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Assessment of perioperative nutrition practices and attitudes—A national survey of colorectal and GI surgical oncology programs

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ABSTRACT

Background: Implementation of evidence-based peri-operative nutrition in the U.S. is poorly described and hypothesized to be suboptimal. This study broadly describes practices and attitudes regarding nutrition screening/intervention in U.S. gastrointestinal and oncologic surgeons.
Methods: Nationwide nutritional practice survey of GI/Oncologic surgical faculty.
Results: Program response rates were 57% and 81% for colorectal and oncology fellowships, respectively. Only 38% had formal nutritional screening processes in place. Average estimated percent of patients malnourished, receiving nutritional screening, and receiving nutritional supplementation preoperatively were 28%, 43%, and 21%, respectively. University-affiliation ($p = 0.0371$) and a formal screening process ($p = 0.0312$) predicted higher preoperative nutritional screening rates. Controversy existed regarding routine use of perioperative immunonutrition, but strong consensus emerged that lack of awareness regarding positive data for immunonutrition impedes usage.
Conclusion: U.S. surgeons recognize importance of perioperative nutritional screening and benefits of basic nutrition therapy. However, limited formal nutrition screening programs currently exist indicating a significant need for implementation of nutrition screening and basic nutrition intervention. Further work on education, implementation and identifying clinical research needs for immunonutrition interventions is also vitally needed.
Summary: This study broadly describes nutritional practices and attitudes of gastrointestinal and oncologic surgeons across the U.S. Surgeons recognize both the importance of proper perioperative surgical nutritional support and the potential value to their practice in terms of outcomes, but this study confirms poor implementation of evidence-based nutrition practices in GI and oncologic surgery programs. This study describes a significant opportunity to capitalize on current favorable surgeon beliefs (and positive published data) regarding the benefit of perioperative nutrition to improve surgical nutrition practice and patient outcomes in the U.S.

1. Introduction

Historically-defining, diagnosing, and treating perioperative malnutrition has been challenging and poorly described. Despite these challenges, it is well-known that sub-optimal nutritional status is a strong independent predictor of poor postoperative outcomes.[1] Malnourished patients have a significantly higher postoperative morbidity, mortality, length-of-stay, readmission rate, and increased hospital costs, especially following major gastrointestinal (GI) and oncologic surgery.[2–4] Appropriate perioperative nutritional therapy has been shown to improve perioperative outcomes in GI/oncologic surgical patients, who often demonstrate the greatest risk of iatrogenic and baseline malnutrition (approximately 65%).[3,5] Strong recommendations from major societal guidelines endorsing preoperative nutrition optimization underscores the importance of appropriate perioperative nutrition practices.[6–8]

Published evidence in European centers suggests that 80% of surgeons are aware perioperative nutrition screening and intervention can reduce postoperative complications.[9] Despite this

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awareness, less than 20% perform preoperative nutrition screening when surveyed.[9] In the U.S., the practice of perioperative nutritional assessment and intervention is poorly described. Thus, an initial description of current U.S. practice and identification of potential areas for improvement are needed.

This study aims to provide an initial description of U.S. perioperative nutrition practice in colorectal and oncologic surgical populations, as this group tends to have the highest described perioperative nutrition risk.[3,5] Utilizing a survey derived and adapted for U.S. surgical practice from previously published European surgical nutrition studies,[9] the specific aims of this study are to: 1) Broadly describe U.S. perioperative nutritional practices and attitudes; 2) Ascertain current U.S. nutritional practices; and 3) Serve as a guide for evaluating local surgical nutritional practices and identify areas for future quality improvement initiatives.

2. Materials and methods

A 24 question survey (Supplemental Appendix 1) was developed from a consensus of key nutrition issues identified by strong recommendations of current nutrition clinical practice guidelines in conjunction with the NIH-supported Colorado Clinical & Translational Sciences Institute (CCTSI) Statistical Core (University of Colorado School of Medicine, Aurora, CO) and reviewed by members of the University of Colorado Interprofessional Nutrition Council to assess 3 major areas related to perioperative nutrition support: 1) Appraisal of local nutritional screening practices; 2) Assessment of nutritional supplementation practices; and 3) Attitudes towards nutrition practice improvement barriers and evidence.[6,10] The survey was piloted and revised with local GI and oncologic surgeons input to identify and reduce potential bias.

A total of 75 potential respondent programs were identified using the American Medical Association's Fellowship and Residency Electronic Interactive Database (FREIDA) by searching for 'Colon and Rectal' and 'Complex General Surgical Oncology' fellowship programs. We focused the study on these programs to provide a convenient and homogenous sample representative of GI surgery, where malnutrition is especially prominent. Moreover, within these programs, we limited surveys to faculty who performed more complex abdominal surgery (such as tumor resections and hepatopancreatobiliary surgery) as these patients are at the highest risk of perioperative malnutrition. The survey was administered to surgeons at their respective programs in September thru November of 2015 in a three-pronged, multi-modal format: phone interview, paper survey, or Web based survey (Survey Monkey® Palo Alto). The modality of communication was tailored to the preference of surgeons in order to maximize response rate, and programs were contacted a minimum of three times. The Colorado Multiple Intuitional Review Board (COMIRB) approved this study with exempt status.

