such as working site and gender might positively affect understanding TPN calculations and adjusted TPN knowledge. Therefore, a review of physician's curricula for undergraduate and postgraduate education to include parenteral nutrition education and training is highly recommended in Saudi medical practice.

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### CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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## Consent for Publications

Informed consent was obtained from all the participants

## Ethical Approval

This research was exempted from research and ethical committee or an Institutional Review Board (IRB) approval.

<https://www.hhs.gov/ohrp/regulations-and-policy/decision-charts-2018/index.html>

## ABBREVIATIONS

**TPNs:** Total Parenteral Nutrition services; **IV:** Intravenous; **MOH:** Ministry of Health; **KSA:** Kingdom of Saudi Arabia; **SPSS:** Statistical Package of Social Sciences; **JASP:** Jeffery's Amazing Statistics Program; **STROBE:** Strengthening the reporting of observational studies in epidemiology statement; **VIF:** Variance Inflation Factor.

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