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Health service nutrition practices and associations with clinical outcomes in patients undergoing resection for upper gastrointestinal cancer: Results from the multi-centre Nourish point prevalence study

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Abstract

Background: The present study aimed to investigate health service nutrition practices of sites providing care to patients undergoing surgery for upper gastrointestinal cancer within Australia, including the provision of perioperative nutrition support services and outpatient clinics, as well as the use of evidence-based nutrition care pathways/protocols. Secondary aims were to investigate associations between the use of a nutrition care pathway/protocol and patient outcomes.

Methods: Principal investigator dietitians for the sites ($n = 27$) participating in the Nourish point prevalence study participated in a purpose-built site-specific survey regarding perioperative nutrition practices and protocols. Data from the 200 patients who participated in the study (including malnutrition prevalence, preoperative weight loss and receipt of dietetics intervention, intraoperative feeding tube insertions, provision of nutrition support day 1 post surgery, length of stay, and complications) were investigated using multivariate analysis to determine associations with the sites' use of a nutrition care pathway/protocol.

Results: The majority of sites (>92%) reported having dietetics services available in chemotherapy/radiotherapy. Eighty-five percent of sites reported having some form of outpatient clinic service; however, a routine service was only available at 26% of sites preoperatively and 37% postoperatively. Most preoperative services were embedded into surgical/oncology clinics (70%); however, this was reported for only 44% of postoperative clinics. Only 44% had a nutrition care pathway/protocol in place. The use of a nutrition care pathway/protocol was associated with lower rates of malnutrition, as well as higher rates of preoperative dietetics intervention, intraoperative feeding tube insertions, and European Society of Clinical Nutrition and Metabolism (ESPEN) guideline compliant care day 1 post surgery.

Conclusions: The results of the present study demonstrate varied perioperative outpatient nutrition services in this high-risk patient group. The use of

nutrition care pathways and protocols was associated with improved patient outcomes.

KEYWORDS

dietitian, gastrointestinal cancer, malnutrition, nutrition care pathway, outpatient

Key points

- Perioperative nutrition support is strongly recommended for patients undergoing surgery for upper gastrointestinal cancer. However, the level of perioperative nutrition services in Australia including the use of outpatient clinics and nutrition care pathways is currently unknown.
- Data from the 27 hospitals, and the 200 patients who participated in the NOURISH point prevalence study was analysed to report on health service nutrition practices in UGI cancer resection, and associations with patient outcomes.
- Results demonstrated inconsistent nutrition support practices, with 44% of sites having an evidence-based nutrition care pathway/protocol in place.
- The use of a nutrition care pathway/protocol was associated with lower rates of malnutrition, and higher rates of preoperative dietetics intervention, intraoperative feeding tube insertions and ESPEN guideline compliant nutrition care day one post surgery.

INTRODUCTION

This Nutritional Outcomes of patients Undergoing Resection for upper gastroIntestinal cancer in AuStralian Hospitals study (the NOURISH point prevalence study) reported that malnutrition prevalence at time of upper gastrointestinal (UGI) cancer surgery was 42%, with 49% of patients reporting clinically significant weight loss in 6 months.¹ Because malnutrition and weight loss are associated with increased morbidity and mortality in patients with cancer,² early identification and treatment is essential to optimise patients' outcomes. However, significant inadequacies and variations in perioperative nutrition care were demonstrated in patients participating in NOURISH, with only 60% reporting seeing a dietitian prior to surgery, and only 50% reporting being prescribed nutrition support prior to surgery.³

The results of the NOURISH point prevalence study demonstrate a clear need for improved identification and treatment of malnutrition in this high-risk patient group. Strategies to improve perioperative care include the funding of dedicated outpatient clinics to enable early access to nutrition assessment, intervention and regular monitoring.⁴ Dietitians should be considered essential members of the multi-disciplinary team, aiming to ensure that nutritional management is addressed appropriately alongside medical care.⁵ Several studies have also demonstrated that implementation of structured nutrition care pathways and protocols can improve adherence to evidence-based nutrition guidelines in several oncology populations, including oesophageal cancer,⁶ lower gastrointestinal surgery,⁷ haematology⁸ and lung cancer.⁹ The European Society of Clinical

