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Malnutrition risk in elective surgery patients and effectiveness of preoperative nutritional interventions at a pre-anaesthetic clinic: a 4-year apart, single-centre, observational study

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Abstract

Background: Approximately 44% of all patients hospitalised for an elective surgical procedure have a malnutrition risk. In this study, we assessed the prevalence of malnutrition risk at a pre-anaesthetic clinic and the feasibility of introducing nutritional support. The primary objective of this study was to assess malnutrition risk prevalence in patients referred to a pre-anaesthetic clinic.

Methods: This was a prospective observational study. The study was divided into two phases: one in 2020 and the other in 2023. Consecutive patients scheduled for an elective surgical procedure at a pre-anaesthetic clinic were asked to participate in the study by filling out the questionnaire. We divided the patients into two groups based on the GLIM criteria.

Results: We included a total of 467 patients, including 214 from 2020 and 253 from 2023. In the total sample, 93 (19.9%) patients met the GLIM criteria for malnutrition risk, and 37 (7.9 %) fulfilled the ESPEN criteria for preoperative nutritional support. Out of 93 patients at malnutrition risk, 41 (44%) had BMI > 25 kg m^{-2}. The number of patients with indications for preoperative nutritional support in all departments remained similar across both time points. However, the number of patients receiving preoperative ONS almost doubled over the study period (36.8% in 2020 vs. 72.2% in 2023).

Conclusions: Malnutrition risk was consistently high among our elective surgery patients. Not all patients with indications for preoperative nutritional support received it. As such, pre-anaesthetic clinics might be one of the major links in the nutritional programme chains of hospitals.

Key words: nutrition, preoperative assessment, preanesthetic clinic, malnutrition, GLIM.

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Approximately 44% of all patients hospitalised for an elective surgical procedure have a malnutrition risk [1]. However, this prevalence varies depending on the malnutrition criteria and screening tools used [2]. In surgery patients, preoperative malnutrition is associated with an increased postoperative complication risk, increased mortality and medical expenditure, as well as a long hospital stay [3].

Several easy-to-use malnutrition screening tools have been used to identify patients with malnutrition risk; they include the Nutritional Risk Score 2002 (NRS-2002) and Subjective Global Assessment (SGA). Some tools are aimed to diagnose the malnutrition, for example Global Leadership Initiative on Malnutrition (GLIM) criteria, which was published recently [4]. The GLIM criteria offer a simple assessment of malnutrition based on the occurrence of specific phenotypical and etiological characteristics. In patients confirmed to have malnutrition, the evaluation of their potential qualification for preoperative nutritional support is performed according to the European Society for Clinical Nutrition and Metabolism guidelines [5].

According to Polish national guidelines, every patient scheduled for an elective surgical procedure should be referred to a pre-anaesthetic clinic for assessment and optimisation. Patients must visit this clinic at least 7 days before the procedure; this period between the clinic visit and the procedure is typically sufficient for administering nutritional intervention without postponing the procedure. However, studies on the role of pre-anaesthetic

clinics in the preoperative nutritional support chain are lacking.

In this study, we assessed the prevalence of malnutrition risk at a pre-anaesthetic clinic and the feasibility of introducing nutritional support. The primary objective of this study was to assess malnutrition prevalence in patients referred to a pre-anaesthetic clinic. The secondary objectives were as follows:

- To assess the preliminary nutritional support in patients scheduled for an elective surgical procedure before their pre-anaesthetic clinic visit.
- To audit the changes in patient nutritional status at the pre-anaesthetic clinic in 2020 and 2023.
- To assess the pre-anaesthetic clinic's feasibility for preoperative nutritional support introduction and monitoring.

METHODS

This was a prospective observational study approved by the Ethical Committee of the Medical University of Lublin (KE-0254/8/2020). The study was divided into two phases: one in 2020 and the other in 2023.

Consecutive patients scheduled for an elective surgical procedure at a pre-anaesthetic clinic were asked to participate in the study by filling out the questionnaire. This questionnaire collected data including their demographic characteristics (sex, age, weight, and height), primary condition, type of scheduled surgical procedure, department [surgery, gynaecology, maxillofacial, and other (e.g., vascular or ophthalmology department)], oncological status, non-volitional preoperative body weight loss (in kg; as observed by the patient), time of observed preoperative body weight loss in months, history of eating difficulties, medical history, use of nutritional support before the pre-anaesthetic clinic visit [oral nutritional support (ONS), enteral nutritional support, or parenteral nutritional support]. The patients' laboratory results that were available at the pre-anaesthetic clinic visit were also recorded.

