

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

186,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Nutritional Support in Dysphagia

Vishal G. Shelat and Garvi J. Pandya

Additional information is available at the end of the chapter

<http://dx.doi.org/10.5772/61243>

1. Introduction

Dysphagia is defined as difficulty in swallowing. It is commonly caused due to neuromuscular (stroke, dementia, Parkinson's disease, myasthenia gravis, etc.), mechanical (oral cancer, oesophageal cancer, etc.), or other causes (radiotherapy treatment, gastroesophageal reflux disease, thrush, etc.). It risks aspiration and associated bronchopulmonary infections, fluid depletion, and under nutrition. It can alter nutritional equilibrium and can affect organ function and ultimately clinical outcome. To improve clinical outcomes, it is important to screen all at risk patients in order to identify patients at nutritional risk due to dysphagia [1–4]. Most dysphagia resolves within few weeks, but in some cases it may persist. This may affect the nutritional state of the individual who is already facing an illness or injury in first instance [5, 6]. Dysphagia and accompanying malnutrition is associated with excess morbidity and increased mortality rates [7, 8]. This chapter will focus on general principles of nutritional management in any patient including patients with dysphagia.

2. Nutritional screening and assessment

Up to 30% of all acute hospital admissions are malnourished and this is further deepened during hospitalisation [9]. Hence, all the patients should be screened for risk of malnutrition.

There are various scoring systems available to screen a patient at nutritional risk. Screening is based on history (weight loss, etc.) and physical examination (height, weight, and body mass index (BMI)). 'Malnutrition universal screening tool' ('MUST') [Figure 1], rapid nutrition screen for hospitalised patients, nutrition risk index (NRI), Mini Nutritional Assessment-Short Form (MNA-SF), Short Nutritional Assessment Questionnaire (SNAQ®) (Table 1) and Nutrition Risk Screening (NRS-2002) are some of the commonly available and used composite tools

in clinical practice [10–15]. An ideal screening tool should be easy to implement, accurate, reliable, inexpensive, and reproducible. NRS-2002 is the best instrument today because it is robust, simple, quick, validated, and based from an analysis of 128 controlled clinical trials. Patients with the risk criteria had a higher likelihood of a better clinical outcome from nutritional support than patients who did not fulfill the criteria [15]. NRS 2002 has also been used by nurses and dietitians in three hospitals of Denmark. Its reliability was validated by inter-observer variation between a nurse, a dietitian, and a physician with a $k = 0.67$. Its practicability was shown by the finding that 99% of 750 newly admitted patients could be screened [16]. Supplement 1 shows the ‘TTSH Nutrition Screening Tool’ (TTSH NST) used by the Nutrition and Dietetics department at Tan Tock Seng Hospital, Singapore. TTSH NST was developed from a cohort of younger hospitalised patients. This was later validated in a cohort of elderly patients using subjective global assessment (SGA) as a comparator. In 281 acute admissions to Tan Tock Seng Hospital with age range of 61–102 years, prevalence of malnutrition was 35% based on SGA. Risk of malnutrition as determined by TTSH NST with a cut-off of 4 had sensitivity, specificity, positive, and negative predictive values of 84%, 79%, 68%, and 90%, respectively, with area under the curve of 0.87. The optimal cut-off remained at 4 even for patients aged >85 years (AUC = 0.85). Risk of malnutrition was predictive of 6-month mortality (adjusted OR: 2.2, $P = 0.05$) and hospital length of stay ($P < 0.05$) [17].

Question	Score
Did you lose weight intentionally?	
• 6 Kg in past 6 months	3
• 3 Kg in the past month	2
Did you experience a decreased appetite over the past month?	1
Did you use supplemental drinks or tube feeding over the past month?	1

