



## Practice patterns and adherence to nutrition guidelines in acute pancreatitis: An international physician survey



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### ABSTRACT

**Background:** There is agreement among GI society guidelines for recommending early oral nutrition with non-liquid diet in patients with mild acute pancreatitis (AP). There is less agreement regarding administration of tube feedings (TF) in AP. Data on physicians' adherence to nutrition guidelines and practice variations are limited.

**Aims:** To report practice patterns in the nutritional management of different severity profiles of AP.

**Methods:** We conducted an anonymous electronic survey among physician members of the International Association of Pancreatology and the American Pancreatic Association. We assessed nutrition practices based on severity of AP, and asked relevant questions regarding the preferred administration strategies for enteral nutrition. Responses were compared by practice location and subspecialty.

**Results:** A total of 178 physicians, mostly medical pancreatologists (40.4%) and surgeons (34.8%) from Europe (43.4%) and North America (32%) responded. Overall, only 26.7% initiated oral nutrition in mild AP on day 1, 40.9% waited >48 h, and 57.3% initiated nutrition with liquid diets. Physicians reported frequently using TF in patients with moderately-severe (30–75%, depending on the amount and location of necrosis) and severe AP (75–80%). Two-thirds of physicians preferred initiating TF after 48 h, administering it post-pylorically, and using semi-elemental or polymeric formulas. Median TF duration was 11 days (IQR, 7–21). Significant variations were noted based on geographic location and physician subspecialty for several aspects of nutritional practices in both mild and non-mild AP.

**Conclusion:** Adherence to oral nutrition guideline recommendations for mild AP is low. There is significant variability in the use of TF in AP. Our study highlights opportunities for improving consistency of nutrition care in AP and identify potential areas for research.

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### Introduction

Acute pancreatitis (AP) is one of the leading gastrointestinal causes for hospitalization - in 2014, there were 279,145 inpatient admissions for AP in the US alone [1]. The majority of patients with

AP have mild disease, but ~20–30% develop local or systemic complications, and ~1–3% have a fatal outcome [2–4]. For patients with mild AP, early initiation of oral feeding (<48 hours [h]), with soft or solid diets of low- or full-fat content, has demonstrated to shorten hospital stay, reduce healthcare costs, and be equally safe and tolerated than late initiation of feedings or with liquid diets [5–9]. Therefore, GI society guidelines have endorsed early onset of oral nutrition with a non-liquid diet in patients with mild AP [10–14]. Current evidence does not support one non-liquid diet over the others, and thus, guidelines provide different low-level recommendations in this aspect.

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Nutritional support is commonly used in patients with moderately-severe and severe AP [3,15]. There is consensus across society guidelines that enteral tube feedings (TF) should be preferred over parenteral nutrition (PN) in patients with AP who need nutritional support [10–14,16]. However, there is a lack of clarity regarding the timing of TF initiation (i.e. early [ $<48$  h], delayed [48–120 h] or on-demand), route of administration (nasogastric [NG], nasojejunal [NJ]), and the composition of TF (elemental, semi-elemental, polymeric, immune-modulating), primarily due to insufficient evidence to conclude superiority of any one of these interventions over other(s) [17,18]. Hence, while some guidelines recommend administering TF through either a NG or NJ tube, and refrain from recommending a timing of initiation or composition of TF [10,12,13], others are more specific in providing recommendations on first-line TF strategies, such as early onset [11,14,16], NG tube [11], NJ tube [14], monomeric formula [16], or polymeric formula [11].

The heterogeneity across different guideline recommendations provides a rationale to assess the current clinical practice patterns across physicians. This can provide insights into areas where guidance is limited, such as the type of discharge diet in mild AP, the need of TF in specific phenotypes based on severity, and the duration of TF. Furthermore, understanding the variations in practice patterns, overall, by geography and subspecialty practice, may help to identify areas in need for more consistent high quality care, and to generate hypotheses for empiric evaluation in future research studies. Therefore, the objectives of this survey-based study were: 1) report current practice patterns in the nutritional management of patients with AP stratified by severity; and 2) compare nutrition practice patterns based on geographic location and subspecialty practice.