We divided the patients into two groups based on the GLIM criteria. In particular, the patients who met at least one phenotypical GLIM criterion and at least one etiological GLIM criterion were included in the malnourished group, whereas the remaining patients were included in the non-malnourishment risk group. Patients were indicated preoperative nutritional interventions on the basis of the European Society for Clinical Nutrition and Metabolism (ESPEN) criteria for severe nutritional risk:

1. Weight loss = 10–15% within 6 months
2. Body mass index (BMI) < 18.5 kg m^{-2}
3. SGA Grade C or NRS > 5
4. Serum albumin < 3 g dL^{-1} (without any hepatic or renal dysfunction evidence)

All data were collected in Microsoft Excel sheets (Microsoft, Redmond, WA, USA). Categorical variables, presented as numbers (frequencies), were analysed using the χ^2 test. Continuous variables were first tested for normal distribution using the Kolmogorov-Smirnov test with the Lilliefors modification. All non-normally distributed variables, presented as medians and interquartile ranges (IQRs), were analysed using the Mann-Whitney *U* test. All statistical calculations were performed using Statistica 13.3 (StatSoft, Tulsa, UT, USA). A *P*-value of ≤0.05 was considered to indicate statistical significance.

RESULTS

We included a total of 467 patients, including: 214 from 2020 and 253 from 2023. The study population included 339 (72.6%) women, and the median age was 53 years. Moreover, 217 (46.5%), 189 (40.5%), 37 (7.9%), and 27 (5.8%) patients were scheduled for elective surgical procedures in

TABLE 1. Patient demographic characteristics in 2020

Factor	Study population ($N = 214$)	Malnourished patients ($n = 48$)	Non-malnourished patients ($n = 166$)	*P*-value
Age (years)	54 (42–66)	56 (37.5–67.5)	54 (43–66)	0.87
Women	160 (74.8%)	31 (64.6%)	129 (60.3%)	0.09
Weight (kg)	73 (63–88.5)	65 (55–72)	74.5 (66–87.5)	< 0.001
BMI (kg m^{-2})	26.5 (22.8–30.4)	22.7 (19.9–26.5)	27.4 (24.2–31.1)	< 0.001
Percent weight loss (%)	0 (0–3)	8 (5–13)	0 (0–0)	< 0.001
Patients with cancer	50 (23.4%)	21 (43.8%)	29 (17.5%)	< 0.001
Departments				
Surgery	112 (52.3%)	33 (68.7%)	79 (47.6%)	
Gynaecology	85 (37.8%)	13 (27.1%)	72 (43.4%)	
Maxillofacial	17 (7.9%)	2 (4.2%)	15 (9%)	

Age, weight, BMI, and percent weight loss are presented as medians (interquartile ranges), whereas the remaining values are presented as numbers (percentages). Significance is set at $P < 0.05$.

TABLE 2. Nutritional assessment results in 2020

Factor	Study population ($N = 214$)	Malnourished patients ($n = 48$)	Non-malnourished patients ($n = 166$)	*P*-value
Available albumin test results (%)	34 (15.9%)	16 (33.3%)	18 (10.8%)	< 0.001
Albumin (g dL^{-1})	4.3 (4–4.5)	4.3 (3.5–4.5)	4.3 (4.1–4.5)	0.51
Protein (g dL^{-1})	6.87 (6.55–7.43)	6.77 (6.37–7.3)	7.08 (6.69–7.51)	0.075
Days between pre-anaesthetic clinic visit and surgery	12 (7–14)	8 (5–13)	12 (8–14)	< 0.005
Patients on ONS before pre-anaesthetic clinic visit	7 (3.3%)	5 (10.4%)	2 (1.2%)	< 0.001
Patients with indications for ONS (%)	19 (8.9%)	19 (39.6%)	0 (0%)	< 0.001
Patients indicated to receive ONS based on departments				
Surgery	112 (52.3%)	16	0	
Gynaecology	85 (37.8%)	2	0	
Maxillofacial	17 (7.9%)	1	0	

