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Review Article

NT 2013: A Recommended Nutrition Screening and Nutrition Format for Practical Clinical Use in Hospitalized Patients in Thailand

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Abstract Nutrition Screening (NS) and Nutrition Assessment (NA) are the initial steps in Nutrition Care Process (NCP). In 2000, the BNT format (Bhumibol Adulyadej Hospital Nutrition Triage) was proposed and was widely used in many hospitals for NS and NA in Thailand. Later, the BNT was updated and became the NT 2013 format in conformance with the Consensus Statement 2012 of A.S.P.E.N., ESPEN, and the Academy of Nutrition and Dietetics on Identification of Adult Malnutrition. Recently, the Society of Parenteral and Enteral Nutrition Support of Thailand (SPENT) was supported by the Ministry of Public Health (MOPH) to initiate "The Qualified Nutrition Support Hospital" project, to encourage the establishment of Nutrition Support Teams at various hospitals. Subsequently the National Health Security Organization (NHSO) began allowing hospitals to file claims for reimbursement for the cost of implementing the new Nutrition Care Process within the NT 2013 format. Also, as an endorsement of the NT 2013, a study by a group of investigators, reported by HITAP has recommended the NT format to be used for NS and NA in Thailand.

Keywords: Nutrition screening, Nutrition assessment, BNT-NT 2013 nutrition assessment form

Introduction

Nutrition Screening (NS) and Nutrition Assessment (NA) are the initial steps in the Nutrition Care Process (NCP). In the past, these procedures were seldom performed for hospitalized patients due to lack of interest and knowledge. In 2000, the BNT format (Bhumibol Adulyadej Hospital Nutrition Triage) was developed and proposed for NA and was widely adopted in many hospitals in Thailand[1-6]. Later, BNT was replaced by the NT 2013 format, to conform with the Consensus Statement 2012 of A.S.P.E.N., ESPEN, and the Academy of Nutrition and Dietetics on Identification of Adult Malnutrition[7-10].

Recently, the Society of Parenteral and Enteral Nutrition of Thailand (SPENT) has obtained the support from the Ministry of Public Health (MOPH) to set up "A Qualified Nutrition Support Hospital" and establishing Nutrition Support Teams in hospitals. Simultaneously the National Health Security Office (NHSO) also supports the adoption of NT 2013 format and allows for cost reimbursement relating to the malnutrition diagnosis based on NT 2013 format[11].

These two activities have built up the interest and growth in NCP among medical personnel nation-wide. A study by a group of investigators, reported by Health Intervention and Technology Assessment Program - HI-

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TAP[12] has recommended the NT 2013 format to be used for NS and NA in Thailand.

The Consensus Statement 2012 Of A.S.P.E.N., ESPEN, and The Academy of Nutrition and Dietetics On Identification of Adult Malnutrition[7-10]

The Consensus Statement had divided the etiology of malnutrition into three categories: starvation-related malnutrition; chronic disease or inflammation related malnutrition; and, acute illness or acute injury related malnutrition (hypermetabolism and hypercatabolism).

The authors also proposed six criteria to identify adult malnutrition:

1) History of inadequate diet or nutrient intake
2) Decrease body weight
3) Accumulation of fluid or edema
4) Loss of body fat
5) Loss of body muscle
6) Loss of muscle strength

Thus, all of these criteria are modified to be used by the NT 2013 format.

Suggestion of The Consensus Statement[7]

The authors placed emphasis on patient-specific definitions, the effect of inflammation, and also the three related etiologies of malnutrition. The following points were suggested for consideration.

1. The meaning of adult malnutrition and undernutrition is the same.
2. History of illness and Diagnosis are useful for identification of a patient's status.
3. Physical examination can reveal the functional and nutritional status.
4. Malnutrition is not correlated with BMI; both too low and too high BMI may increase risk.
5. The amount of caloric intake should be monitored.
6. Inflammatory conditions increase the risk of malnutrition.
7. No definite inflammatory indicator is proposed for diagnosis.
8. Serum albumin/prealbumin are not related to malnutrition, but inflammation.
9. Follow up and appropriate reassessment is better than any single measure.
10. Chronic illness is one lasting at least three months (National Center for Health Statistics).
11. Nutritional assessment in certain conditions should be done carefully.