## Materials and methods

### Study design

This study included a prospective two-phase survey instrument development and distribution performed between October, 2017 and November, 2019. The study was approved by the Colorado Multiple Institutional Review Board (COMIRB 18–0634).

### Study population

The target population was physicians with clinical practices focusing on management of patients with AP. For this reason, the source population included active physician members of the International Association of Pancreatology (IAP) and the American Pancreatic Association (APA).

### Survey instrument development

First, a comprehensive literature review informed generation of potentially relevant questions of interest. Next, a mixed-methods approach was used to create the survey instrument. Content validity was established after independent survey review by five international experts in AP. Pilot testing was then performed by ten experts in the field that informed the final version of the survey.

The survey (Supplementary Appendix A) included demographic questions such as practice location, medical specialty, type of clinical practice, years of clinical experience, and yearly volume of AP patients treated in the practice. Content related to nutrition practices in AP consisted of 23-items, which addressed the following domains: practice patterns in patients with mild AP; practice patterns in patients with moderately-severe and severe AP; and route of TF administration, method of tube placement, TF

formula and care after tube placement. Disease severity was defined using the Revised Atlanta Classification [19]. Questions about mild AP centered on the timing and type of initial and discharge oral nutrition. For moderately-severe and severe AP, respondents were asked to report the frequency of TF utilization (from 0 to 100%) in different clinical scenarios of organ failure, degree and location of necrosis. The onset of TF was classified as early (within 24–48 h from presentation), delayed (after 48–72 h of presentation), and on demand (only if failure to tolerate oral nutrition, up to 5–7 days from presentation). The median duration of TF and timing for cross-sectional images after TF initiation were also assessed. Physicians were asked about their preferences for the route of TF (NG, NJ, port-pyloric), placement of NJ tube (radiologically, endoscopically, bedside), and type of formula (elemental, semi-elemental, polymeric, immune-modulating). Finally, responses were recorded on a five-point balanced Likert scale (1 = most influential to 5 = least influential) for factors that influenced the decision for initiating TF in mild AP, and for selecting the route of enteral nutrition (NG vs. NJ).

### Survey distribution and data management

The survey was designed and conducted using REDCap (Research Electronic Data Capture), a secure, web-based application used to support data capture for research studies [20]. The survey was first distributed by e-mail in March 2019. Monthly reminders were sent until November 2019, at which time the survey was closed, and analysis was conducted. To ensure confidentiality, each participant's information was de-identified.

### Statistical analysis

The primary analysis was a descriptive assessment of individual survey response items in different domains. Descriptive statistics were reported as proportions for categorical data, and as median (interquartile range [IQR]) for continuous data. Secondary analysis evaluated differences in survey responses according to practice location (North America vs. Europe) and subspecialty (medical pancreatology vs. surgery). These univariate comparisons were performed using chi-square test (or trend test when appropriate) for categorical data and Wilcoxon rank-sum test for continuous variables. Statistical significance was defined as  $p < 0.05$ . All statistical analyses were performed using Stata/SE version 15.1 (College Station, TX) and missing data was not imputed.

## Results

### Demographic characteristics

A total of 178 physicians responded to the survey (76 Europe, 56 North America, 23 Asia, 13 Latin America, 7 Australia). Most physicians identified themselves as medical pancreatologists (40.4%) and surgeons (34.8%). The majority practiced in an academic hospital (85.4%), with  $>100$  AP hospitalizations yearly (53.1%), and had  $>10$  years of clinical practice experience (72.4%) (Table 1).