Nutrition and Metabolism (ESPEN) surgical guidelines recommend that standard operating procedures/protocols should be utilised to ensure effective provision of nutrition support post surgery.¹⁰ Furthermore, the Enhanced Recovery After Surgery (ERAS) guidelines outline several nutritional recommendations that should be embedded into surgical pathways, including nutrition assessment and provision of nutrition support prior to surgery, as well as early commencement of oral or enteral nutrition postoperatively.¹¹

However, it is currently unknown whether tertiary institutions conducting curative UGI cancer surgery in Australia provide dedicated perioperative nutrition services such as outpatient clinics and what level of service is provided. Furthermore, it is also unknown whether these institutions provide care according to nutrition care pathways or protocols, and whether this is associated with patient outcomes including provision of evidence-based perioperative nutrition care. Therefore, the primary aim of the present study was to investigate health service nutrition practices of sites participating in the NOURISH point prevalence study,¹² including the provision of perioperative nutrition support services and outpatient clinics, as well as the use of evidence-based nutrition care pathways and protocols. Its secondary aims were to investigate associations between the use of an evidence-based nutrition care pathway/protocol and patient level outcomes, including malnutrition prevalence, preoperative weight loss, rates of dietetics intervention and nutrition support, intraoperative feeding tube insertions, ESPEN guideline compliant postoperative nutrition care, and surgical outcomes (length of stay (LOS) and complications).

METHODS

Study design and population

Twenty-seven tertiary hospitals from six of eight Australian states/territories participated in the NOURISH point prevalence study. Prior to beginning patient recruitment for the study, each site's principal investigator dietitian completed a purpose-built survey regarding dietetics practices for the management of UGI surgical oncology patients at their site (see Supplementary File 1). Figure 1 outlines the data utilised in this substudy of the NOURISH point prevalence study.

Site-specific dietetics practices questionnaire

The purpose-built survey was developed by the study's investigators, which included clinical and academic dietitians, as well as an academic surgeon. The survey was piloted on two UGI dietitians to ensure clarity of the survey questions and instructions. The survey was not formally validated because it contained questions that required factual answers only. The survey comprised 42 questions pertaining to: (1) dietitian attendance at the weekly surgical oncology multidisciplinary meeting (MDM); (2) site specific perioperative dietetics services (type of services available before/during/after surgical admission, referral procedures, time allocation per week); and (3) the use of evidence-based nutrition care pathways or protocols (presence of ERAS and nutrition aspects included, presence of nutrition care pathways/protocol and timepoints of commencement/completion of pathway, areas of nutritional management outlined, year of development, and frequency of review). Each site provided identifiable site data to be able to perform data linkage of the site's responses with the site's patient data.

Patient recruitment and data collection

Full descriptions of methodology, inclusion and exclusion criteria, as well as a detailed description of the study's patient population, are available elsewhere.^{1,12} Patients (≥ 18 years)

were eligible to participate if they had undergone curative intent oesophageal, gastric or pancreatic surgery for UGI cancer, were able to consent to participation by English language communication or with the presence of an interpreter, and had received an assessment of nutritional status with Subjective Global Assessment (SGA) by a dietitian within 7 days of surgery. Patients were ineligible if they were unaware of their diagnosis or unable to participate in SGA, or if their surgery was palliative or non-oncological.

Baseline data included in this substudy related to age, sex, tumour stage and nutritional status.¹² The SGA was performed by trained dietitians to determine nutritional status (malnourished [SGA B/C] or well nourished [SGA A]) within 7 days of surgery¹³ because most sites were not funded to perform nutritional assessments prior to surgery. All sites' investigator dietitians performing the SGA utilised a standard protocol and undertook training prior to commencement of the study, as described in the published protocol.¹² Patients' weight was measured using calibrated scales or was patient reported (patients were asked to recall their weight the week before surgery if they could not be weighed at the time of surgery). Patients were also asked to recall information regarding preoperative weights at 2 weeks, 1 month, 3 months and 6 months, with recall data cross-checked where possible from the medical records. Preoperative weight loss was calculated, with clinically significant weight loss set as $\geq 5\%$ in 6 months prior to surgery.¹⁴ The insertion of intraoperative feeding tubes, nil by mouth or fluid 'diet codes' (clear fluids, free fluids) and the use of enteral nutrition, parenteral nutrition or oral nutrition support day 1 post surgery were recorded by dietitians, to determine whether nutrition intervention provided then was compliant with ESPEN recommendations of early nutrition support.¹⁰ Length of stay (in days) post surgery was calculated from the medical record. Surgical complications were recorded as documented by the medical team in the patient's medical entry (sepsis, anastomotic leak, pancreatic fistula, pneumonia/respiratory tract infection, pneumothorax, pressure injury, wound infection, return to theatre, abdominal collection, ileus, chyle leak, gastroparesis and pleural effusion). For analysis, based on the spread of data, complications were reclassified into 'no complication' or ' ≥ 1 complication'.¹