For example, an 80 to 90-year-old patient who looks healthy and can take an optimal amount of diet (i.e., less than generally recommended) may weigh less than the ideal body weight but is optimally active. Thus, to diagnose the patient as malnourished is not appropriate.

NT 2013: A Nutrition Screening and Nutrition Assessment Format

NT 2013 is a scored nutrition evaluation tool consisting of two parts: Nutrition Screening and Nutrition Assessment. The parameters correspond to those of the Consensus Statement of 2012. We also include ECOG (Eastern Cooperative Oncology Group) and Karnofsky Performance Status scoring system which are widely used for evaluation of performance status among cancer patients. The ECOG scale, now part of the ECOG-ACRIN Cancer Research Group, was published in 1982. It is in the public domain and is therefore available freely for public use. It is displayed below both for future reference and to spur further standardization among researchers who design and evaluate cancer clinical research[13].

GRADE	ECOG PERFORMANCE STATUS
0	Fully active, able to carry on all pre-disease performance without restriction
1	Restricted in physically strenuous activity but ambulatory and able to carry out work of a light or sedentary nature, e.g., light house work, office work
2	Ambulatory and capable of all selfcare but unable to carry out any work activities; up and about more than 50% of waking hours
3	Capable of only limited selfcare; confined to bed or chair more than 50% of waking hours
4	Completely disabled; cannot carry on any selfcare; totally confined to bed or chair

Figure 1 ECOG Performance Status and grading

Nutrition Screening

There are four yes/no questions to be answered during screening. These are:

1. Decreasing diet or nutrient intake during the past seven days or more?

2. Decreasing body weight during the past six months?

3. BMI less than 18.5 or more than 24.9?

4. Presently having critical illness or serious injury?

Answering yes to any of the above questions suggests that there are abnormalities. Two or more yes's require that the patient proceeds to Nutrition Assessment to obtain additional detailed information. Generally, the concept of screening parameters should be simple, use little time, and sufficiently informative to determine whether a patient requires further assessment. Parameters most frequently used are BW or BMI. We may also add one or two more questions, and the more questions the more reliable the result, although possibly unnecessarily time consuming. However, from our study, four questions give sufficient reliability to screen for patients at risk, especially in the context where there may not be sufficient time to apply NA.

Nutrition Assessment

The concepts of NA are:

1. The inclusion of various relevant causes.

2. Each cause should be classified along with a degree of adverse effect on the patient, combined into a scoring system.

3. The severity scores of the diseases or harmful conditions should not be constant or a fixed number, but should correlate with disease status.

The NT format follows the above concepts carefully to prevent oversensitivity and low specificity in detecting malnutrition risk. The format includes nine items used to assess patient conditions and evaluations for the purpose of weighing and scoring the risk of malnutrition effect on the patient.

The severity of related causes can be scored in the following way:

1) a score of 0 means no disease or not at risk

2) a score of 1 means little or mild adverse effect

3) a score of 2 means moderately harmful

4) a score of 3 means severely affected

The final score is the sum of scores from item 1 to item 8 below and can then be classified into four levels of nutrition status, in item 9. These are:

NT-1 (score 0-4) means no malnutrition or at risk

NT-2 (score 5-7) means mild malnutrition

NT-3 (score 8-10) means moderate malnutrition

NT-4 (score $\geq$ 11) means severe malnutrition

Item 1: History of Diet or Other Nutrients Intake

We have to find out the patient's real intake and not only rely on the physician's prescription. To assess the abnormality of nutrient intake, four aspects should be integrated, these are: the type, the amount, the quality, and the duration of related inappropriate dietary intake.

The type of food is different in nutritional value, for example: regular diet, soft diet, liquid diet or only some snack, fruits or juice.

The amount of intake should not be subjective such as: can take some food, just a small amount, but should be an objective view such as: 75-100 %, 25-50 %, less than 10 % of usual, or just only 3-4 spoons of a meal or the patient is on NPO (nothing per oral) and on IV fluid.

The quality of food should be considered: low in calorie and/or protein or inappropriate compositions of nutrients.

The duration of inappropriate diet intake, in days, weeks or months; the longer the time, the more the adverse effect.