### Nutrition practice patterns in mild AP

The majority of physicians start oral nutrition within the first 48 h of admission (59.1%), although only 26.7% feel comfortable starting it at day 1 (Table 2). Most physicians reported reintroducing oral feedings with a liquid diet (clear 40.3%; full 17%), and only about a quarter recommend starting with a solid diet (low fat 21%, regular 4.6%). At the time of discharge, the large majority of respondents recommend a low fat diet (54%). When evaluating factors that lead to

**Table 1**  
Information on clinical practice of survey respondents.

Variable (N = 178)	N (%)
<b>Practice location (n = 175)</b>	
Europe	76 (43.4)
North America	56 (32)
Asia	23 (13.1)
Latin America	13 (7.4)
Australia	7 (4)
<b>Medical subspecialty</b>	
Medical Pancreatology	72 (40.4)
Surgery	62 (34.8)
Other	44 (24.7)
Advanced endoscopy	24 (13.5)
General gastroenterology	12 (6.7)
Other	8 (4.5)
<b>Type of practice</b>	
Academic hospital	152 (85.4)
Community hospital	32 (18)
Private practice	16 (9)
Veteran administration hospital	2 (1.1)
<b>Years in practice (n = 174)</b>	
>20	73 (42.0)
16-20	23 (13.2)
11-15	30 (17.2)
5-10	24 (13.8)
<5	20 (11.5)
Currently in training	4 (2.3)
<b>Yearly AP volume (n = 175)</b>	
>200	24 (13.7)
150-200	29 (16.6)
100-150	40 (22.9)
50-100	48 (27.4)
0-50	33 (18.9)
Unknown	1 (0.6)

AP: acute pancreatitis.

physician decision for initiating TF, physicians place the greatest importance on intolerance to oral nutrition (50.3%) and presence of ileus (18.7%). A majority of physicians reported making a decision to start TF after 3 days of admission (53.5%).

In subset analysis, when compared with Europe, North American physicians were more likely to reintroduce oral feedings with a clear liquid diet (55.6 vs. 23.7%,  $p < 0.0001$ ). With regard to initiation of TF, North American physicians place the most emphasis on intolerance to oral nutrition (59.2% vs. 43.5%), whereas European physicians were more likely to consider persistent systemic inflammatory response syndrome (15.9% vs. 6.1%) and length of stay (14.5% vs. 4.1%,  $p = 0.029$ ). Nutritional practice patterns were mostly similar when stratified by specialty, except that pancreatologists felt more comfortable recommending a low fat diet as the initial type of oral feedings (33.3% vs. 11.3%), whereas surgeons opted more frequently for a full liquid diet (22.6% vs. 9.7%,  $p = 0.013$ ).

*Nutrition practice patterns in moderately-severe and severe AP*

Physicians reported utilizing TF in 80% (IQR, 50–98%) of patients with persistent multiple organ failure, 80% (IQR, 39–98%) with persistent isolated respiratory failure, 75% (IQR, 25–97%) with persistent isolated renal failure, and 75% (30–97%) with >50% pancreatic necrosis without organ failure (Table 3). The proportion of patients in which physicians utilize TF was  $\leq 50\%$  in the absence of organ failure and with peripancreatic or smaller amount of necrosis. The timing for initiation of TF was roughly divided equally (about one-thirds each) between early, delayed and on-demand onset strategies. Upon initiation of TF, physicians report obtaining cross-sectional images at a median of 7 days (IQR, 6–14) and administer TF for a median duration of 11 days (IQR, 7–21).