Albumin, proteins, and days between pre-anaesthetic clinic visit and surgery are presented as medians (interquartile ranges), whereas the remaining values are presented as numbers (percentages). Significance is set at $P < 0.05$.
ONS – oral nutrition supplements

TABLE 3. Patient demographic characteristics in 2023

Factor	Study population ($N = 253$)	Malnourished patients ($n = 45$)	Non- malnourished patients ($n = 208$)	*P*-value
Age (years)	53 (39–65)	56 (44–70)	52 (39–64)	0.14
Women	179 (70.7%)	27 (60.0%)	129 (73.1%)	0.80
Weight (kg)	75 (62–87.5)	73 (65–89)	75 (62–87.5)	0.87
BMI (kg m^{-2})	26.6 (23.6–31.3)	25.8 (23.9–30.4)	26.9 (23.5–31.3)	0.63
Patients with cancer	66 (26.1%)	25 (55.6%)	41 (19.7%)	< 0.001
Departments				
Surgery	105 (41.5%)	31 (64.5%)	74 (35.6%)	
Gynaecology	104 (41.1%)	10 (22.2%)	94 (45.2%)	
Maxillofacial	20 (7.9%)	3 (6.7%)	17 (8.2%)	
Other	27 (7.5%)	1 (2.2%)	26 (12.5%)	

Age, weight, BMI, and percent weight loss are presented as medians (interquartile ranges), whereas the remaining values are presented as numbers (percentages). Significance is set at $P < 0.05$.

the surgery, gynaecology, maxillofacial, and other departments, respectively.

In the total sample, 93 (19.9%) patients met the GLIM criteria for malnutrition, and 37 (7.9 %) fulfilled the ESPEN criteria for preoperative nutritional support. In the surgery, gynaecology, maxillofacial, and other departments, 64 (29.5%), 23 (12.2%), 5 (13.5%) and 1 (5%) patients had malnutrition, respectively; moreover, 28 (12.9%), 7 (3.7%), 2 (5.4%), and 0 (0%) met the preoperative nutritional support criteria, respectively.

As presented in Table 2, the median albumin levels in both patient groups were within the normal range (3.5–5.5 g dL^{-1}); they did not demonstrate any significant between-group differences. However, the median protein level in both groups was above the normal range (6.2–8.0 g dL^{-1}); the between-group differences were nonsignificant. In patients with malnutrition, the duration between the pre-anaesthetic clinic visit and surgery was significantly shorter than that in patients without malnutrition risk.

Of the 48 patients with malnutrition, 14 (29.1%) had a BMI of > 25 kg m^{-2}. The main indication for preoperative nutritional support was non-volitional preoperative body weight loss, which was observed in 17 (89.5%) patients. Finally, 3 (15.8%) patients had a BMI of < 18.5 kg m^{-2}, but no patients had an albumin level of < 3.0 g dL^{-1}.

As indicated in Table 4, the difference in the availability of presurgical albumin test results between the patient groups was nonsignificant. In both groups, the median albumin levels were within the normal range without any significant between-group differences. However, the median protein levels were above the normal range; nevertheless, the median protein levels were higher in patients with malnutrition than in those without malnutrition. The between-group difference in the median duration between the pre-anaesthetic clinic visit and

TABLE 4. Nutritional assessment in 2023

Factor	Study population ($N = 253$)	Malnourished patients ($n = 45$)	Non-malnourished patients ($n = 208$)	*P*-value
Available albumin test results (%)	42 (16.6%)	11 (24.4%)	31 (14.9%)	0.11
Albumin (g dL^{-1})	4.4 (4.2–4.8)	4.5 (3.7–4.8)	4.4 (4.3–4.8)	0.46
Protein (g dL^{-1})	7.2 (6.88–7.62)	7.52 (7.22–7.88)	7.1 (6.82–7.46)	0.05
Days between pre-anaesthetic clinic visit and surgery	9 (7–12)	9 (7–11.5)	10 (8–12)	0.12
Patients on ONS before pre-anaesthetic clinic visit	13 (5.1%)	10 (22.2%)	3 (1.4%)	< 0.001
Patients with indications for ONS (%)	18 (7.1%)	18 (40.0%)	0 (0%)	< 0.001
Patients indicated to receive ONS based on departments				
Surgery	105 (52.3%)	12 (66.6%)	0	
Gynaecology	104 (37.8%)	5 (27.8%)	0	
Maxillofacial	17 (7.9%)	1 (5.6%)	0	
Other	27 (10.7%)	0	0	