Descriptive statistics were used to analyze aggregated survey results and are expressed as either absolute percentages or frequencies that indicate the percent of respondents who selected a given response. Multiple linear regression analysis was used to identify characteristics that explain estimated percentages of malnourished patients, patients who receive nutritional screening, and patients who receive nutritional supplementation prior to surgery. These characteristics were surgeon type (colorectal surgeon vs. surgical oncologist), annual facility procedural volume (high vs. low annual procedure volume using 400 surgical procedures per facility as a cutoff), university affiliation status (university-affiliated vs. non-university affiliated), and the presence of a formal nutrition screening process (formal screening process in place vs. no formal screening process in place). We hypothesized that surgical oncologists, high-volume centers, university-affiliation, and the presence of a formal screening process would all predict higher estimated percentages of malnourished patients, nutritional screening, and nutritional supplementation prior to surgery. A two-sided Fischer's exact test was used for comparison of categorical variables that related to attitudes and barriers between these same characteristics. Significance was set at a p-value of <0.05 for all analyses.

3. Results

3.1. Survey demographics

Overall, 48 fellowship programs and 54 individual respondents participated in the survey leading to a total program response rate of 64%. 57% of colorectal programs and 81% of surgical oncology programs in the U.S. participated. 61% and 37% of individual respondents were from colorectal and oncology fellowship programs, respectively. 81% and 77% of responding programs identified themselves as high-volume centers and university-affiliated, respectively.

3.2. Characterization of practice and nutritional screening

Our data reveals only 38% of fellowship programs utilize a formal preoperative nutritional screening process. The average estimated percent of patients that: were malnourished, received nutritional screening, and received nutritional supplementation prior to surgery were 28%, 43%, and 21% respectively. Multiple linear regression reveals only university affiliation (p-value $= 0.0371$, b $= 0.224$) and presence of a formal nutritional screening process (p-value $= 0.0312$, b $= 0.201$) predicted a higher use of preoperative nutrition screening.

Surgeons (85%) and dietitians (35%) were most often cited as the responsible party for nutritional screening (Fig. 1). Approximately 40% of respondents took a team approach to nutritional screening (i.e. more than one responsible party addressed nutritional status) while 54% had only one responsible individual.

In the 43% who received pre-operative nutrition screening, this was most often performed in the preoperative outpatient clinic (80%). Postoperatively, when nutrition screening was conducted, it occurred on the surgical ward 50% of the time and less often in the ICU (26%). When screening was performed, the majority (approximately 84%) of respondents were relatively split on either performing screening only prior to surgery or both before and after surgery (Fig. 2).

Clinical parameters, subjective measures, and laboratory values were the most frequent modalities used for nutritional screening. Clinical nutrition scoring tools and biometrical measurements were rarely employed (Fig. 3). Virtually all respondents used a multimodal (two or more screening modalities) approach to nutritional screening.

3.3. Description of nutritional supplementation practices

Respondents indicated nutritional supplements were only given in 21% of patients pre-operatively and 22% post-operative patients. When nutrition supplements were given it was most often given with equal frequency preoperatively in the outpatient clinic or postoperatively on the surgical ward (74% each) and far less often postoperatively in the ICU (41%) or preoperatively upon admission (20%). In rough proportions, one-fourth of respondents supplemented patients only preoperatively, half supplemented both pre- and postoperatively, and one-fourth supplemented only postoperatively (Fig. 2). Protein-containing supplements were the most common nutritional supplement utilized (81%). Only 24% used

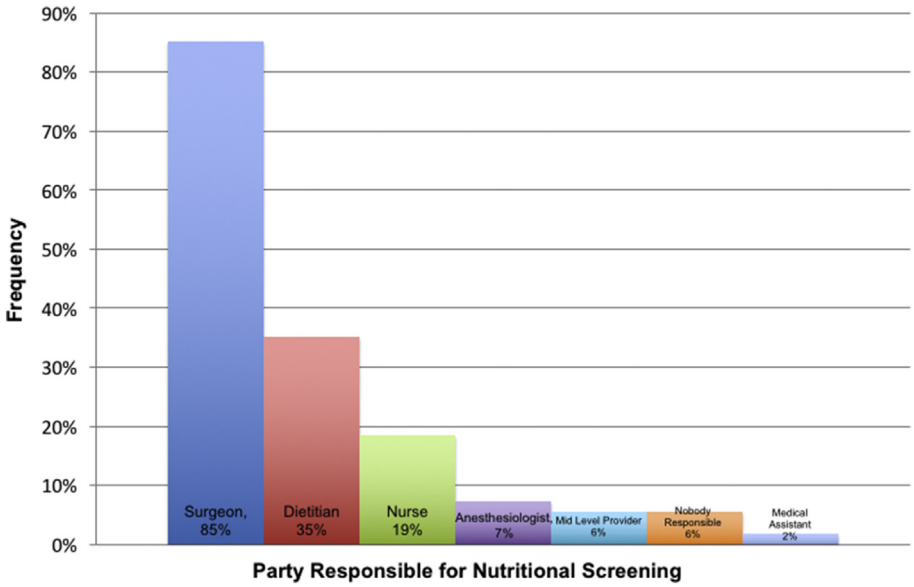

Fig. 1. Who is Responsible for Nutritional Screening. Responsible parties for nutritional screening in clinical practice, represented by the frequency of each party as chosen by survey respondents.