**Table 2**  
Physician preferences and their nutrition practice patterns in patients with mild AP.

Characteristics	All (N = 178)	Europe (n = 76)	North America (n = 56)	P-value	Pancreatology (n = 72)	Surgery (n = 62)	P-value
<b>Day of starting oral diet (n = 176), n (%)</b>							
1	47 (26.7)	24 (31.6)	16 (29.6)	0.24	21 (29.2)	19 (30.7)	0.51
2	57 (32.4)	19 (25)	22 (40.7)		28 (38.9)	18 (29)	
3	46 (26.1)	26 (32.2)	13 (24.1)		14 (19.4)	18 (29)	
4 or more	26 (14.8)	7 (11.2)	3 (5.6)		9 (12.5)	7 (11.3)	
<b>Type of initial oral nutrition (n = 176), n (%)</b>							
Clear liquid	71 (40.3)	18 (23.7)	30 (55.6)	<0.0001	29 (40.3)	25 (40.3)	0.013
Full liquid	30 (17)	16 (21.1)	4 (7.4)		7 (9.7)	14 (22.6)	
Soft	30 (17)	20 (26.3)	3 (5.6)		10 (13.9)	11 (17.7)	
Low fat	37 (21)	17 (22.4)	14 (25.9)		24 (33.3)	7 (11.3)	
Regular	8 (4.6)	5 (6.6)	3 (5.6)		2 (2.8)	5 (8.1)	
<b>Type of discharge oral nutrition (n = 176), n (%)</b>							
Full liquid	3 (1.7)	1 (1.3)	1 (1.9)	0.12	1 (1.4)	1 (1.6)	0.1
Soft	15 (8.5)	4 (5.3)	2 (3.7)		2 (2.8)	9 (14.5)	
Low fat	95 (54)	35 (46.1)	36 (66.7)		42 (58.3)	30 (48.4)	
Regular	63 (35.8)	36 (47.4)	15 (27.8)		27 (37.5)	22 (35.5)	
<b>Determinant factors of TF use (n = 155), n (%)</b>							
Intolerance to oral nutrition	78 (50.3)	30 (43.5)	29 (59.2)	0.029	31 (47)	30 (56.6)	0.27
Paralytic ileus	29 (18.7)	16 (23.2)	9 (18.4)		13 (19.7)	10 (18.9)	
Persistent abdominal pain	15 (9.7)	2 (2.9)	6 (12.2)		6 (9.1)	2 (3.8)	
Persistent SIRS	18 (11.6)	11 (15.9)	3 (6.1)		6 (9.1)	8 (15.1)	
Prolonged hospital stay	15 (9.7)	10 (14.5)	2 (4.1)		10 (15.1)	3 (5.7)	
<b>Day of starting TF (n = 172), n (%)</b>							
1	9 (5.2)	5 (6.7)	1 (1.9)	0.63	4 (5.7)	2 (3.3)	0.51
2	27 (15.7)	11 (14.7)	7 (13.2)		9 (12.9)	11 (18.3)	
3	44 (25.6)	19 (25.3)	14 (26.4)		23 (32.9)	14 (23.3)	
4 or after	92 (53.5)	40 (53.3)	31 (58.5)		34 (48.5)	33 (55.1)	

TF: tube feedings. Comparisons were performed using chi-square test.

**Table 3**  
Physician preferences and their nutrition practice patterns in patients with moderately-severe and severe AP.

Characteristics	All (N = 178)	Europe (n = 76)	North America (n = 56)	P-value	Pancreatology (n = 72)	Surgery (n = 62)	P-value
<b>Utilization of TF, median % (IQR)</b>							
Persistent multiple OF	80 (50–98)	85 (55–100)	90 (75–98)	0.63	84 (60–99)	80 (50–99)	0.63
Persistent isolated respiratory failure	80 (39–98)	80 (30–99)	86 (75–99)	0.07	78 (39–98)	85 (50–98)	0.32
Persistent isolated renal failure	75 (25–97)	75 (25–100)	75 (34–96)	0.52	73 (25–90)	80 (50–97)	0.23
>50% of pancreatic necrosis without OF	75 (30–97)	75 (30–100)	70 (50–90)	0.63	64 (30–95)	80 (41–97)	0.16
30–50% of pancreatic necrosis without OF	50 (20–95)	50 (15–94)	50 (25–90)	0.82	44 (13–82)	50 (25–90)	0.21
<30% of pancreatic necrosis without OF	30 (10–89)	30 (10–81)	27 (10–85)	0.69	20 (7–80)	39 (19–89)	0.06
Isolated peripancreatic necrosis without OF	30 (10–91)	20 (6–97)	28 (10–81)	0.90	24 (5–79)	30 (10–98)	0.31
<b>Strategy to initiate TF (n = 174), n (%)</b>							
Early onset	58 (33.3)	27 (36.5)	13 (24.1)		19 (26.8)	23 (37.7)	
Delayed onset	51 (29.3)	18 (24.3)	21 (38.9)	0.15	19 (26.8)	25 (41)	0.01
On demand	65 (37.4)	29 (39.2)	20 (37)		33 (46.5)	13 (21.3)	
<b>Timing of cross sectional imaging after initiation of feedings, median days (IQR)</b>	7 (6–14)	7 (5–12)	7 (7–21)	0.16	7 (6–20)	7 (6–10)	0.31
<b>Duration of TF, median days (IQR)</b>	11 (7–21)	10 (7–15)	15 (7–30)	0.004	11 (7–24)	12 (7–21)	0.86