These four pieces of information are integrated to form a score for severity of the patient's status. Extra care should be taken when assessing the following patients. Patients who are on NG tube feeding with adequate quantity of blenderized diet (BD), are usually not abnormal. Patients who are on liquid diet may be misinterpreted for taking low quality meal. Also make sure before scoring the abnormality whether the patient is having the medical food formula. Patients who are on parenteral nutrition may receive adequate energy, protein, and other nutrients.

Item 2: Unintentional Loss of Body Weight (BW)

There are generally three aspects of BW (kg). The usual BW is the BW when the patient is in a good health or normal health or at the early beginning of illness. The current BW is the BW when the patient is seen or recent BW (not excluding the edema or ascites status or tumor mass). The ideal BW is the calculated BW obtained from the patient's height in centimeter minus 100 in men or 105 -110 in women. IBW can be calculate from the equation.

For men: IBW (kg) = 50.0 + [0.91 x [height (cm) -152.4]]

For women: IBW (kg) = 45.5 + [0.91 x [height

(cm) - 152.4]][14]

To assess the amount and degree of BW change we should consider:

1. The Amount of weight loss can be calculated by UBW minus CBW.
2. The Weight loss as a percentage can be calculated by {(UBW-CBW) / UBW} x 100.
3. The Duration of weight loss in terms of weeks or months.

Sometimes when the BW cannot be obtained due to non-weighing for a long time. We can consider whether the CBW is less than IBW by at least 20% *or* CBW is less than previous year's BW of about 20% or more. These two aspects can be considered to be severe changes in BW.

BMI, like a BW measurement is a simple and useful parameter but with several limitations. High BMI represents excess amount of fatty tissue but not the muscular component of the body. Normal BMI does not exclude malnutrition. BMI less or greater than normal range may both indicate malnourished risk. However low BMI should be interpreted carefully in conjunction with performance status, occupation, and race; for example, marathon runners, ballet dancers, jockeys (horse racing), and Asians may have low BMI without malnutrition.

Item 3: Edema or Accumulation of Fluid

There are two types of edema of the body. **The localized form** is usually related to local causes, and in general the adverse effect is less than that of the general form. Examples of localized edema include a right lower leg edema from deep vein thrombosis, or a left arm edema postmastectomy with axillary lymph node dissection.

The generalized form is usually more important as it is related to systemic causes. Examples include pitting edema over both lower legs and arms or facial edema. The cause may be from heart failure, liver disease, chronic kidney disease or malnutrition.

Physical examination can differentiate the degree of edema. By applying finger pressure on the affected part for about 5 seconds, and assessing the depth of the cutaneous pitting, 2, 4, 6, or 8 mm depth corresponds to 1^+, 2^+, 3^+, or 4^+ degree of edema, respectively. The assessment of severity of edema by a more common scoring system uses scores 0, 1, 2, and 3, where a score of 0 refers to no edema, a score of 1 or 2 means mild or moderate edema, and a score of 3 means severe edema.

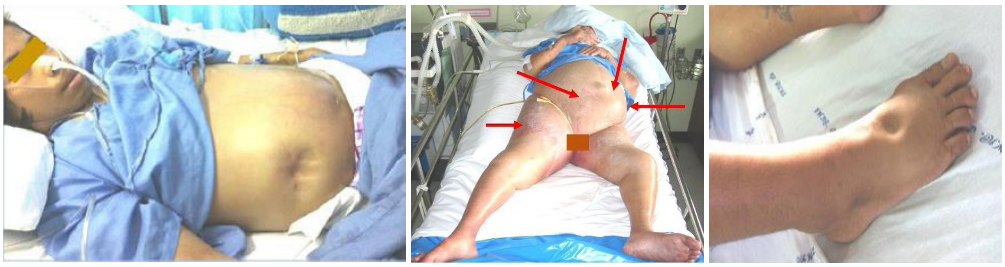

Figure 2 Degree of edematous skin = 3^+ (abdominal wall & both lower legs); severity score = 3

Figure 3 Evaluation of the subcutaneous fat of the body

Item 4: Assessment of Body Fat Loss

Physical examination should be done carefully to assess the subcutaneous fat; at the temporalis area, eyelids, cheeks, chest wall, prominent clavicle, subclavicular skin fold and ribs, abdominal wall, arms especially biceps and triceps skin folds, hands, pelvis, and lower extremities. Skin calipers are infrequently used for this examination.