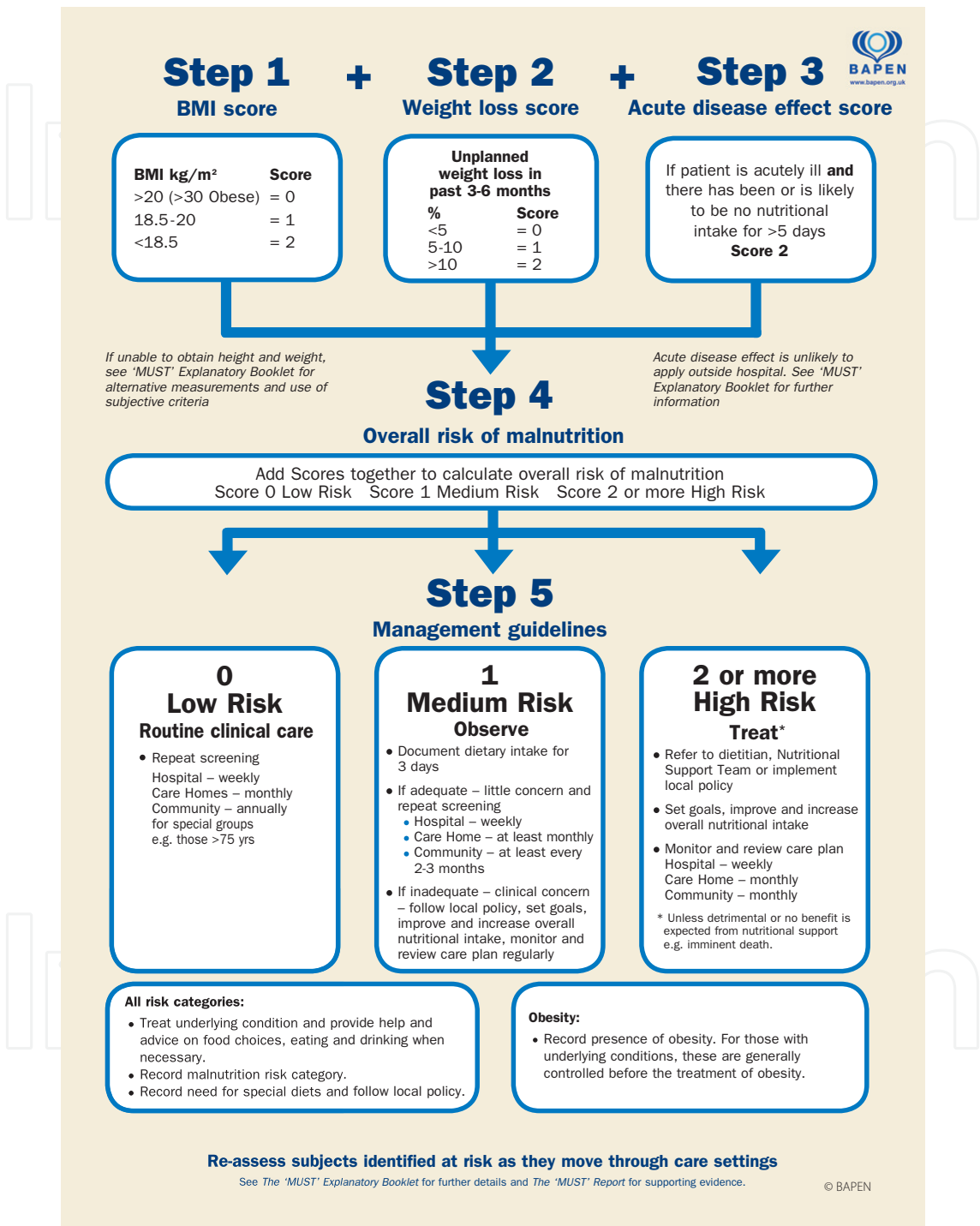
^a Patients who scored 0 or 1 points were classified as well-nourished and did not receive intervention. Patients who scored 2 points were classified as moderately malnourished and received nutritional intervention. Patients who scored 3 points were classified as severely malnourished and received nutritional intervention and treatment by a dietician.

Reproduced from: *Am J Clin Nutr* 2005;82:1082-9. © 2005 American Society for Nutrition

Table 1. Short Nutritional Assessment Questionnaire ^a

Nutritional assessment is a more detailed process and is done in patients screened at risk or when metabolic or functional problems prevent a standard plan being carried out. There are few tools for evaluating the nutritional status of hospitalised patients. SGA, short nutritional assessment questionnaire, mini nutritional assessment (MNA), and corrected arm muscle area (CAMA) are tools used for nutritional assessment [18]. The assessment of nutritional status includes a nutritional history and physical examination in conjunction with appropriate laboratory studies [Figure 2]. Regurgitation, hoarse voice, coughing during or after swallowing, globus sensation, nasal regurgitation, recurrent chest infections, and frequent throat clearing symptoms may indicate dysphagia [19]. In all patients with dysphagia, a complete

evaluation of the cause of dysphagia must be performed and for the purpose of this chapter we will only discuss nutrition-related assessment.



The 'Malnutrition Universal Screening Tool' ('MUST') is reproduced here with the kind permission of BAPEN (British Association for Parenteral and Enteral Nutrition). For further information on 'MUST' see www.bapen.org.uk Copy-right © BAPEN 2012

Figure 1. 'MUST' flowchart

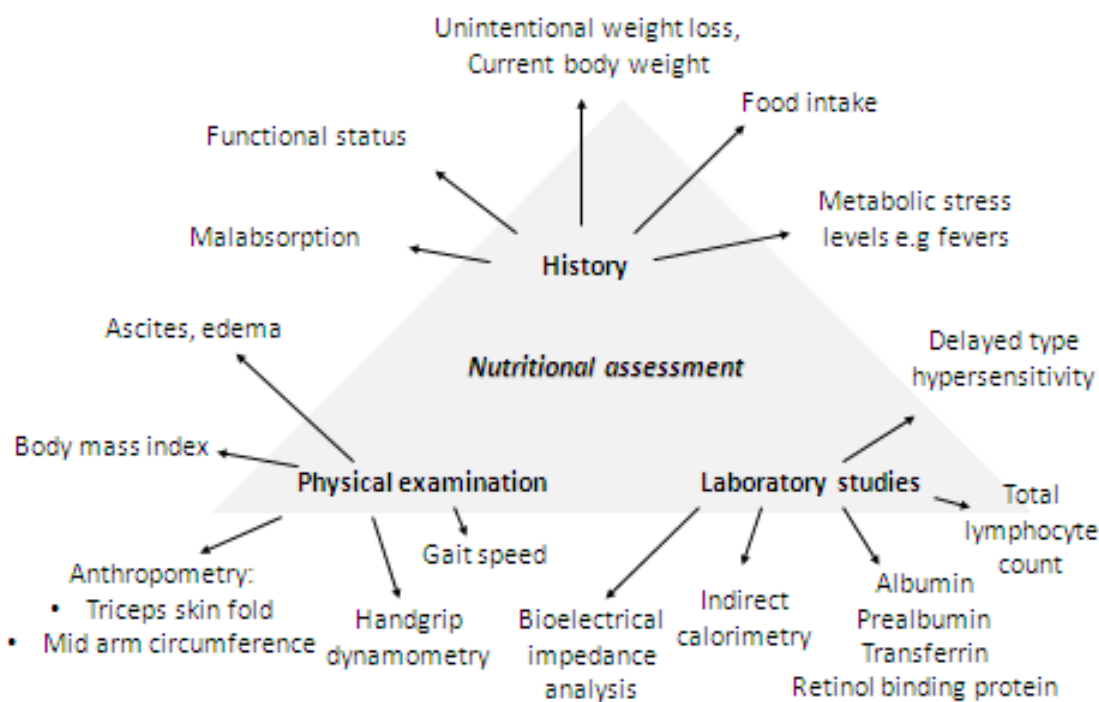


Figure 2. Nutritional assessment

The nutritional history should evaluate the following:

1. Food intake

A change in the dietary pattern due to dysphagia should be ascertained.