immunonutrition supplements and total parenteral nutrition (TPN) was listed as an additional method of supplementation by 22% of respondents. A minority (2%) of respondents used no nutritional supplementation.

Both the duration and tracking of supplementation efficacy was variable. 11 days or more of supplementation was the most common (31%) time frame, followed by 4–7 days (28%), 8–10 days (22%), and 3 days or less (2%). A sizeable proportion (31%) did not track the success of nutritional supplementation. Lab values (61%) and clinical parameters (50%) were used most often for tracking efficacy (Table 1). A small number of respondents volunteered that they employed databases to track the success of their nutritional interventions.

3.4. Attitudes and barriers related to optimal nutritional practices

Malnutrition was widely recognized as a major problem in GI surgical patients (74% agreement). Most respondents agreed that sufficient evidence supports routine use of preoperative nutritional screening in GI surgical patients (72% agreement) and that

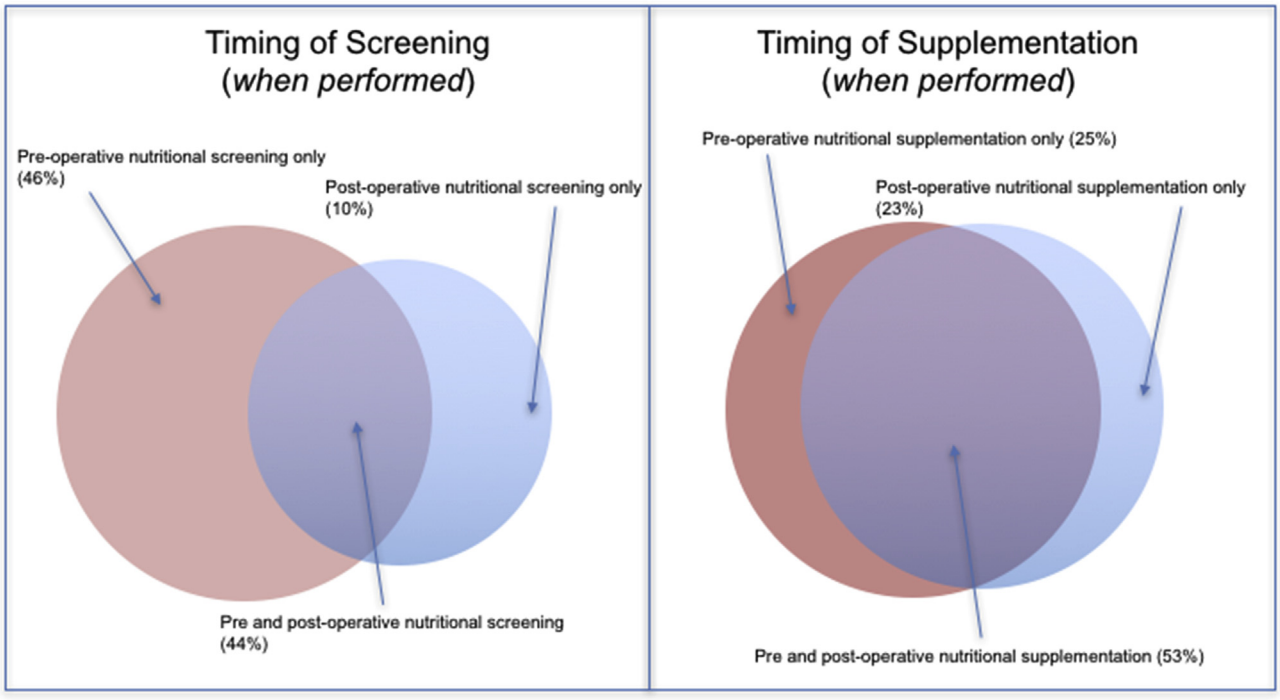

Fig. 2. When Nutritional Screening and Supplementation is Conducted. Venn diagrams showing the timing of both nutritional screening and nutritional supplementation (categorized as pre-operatively only, post-operatively only, pre- and post-operatively, or not performed).