Albumin, proteins, and days between pre-anaesthetic clinic visit and surgery are presented as medians (interquartile ranges), whereas the remaining values are presented as numbers (percentages). Significance is set at $P < 0.05$
ONS – oral nutrition support

TABLE 5. Comparison of patient demographic characteristics in 2020 and 2023

Factor	Study population ($N = 467$)	2020 ($n = 214$)	2023 ($n = 253$)	*P*-value
Age (years)	53 (40–66)	54 (42–66)	53 (39–65)	0.58
Women	339 (72.6%)	160 (74.8%)	179 (70.7%)	0.33
Weight (kg)	74 (62.5–86)	73 (63–88.5)	75 (62–87.5)	0.38
BMI (kg m^{-2})	26.6 (23.3–30.8)	26.5 (22.8–30.4)	26.6 (23.6–31.3)	0.38
Percent weight loss (%)	0 (0–3)	0 (0–3)	0 (0–3)	0.65
Patients with cancer	116 (24.8%)	50 (23.4%)	66 (26.1%)	0.49
Departments				
Surgery	217 (46.5%)	112 (52.3%)	105 (52.3%)	
Gynaecology	189 (40.5%)	85 (37.8%)	104 (43.4%)	
Maxillofacial	37 (7.9%)	17 (7.9%)	20 (9%)	
Others	27 (5.8%)	0	27 (10.7%)	

Age, weight, BMI, and percent weight loss are presented as medians (interquartile ranges), whereas the remaining values are presented as numbers (percentages). Significance is set at $P < 0.05$.

surgery was nonsignificant. Compared with the 2020 data, the median duration increased by 1 day in the malnourishment group and decreased by 2 days in the non–malnourishment risk group in 2023.

Of the 45 patients with malnutrition risk, 27 (60%) had a BMI of >25 kg m^{-2}. The main indication for preoperative nutritional support was non-volitional preoperative body weight loss, which was observed in all 18 (100%) patients. Moreover, 1 (5.5%) patient had a BMI of < 18.5 kg m^{-2}, and one had an albumin level of 2.7 g dL^{-1} (i.e., < 3.0 g dL^{-1}).

As presented in Table 5, the differences in most of the demographic characteristics between the 2020 and 2023 patients were nonsignificant. Nevertheless, in 2020, patients with malnutrition had significantly lower weight and BMI than those in 2023 [65 (55–72) vs. 73 (65–89) kg ($P = 0.003$) and 22.7 (19.9–26.5) vs. 25.8 (23.9–30.4) kg m^{-2} ($P = 0.002$), respectively].

As shown in Table 6, both median albumin and protein serum levels were significantly higher in patients from 2023 than in patients from 2020. Nevertheless, at both timepoints, the median levels were within the normal range. The median duration between the pre-anaesthetic clinic visit and surgery significantly decreased by 3 days from 2020 to 2023, but malnutrition occurrence remained similar (21% in 2020 vs. 19% in 2023). Furthermore, the number of patients with indications for preoperative nutritional support in all departments remained similar across both time points. However, the number of patients receiving preoperative ONS almost doubled over the study period (36.8% in 2020 vs. 72.2% in 2023). In 2020, of 16 patients from the surgery department

TABLE 6. Comparison of nutritional assessment between 2020 and 2023

Factor	Study population ($N = 467$)	2020 ($n = 214$)	2023 ($n = 253$)	*P*-value
Available albumin test results (%)	76 (16.3%)	34 (15.9%)	42 (16.6%)	0.84
Albumin (g dL^{-1})	4.4 (4.0–4.6)	4.3 (4–4.5)	4.4 (4.2–4.8)	0.03
Protein (g dL^{-1})	7.1 (6.7–7.5)	6.87 (6.55–7.43)	7.2 (6.88–7.62)	0.02
Days between pre-anaesthetic clinic visit and surgery	10 (7–13)	12 (7–14)	9 (7–12)	0.02
Patients with malnutrition	93 (19.9%)	45 (21.0%)	48 (19.0%)	0.58
Patients on ONS before pre-anaesthetic clinic visit	20 (4.3%)	7 (3.3%)	13 (5.1%)	0.32
Patients with indications for ONS (%)	37 (7.9%)	19 (8.9%)	18 (7.1%)	0.49
Patients with indications receiving ONS before the pre-anaesthetic clinic visit	20 (54%)	7 (36.8%)	13 (72.2%)	0.03
Patients indicated to receive ONS based on departments		2020 ($n = 19$)	2023 ($n = 18$)	
Surgery	217 (46.5%)	16 (84.2%)	12 (66.6%)	0.26
Gynaecology	189 (40.5%)	2 (10.6%)	5 (27.8%)	0.23
Maxillofacial	37 (7.9%)	1 (5.2%)	1 (5.6%)	1
Other	27 (5.8%)	0	0	