Other related factors or information to be included when determining the severity of body fat loss are the loss of BW, thin appearance, decrease in size of the body and extremities, looseness of clothing, watch and ring etc. Then the appropriate severity score of edema will be selected as 0, 1, 2, 3.

Item 5: Assessment of Muscle Loss

The assessment process consists of visual inspection, manual palpation, and estimating the size and contour of individual muscles. The procedure can be done simultaneously with and is similar to assessment of body fat loss. The overall status of body muscle loss is assessed similarly with a severity score of 0, 1, 2, or 3; as in Figure 4.

Item 6: Assessment of Muscle Strength

Practically, we can assess the overall muscle strength by patient's general appearance and activity as defined by ECOG or Karnofsky scores. Physical examination can obtain more information from his or her self-movement and the ability to resist active force. Spontaneous movements of extremities, hands, and neck should be noted, for example. The active parts should be evaluated but not the diseased component. Some authors suggest testing muscle strength by hand-grip dynamometer (HGD). However, there are some disadvantages of using such devices, such as requiring the patient's cooperation, limited application to a few parts of the body, the lack of standardization, inconvenience, and the high cost of the device.

The muscle strength may be classified into six grades of 0, 1, 2, 3, 4, 5[15] as shown in the chart below.

Item 7: Assessment of the Chronic Diseases and Severity

This item consists of various chronic diseases of medical and surgical conditions. The Consensus Statement suggests that a chronic disease should be at least of six months' duration. We propose some criteria to be considered before scoring each condition.

Evaluation of Subcutaneous Fat

Evaluation of Muscle Mass

Muscle Status:				
temples (temporalis muscle)	0	1+	2+	3+
clavicles (pectoralis & deltoids)	0	1+	2+	3+
shoulders (deltoids)	0	1+	2+	3+
interosseous muscles	0	1+	2+	3+
Scapula (latissimus dorsi, trapezius, deltoids)	0	1+	2+	3+
thigh (quadriceps)	0	1+	2+	3+
calf (gastrocnemius)	0	1+	2+	3+
Global muscle status rating	**0**	**1+**	**2+**	**3+**

0 = no deficit, 1+ = mild deficit,
2+ = moderate deficit, 3+ = severe deficit

Figure 4 Evaluation of subcutaneous fat and muscle mass and the degree of muscle mass deficit

Figure 5 Physical examination to assess muscle strength

1. The harmful effect of the diseases to the body on nutrition status, the hypermetabolism or hypercatabolism effects are not constant but vary with the stage of disease and the treatment process.

2. The severity scores of the chronic disease are 0 for no disease or no risk; 1 and 2 for mild and moderate risk respectively, and 3 for high risk.

3. When scoring for multiple diseases or conditions, the final sum of score should not be higher than three to prevent over-sensitivity and low specificity.

The following are examples for consideration.

1) Solid cancer. The harmful effects are related to stage 1, 2, 3, 4 of disease so the severity score is not constant or fixed. The scores 0, 1, 2, 3 should be carefully selected to match the disease status.

Grading of Muscle Strength (Harrison : Principle of Medicine, 20 edition, 2018, p.3028)	NT score (Severity score)
0 = no movement	3
1 = trace of contraction	3
2 = movement with gravity eliminated	2
3 = movement against gravity	2
4 = movement against mild/moderate resistance	1
5 = movement with full power	0

Figure 6 NT 2013 severity score is modified to correlate with muscle strength

2) Pulmonary diseases. For example, COPD[16], TB, chronic bronchitis will affect the lung tissue and decrease the efficiency of lung function, which is related to stage of disease and result of treatment. To score the severity of pulmonary function status, we modified the CAT (COPD-severity-assessment test) based on the mMRC (modified Medical Research Council) Dyspnea scale, which provides a single number for the degree of breathlessness. The severity score in NT format is modified to incorporate mMRC scale as in Figure 7.

3) Liver disease[17]. To score the severity of liver function status, we modified the NT score to correspond to the Child - Pugh classification as shown in Figure 8.

4) Kidney Disease[18]. A patient with chronic kidney disease should have a deterioration of glomerular filtration rate. The severity score in NT 2013 is modified to correspond to the various abnormal levels of eGFR, as in Figure 9.