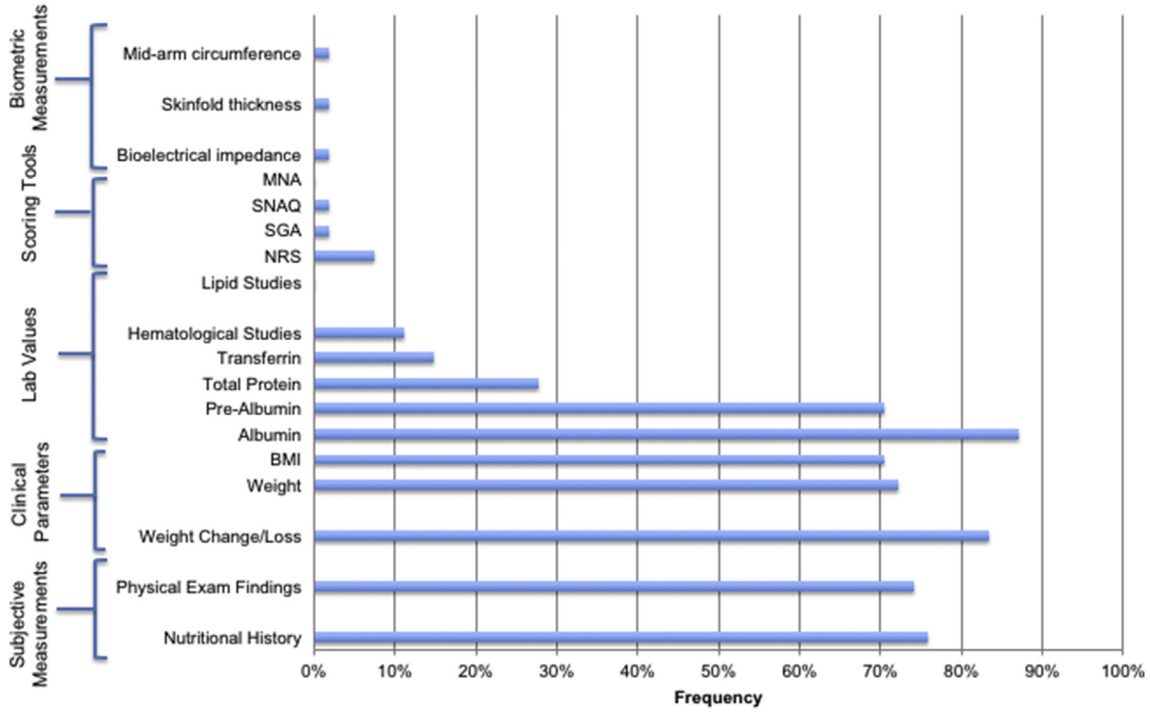

Fig. 3. How Nutritional Screening is Performed. Methods employed during nutritional screening in clinical practice, represented by the frequency of each method as chosen by survey respondents (categorized as biometric measurements, scoring tools, lab values, clinical parameters, and subjective measurements).

preoperative nutritional supplementation reduces the perioperative complication rate (83% agreement) and length-of-stay (74% agreement). Respondents did not concur about barriers to optimal nutritional practices (Fig. 4). Most respondents (81%) believed that a standardized protocol would greatly aid in optimizing nutrition practices. No statistically significant difference was found in attitudes and barriers between respondent characteristics.

3.5. Attitudes and barriers related to use of immunonutrition supplements

Glutamine (72%) and arginine (61%) were the most widely recognized components of immunonutrition. Disagreement emerged regarding evidence and cost-effectiveness to support routine use of immunonutrition prior to major GI surgery. *However, a strong consensus (89% agreement) emerged that a lack of awareness or knowledge about immunonutrition impedes its usage in clinical practice* (Fig. 4). No statistically significant difference was found in responses related to attitudes and barriers between respondent characteristics.

4. Discussion

4.1. Nutritional screening

To our knowledge, this is among the first descriptions of the current state of U.S. perioperative nutrition practice. Our data reveals less then 40% of hospitals with fellowship training in GI or

Table 1
Description of nutritional supplementation practices when supplementation was performed.[a]

	WHEN Are Supplements Given	*WHAT* Supplements are Used Pre-Operatively	*DURATION* of Pre-Operative Supplements	*MONITORING* of Supplementation Efficacy
Most Common ↓ *Least Common*	-Pre-operatively in outpatient clinic (74%) -Post-operatively on surgical ward (74%) -Post-operatively in ICU (41%) -Pre-operatively on admission (20%) -Supplementation is not conducted (0%)	-Protein drinks (81%) -Immunonutrition (24%) -Total parenteral nutrition (22%) -No supplement used (2%)	-11 days or more (31%) -4-7 days (28%) -8-10 days (22%) -No pre-op supplementation used (9%) -3 days or less (2%)	-Lab values (61%) -Clinical parameters (50%) -Success is not tracked (31%) -Physical exam (33%) -Nutritional history or diary (17%) -Biometrical measurements (0%)

NOTE: Respondents indicated nutritional supplements were only given in 21% of patients pre-operatively and 22% post-operative patients.

[a] Percentages refer to the percent of respondents who selected the respective answer choice.