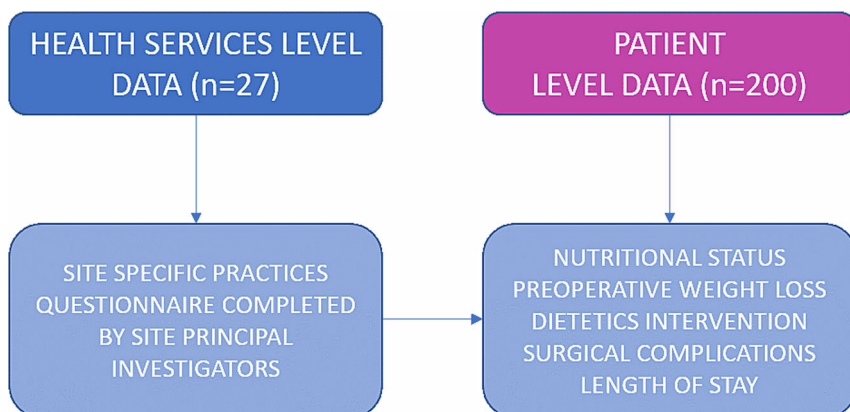


FIGURE 1 Data utilised in the present study

Statistical analysis

A descriptive analysis was undertaken including frequencies and percentages. Multivariate regression models adjusting for age, sex, malnutrition, $\geq 5\%$ weight loss in 6 months, surgical procedure (gastrectomy, pancreatectomy, oesophagectomy), neoadjuvant therapy and tumour stage were utilised to determine associations between the use of a preoperative nutrition care pathway and malnutrition at time of surgery, receipt of preoperative dietetics intervention, preoperative nutrition support, and 1- and 2-month preoperative weight loss. Multivariate regression models adjusting for age, sex, malnutrition, $\geq 5\%$ weight loss in 6 months, use of ERAS protocol within surgical unit, surgical procedure and tumour stage determined associations between the use of a nutrition care pathway and postoperative outcomes. These associations included LOS, surgical complications, intraoperative feeding tube insertions and adherence to ESPEN guidelines for postoperative initial nutrition management. Linear regression was utilised for continuous outcomes, whereas logistic regression was used for binary outcomes. $p < 0.05$ (two-tailed) was considered statistically significant. Statistical analyses were conducted using Stata/IC, version 16.0 (StataCorp LLC).

RESULTS

Site characteristics

Of the 27 hospitals that participated in the study, 92.6% ($n = 25$) were publicly funded and 7.4% ($n = 2$) were privately funded. The majority (92.6%, $n = 25$) were located in a metropolitan area and 7.4% ($n = 2$) were regional. The majority of sites (77.8%, $n = 21$) performed an estimated annual UGI surgical caseload of >30 surgeries per annum, and there were six sites (22.2%) with an annual caseload of 20–30 surgeries per annum.

Patient characteristics

Of the 240 patients screened, 200 consented and participated in the study (all of whom are included in this substudy). Table 1 outlines the baseline characteristics of the patient cohort.

Preoperative and postoperative nutrition practices

Regular dietitian attendance at the surgical oncology MDM was reported in 59.3% ($n = 16$) sites and 22.2% ($n = 6$) reported that the dietitian ‘sometimes’ attended. Five health services (18.5%) reported no dietetic representation at the MDM. Table 2 describes the preoperative and postoperative nutrition practices of sites in terms of oncology and

TABLE 1 Patient baseline characteristics ($n = 200$)

Variable	<i>n</i>	%
Age (years), mean (SD) ^a	67 (10)	
Sex (<i>n</i> , %)		
Male	117	58.0%
Female	83	42.0%
Surgery type (<i>n</i> , %)		
Oesophagectomy	66	33.0%
Gastrectomy	50	25.0%
Pancreatectomy	84	42.0%
Tumour stage (<i>n</i> , %)		
T0	15	7.5%
T1	44	22.0%
T2	49	24.5%
T3	63	31.5%
T4	14	7.0%
TX	2	1.0%
Unknown/unassessed	13	6.5%
Nutritional status (<i>n</i> , %)		
Well-nourished	116	58.0%
Malnourished	84	42.0%

^aContinuous data are expressed as the mean (SD).

outpatient clinic services provided. Sites consistently reported higher levels of service in the postoperative setting than in the preoperative setting.