2. Body weight

The presence of unintentional weight loss over past six months should be ascertained. 10% or greater unintentional weight loss over the past six months is categorised as severe weight loss and is associated with a poor clinical outcome. In a study involving 3,047 patients enrolled in 12 chemotherapy protocols of Eastern Cooperative Oncology Group, Dewys WD, et al. has shown that chemotherapy response rates and median survival rates were lower in patients with weight loss [20]. The *functional status* of the patients (e.g., bedridden) and *metabolic stress* due to accompanied illness or injury also need to be ascertained.

3. Physical examination

Body mass index (BMI): Patients are classified by BMI as underweight ($<18.5 \text{ kg/m}^2$), normal weight ($18.5\text{--}24.9 \text{ kg/m}^2$), overweight ($25.0\text{--}29.9 \text{ kg/m}^2$), class I obesity ($30.0\text{--}34.9 \text{ kg/m}^2$), class II obesity ($35.0\text{--}39.9 \text{ kg/m}^2$), or class III obesity ($\geq 40.0 \text{ kg/m}^2$) [21].

Hand grip strength, gait speed, triceps skin fold thickness, mid-arm circumference, mucosal xerosis, and edema are some of the physical signs which could help establish malnutrition in patients with dysphagia. Handgrip strength reflects, in part, the association of muscle strength and lean body mass with malnutrition [22]. In a study conducted by the International Academy on

Nutrition and Aging (IANA) Task Force, gait speed at usual pace is found to be a consistent risk factor for disability, cognitive impairment, falls, institutionalisation, and/or mortality and at least as sensitive as composite tools [23].

4. Laboratory studies

Measurements of serum albumin, prealbumin, retinol-binding protein, transferrin, creatinine height index, creatinine excretion in urine and total lymphocyte count have been shown to correlate with clinical outcome. In a study involving 17 critically ill patients, Apelgren KN et al. have shown that a serum albumin <2.5 g/dL concentration is associated with an increased incidence of medical complications and death and it correctly separated 93% of patients in terms of survival prognosis [24]. Serum albumin levels are often used as a surrogate for preoperative nutritional assessment, but it is confounded by coexisting inflammation [25, 26]. Injury and inflammation decreases synthesis, increases degradation and transmembrane losses from the plasma compartment. In addition, albumin is also lost from open wounds (burns, etc.), peritonitis and through the gastrointestinal tract and/or kidneys in certain diseases. The association between hypoalbuminemia and poor clinical outcome is independent of both nutritional and inflammatory status [27]. Serum albumin is a good predictor of clinical outcomes but is a poor marker for nutritional assessment.

3. Nutritional pharmacology

If a patient is identified as at risk of malnutrition, appropriate intervention should be done to improve outcomes. Nutritional pharmacology is an emerging science over the last two decades. Nutrients such as arginine, glutamine, and long chain fatty acids (both omega 3 and omega 6) have been shown to improve clinical outcomes in diverse group of patients [28]. Arginine exhibits diverse effects including wound healing, protects against ischemia-reperfusion, improves macrophage function after injury, blocks adhesion molecules, inhibits lipid peroxidation, and improves cerebral and myocardial perfusion [28]. In a double blind randomised controlled trial involving 32 malnourished patients with head and neck cancer, Buijs N et al. concluded that perioperative arginine-enriched enteral nutrition improved long term overall survival and long term disease specific survival [29]. Glutamine is the most abundant amino acid and is a fuel of neutrophils, lymphocytes, and enterocytes. Glutamine is a conditionally essential amino acid in situations of stress. A recent Cochrane review including 4,671 patients with critical illness or elective major surgery concluded that glutamine supplementation reduced the infection rate and days on mechanical ventilation in critically ill or surgical patients [30]. Long chain fatty acids are important in function of cell membranes and act as intracellular messengers.

4. Enteral nutrition

Enteral route is physiologic and '*A functioning gastrointestinal system should be used to prevent its malfunction*'. Oral nutritional is ideal. Patients with dysphagia are at risk of aspiration

pneumonia. Authors recommend a swallowing history and assessment prior to oral feeding. Until safety of oral feeding is established, tube feeding should be considered. Figure 3 outlines a simplistic approach in decision making for nutritional supplementation.

4.1. Formula feeds

There are various feeding formulas and selection should be based on fluid electrolyte and metabolic needs, digestion and absorption capacity, caloric and protein density of formula, physical characteristics of formula (osmolality, viscosity etc.), and cost. General purpose feeding formulas contain intact proteins and need an intact digestive and absorptive function of gastrointestinal system. Semi-elemental feeds contain free amino acids with minimal fat and are used in patients with compromised gastrointestinal function. There are also various disease-specific feeds available for patients with hepatic, renal, or pulmonary dysfunction. In addition, nutrient composition of the formulas can be altered to tailor individual patients need and such modular feeds require mixing by local pharmacy and are costly [31]. Once the feeding formula is decided and the nutritional requirement calculated, the rate and delivery of the feeding is established.