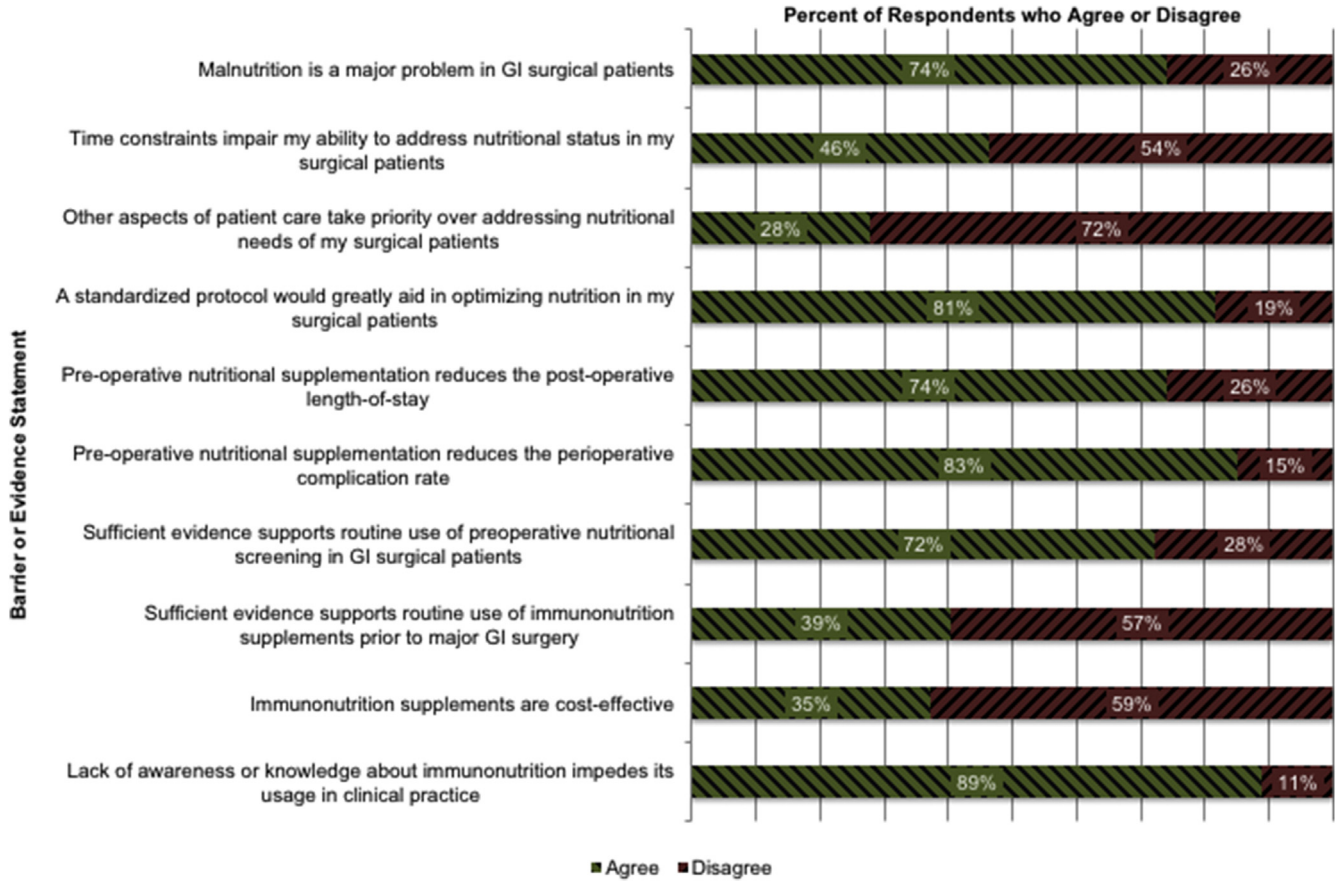

Fig. 4. Assessment of Barriers and Evidence in Nutritional Practice. Selected assessment and barriers to optimal nutritional practice, represented by the percent of respondents who agree or disagree with each barrier or evidence statement. (Color version of figure available online.)

oncologic surgery have a formal nutrition screening process. Further, less then 50% of these often high malnutrition risk patients received any nutrition screening at all at surveyed programs. Perhaps more concerning is the fact the survey focused on dedicated training academic fellowship programs, where it may be reasonable to infer that program directors and surgeons surveyed likely have a greater imperative to employ and teach evidence-based nutrition practices than may occur in non-training centers. Despite this, a majority of programs currently lack a formal nutrition screening process. The average estimated prevalence of malnutrition in respondents' local practice was highly variable, but was consistently lower than published objective and subjective estimates of malnutrition in clinical GI and oncologic surgery of 40%–85% depending on surgical type.[9,11,12] This likely reflects limited physician education in medical school and residency training in identifying malnutrition leading to an underestimation of malnutrition by clinicians. Unfortunately, the average self-reported percentage of patients who received nutritional supplements was lower than the average self-reported percentage of patients who were believed to be malnourished. This likely represents a deficiency in the provision of perioperative nutrition support to those with a clinical indication for such support and an area that could be targeted for improvement. The reported rates of nutritional screening in our U.S. survey are lower than those recently reported in Europe.[9] The lack of consensus on a team approach in addressing nutritional status is consistent with literature demonstrating this continues to be a challenge in U.S. surgical practice.[9,13]