Albumin, proteins, and days between pre-anaesthetic clinic visit and surgery are presented as medians (interquartile ranges), whereas the remaining values are presented as numbers (percentages). Significance is set at $P < 0.05$.
ONS – oral nutrition support

indicated receiving nutritional support, 6 (37.5%) received ONS before surgery, whereas in 2023, all 12 (100%) of 16 patients from the surgery department indicated receiving nutritional support received preoperative ONS. In all patients, their cancer status was the major determinant of malnutrition risk.

DISCUSSION

According to the current results, nearly 20% of all patients referred to our pre-anaesthetic clinic had malnutrition according to the GLIM criteria, and almost 8% of all patients required preoperative nutritional support. A study reported that up to 38% of patients met the malnutrition criteria before elective surgery [6], comparable to the 29.5% observed in our surgery department patients. Arman *et al*. indicated that nearly half of the patients with malnutrition risk have a BMI of > 25 kg m^{-2}. In our malnutrition group, 41 (44.1%) patients had a BMI of > 25 kg m^{-2}, and this number almost doubled from 2020 ($n = 14$) to 2023 ($n = 27$). In patients classified as overweight or obese by the World Health Organization, malnutrition risk, which requires a comprehensive assessment of nutritional status, often remains undiagnosed [7]. Considering that only 1 in 10 patients with malnourishment are identified in the hospital, even fewer patients receive appropriate nutritional support [8]. In the current study, the malnutrition risk in patients from departments other than the surgery department was lower than that in patients from the surgery department. Furthermore, 12.9% of the patients from the gynaecology department met the GLIM criteria. This finding is corroborated by a previous finding that 10% of gynaecology department patients with reported non-volitional body weight loss preoperatively met the GLIM criteria; this weight loss leads to a prolonged hospital stay and an increased postoperative complication risk [9]. Thus, appropriate protein intake is essential during the perioperative period [10].

Of all our patients, 37 (7.9%) met the ESPEN criteria for preoperative nutritional support; of them, 20 (54.1%) received it before visiting the pre-anaesthetic clinic. Preoperative ONS is a well-established method used to reduce malnutrition-related complication risk before elective surgery [11]. Among our patients, the prevalence of ONS being administered before the pre-anaesthetic clinic visit almost doubled from 2020 to 2023; however, almost half of the patients with indications for it did not receive it. One of the reasons for this might be the cost of preoperative ONS; the cost plays a major role in therapy adherence, and ONS can be expensive for some patients [12]. Another reason may be related to the general lack of nutritional screening programmes in medical practice. Only 38% of gastrointestinal and oncology departments have official nutritional screening programmes at their facilities; this also explains the extremely low malnourished patient identification rate [13]. Finally, nearly 80% of physicians agree that they have difficulty in identifying patients at nutritional risk; moreover, 78% have difficulties in arranging nutritional programmes at their centres [14]. Without proper identification of patients' nutritional risks, implementing preoperative nutritional support can be

challenging. Research focused on the development of markers to better identify patients with malnutrition risk is underway [15]. Nevertheless, regardless of their indications and malnutrition risks, introducing preoperative ONS can be beneficial to patients with cancer and improve their outcomes [16].