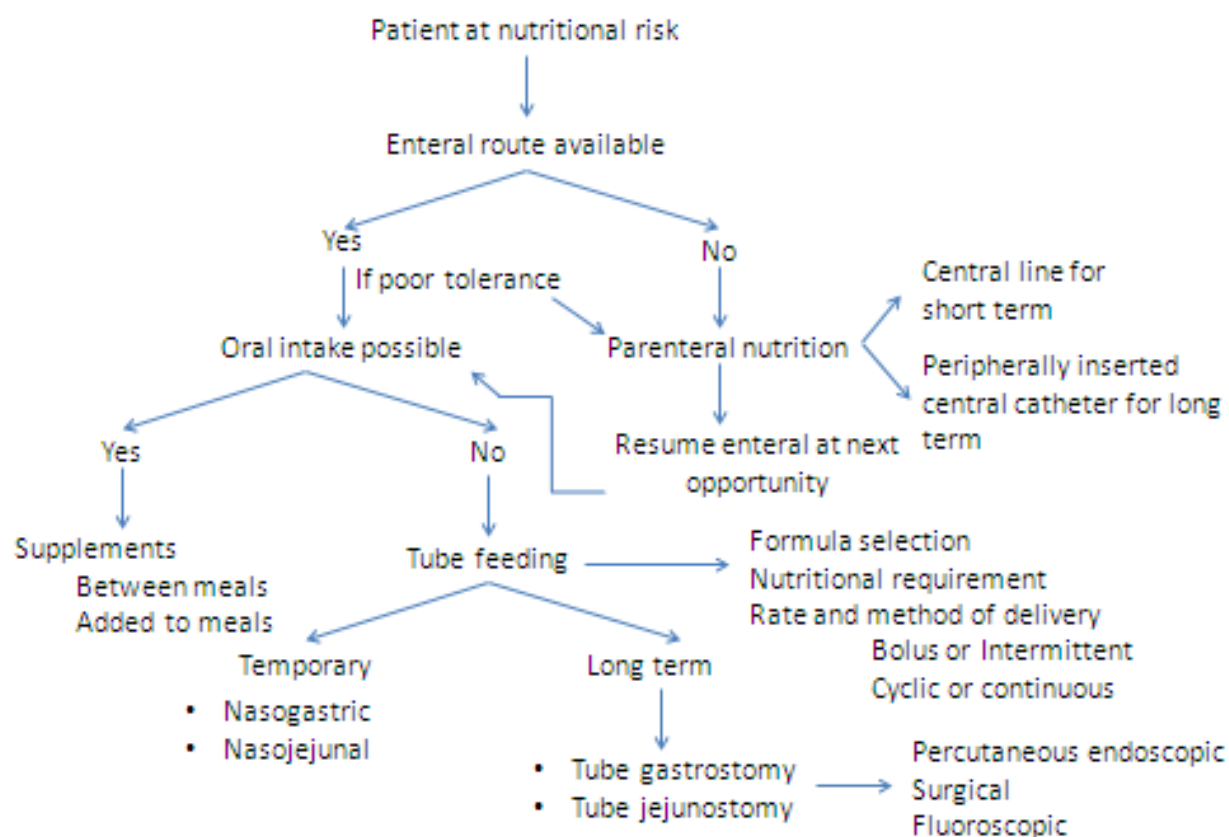


Figure 3. Algorithm of nutritional supplementation

4.2. Feed delivery

Intermittent bolus feeding is convenient to administer by nasogastric or percutaneous gastric tube and is suitable in ambulatory patients. Although there are no definitive studies, bolus feeding reduces lower esophageal sphincter pressure and may increase the chance for reflux and aspiration [32]. Intermittent cyclic feeding is indicated during weaning from tube feeding to oral feeding. It can be pump-assisted or gravity-assisted and feeding cycles of varying duration of period can be planned. This feeding is advantageous when an overnight tube feed is administered and the patient continues his normal oral intake during the day. Constant feeding infusion assisted by pump or gravity is indicated in bedridden patients with critical illness. Nasal tubes are associated with discomfort, excoriation and bleeding, and anosmia. Hence, when long-term feeding is required, percutaneous gastrostomy or jejunostomy tubes should be used. In a United Kingdom study involving 1,327 patients including 1,027 patients with gastrostomy tube insertion, Kurien M et al. has demonstrated that patients who undergo gastrostomy have significantly lower mortality than those who defer the procedure (11.2% vs. 35.5% at 30 days and 41.1% vs. 74.3% at 1 year, $p < 0.0001$) [33]. The most common indication of feeding gastrostomy remains inadequate swallowing as a result of a neurological event, oropharyngeal or esophageal cancer, or facial trauma [34]. Traditionally, tube feeding is delayed until the next day after the procedure. Authors' personal preference is to institute the feeding at the next opportunity. In a meta-analysis of six randomised controlled trials involving 467 patients, Bechtold ML et al. has shown that early feeding (defined as within 4 hrs) after percutaneous endoscopic gastrostomy placement was safe [35]. In patients with restricted mouth opening, oral cavity is inaccessible and a surgical gastrostomy needs to be created. Feeding gastrostomy is associated with the risk of aspiration and is not possible in patients with gastric outlet obstruction, gastroparesis, or gastric resection. In such patients, feeding jejunostomy is an alternative. Percutaneous feeding jejunostomy can also be inserted via the existing gastrostomy site. Percutaneous placement of feeding jejunostomy is technically difficult compared to gastrostomy. In a study involving 150 patients without a previous history of major abdominal surgery, Shike M et al. found that direct percutaneous endoscopic jejunostomy was successful in 129 procedures (86%) and aspiration occurred in 3% of patients [36]. Enteral nutrition preserves the gut integrity, reduces bacterial translocation, maintains the gut immune function, is easily administered and monitored, and cheaper compared to parenteral nutrition. However, it can also lead to complications.