Current evidence emphasizes the importance of nutritional screening as a first vital step in improving outcome. *Patients diagnosed with malnutrition via early screening had shorter length-of-stays, lower complication rates, and lower mortality risk when identified*.[10,14] Despite the relatively low nutritional status screening rates reported here, the wide recognition of the importance of both nutritional screening and malnutrition is consistent with evidence from abroad and encouraging for future improvement of this practice in the U.S.[13]

While the importance of nutritional screening is clearly recognized by U.S. surgeons surveyed, the ideal methods for screening are not widely agreed upon by respondents. Opinions appeared dependent upon many factors including resource availability and local practice.[10] The broad methods of screening (many of which coincide with societal guidelines) and the variable involvement of other professionals reported here supports that nutritional screening would benefit from improved standardization prior to surgery in U.S. colorectal and surgical oncology practice.[1,6] For example, the common use of albumin to screen malnutrition is consistent with evidence-based practice (as preoperative albumin is predicative of postoperative morbidity and mortality) while near negligible use of standardized screening tools like the Nutrition Risk Score (NRS), despite its data-validated ability to predict postoperative morbidity and endorsement from nutrition societies.[6,7] This suggests implementation of screening instruments may be challenging in U.S. surgical practice.[15] Development of surgery-specific tools and programs may be useful avenues for future research.

The “Strong for Surgery” program, which stems from the Surgical Clinical Outcomes Assessment Program (SCOAP) in

Washington state is one such evidence-based, standardized campaign that optimizes surgical patients prior to surgery with a nutrition screening checklist (which incorporates preoperative albumen) as one of the "key areas." The program's success combined with its ease of implementation has led to its 2015 endorsement by the American College of Surgeons to help it gain national adoption. This program has shown nutrition screening need not be difficult or resource intensive and this "turn-key" solution can be replicated at any practice site and it hoped can serve as a potential national standard of care for preoperative nutrition screening.

4.2. Nutrition supplementation practices

The ultimate objective of nutritional screening is to rectify poor nutritional status, as it is among the few modifiable preoperative risk factors associated with poor surgical outcomes, including mortality, in general surgery.[16] Further, perioperative oral or enteral nutrition has been shown to reduce infectious morbidity and mortality.[17] The important role of preoperative nutritional support is clear as a long history of randomized controlled trials and meta-analyses show perioperative nutrition intervention (regardless of route of administration) in malnourished patients prior to GI surgery reduces postoperative morbidity by 20% and postoperative mortality as well.[18] Postoperative nutritional support is often too late to serve as an effective intervention for pre-existing malnutrition, but is vital in maintaining nutritional status during the catabolic postoperative period and underscored by the evidence for early and sustained enteral feeding following surgery as a part of "Fast Track/Enhanced Recover After Surgery (ERAS)" protocols.[19–21] In fact, the advancement of oral intake has been identified as an independent determinant of early recovery in post-colorectal surgery.[22] The majority of respondents supplemented GI surgical patients at least preoperatively, if not both pre- and postoperatively, and is largely consistent with the concept that nutrition support should encompass the entire perioperative period with an increased focus on "prehabilitation".[23–25]

Early recognition and diagnosis of malnutrition prior to GI surgery is a crucial "rate-limiting" step in initiating nutritional support because *the ideal preoperative nutritional supplementation period is at least 7–10 days but should be extended if severe malnutrition is present (even advocating for a delay surgery if necessary) and continue into the postoperative period*.[18] This aligns with the most common reported period of supplementation (11 days or more) in our data. However, only about half of survey respondents supplemented the minimum recommended number of days, less than one-third supplemented beyond 10 days, and at least 30% of patients received nutritional supplementation for 7 days or less (which, in malnourished patients, is likely inadequate). This underscores a need for improving identification of nutritionally at-risk patients and extending the duration of preoperative supplementation.

Moreover, benefit has been demonstrated in certain GI surgical populations with just 7 days of supplementation, which could also explain variation in practice.[23] This shorter pre-operative supplementation data is largely drawn from evidence-based guideline recommendations for "immunonutrition" supplements of 5–7 days preoperatively (a guideline recommendation which is independent of nutrition status in all major GI surgery patients).[24,26] When taken together, this may further explain, at least in part, why 4–7 days was the second most common reported supplementation duration.[27] Accumulating evidence and recent consensus recommendations describe a shift in preoperative nutritional therapy from simply correcting deficiencies in severely malnourished patients to **continuous perioperative "metabolic preparation" in anticipation of surgical stress in *all* patients prior to major surgery**.[24,26] This change in thinking is captured by our findings (72% agreed with "routine" screening in GI surgical patients) and emphasizes the need for better identification of patients who are likely to benefit from nutritional supplementation and should serve as an impetus for routine, standardized screening and supplementation processes akin to other routine preoperative surgical evaluations such as cardiopulmonary risk stratification.[23] Our data, which are consistent with previous findings that surgeons underestimate malnutrition along with our finding that the presence of a formal nutritional screening processes predicted significantly higher success rates of nutritional screening supports the paradigm that nutritional screening leads to better nutritional delivery.