Nutrition pathways and protocols

Forty-four percent of sites reported having an ERAS protocol in place in their UGI surgical unit; however, nutrition components of ERAS were not consistently utilised at these sites (Table 3). Similarly, 44% reported having a formal nutrition care pathway or protocol, with the majority (58.3%) of pathways commencing at initial cancer diagnosis and treatment planning. Figure 2 demonstrates the components of nutritional management outlined in the care pathways at these 12 sites.

Associations between nutrition care pathways and protocols, and patient outcomes

Of the 200 patients who participated in the point prevalence study, 86 (43%) received dietetics care at a site that had a nutrition care pathway which commenced in the preoperative period, whereas 97 (49%) received

TABLE 2 Preoperative and postoperative nutrition practices

Variable	Preoperative setting		Postoperative setting	
	<i>n</i>	%	<i>n</i>	%
Dietetics services in chemotherapy ^a				
Routine service	6	23.1%	8	30.8%
Processes in place to see high risk patients	14	53.8%	14	53.8%
Referrals only	4	15.4%	4	15.4%
No service	2	7.7%	0	0.0%
Dietetics services in radiotherapy ^b				
Routine service	9	39.1%	10	43.5%
Processes in place to see high risk patients	7	30.4%	8	34.8%
Referrals only	6	26.1%	5	21.7%
No service	1	4.3%	0	0.0%
Outpatient clinic				
Routine service for all UGI surgical oncology patients	7	25.9%	10	37.0%
Processes in place to see high risk patients	3	11.1%	11	40.8%
Referrals only	13	48.2%	2	7.4%
No service	4	14.8%	4	14.8%
Location of outpatient clinic ^c				
Clinic embedded in surgical/oncology or preadmission clinic	16	21.7%	10	43.5%
Dietetics stand-alone clinic	5	69.6%	12	52.2%
No set location, ad hoc or phonecalls	2	8.7%	1	4.3%
Main referral procedure to nutrition service ^c				
Referrals by other MDT members	16	69.6%	1	4.3%
Dietitian screens patients	3	12.0%	21	91.3%
Screening by dietitians and referrals from MDT members	2	8.7%	0	0.0%
No set referral process	2	8.7%	1	4.3%
Hours per week for UGI outpatient service ^c				
<1 h per week	12	52.2%	4	17.4%
1–2 h per week	9	39.1%	13	56.5%
3–4 h per week	2	8.7%	5	21.7%
>6 h per week	0	0.0%	1	4.3%
Referrals to other outpatient dietetics services postoperatively ^d				
Private dietitians	NA	NA	5	18.5%
Community health service dietitians	NA	NA	9	33.3%
Other health service	NA	NA	8	29.6%
Rarely refer to other services	NA	NA	12	44.4%

Abbreviations: NA, not available; MDT, multi-disciplinary team; UGI, upper gastrointestinal.

^aPresented as a proportion of sites who had chemotherapy services at their site (*n* = 26).

^bPresented as a proportion of sites who had radiotherapy services at their site (*n* = 23).

^cPresented as a proportion of sites who had an outpatient service for UGI surgical oncology patients at their site (*n* = 23).

^dParticipants could select multiple response options.