4.3. Enteral nutrition: Common issues

Enteral nutrition causes mechanical problems with tube placement (migration, clogging etc.), metabolic problems (osmotic diarrhoea, overhydration, etc.), and is labour intensive (tube management, infusion pump device usage, etc.). In patients with tube feeding, prior to commencing feeding, a radiological confirmation of tube placement must be checked. Tube clogging could be prevented by using a wide tube, flushing the tube with water after medicine administration, minimising gastric aspirates to keep pH levels low, and using pancreatic enzymes mixed with bicarbonate [37]. Peristomal wound infections and leakage are also common problems associated with tube feeding and add to patient and family anxiety along

with the nursing care burden [38]. In a Cochrane review with a pooled analysis of 1,271 patients from 12 randomised controlled trials, Lipp A et al. have shown that administration of prophylactic systemic antibiotics for percutaneous endoscopic gastrostomy tube placement reduces peristomal infection rates (OR 0.36, 95% CI: 0.26–0.50) [39]. Peristomal leakage can be reduced by appropriate fixation technique and antiseptory agents. In patients with persistent leakage, the tube should be withdrawn and replaced after few days or a new tube placed at the separate site, but no attempt should be made to control the leakage with a wider tube as it may exacerbate the leakage [40–42]. Diarrhoea remains the commonest gastrointestinal side effect of enteral tube feeding [43, 44]. Addition of fibre and probiotics has shown to reduce diarrhoea in enteral feeding. In a systematic review and meta-analysis including 51 studies, 43 randomised control trials and 1,762 subjects (1,591 patients and 171 healthy volunteers), Elia M et al. have shown that fibre supplementation was generally well tolerated and the incidence of diarrhoea reduced (OR 0.68, 95% CI: 0.48–0.96; 13 randomised control trials) [45]. In a randomised double blind placebo controlled trial involving 62 patients, Heimbürger DC et al. have shown that most cases of diarrhoea in tube fed patients are caused by factors extraneous to tube feeding and lactobacillus treatment did not alter the risk of diarrhoea [46]. Patients on enteral feeding are also at risk of aspiration pneumonia. There are various strategies recommended to reduce the risk of aspiration namely head end of bed elevation, gastric residual volume measurement and postpyloric feeding. In a prospective randomized study involving 38 patients in medical and surgical intensive care units, endoscopically placed feeding jejunal tube-fed patients had a lower rate of pneumonia (nil vs. 10.5%) compared to patients fed by continuous gastric tube feeding [47]. In a literature review of 45 studies including patients with neurogenic oropharyngeal dysphagia over a period of 1978 to 1989, authors were not able to derive any meaningful conclusions with regard to superiority of postpyloric feeding due to limitations of individual studies with small sample size, inconsistent definitions of aspiration, varying feeding protocols, unspecified time frames, and heterogeneous populations [48]. Monitoring enteral nutrition involves fluid electrolyte balance, weight chart, serum electrolyte and glucose measurement, and stool charting. Refeeding syndrome is characterised by electrolyte depletion, fluid shifts, and glucose derangements that occur on reinstitution of nutrition in malnourished patients [49]. Chronically malnourished patients (e.g., patients with dysphagia) are at high risk of refeeding syndrome. In a study involving 321 patients with 92 patients at risk of refeeding hypophosphataemia, Zeki S et al. has shown that refeeding hypophosphataemia is more common in enteral-fed patients compared to parenteral nutrition [50]. Gradual introduction and progression of feeding over a few days with close monitoring of fluid and electrolytes can help in the prevention and early recognition of refeeding syndrome.

National Institute of Clinical Excellence (NICE) guidelines recommend that in an acute setting, if patients are unable to swallow safely or meet caloric needs orally, they should have an initial 2–4 week trial of nasogastric enteral tube feeding. Health care professionals with relevant skills and training in the diagnosis, assessment, and management of swallowing disorders should assess the prognosis and options for future nutrition support [19]. Before modifying nutritional support in a patient with dysphagia, level of alertness, need for feeding assistance, mobility, recurrent chest infections, metabolic needs, etc. should be considered [19].

5. Parenteral nutrition

In patients with short bowel or gastrointestinal intolerance, total parenteral nutrition is required. In general, parenteral nutrition should be considered if energy intake has been, or is anticipated to be, inadequate (<50% of daily requirements) for more than 7 days and enteral feeding is not feasible. Total parenteral nutrition requires labour-intensive monitoring for infection and haemodynamic stability. Metabolic complications, such as fluid overload, hypertriglyceridemia, hypercalcemia, hypoglycaemia, hyperglycaemia, and specific nutrient deficiencies, are usually caused by overzealous or inadequate nutrient administration. Catheter-related blood-borne infection is the most common life-threatening complication in patients who receive total parenteral nutrition and is commonly caused by *Staphylococcus epidermidis* or *Staphylococcus aureus* [51]. In a study involving 331 central venous catheters used for home parenteral nutrition with a median duration of 730 days, Buchman AL et al. have demonstrated increased rates of catheter-related blood-borne infections in patients receiving lipid emulsions, obtaining blood from catheter and administering medications via the catheter [52]. The incidence of most complications associated with the use of total parenteral nutrition is reduced with careful management and supervision, preferably by an experienced nutrition support team if available [53].

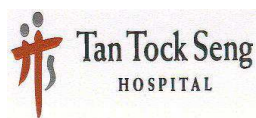
6. Nutrition support team

An interdisciplinary nutrition support team could include physicians, dietitians, pharmacists, and nurse clinicians. In a study involving 209 parenteral nutrition starts, Trujillo EB et al. have showed that non-indicated and preventable parenteral nutrition initiation, short-term (defined as less than 6 days) parenteral nutrition use and metabolic complications are less likely (34% vs. 66%, $p = 0.04$) when patients receive consultation by a multidisciplinary metabolic support service [54]. Nutritional support teams closely work with speech and swallowing assessment teams locally at Tan Tock Seng Hospital. In patients with non-obstructive dysphagia, video-fluoroscopy swallowing study is conducted prior to determining the route of feeding. It is possible that patients may be permitted oral feeds and in addition enteral tube feeding to ensure their caloric requirements are met.