TF: tube feedings; OF: organ failure; IQR: interquartile range.

In subset analysis, the frequency of TF in patients with moderately-severe and severe AP was similar in Europe and North America, and by specialty. Physicians in North America tend to continue TF for a longer duration compared to Europe (median 15 vs. 10 days,  $p = 0.004$ ). On the other hand, medical pancreatologists reported preferring initiation of TF using an on-demand strategy (46.5% vs. 21.3%) more often when compared with surgeons who preferred early onset TF (37.7 vs. 26.8%) ( $p = 0.01$ ).

*Route, method of TF placement, TF formula and care post TF placement*

About two-thirds of physicians prefer administering post-pyloric TF (nasojunal 50.6%, anywhere post-pyloric 13.6%) (Table 4). Among those preferring a NJ route, less pancreatic stimulation (36.7%), better digestive tolerance (31.6%), and a better safety profile (20.2%) were the most influential factors. The majority preferred placing the NJ endoscopically, with (34.9%) or without (33.1%) fluoroscopic guidance. About one-third of physician favored TF via a NG (35.8%). Among them, the most influential factors for this choice were data supporting similar outcomes (38.8%), easy placement (27.7%) and immediate access (12.9%). After excluding 30 participants who did not know the type of TF used in their practice, the majority reported using semi-elemental (38.6%) or polymeric (34.5%) formulas. Re-initiation of oral nutrition after TF was equally distributed between liquid and solid food, with only a small fraction of physicians initiating a regular diet.

In subset analysis, endoscopic placement of an NJ tube was preferred by European physicians when compared to North American physicians (83.8 vs. 52.8%,  $p < 0.001$ ), and by pancreatologists when compared to surgeons (74.3 vs. 57.3%,  $p = 0.012$ ). When the factors that influenced the use of NJ tubes were compared, pancreatologists placed greater importance on reduced pancreatic stimulation (45.7 vs. 22.2%), in contrast to surgeons, who emphasized more on TF tolerance (51.6 vs. 27.3%) ( $p = 0.043$ ). In addition, pancreatologists were more likely to use a semi-elemental formula (45 vs. 32.7%), while surgeons reported higher utilization of immune-modulating formulas (15.4 vs. 0%,  $p = 0.012$ ). Responses from physicians in Asia and Latin America are summarized in Supplementary Table 1; however, their number was small for meaningful comparisons with European and North American physicians.

**Discussion**

Our survey provides a snapshot of the current nutrition practice patterns in AP among an international group of predominantly North American and European physicians from high-volume academic centers. We found variability in several areas of clinical practice, which in part, was explained by geographic location and subspecialty practice. Our observations provide empiric data that may help to identify areas where quality improvement interventions are needed to improve adherence to evidence-based practice guidelines and for future research directions.