5) Diabetes Mellitus. A diabetic patient who regularly keeps a good control of blood sugar or hemoglobin A_1C level will have a reduced diabetic-related complication. So, the scoring of disease severity should not be a constant or fixed number or just due to the diagnosis of DM, but instead it should be adjusted to blood sugar level and clinical manifestations.

For example, a university teacher has been diagnosed with DM for about five years. He always keeps a good diabetic care with regular diet control, frequent

COPD severity assessment

(based on mMRC scale)

0 = only with strenuous activity

1 = hurrying on level ground *or* walking up a slight hill

2 = walk slower than peers *or* stop walking at their own pace

3 = walking about 100 yards *or* after a few minutes on level ground

4 = too breathless to leave the house *or* when dressing

mMRC score	NT score
0	0
1	0
2	1
3	2
4	3

Figure 7 NT 2013 severity score is modified to correlate with mMRC Dyspnea scale.

factors	points (related to Liver function)			
	unit	1	2	3
1. bilirubin	mg%	< 2.0	2.0 - 3.0	> 3.0
2. albumin	gm%	> 3.5	3.0 - 3.5	< 3.0
3. PT	second	< 4.0	4.0 - 6.0	> 6.0
	INR	< 1.7	1.7 - 2.3	> 2.3
4. ascites	.....	none	easily control	poorly control
5. HE	.....	none	minimal	advanced

Child - Pugh classification		modified NT score
level	score	score
---	≤ 4	0
Child A	5-6	1
Child B	7-9	2
Child C	≥ 10	3

Figure 8 NT 2013 severity score is modified to correlate with the Child-Pugh classification.

Prognosis of CKD by GFR (ml/min/1.73 m²) (KDIGO : Kidney Disease Improving Global Outcome)			modified NT score
G 1	normal *or* high	≥ 90	0
G 2	mildly decreased	60 - 89	1
G 3a	mildly to moderately decreased	45 - 59	2
G 3b	moderately to severely decreased	30 - 44	
G 4	severely decreased	15 - 29	
G 5	Kidney failure	< 15	3

Figure 9 NT 2013 severity score is modified to correlate with eGFR.

exercise, and takes only half of an antidiabetic drug each other day. His average blood sugar level is around 125 mg% (normal level is 80-100 mg %). He had 2 times maximal blood sugar around 150 mg % during the past follow up period. So, he deserves the score of 0 or 1 for DM severity.

Contrary to another patient who enjoys taking in all kinds of food without caring about the adverse effect and self-adjusting the intake of his antidiabetic drug. His follow-up blood sugars and HbA_1C are on average much higher than normal with occasional diabetic complication. So, this patient deserves the score of 2 or 3 for DM severity.

Neuro-muscular Disease and other abnormality. To score the severity for a patient with neuro-muscular disorders (dementia, Alzheimer, post stroke attack, or Parkinsonism) we have to consider the remaining performance status, ability to self-care, or the need for assistance from others in view of diet intake adequacy. Do not rely only on the diagnosis and give fixed scores. So, the score of 0, 1, 2, 3 should be selected to match the performance status of the non-affected part of the body. Let's think about Paralympics athletes, for example.

Item 8: Assessment of Acute Disease or Injury-related Malnutrition

Acute disease (medical *or* surgical conditions) or injury can induce abnormal physiologic response of hypermetabolic state and may lead to malnutrition. The degree of response correlated to the causative factors, type, severity of the insults and the patient's status.

The harmful effect to the body on nutrition status is thus not a constant or fixed number but varies with the stage of disease and the treatment process. Thus, the severity score of the disease should be carefully selected as 0, 1, 2, or 3. The score of 0 should refer to no disease or little or no harm; score 1 and 2 as mild and moderate harm, respectively; and score 3 as severe harm. When determining severity score in the case of multiple diseases or conditions, the final sum of score should not be more than 3 to prevent oversensitivity and low specificity.

The **qSOFA score** identifies patients with suspected infection who are at **high risk** for **in-hospital MR** outside of the ICU.

qSOFA scores (range 0 - 3) (best *to* worst points)

qSOFA criteria :

altered mental status - GCS score < 15

systolic blood pressure < 100

respiratory rate > 22

qSOFA score	NT score
0	0
1	1
2	2
3	3

Figure 10 NT 2013 severity score is modified to correlate with qSOFA score.