4.3. Use of immunonutrition

Extensive evidence for "immunonutrition" (or arginine-containing) supplements exists showing that this intervention can significantly reduce post-operative infections by ~40% and significantly reduce post-operative length-of-stay by ~2 days.[27] This has been emphasized by a number of larger, higher-quality randomized controlled trials of immunonutrition showing benefit of this intervention in major elective GI and oncologic surgery in studies of 150 to >300 patients.[28–30] Eight different meta-analyses have demonstrated this benefit and more than 30 trials in over 3000 patients have been published (example-ref. 25). It is now well documented in societal guidelines that this nutritional intervention should be a standard of care as a pre- and peri-operative intervention for patients undergoing major GI surgery.[6,7] Illustrating this point, immunonutrition therapy is increasingly becoming a routine component of ERAS protocols and represents a key intervention in the Strong for Surgery program.[3,6,31–34] Unfortunately our data show the use of this well-studied intervention remains exceptionally poor in the U.S. versus other countries. Our results clearly identify a lack of awareness of data supporting preoperative immune-modulating nutrition therapy and doubt about cost-effectiveness as factors impeding usage. This skepticism may be due to confusion with studies showing potential risk in critically ill (largely non-surgical) sepsis patients treated with arginine supplementation.[35] In order to clarify this, as stated above, multiple meta-analyses using this data have been undertaken and *all recent systematic analyses have demonstrated a clear benefit in reduced length of hospital stay, significantly fewer infectious complications (approximate 40% reduction of postoperative infections), and cost effectiveness*.[31,33,36] Despite this compelling data, limited use of immunonutrition in the U.S. persists as emphasized by our survey results. Concerns regarding the use of a single product in many of the trials and need for potentially even larger trials of immunonutrition are proposed as the etiology of the skepticism in some cases. We hope future efforts will focus on quality improvement and implementation projects in conjunction with further education and awareness aimed at improving uptake of this beneficial intervention.

Nutritional education in training healthcare providers is notoriously inadequate, but enhanced training at all levels is also needed to increase future compliance with evidence-based nutrition therapy and supplementation practices.[12] Examples of such educational reforms include enhanced medical school and residency curricula (additional rotations or classes), expanded CME nutrition focusing on actionable practice improvement, and formal advanced training opportunities such as the ACGME-accredited Nestle Nutrition Institute Clinical Nutrition Fellowship endorsed by American Society for Parenteral and Enteral Nutrition and the American Gastroenterological Association.

4.4. Barriers, attitudes, limitations, and future directions

Time constraints or other aspects of patient care were not universally identified as barriers to optimal nutritional support, but our findings were consistent with other studies that identify these factors as barriers.[13,37] Further exploration of barriers and attitudes in perioperative nutritional support would be quite helpful at a local level given the myriad of unique barriers and enablers that influence nutritional care in each local setting. Regardless, our survey indicated reduced length-of-stay and overall complications are widely recognized benefits of nutritional support by GI/oncologic surgeons in the U.S. Our data also identifies employing standardized screening/intervention protocols as an appealing method to improve surgical nutrition practices and such algorithms have already been proposed.[13,38,39] The development of local protocols that address specific practice characteristics could be a blueprint for improving perioperative nutrition on a national level.

An additional future area of focus to improve perioperative nutrition screening and intervention is involvement of governmental and private insurance payers. We have initiated discussions with state Medicaid programs to provide full Medicaid coverage and payment for preoperative nutrition interventions based on existing outcome data for perioperative nutrition screening and intervention. We hope payers nationwide will consider adopting this coverage. We also believe efforts focused on working with hospital administrators to establish perioperative nutrition screening and intervention will bolster the current data demonstrating clinical and cost-effectiveness of surgical nutrition interventions.[31,36] Fig. 5 describes a framework of stakeholders and areas of potential quality improvement and intervention for perioperative nutritional support in the U.S.