TABLE 3 Nutrition pathways and protocols

Variable	n	%
ERAS protocols in place		
Yes	12	44.4%
No	15	55.6%
Nutrition components of ERAS ^a		
Immunonutrition	5	41.7%
Carbohydrate loading	10	83.3%
Preoperative nutrition advice	4	33.3%
Formal nutrition care pathway or protocols		
Yes	12	44.4%
No	14	51.9%
Unsure	1	3.7%
Timepoint that pathway/protocol commences ^b		
Initial cancer diagnosis and treatment planning	7	58.3%
Preadmission clinic	2	16.7%
At the start of the surgical admission	3	25.0%
Timepoint that pathway/protocol is completed ^b		
At the end of the surgical admission	7	58.3%
1–3 months after surgery	2	16.7%
3–6 months after surgery	2	16.7%
> 12 months after surgery	1	8.3%
Duration of pathway being in place ^b		
< 2 years	2	16.7%
<5 years	6	50.0%
5–10 years	3	25.0%
> 10 years	1	8.3%
Frequency of pathway review ^b		
Never	1	8.3%
Annually	1	8.3%
Every 2 years	2	16.7%
> Every 2 years	3	25.0%
When required	4	33.3%
Unsure	1	8.3%

Abbreviation: ERAS, Enhanced Recovery After Surgery.

^aPresented as a proportion of sites who had ERAS protocols ($n = 12$), participants could select multiple options.

^bPresented as a proportion of sites who had nutrition care pathways/protocols in place ($n = 12$).

care at a site that had a nutrition care pathway including the postoperative period (surgical inpatient admission until surgical discharge). Table 4 presents patient level data assessed using multivariate regression analysis to determine the association of receiving care at a site with a

nutrition care pathway and patient outcomes including malnutrition, preoperative weight loss, receipt of preoperative dietetics intervention/nutrition support, feeding tube insertions and receipt of ESPEN guideline compliant postoperative nutrition care. Patients who received care at a site with a preoperative care pathway were less likely to be malnourished on admission for surgery ($p = 0.048$) and more likely to receive preoperative dietetics intervention ($p = 0.036$). A postoperative nutrition care pathway was associated with a higher likelihood of receiving an intraoperative feeding tube insertion ($p = 0.018$) and a higher likelihood of receiving care that was compliant with ESPEN guidelines ($p < 0.05$ for all three guideline recommendations assessed).

DISCUSSION

Perioperative nutrition services

Over 80% of sites in the present study reported some form of perioperative dietetics service available to patients undergoing UGI cancer surgery. However, less than half of sites reported a routine outpatient service for this high-risk population, indicating that service and referral procedures still require improvement. Platek et al.¹⁵ conducted a study of Comprehensive Cancer Centres in the USA and found that, although nutrition services were available, 77% reported that services for patients with gastrointestinal cancer were referral/consult-based only. Prior research demonstrates that malnutrition risk may not always be appropriately identified in oncology patients and referrals to dietitians by other healthcare professionals may be missed or delayed.^{16,17} A recent survey of surgeons demonstrated that 44% did not arrange any form of preoperative nutrition consultation for patients undergoing pancreaticoduodenectomy.¹⁸ Interestingly, in the present study, almost half of sites reported a referral-only based outpatient service preoperatively; however, this dropped to less than 10% for the postoperative setting with most sites reporting a routine service or procedures in place to see high-risk patients. This could be a result of dietitians being able to self-refer patients to postoperative services from the surgical admission (91% vs. 12% preoperatively) and increased funding of postoperative services. Historically, there has been a stronger focus on ‘rehabilitation’ than ‘prehabilitation’ in elective abdominal surgery,¹⁹ and the majority of sites reported a higher number of hours per week allocated to postoperative dietetics services than for the preoperative setting. In a recent study of multi-disciplinary Australian UGI clinicians, 77% of respondents felt that lack of funding for dietitians was a barrier for providing optimal outpatient nutrition support services. Given the strong recommendations for perioperative nutrition assessment and intervention,¹⁰ it