7. Conclusion

Dysphagia patients are at risk of malnutrition. Malnutrition worsens during hospitalisation. Nutritional screening and assessment are paramount to improve outcomes. There are various tools to assist in nutritional screening and assessment and it is advisable to use the locally validated tool in clinical practise. Patients with dysphagia have special needs and this need to be considered during initiation and modification of nutrition therapy. Enteral nutrition is recommended wherever feasible. Nutrition support teams and swallowing therapy experts should be involved in all patients with dysphagia who require nutrition therapy.

Supplement



Ward	Bed	Unit
Patient Details		

TTSH-Nutrition Screening Tool

Indicators	Scoring
<i>Refer to instructions overleaf</i>	
Diagnosis nutritional risk level	Low 0
	Moderate 1
	High 2
Physical appearance	Normal 0
	Moderately underweight 1
	Severely underweight 2
Diet intake adequacy over past 5 days or more	Normal 0
	Reduced moderately 1
	Reduced severely 2
	Not available --
Unintentional weight loss over past 6 months	No 0
	Unsure 1
	Yes, 0.5 – 3.0kg 2
	Yes, >3.0-7.0kg 3
	Yes, >7.0kg 4
	Yes, Unsure 2
Total Score*	

***IF SCORE IS 4 OR MORE, REFER TO THE DIETITIAN.**

Name /Sign _____

Date _____

Dietitian contacted _____



Instructions: Score the patients for each criterion by referring to the tables below

	High risk = 2		Moderate risk = 1		Low risk = 0	
Diagnosis	AIDS		Alzheimer' s disease /dementia		Angina	
Nutritional	Burns, major		Cardiomyopathy		Cancer All others	
	Cancer GI Tract/ Head & Neck		Chemotherapy		Cardiac disease	
Risk Level	COPD- unstable		Congestive Heart Failure		COPD stable	
	Dysphagia		Diabetes (Newly Diagnosed)		DM (controlled)	
	Gastro- intestinal (GI) disease malabsorption/ maldigestion /Ileus		Diabetes (Uncontrolled)		Fractures, others	
	GI obstruction /stricture/fistula		Fractures, major		HIV +	
	Hepatic Coma/encephalopathy		GI diseases all others		Hypertension	
	Infection -Prolonged/severe		Infection with fever		Neurological no deficits	
	Neurological severe deficits/coma		Liver diseases-other		Peripheral vascular disease	
	Skin Ulcers-pressure ulcers - stages III-IV		Nutritional anaemia		Psychological-Others	
	Pulmonary disease: Failure requiring ventilation		Pneumonia		Radiation Therapy: all others	
	Radiation Therapy GI Tract		Skin ulcers-diabetic, pressure ulcers - stage II		Surgeries all not mentioned	
	Renal Disease -ARF		Psychological -Eating Disorders			
	Sepsis		Pulmonary Disease O2 dependant			
	SLE flare		Radiation Therapy H & N			
	Spinal Cord Injury- new		Renal Disease- CRF			
	Surgery-GI major		SLE stable			
	Trauma-Head/Multi		Substance abuse			
Wounds, non healing		Tuberculosis				
Physical Appearance	Severely underweight = 2		Moderately underweight =1		Normal = 0	
	<ul style="list-style-type: none">Severe loss of fat from triceps (minimal space between fingers)Hollowing, depression of temples, facial muscle wastingProtruding, prominent bones		<ul style="list-style-type: none">Mild or moderate loss of fat from triceps and deltoid regionSlight depression of temples, moderate facial muscle wastingBones may show slightly		<ul style="list-style-type: none">At least normal muscle bulk and fat stores:Large space between fingersRounded shoulders	
Diet intake adequacy over past 5 days	Reduced severely = 2		Reduced moderately = 1		Normal = 0	
	<ul style="list-style-type: none">Takes less than ½ normal intake or has been NBMDoes not take a diet supplementLess than 750 to 1000ml of a 1-calorie/ml formula per day via feeding tube or orally		<ul style="list-style-type: none">Takes ½ -3/4 normal intakeOccasionally takes a diet supplement1000-1200ml of a 1-calorie /ml formula per day via feeding tube or orally		<ul style="list-style-type: none">No changeTakes formulas to supplement diet1200-2000 ml of a 1-calorie/ml formula per day via feeding tube or orally	
Unintentional weight loss	2	4	3	2	1	0
	Yes, Unsure	Yes > 7 kg	Yes > 3- 7 kg	Yes 0.5 - 3kg	Unsure	No

Acknowledgements

We are grateful to the Department of Nutrition and Dietetics, Tan Tock Seng Hospital, Singapore, for permission to publish Tan Tock Seng Hospital Nutrition Screening Tool (TTSH NST).