At 5 years apart, we observed some improvements in the population of patients referred to the pre-anaesthetic clinic. As mentioned above, the number of patients receiving ONS almost doubled over time (Table 6). In the study hospital, few steps have been taken to improve patient nutritional status before elective surgery. According to the Polish national guidelines, since 2012, every elective surgery patient admitted to a hospital must receive a nutritional assessment using the NRS-2002 or SGA scale. Furthermore, the study hospital reduces the potential risk of missing the preoperative malnutrition status of its patients by including the NRS-2002 scale in its pre-anaesthetic questionnaire administered during the patients' medical examination. Moreover, for elective surgery patients who require preoperative nutritional support but do not receive it at least 7 days preoperatively, surgeons discuss and decide on whether postponing surgery is a relatively safe option for the patient and whether introducing preoperative nutritional support at this stage is feasible and beneficial. Academic interest in preoperative nutrition is increasing: we found 6400 articles related to preoperative nutrition in our PubMed database search in 2020; by 2023, this number has increased to 8126. This increase in interest may aid in gaining an overall improved understanding of the importance of reducing malnutrition risk in surgery patients. Taken together, the aforementioned factors may be the reason underlying the improved nutritional status of patients admitted to the study hospital.

Although our patients from 2020 to 2023 demonstrated similar malnutrition risks, there were a few differences. Both albumin and protein levels were significantly higher in 2023 than in 2020. Moreover, in 2023, protein levels were higher in patients with malnourishment risk than in those without malnourishment. However, this result may be skewed because, in the study hospital, patients are assessed thoroughly before they are referred to a pre-anaesthetic clinic, and patients who have an impaired nutritional status are not qualified for an elective surgical procedure until their nutritional status improves. In other words, only patients in a better overall condition are qualified and referred to the pre-anaesthetic clinic. Another result supporting this assumption is the reduction in the median duration between the pre-anaesthetic clinic visit and surgery, most probably due to improved internal hospital protocol designs.

Finally, we assessed the feasibility of introducing and monitoring preoperative nutritional support at the pre-anaesthetic clinic. In the study hospital, the pre-anaesthetic clinic, which opened in 2018, partially participated in patient nutritional support. Nevertheless, one of its main roles is preoperative reversible condition identification and treatment [17]. The nutritional assessment and indications for preoperative nutritional support mainly require adequate medical history taking and anthropomorphic measurements. In the pre-anaesthetic clinic, all GLIM criteria – except body mass, measured using validated body composition measuring techniques – can be assessed. The ESPEN recommendations for introducing preoperative nutritional support are also, in most cases, assessable through comprehensive medical history taking and physical examination, followed by the measurement on the SGA scale [5]. Preoperative albumin levels were unavailable for most of our patients; additionally albumins and protein levels are not widely accepted as parameters of malnutrition anymore. A drop in the serum albumin is primarily a parameter of the acute phase or liver failure. Nevertheless, the only patient with albumin < 3.0 g dL^{-1} also met the preoperative body weight loss criterion. All 37 patients who met the ESPEN criteria fulfilled either low BMI or low non-volitional body weight criterion, and body weight loss was the most commonly fulfilled criterion. The median duration between the pre-anaesthetic clinic visit and surgery was shorter in 2023 than in 2020; nevertheless, the median duration of 9 days in 2023 was a sufficient window for introducing preoperative ONS. According to the ESPEN guideline, nutritional support intervention for 7–14 days is beneficial. Finally, all 17 patients who, despite indications, did not receive nutritional support before the pre-anaesthetic clinic visit received ONS recommendations with instructions at the pre-anaesthetic clinic visit.

This study has some limitations. First, we collected most of the data directly from the patients; therefore, some values, such as those of preoperative body weight loss and duration, may have been inaccurate. Moreover, because only approximately 62.5% of all surgery patients are typically referred to pre-anaesthetic clinics, our results may not be generalisable to all patients undergoing elective surgical procedures. Furthermore, because the study hospital is in the process of improving its nutritional programmes, some of the 2023 data, including malnutrition risk prevalence, may be inaccurate and inapplicable to all elective surgery patients. Finally, we did not perform a follow-up assessment to assess whether the patients complied with the recommended nutritional support until surgery.

CONCLUSIONS

Malnutrition risk was consistently high among our elective surgery patients. However, not all patients with indications for preoperative nutritional support received it. As such, pre-anaesthetic clinics might be one of the major links in the nutritional programme chains of hospitals. Implementing programmes to improve nutritional assessment, particularly in prehospital facilities such as pre-anaesthetic clinics, may aid in administering appropriate presurgical nutritional support.

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