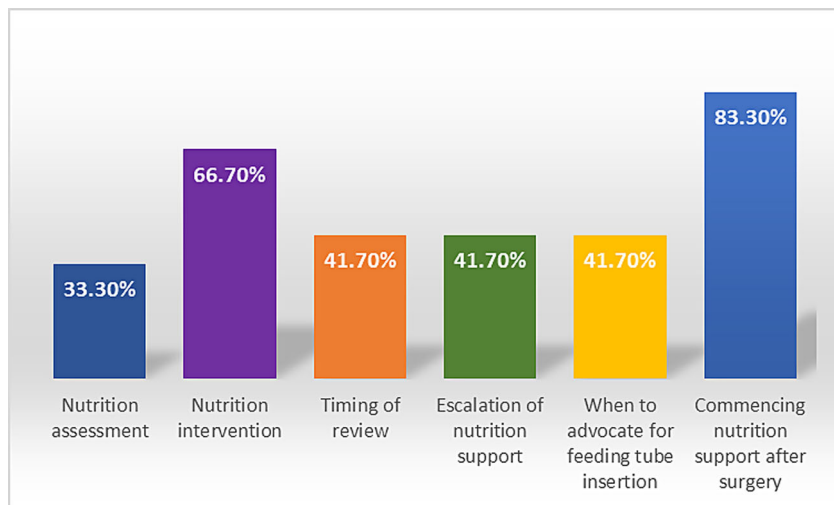


FIGURE 2 Components of nutrition management outlined in the nutrition care pathways of sites ($n = 12$)

is concerning that 15% of sites in the present study reported no outpatient services before or after surgery. However overall, the results of the present study are more positive compared to the results of previously conducted surveys of Australian UGI dietitians over 7–10 years ago, which estimated significantly lower outpatient service provision to this population.^{4,20}

We have previously demonstrated that receiving neoadjuvant therapy was associated with greater likelihood of receiving preoperative dietetics intervention,³ which is supported by the results of this study demonstrating that the vast majority of sites had dietetics services available in the chemo/radiotherapy settings. However, only 23% and 39% of sites reported having a routine service for the preoperative chemotherapy and radiotherapy settings, respectively, with 31% and 43% for the postoperative chemotherapy and radiotherapy settings. The ESPEN recommendations outline that patients undergoing oncological treatment for UGI cancers are considered at high risk, and that all patients should receive dietetics assessment.²¹

Management of nutritional status should be performed in parallel with the oncology pathway and should be performed collaboratively between members of the multi-disciplinary team.²² The Australian Optimal Care Pathways for UGI cancers outline the dietitian as an essential member of the multi-disciplinary team who should be present at surgical oncology MDM meetings.⁵ Over 50% of sites reported regular dietitian attendance at these meetings, whereas 22% reported irregular attendance and 19% reported no attendance. In a large European survey of oncology surgeons, only one-third of respondents reported that dietitians/nutritionists attend the MDM.²³ There are several advantages of dietetics care being provided in a multi-disciplinary outpatient clinic setting. Patients often require medications for symptom control, which require prescription by a medical practitioner. Furthermore, collaborative discussions regarding early screening of patients, escalation

of nutrition support and insertion of enteral feeding tubes can facilitate more timely and proactive care.²² Seventy percent of preoperative dietetics services were co-located within a surgical/oncology or preadmission clinic, which is encouraging because patients can present with significant nutritional issues at diagnosis that may require multidisciplinary management.^{24,25} However, this was the case for only 43% of postoperative clinics. Considering that many patients report significant weight loss and ongoing symptoms after surgery,²⁶ it is surprising that multidisciplinary nutrition care is not continued postoperatively at some sites and this could be seen as an area for service improvement.

Nutrition care pathways and protocols

Less than half of sites in the present study reported having any form of nutrition pathway or protocol in place for nutrition in UGI cancer surgery. The study by Platek et al.¹⁵ also found that 46% of participating centres reported utilising a standard nutrition protocol for gastrointestinal cancer outpatients. In terms of the impact on patient outcomes in the present study, a 50% risk reduction of malnutrition at the time of surgery was demonstrated for patients who received care under a preoperative nutrition care pathway/protocol, which may be because patients were also more likely to receive preoperative dietetics intervention. Although not statistically significant, patients who received care under a nutrition care pathway also lost less weight in the immediate preoperative period than those who did not. This is not surprising given that we have previously reported that receiving ≥ 3 preoperative dietetics appointments was associated with lower percentage weight loss because a nutrition care pathway can create a structured approach to nutrition reviews enabling ongoing monitoring and adjustment of intervention.³ Previous studies have also demonstrated a reduction in malnutrition rates and

weight loss when a nutrition care pathway was implemented in an oncology population.^{27,28} Receiving care under a pathway/protocol was not associated with receiving preoperative nutrition support, and this could be a result of other health care professionals administering nutrition support such as oral nutrition supplements without the involvement of a dietitian,³ particularly at sites with limited dietetics services.