A limitation of our survey is non-response bias, but this is mitigated to some degree by our reasonably high response rates. As non-responders likely have a lower prioritization of nutrition evaluation and intervention, this initial description of U.S. perioperative nutrition practice in GI and oncologic surgery likely overestimates the current practice of nutrition screening and intervention nationwide. This likely serves to strengthen our conclusions regarding the need for improved identification and treatment of malnourished patients. Selection bias is also possible, but was minimized by approaching all fellowship programs across the country multiple times to encourage participation. Assuming a positive selection bias, the picture of nutritional practices portrayed here could be similarly less optimal than described. As this study focused on fellowship programs which were largely high-volume academic centers, the conclusions of this study may not be representative or applicable to smaller community practices or practices treating different surgical patient populations. This emphasizes the need for further research describing nutrition practice across a wider range of surgical specialties. Despite these limitations, we believe this study represents the best approximation of the current state of nutritional practices in GI and oncologic surgery across the U.S. and may be useful to evaluate local practice and identify improvement opportunities.

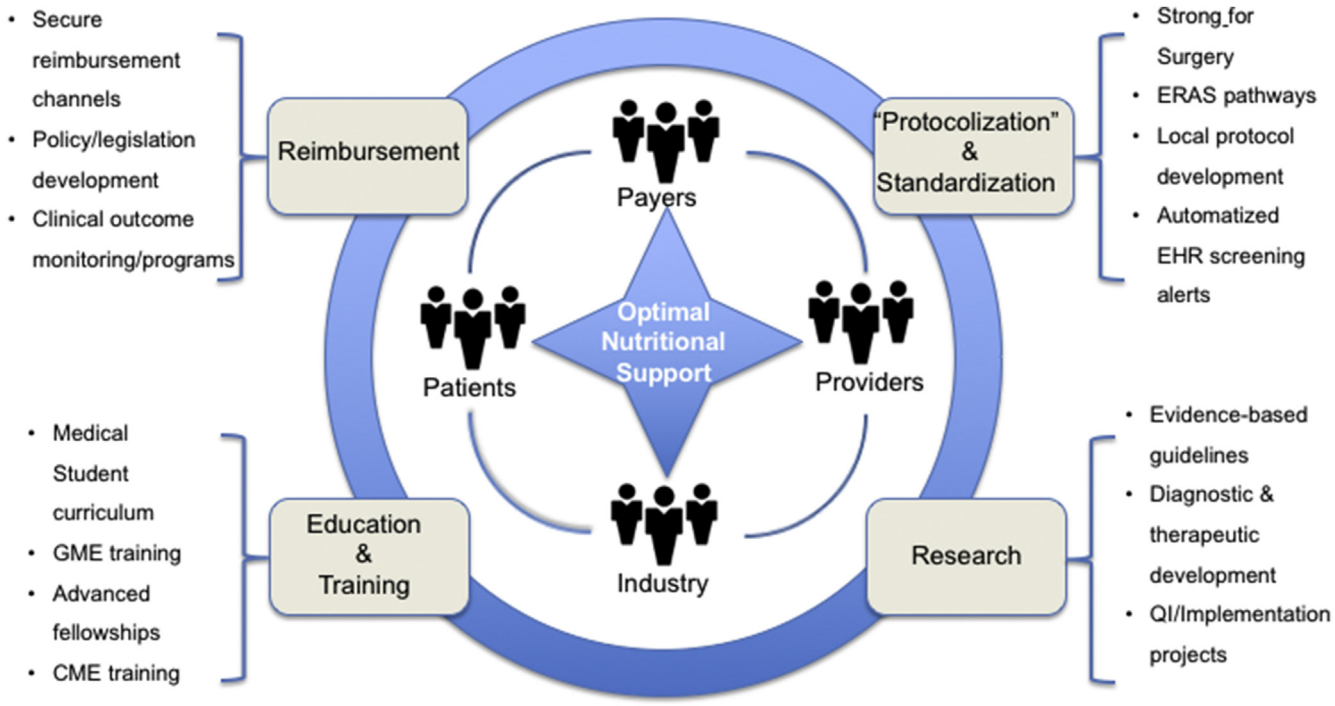

Fig. 5. Framework for Improving Surgical Nutrition Support. A proposed framework to improve nutritional practice that includes key shareholders and highlights actionable activities.

5. Conclusion

In conclusion, surgeons recognize both the importance of proper perioperative surgical nutritional support and the potential value to their patient's outcomes. Despite these beliefs, our data confirms poor implementation of evidence-based nutrition practices in GI and oncologic surgery programs with only four out of every ten U.S. GI surgical and/or surgical oncology patients currently receiving any malnutrition screening at all.

We believe this data demonstrates a significant opportunity to capitalize on current favorable surgeon beliefs (and positive published data) regarding the benefit of basic perioperative nutrition therapy to improve U.S. surgical nutrition practice and outcomes. This will need to be achieved by local and national quality improvement initiatives, such as programs like the ongoing international ERAS initiatives and ACS-endorsed Strong for Surgery being more widely implemented in U.S. centers. We also hope continued efforts to improve governmental and insurer coverage and requirements for implementation of perioperative nutrition practices will be initiated. Finally we hope this data will provide an impetus for further and broader surveys of U.S. perioperative nutrition practice to continue to grow our understanding surgical nutrition practice and provide guidance for future perioperative nutrition research priorities.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.amjsurg.2016.10.008.

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