Many RCTs have evaluated various aspects of the nutrition of AP patients and their results have been translated into different evidence-based guidelines (Supplementary Table 2) [5–9,17,21–26]. Early reinitiation of oral nutrition with a non-liquid diet is recommended by several published guidelines for mild AP [10–13], with some variability on when to refeed (e.g. within 24 h<sup>10</sup>, as soon as tolerated [11–14]) and the type of non-liquid nutrition (e.g. low-fat soft [11] or solid [12], unspecified [10,13,14]). Quality indicators, that aim to measure the performance of care delivered to AP patients, were recently published by a panel of GI experts, and endorsed by a quality measures committee of the American Gastroenterological Association [27,28]. They propose measuring the percent of adult AP patients who receive oral feeding within 24 h of admission as a quality indicator; however, no threshold has been suggested. There is less agreement among RCTs and guidelines regarding several aspects of enteral TF nutrition in AP [10–14,16]. With regards to the timing of TF initiation, some guidelines recommend early onset [11,14,16], whereas others refrain from making a recommendation based on results of high-quality RCTs [10,12,13,21,22]. Some guidelines recommend administering TF using a NG or NJ tube [10,12,13], based on results from RCTs that do not support one feeding tube over the other [23–25], while other guidelines specifically support a particular approach [11,14]. Most guidelines do not provide recommendations on the composition of TF as a consequence of multiple RCTs showing negative results [10,12,13,26], although some guidelines recommend using monomeric or polymeric formulas [11,16].

We found noncompliance with oral nutrition guidelines in mild AP to be common. Specifically, only 27% of clinicians adhered to early oral nutrition within 24 h and 41% kept patients nil per os for over 48 h. Compliance with initiating a non-liquid diet was also low (43%) and highly variable by practice location, e.g. physicians practicing in North America and surgeons more commonly use a liquid diet first,

**Table 4**  
Physician preferences of the route, method of TF placement, TF formula and post TF placement care.

Characteristics	All (N = 178)	Europe (n = 76)	North America (n = 56)	P- value	Pancreatology (n = 72)	Surgery (n = 62)	P- value
<b>Preferred route of administration (n = 162), n (%)</b>							
NJ	82 (50.6)	36 (50.7)	29 (56.8)	0.32	31 (46.3)	31 (51.7)	0.95
Anywhere past the ligament of Treitz	51 (31.5)	19 (26.8)	21 (41.2)		19 (28.4)	19 (31.7)	
At least 20 cm past the ligament of Treitz	31 (19.1)	17 (23.9)	8 (15.6)		12 (17.9)	12 (20)	
NG	58 (35.8)	25 (35.2)	14 (27.5)		26 (38.8)	21 (35)	
Post-pyloric (anywhere past the pylorus)	22 (13.6)	10 (14.1)	8 (14.3)		10 (14.9)	8 (13.3)	
<b>Most important factor to prefer NG TF (n = 54), n (%)</b>							
Easy placement	15 (27.7)	7 (30.4)	2 (15.4)	0.37	7 (29.2)	5 (26.3)	0.94
Similar outcomes	21 (38.8)	9 (39.1)	7 (53.8)		9 (37.5)	7 (36.8)	
Immediate access	7 (12.9)	5 (21.7)	1 (7.7)		4 (16.7)	2 (10.5)	
Lower cost	9 (16.6)	2 (8.7)	2 (15.4)		3 (12.5)	4 (21.1)	
Similar safety profile	2 (3.7)	0	1 (7.7)		1 (4.2)	1 (5.3)	
<b>Most important factor to use NJ TF (n = 79), n (%)</b>							
Less pancreatic stimulation	29 (36.7)	11 (30.6)	14 (48.3)	0.35	16 (45.7)	6 (22.2)	0.043
Better tolerance of feedings	25 (31.6)	13 (33.3)	11 (37.9)		9 (27.3)	16 (51.6)	
Better safety profile	16 (20.2)	9 (23.7)	5 (16.1)		7 (20.6)	7 (25)	
More comfortable for the patient	7 (8.9)	4 (10.5)	1 (3.3)		3 (8.6)	1 (3.7)	
Convenient outpatient use	2 (2.5)	2 (5.6)	0		0	1 (3.7)	
<b>Insertion method of NJ tube (n = 172), n (%)</b>							
Endoscopically	117 (68.0)	62 (83.8)	28 (52.8)	<0.001	52 (74.3)	60 (57.3)	0.012
With fluoroscopic guidance	60 (34.9)	24 (32.4)	22 (41.5)		30 (42.9)	11 (18)	
Without fluoroscopy	57 (33.1)	38 (51.4)	6 (11.3)		22 (31.4)	24 (39.3)	
Fluoroscopically without endoscopy	32 (18.6)	5 (6.8)	12 (22.6)		12 (17.1)	13 (21.3)	
At the bedside without endoscopy or fluoroscopy	23 (13.4)	7 (9.4)	13 (24.5)		6 (8.6)	13 (21.3)	
<b>Type of TF formula (n = 145), n (%)<sup>a</sup></b>							
Oligomeric or semi-elemental	56 (38.6)	25 (42.4)	19 (41.3)	0.31	27 (45.0)	17 (32.7)	0.012
Polymeric	50 (34.5)	22 (37.3)	15 (32.6)		19 (31.7)	18 (34.6)	
Monomeric or elemental	30 (20.7)	6 (10.1)	10 (21.7)		14 (23.3)	9 (17.3)	
Immune-modulating	9 (6.2)	6 (10.1)	2 (4.4)		0 (0)	8 (15.4)	
<b>Type of oral nutrition after TF (n = 173), n (%)</b>							
Clear liquid	46 (26.6)	13 (17.6)	16 (30.2)	0.039	14 (19.4)	17 (27.9)	0.032
Full liquid	38 (22)	20 (27)	9 (17)		16 (22.2)	14 (23)	
Soft	43 (24.8)	23 (31.1)	7 (13.2)		18 (25)	16 (26.2)	
Low fat	38 (22)	15 (20.3)	17 (32.1)		23 (31.9)	8 (13.1)	
Regular	8 (4.6)	3 (4)	4 (7.5)		1 (1.4)	6 (9.8)	
<b>ER visit due to TF complications (n = 147), median % (IQR)</b>	14 (5–39)	10 (1–20)	30 (15–50)	<0.001	13 (4–30)	11 (7–50)	0.60
<b>Unexpected admission due to TF complications (n = 115), median % (IQR)</b>	10 (2–17)	6 (1–12)	16 (10–30)	<0.001	9 (2–25)	10 (5–16)	0.60