Author details

Vishal G. Shelat^{1*} and Garvi J. Pandya²

*Address all correspondence to: vgshelat@gmail.com

1 Tan Tock Seng Hospital, Singapore

2 Ministry of Health Holdings Pte Ltd, Singapore

References

- [1] Martino R, Pron G, Diamant N. Screening for oropharyngeal dysphagia in stroke: Insufficient evidence for guidelines. *Dysphagia* 2000;15(1):19-30.
- [2] Brown T, Findlay M, Von Dincklage J, Davidson W, Hill J, Isenring E, Talwar B, Bell K, Kiss N, Kurmis R, Loeliger J, Sandison A, Taylor K, Bauer J. Using a wiki platform to promote guidelines internationally and maintain their currency: Evidence-based guidelines for the nutritional management of adult patients with head and neck cancer. *J Hum Nutr Diet* 2013;26(2):182-190.
- [3] Garg S, Yoo J, Winkquist E. Nutritional support for head and neck cancer patients receiving radiotherapy: A systematic review. *Support Care Cancer* 2010;18(6):667-677.
- [4] Beaver ME, Matheny KE, Roberts DB, Myers JN. Predictors of weight loss during radiation therapy. *Otolaryngol Head Neck Surg* 2001;125(6):645-648.
- [5] Barer DH. The natural history and functional consequences of dysphagia after hemispheric stroke. *J Neurol Neurosurg Psychiatry* 1989;52(2):236-41.
- [6] Teasell RW, Bach D, McRae M. Prevalence and recovery of aspiration post stroke: A retrospective analysis. *Dysphagia* 1994;9(1):35-9.
- [7] Sala R, Munto MJ, de la Calle J, Preciado I, Miralles T, Cortes A, et al. Swallowing changes in cerebrovascular accidents: Incidence, natural history, and repercussions on the nutritional status, morbidity, and mortality. *Rev Neurol* 1998;27(159):759-66.

- [8] Correia MI, Waitzberg DL. The impact of malnutrition on morbidity. Mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Clin Nutr* 2003;22(3): 235–239.
- [9] Nutrition screening surveys in hospitals in the UK, 2007-2011. A report based on the amalgamated data from the four Nutrition Screening Week Surveys undertaken by BAPEN in 2007,2008, 2010 and 2011. Accessed <http://www.bapen.org.uk/pdfs/nsw/bapen-nsw-uk.pdf> on April 21, 2014.
- [10] http://www.bapen.org.uk/must_tool.html. Accessed October 25, 2014.
- [11] Kruizenga HM, van Tulder MW, Seidell JC, Thijs A, Ader HJ, van Bokhorst-de van der Schueren MA. Effectiveness and cost-effectiveness of early screening and treatment of malnourished patients. *Am J Clin Nutr*. 2005;82:1082-1089.
- [12] Ferguson M, Capra S, Bauer J, Banks M. Development of a valid and reliable malnutrition screening tool for adult acute hospital patients. *Nutrition* 1999;15:458-64.
- [13] Wolinsky FD, Coe RM, McIntosh WMA, et al. Progress in the development of a Nutritional Risk Index. *J Nutr* 1990;120:1549-1553.
- [14] Reilly HM, Martineau JK, Moran A, Kennedy H. Nutritional screening—evaluation and implementation of a simple Nutrition Risk Score. *Clinical Nutrition* 1995;14:269-273.
- [15] Kondrup J, Rasmussen HH, Hamberg O, et al. Nutritional Risk Screening (NRS 2002): A new method based on an analysis of controlled clinical trials. *Clin Nutr* 2003;22:321-336.
- [16] Kondrup J, Johansen N, Plum LM, et al. Incidence of nutritional risk and causes of inadequate nutritional care in hospitals. *Clin Nutr* 2002;21:461-468.
- [17] Lim YP, Lim WS, Tan TL, Daniels L. Evaluating the validity of a nutritional screening tool in hospitalized older adults. *Ann Acad of Med Singapore*. 2008;37(Suppl 11):S5.
- [18] Detsky AS, McLaughlin JR, Baker JP, et al. What is subjective global assessment of nutritional status? *J Parenter Enteral Nutr* 1987;1(1):8-13.
- [19] <http://www.nice.org.uk/guidance/cg032/chapter/1-guidance#enteral-tube-feeding-in-hospital-and-the-community>. Accessed October 25, 2014.
- [20] Dewys WD, Begg C, Lavin PT, et al. Prognostic effect of weight loss prior to chemotherapy in cancer patients. Eastern Cooperative Oncology Group. *Am J Med* 1980;69(4):491-7.
- [21] National Institutes of Health, National Heart, Lung, and Blood Institute. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults—the evidence report. National Institutes of Health, National Heart, Lung, and Blood Institute. *Obes Res*. 1998;6(Suppl 2):S53-S54.

- [22] Wang AY, Sea MM, Ho ZS, et al. Evaluation of handgrip strength as a nutritional marker and prognostic indicator in peritoneal dialysis patients. *Am J Clin Nutr* 2005;81(1):79-86.
- [23] van Kan AG, Rolland Y, Andrieu S, et al. Gait speed at usual pace as a predictor of adverse outcomes in community-dwelling older people—an International Academy on Nutrition and Aging (IANA) Task Force. *J Nutr Health Aging* 2009;13(10):881-9.
- [24] Apeltgren KH, Rombeau JL, Twomey PL, Miller RA. Comparison of nutritional indices and outcome in critically ill patients. *Crit Care Med* 1982;10(5):305-7.
- [25] Klein S. The myth of serum albumin as a measure of nutritional status. *Gastroenterology* 1990;99(6):1845-6.
- [26] Don BR, Kaysen G. Serum albumin: Relationship to inflammation and nutrition. *Semin Dial*. 2004 Nov-Dec;17(6):432-7.
- [27] Vincent JL, Dubois MJ, Navickis RJ, Wilkes MM. Hypoalbuminemia in acute illness: Is there a rationale for intervention? A meta-analysis of cohort studies and controlled trials. *Ann Surg* 2003;237(3):319-34.
- [28] Alexander JW. Nutritional pharmacology in surgical patients. *The American Journal of Surgery* 2002;183:349-352.
- [29] Buijs N, van Bokhorst-de van der Schueren MAE, Langius JAE, Leemans CR, Kuik DJ, Vermeulen M AR and van Leeuwen P AM. Perioperative arginine-supplemented nutrition in malnourished patients with head and neck cancer improves long-term survival. *Am J Clin Nutr* 2010;92(5):1151-6.
- [30] Tao KM, Li XQ, Yang LQ, Yu WF, Lu ZJ, Sun YM, Wu FX. Glutamine supplementation for critically ill adults. *Cochrane Database Syst Rev* 2014 Sept 9;9:CD010050.
- [31] Olree K, et al. Enteral formulations. In *The ASPEN nutrition support practice manual*, Silver Spring, Md, 1998, American Society for Parenteral and Enteral Nutrition.
- [32] Metheny NA. Risk factors of aspiration. *J Parenter Enteral Nutr* 2002;26:S26-S31.
- [33] Kurien M, Leeds JS, Delege MH, Robson HE, Grant J, Lee FK, AcAlindon ME, Sanders DS. Mortality among patients who receive or defer gastrostomies. *Clin Gastroenterol Hepatol* 2013;11(11):1445-50.
- [34] Itkin M, DeLegge MH, Fang JC, et al. Multidisciplinary practical guidelines for gastrointestinal access for enteral nutrition and decompression from the Society of Interventional Radiology and American Gastroenterological Association (AGA) Institute, with endorsement by Canadian Interventional Radiological Association (CIRA) and Cardiovascular and Interventional Radiological Society of Europe (CIRSE). *Gastroenterology* 2011;141:742-765.