CURB-65 score *and* Outcome

(Harrison, Principle of Internal Medicine, 20 edition, p.912)

score 0 30 day Mortality rate is 1.5 %

score 1 or 2 pt. should be hospitalized (unless the score is entirely or in part attributable to age ≥ 65)

score 3 Mortality rate are 22 % overall; these patients may require ICU admission

modified relationship CURB-65 score	NT score
0	0
1	1
2	2
≥ 3	3

Figure 11 NT 2013 severity score is modified to correlate with CURB-65 score.

The following are examples for consideration.

1) Critically Ill Patients[19]. There are multiple scoring systems for assessment of severity of Illness, such as SOFA, APACHE, and SAPS. The SOFA score is used to evaluate six organ dysfunctions, graded from 0 to 4 and recently adapted to quickSOFA (qSOFA score) which is intended to screen patients for ICU admission. The higher the score the higher mortality rate. So, NT 2013 is modified to correlated with the qSOFA score (bedside score) to assess the severity of patient's dysfunctional status (Figure 10).

2) Sepsis[20,21,22]. In 2016 the Third International Consensus Definitions defined sepsis as a dysregulated host response to infection that leads to organ dysfunction and should be distinguished from uncomplicated infection. Septic shock is a subset of sepsis with circulatory and metabolic abnormalities. New sepsis-3 clinical criteria are suspected infection with acute organ dysfunction: defined as an increase by 2 or more points from baseline SOFA score.

The criteria for septic shock include sepsis plus vasopressor resuscitation to increase MAP to ≥ 65 mmHg with serum lactate > 2.0 mmol/L despite adequate fluid resuscitation. The SOFA score has been simplified to qSOFA score. There are various studies in sepsis patients showing that the increase in scores correlated with the higher risk of in-hospital mortality. The qSOFA score may be used as screening criteria for transferring the patient to ICU.

Burns surface area ≥ 2^0 burns	NT score
small 10 - 20 %	1
large 20 - 40 %	2
major 40 - 60 %	3
massive > 60 %	3

Figure 12 NT 2013 severity score is modified to correlate with severity of Burn injury.

3) Pneumonia[23]. The CURB-65 criteria (a severity of illness score) include 5 variables: C=confusion; U = urea >7 mmol/L; R =respiratory rate > 30/min; B = SBP < 90 *or* DBP< 60; 65 = age > 65 years. The study found the relationship between total score and outcome as shown in Figure 11.

Post recent **major** operation *or* Trauma (1-2 wks.)	NT score
# esophagectomy, gastrectomy, pancreatectomy, colectomy, ... etc.	1 - 2
# (above conditions + major complications)	2 - 3
# appendectomy, hernioraphy, excision of breast mass, ... etc.	0

Figure 13 NT 2013 severity score is modified to correlate with the extent of operations.

4) Burns [24,25] ***(Second degree or more severe burn).*** The pathophysiologic metabolic response varies with the degree of burns. The hypermetabolic and hypercatabolic state increases with the extent of burn surface area. Generally, adult patients with BSA less than 15 % can be managed with oral hydration and intravenous fluid resuscitation is not necessary (Figure 12).

5) Recent Major Operation. Surgery can induce physiological and metabolic alteration in patients. The greater the extent of operation and complications, the greater the hypermetabolic - hypercatabolic response. Starvation-related conditions due to NPO may worsen the case. For patients who undergo a major operation without any adverse effect and not requiring ICU care, the severity score should be 1 or 2. But for a patient who had complications affecting the vital signs, the severity score should be 2 or 3 as correlated to the patient's condition. Figure 13, provides examples of various operations to be considered.

Item 9: Summation of total score and classification level of NT 2013

This last item is the summation of total score from item-1 to item-8. The final number of score will be used to indicate the level of nutrition status by NT 2013 which have been classified into 4 levels: NT-1 (score 0-4) = normal nutrition *or* just at risk; NT-2 (score 5-7) = mild malnutrition; NT-3 (score 8-10) = moderate; NT- 4 (score > 11) = severe malnutrition.

Conclusion

We present a review of the nutritional screening and assessment process as codified by the NT 2013 format. We hope that the underlying principles and logic can be widely applied in all clinical situations and help optimize the care of moderate to severely ill patients who are often significantly malnourished.

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