NG: nasogastric; NJ: nasojejunal; TF: tube feedings; ER: emergency room; IQR: interquartile range.

<sup>a</sup> After excluding 30 survey respondents who did not know the type of TF used in their practice.

as compared to European physicians and pancreatologists who were more comfortable starting a soft or solid diet. Potential explanations for practice variation may include personal beliefs regarding the duration of “pancreas rest” needed, caution for exacerbating symptoms, or lack of awareness of current evidence. Other factors may include diversity of hospital protocols, ambiguity in guideline recommendations, delayed translation of evidence into medical care, or reluctance of physicians to comply with guidelines. Tailored interventions may help overcome these barriers to allow wider adoption of evidence-based guidelines. Physician education through wider dissemination of educational material (e.g. mailing of recommendations, mass media, audiovisual material), national conferences, local workshops, e-learning, and opinion leaders, is one of the potential interventions. Benchmarking in this area can be used to conduct audits, to generate performance feedback reports, and to create incentives for high-performers; all of which can enhance quality of care [29]. For this reason, consensus documents and quality indicators should propose minimal thresholds for oral nutrition practices in mild AP, taking into consideration the variability in clinical presentation and course, e.g. patients with ileus or frequent vomiting may not tolerate early non-liquid diet.

In terms of enteral nutrition, we noted that the utilization of TF in patients with moderately-severe and severe AP was high, and it

increased based on the amount of necrosis and presence of persistent organ failure. The lack of universal use of TF in patients with respiratory or multiorgan failure is notable, and may be explained by preferential use of PN, clinical improvement before TF initiation, or the lack of local expertise in enteral nutrition. Ours is the first study to report the proportion of patients across the spectrum of AP severity who receive TF in clinical practice across geographic regions and specialty. In the absence of data, results of this survey may help in setting benchmarks for future guidelines and quality measures for enteral nutrition in moderately-severe and severe AP.