Improved compliance with ESPEN guidelines for early oral intake and nutrition support were demonstrated at sites where dietitians implemented nutrition care pathways/

TABLE 4 Associations between nutrition care pathways and protocols and patient outcomes

Variable from patient NOURISH patient level data	No nutrition care pathway	Nutrition care pathway	Multivariate analysis OR (95% CI)	<i>p</i> -value
Malnutrition at time of surgery^a				
No	55 (53.4)	61 (62.9)		
Yes	48 (46.6)	36 (37.1)	0.5 (0.3, 0.9)	0.048
Preoperative dietetics intervention^a				
No	49 (48.5)	29 (30.2)		
Yes	52 (51.5)	67 (69.8)	2.2 (1.1, 4.5)	0.036
Preoperative nutrition support^a				
No	53 (52.0)	45 (47.4)		
Yes	49 (48.0)	50 (52.6)	0.9 (0.5, 1.8)	0.878
1 month weight loss ^{a,b}	2.4 (3.2)	1.9 (2.5)	-0.4 (-1, 0.8)	0.554
2 weeks weight loss ^{a,b}	1.2 (2.1)	1.1 (2.1)	-0.2 (-1.1, 0.7)	0.659
Length of stay ^{c,d}	14 (8.8, 18)	10 (8, 15)	2.5 (-1.1, 6.2)	0.170
Complications^c				
No	64 (62.1)	51 (52.6)		
Yes	39 (37.9)	46 (47.4)	1.4 (0.7, 2.3)	0.366
Intraoperative feeding tube insertion^c				
No	64 (64.0)	40 (42.1)		
Yes	36 (36.0)	55 (57.9)	2.9 (1.2, 6.9)	0.018
ESPEN guideline followed day 1 post surgery^{c,e}				
No	66 (64.1)	38 (39.2)		
Yes	37 (35.9)	59 (60.8)	3.5 (1.6, 7.9)	0.002
EN/PN started if NBM day 1 post surgery^c				
No	45 (59.2)	30 (39.0)		
Yes	31 (40.8)	47 (61.0)	3.5 (1.3, 9.3)	0.012
ONS/EN/PN started day 1 post surgery^c				

(Continues)

TABLE 4 (Continued)

Variable from patient NOURISH patient level data	No nutrition care pathway	Nutrition care pathway	Multivariate analysis OR (95% CI)	<i>p</i> -value
No	65 (63.1)	36 (37.1)		
Yes	38 (36.9)	61 (62.9)	4.0 (1.8, 9.0)	0.001

Note: Bold *p* values indicate statistical significance.

Abbreviations: CF, clear fluids; CI, confidence interval; EN, enteral nutrition; FF, free fluids; NBM, nil by mouth; ONS, oral nutrition support; OR, odds ratio; PN, parenteral nutrition.

^aThis analysis assessed data from sites who had a preoperative nutrition care pathway in place versus those sites that did not. Each variable adjusted for age, sex, tumour stage, surgery type, neoadjuvant therapy, presence of malnutrition and $\geq 5\%$ weight loss in 6 months in multivariate regression models.

^bContinuous data expressed as the mean (SD), multivariate regression coefficient.

^cThis analysis assessed data from sites who had a postoperative nutrition care pathway in place versus those sites that did not. Each variable adjusted for age, sex, tumour stage, surgery type, ERAS procedure in place in surgical unit, presence of malnutrition and $\geq 5\%$ weight loss in 6 months in multivariate regression models.

^dContinuous data expressed as the median (interquartile range), multivariate regression coefficient

^eEarly oral intake or EN/PN commenced day 1 post surgery according to ESPEN guidelines.

protocols. This is not surprising given that 83% of the 12 sites reported that their pathway outlined standardised guidelines for commencing nutrition support after surgery. Standardised protocols have been shown to improve nutrition support prescription in other clinical areas, including the intensive care setting.²⁹ Given the strong evidence for ERAS protocols in major abdominal surgery,¹¹ it is surprising that only 44% of sites had ERAS protocols implemented within their surgical unit and, of those, only 33% included preoperative nutrition advice. Further quality improvement is required to embed nutrition protocols within existing ERAS protocols.