- [35] Bechtold ML, Matteson ML, Choudhary A, Puli SR, Jiang PP, Roy PK. Early versus delayed feeding after placement of a percutaneous endoscopic gastrostomy: A meta-analysis. *Am J Gastroenterol* 2008;103(11):2919-24.
- [36] Shike M, Latkany L, Gerdes H, Bloch AS. Direct percutaneous endoscopic jejunostomies for enteral feeding. *Gastrointest Endosc* 1996;44(5):536-540.
- [37] Sriram K, Jayanthi V, Lakshmi RG, George VS. Prophylactic locking of enteral feeding tubes with pancreatic enzymes. *JPEN J Parenter Enteral Nutr* 1997;21:353-356.
- [38] Scharg SP, Sharma R, Jaik NP, Seamon MJ, et al. Complications related to percutaneous endoscopic gastrostomy (PEG) tubes. A comprehensive clinical review. *J Gastrointest Liver Dis* 2007;16:407-418.
- [39] Lipp A, Lusardi G. Systemic antimicrobial prophylaxis for percutaneous endoscopic gastrostomy. *Cochrane Database Syst Rev*. 2013;11:CD005571.
- [40] Tsang TK, Eaton D, Falconio MA. Percutaneous ostomy dilatation: A technique for dilating the closed percutaneous endoscopic gastrostomy sites and reinserting gastrostomies. *Gastrointest Endosc* 1989;35(4):336-7.
- [41] Schapiro GD, Edmundowicz SA. Complications of percutaneous endoscopic gastrostomy. *Gastrointest Endosc Clin N Am* 1996;6:409-422.
- [42] Lynch CR, Fang JC. Prevention and management of complications of percutaneous endoscopic gastrostomy (PEG) tubes. *Pract Gastroenterol* 2004;28:66-76.
- [43] Majid HA, Emery PW, Whelan K. Definitions, attitudes, and management practices in relation to diarrhea during enteral nutrition: A survey of patients, nurses, and dietitians. *Nutr Clin Pract* 2012;27:252-260.
- [44] Whelan K, Schneider SM. Mechanisms, prevention, and management of diarrhea in enteral nutrition. *Curr Opin Gastroenterol* 2011;27:152-159.
- [45] Elia M, Engfer MB, GreenCJ, Silk DB. Systematic review and meta-analysis: The clinical and physiological effects of fibre-containing enteral formulae. *Aliment Pharmacol Ther* 2008 27(2):120-45.
- [46] Heimburger DC, Sockwell DG, Geels WJ. Diarrhea with enteral feeding: Prospective reappraisal of putative causes. *Nutrition* 1994;10(5):392-6.
- [47] Montecalvo MA, Steger KA, Farber HW, et al. Nutritional outcome and pneumonia in critical care patients randomized to gastric versus jejunal tube feedings. The critical care research team. *Crit Care Med* 1992; 20(10):1377-87.
- [48] Lazarus BA, Murphy JB, Culpepper L. Aspiration associated with long term gastric versus jejunal feeding: a critical analysis of the literature. *Arch Phys Med Rehabil* 1990;71(1):46-53.

- [49] Marinella MA. The refeeding syndrome and hypophosphatemia. *Nutr Rev* 2003;61:320-323.
- [50] Zeki S, Culkin A, Gabe SM, Nightingale JM. Refeeding hypophosphataemia is more common in enteral than parenteral feeding in adult patients. *Clin Nutr* 2011;30(3): 365-8.
- [51] Dibb MJ, Abraham A, Chadwick PR, Shaffer JL, Teubner A, Carlson GL, Lal S. Central venous catheter salvage in home parenteral nutrition catheter-related blood stream infections: Long term safety and efficacy data. *JPEN J Parenter Enteral Nutr*. 2014 Sept 15. Pii: 0148607114549999 [Epub ahead of print].
- [52] Buchman AL, Opilla M, Kwasny M, Zdiamantidis TG, Okamoto R. Risk factors for the development of catheter-related bloodstream infections in patients receiving home parenteral nutrition. *JPEN J Parenter Enteral nutr* 2013;38(6):744-9.
- [53] Nehme AE. Nutritional support of the hospitalized patient. The team concept. *JAMA* 1980;243(19):1906-8.
- [54] Trujillo EB, Young LS, Chertow GM, Randall S, Clemos T, Jacobs DO, Robinson MK. Metabolic and monetary costs of avoidable parenteral nutrition use. *JPEN. J Parenter Enteral Nutr* 1999;23(2):109-13.