Our results demonstrate variability in three areas of enteral nutrition practices, for which no clear guidelines exist – timing of TF initiation, timing of follow-up cross-sectional images, and duration of TF. The strategy to initiate TF was roughly divided equally between early-onset, delayed onset, and on-demand enteral nutrition; although, medical pancreatologists waited more than surgeons to decide initiation of TF. Preference for delayed or on-demand TF over early TF initiation may be influenced by similar outcomes in RCTs [21,22], safety concerns with early TF [30], and suboptimal methods for early prediction of AP severity [31]. Physicians preferred to obtain cross-sectional imaging at a median of 7 days, and administer TF for a median of 11 days. Physicians in North

American reported continuing TF for a longer duration when compared with their European counterparts. These time points may be aided by results of randomized clinical trials conducted for TF initiation, where frequent oral challenges were offered early, and TF lasted for 1 week [21,22]. Since the Revised Atlanta Classification suggests waiting for ~4 weeks to determine the status of local complications (e.g. transition of acute necrotic collections to walled-off necrosis), performing cross-sectional imaging at 3–4 weeks after presentation, unless warranted otherwise by clinical need, and administering TF for an average of ~4 weeks should be a consideration [15,32].

There are no uniform societal recommendations for the route of TF administration and the type of formula to use [10–14]. About two thirds of physicians reported post-pyloric administration of TF, inserting NJ tubes endoscopically, and using semi-elemental or polymeric formulations, with variations based on practice location and medical subspecialty. When exploring factors guiding the route of administration, physicians opting an NJ route used less pancreatic stimulation and better digestive tolerance as their rationale, although the former is only based on anecdotal evidence and is not evidence-based. In contrast, those preferring NG tubes supported their decision on similar outcomes and easy placement. Potential reasons explaining the preferences for NJ tube insertion method and TF composition may depend on anecdotal experience and local availability of resources. Appropriately powered multicenter RCTs that compare the efficacy, safety, indications, and cost-effectiveness of these TF strategies are needed, however, these are difficult, intense, and expensive to conduct [17].

Our study is not without limitations. We did not have information on the total membership of the APA and IAP, and the fraction of members who are practicing clinicians to calculate the survey response rate to assess for non-response bias. However, we speculate response rate was low, based on a meta-analysis that found low response rate of 38% when using online surveys among healthcare professionals [33]. Participation of physicians from Asia, Australia, or Latin America, and non-academic institutions, was limited, which precluded our ability to conduct meaningful comparisons with other groups, and may affect the generalizability of our results. In the absence of patient level data, it is possible that physician survey responses might not accurately reflect their actual clinical practice patterns, and some practices may be over-represented in our sample due to survey completion by more than one physician. Intrinsic to the use of a cross-sectional survey design is recall and reporting biases, which could have led to misclassification of measurements. Although the survey instrument was rigorously designed, internal consistency and reliability (test-retest or inter-rater) were not measured. Furthermore, the survey was in English and not translated to other languages, which may have caused selection bias and response bias in participants from non-native English speaking countries.

Despite the above limitations, strengths of our study are the inclusion of a large panel of physicians from 5 continents, and systematic evaluation of several nutrition management strategies for different severity phenotypes of AP. The use of a survey design allowed us to efficiently obtain large amounts of real-world data in a short period of time despite the lack of financial support for the study.

In conclusion, most clinicians do not adhere to guidelines for timing of initiation and type of oral nutrition in mild AP, which may potentially delay hospital discharge and increase costs. TF are commonly administered in patients with moderately-severe and severe AP, are usually initiated after 48 h, administered post-pylorically, with semi-elemental or polymeric formulas, and for a median duration of 11 days. Nutrition practice patterns vary based on geographic location and physician subspecialty, which in part

may reflect uncertainties in published literature and guidelines. Since this survey is mostly representative of expert physicians managing patients with AP, our study identifies opportunities for improving consistency of care through education, provides empiric data to inform quality indicators, and hypothesis generating ideas for future research. Future studies using patient level data are needed to confirm the practice patterns and preferences reported in this international survey.

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### Declaration of competing interest

None.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pan.2021.01.001>.

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