Implications for practice and future research

In high-risk settings such as UGI surgical oncology, preoperative nutrition screening and intervention should be a fundamental component of dietetics care. However, as demonstrated in the present study and the aforementioned studies, finite resources and competing priorities for these resources mean that this is not always the case. Nutrition care pathways and dedicated outpatient clinics require an investment of funding for dietitians, and this is largely considered to be a main reason why improved services have not been facilitated despite the evidence for early and sustained nutrition support in surgical oncology. However, given the healthcare costs associated with malnutrition, the reduction of malnutrition rates demonstrated presents a strong argument for a potential cost benefit of implementation. Findlay et al.³⁰ implemented

an evidence-based model of nutrition care for patients with head and neck cancer that resulted in improved nutrition care according to guideline recommendations, including early access to nutrition assessment and intervention. A cost saving of \$121,000 AUD per annum was demonstrated, which was attributed to a reduction of unplanned hospital admissions.³⁰ Similar interventional studies in the UGI setting would be beneficial to demonstrate cost benefit savings and enable advocacy for resource allocation for preoperative services. Well-conducted randomised controlled trials would also assist in the development of UGI specific nutrition guidelines outlining the most optimal type, timing and frequency of care to be provided, enabling further standardisation of nutrition care across health services and settings.⁴ These studies should include an analysis of barriers and enablers to implementation, aiming to ensure that evidence is directly translatable into clinical practice.

Strengths and limitations

The strengths of the present study include the detailed reporting of 'real world' nutrition services available to UGI surgical oncology patients across Australia, as well as the ability to investigate the impact of site-specific nutrition support practices with patient level outcomes. Although only participating NOURISH point prevalence study sites were included, they include representation from six of eight Australian states/territories. The results would likely be generalisable to other Australian and international health services, including the UK and Canada, where dietitians are actively involved as members of multi-disciplinary oncology care. However, the results may not be generalisable to European health services, where nutrition models of care vary. To our knowledge, this is the first study to demonstrate improved adherence to evidence-based perioperative nutrition recommendations when nutrition care pathways are utilised in a large UGI surgical cohort. We also accounted for the use of ERAS protocols in the analysis, further demonstrating the benefits of nutrition protocols embedded into dietetics and surgical care. The self-reported nature of sites' practices by dietitians is a limitation; however, the survey was completed by principal investigator dietitians who were UGI leads and well placed to be able to report on UGI nutrition practices within their individual sites. Practices may have also changed at some sites during the course of patient recruitment, and adherence to nutrition care pathways was not assessed. Because of the low number of privately funded hospitals ($n = 2$), we were unable to investigate differences between private and public hospitals. Finally, the study was powered for malnutrition prevalence precision (the primary aim of the main study) and not for the outcomes analysed in this substudy which could influence the statistical significance of the results in this substudy.

CONCLUSIONS

The present study demonstrates that preoperative outpatient dietetics services in UGI cancer are varied and most sites do not provide a routine preoperative service to all UGI surgical oncology patients despite recommendations. Postoperative outpatient services were reported to have more streamlined referral systems and funding allocation to service high-risk patients than preoperative services. The use of nutrition care pathways and protocols was associated with lower rates of malnutrition, preoperative dietetics intervention and ESPEN guideline compliant postoperative nutrition care. Further research should be conducted in a randomised trial setting to provide strong evidence to form UGI specific nutrition guidelines.

AUTHOR CONTRIBUTIONS

Irene Deftereos is the coordinating investigator and conceptualised the study. Nicole Kiss, Justin M. C. Yeung, Elizabeth Isenring and Vanessa M. Carter contributed to the study conception and design. Irene Deftereos drafted and edited the study protocol and manuscript. Nicole Kiss, Justin M. C. Yeung, Vanessa M. Carter and Elizabeth Isenring assisted with the study protocol and edited the manuscript. Janan Arslan and Irene Deftereos performed the statistical analysis. Members of the NOURISH Point Prevalence Study Group provided feedback on the study protocol and manuscript, carried out the study recruitment and data collection. All authors have read and approved the final version of the manuscript submitted for publication.

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CONFLICTS OF INTEREST

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ETHICS STATEMENT

Ethics approval was obtained from The Peter MacCallum Cancer Centre Ethics Committee (LNR/51107/PMCC-2019). Patient recruitment was conducted between 2 September 2019 and 30 May 2020 with data collection completed on 30 June 2020.

TRANSPARENCY DECLARATION

The authors affirm that this manuscript is an honest, accurate and transparent account of the study being reported. The authors affirm that no important aspects of the study have been omitted and that any discrepancies from the study as planned have been explained.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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