Nutrition and glucose control

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Nutrition

Macronutrients vs Micronutrients

Macronutrients	Micronutrients
• Carbohydrates • Proteins • Lipid (fat) • Water	• Vitamins • Minerals

Malnutrition

- **Malnutrition**: no universally accepted definition
  - A deficiency, excess, or imbalance in a wide range of nutrients involving micronutrition
  - Long-standing negative imbalance in both energy and protein intake and requirements
  - measurable adverse effect on body composition, function, and clinical outcome
  - **Protein-calorie (energy) malnutrition**
  - **Not universally accepted gold standard for nutritional assessment**

Malnutrition as a risk factor for adverse outcome

- Prevalence
  - 30-50% in neurocritical illness patients
- 10 days of bed rest in older patients
  - Decreased muscle protein synthesis by 30%
  - Leg lean mass by 6% and 16% reduced muscle strength
- Protein-energy malnutrition
  - Expression of plasticity-associated genes: recovery mechanisms
  - Decreased response to stressful environment

Malnutrition as a risk factor for adverse outcome

- Malnourished patients in NeuroICU
  - Intense stress reactions and increased infection
  - Higher rates of pressure ulcer
  - Longer duration of hospitalization and higher mortality

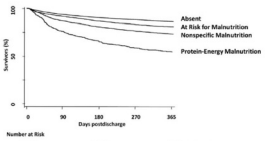
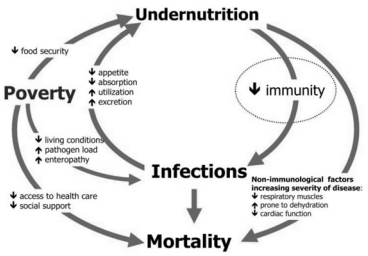


Table 3. Unadjusted and Adjusted Associations Between Nutrition Status and Postdischarge Mortality.[a]

Outcome	Absent	Malnutrition: Mortality OR (95% CI) At Risk for Malnutrition	Nonspecific Malnutrition	Protein-Energy Malnutrition
90-day post discharge mortality				
Crude	1.00 (Referent)	1.40 (1.19–1.64)	2.38 (2.13–2.67)	5.04 (4.21–6.03)
Adjusted[b]	1.00 (Referent)	1.14 (0.97–1.35)	1.96 (1.74–2.21)	3.93 (3.25–4.76)
Adjusted[c]	1.00 (Referent)	1.20 (1.02–1.41)	2.04 (1.82–2.29)	3.99 (3.31–4.81)
Propensity score matched[d]	1.00 (Referent)	1.15 (0.85–1.56)	1.75 (1.49–2.05)	3.52 (2.83–4.39)
365-day post discharge mortality				
Crude	1.00 (Referent)	1.48 (1.32–1.66)	2.28 (2.09–2.49)	5.22 (4.46–6.10)
Adjusted[b]	1.00 (Referent)	1.24 (1.10–1.41)	1.90 (1.73–2.09)	4.24 (3.59–5.01)
Adjusted[c]	1.00 (Referent)	1.30 (1.15–1.47)	2.02 (1.84–2.21)	4.36 (3.71–5.14)
Propensity score matched[d]	1.00 (Referent)	1.14 (0.90–1.44)	1.70 (1.50–1.92)	3.75 (3.11–4.51)

JPEN J Parenter Enteral Nutr. 2018 Mar;42(3):557-565

Impact of Malnutrition on critically illness patients



Rytter MJ, et al; PLoS One (2014)

Risk factor of malnutrition

- **Pre-ICU care: patients' comorbidities**
  - Chronic disease: DM, previous stroke (71% on admission)…
  - Dysphagia
  - Functional disability
  - Malignancy, GI diseases…
  - Chronic alcoholics
- **Post-ICU care: neurological symptom and ICU care**
  - Dysphagia
  - Inadequate nutritional intake in patients without dysphagia: protein
  - Post stroke depression and dementia
  - Poor oral hygiene
  - Poor mobility or inactivity: disease severity
  - Poor nursing care, no early rehabilitation
  - Pre-stroke malnutrition

Nutrition Assessment

- **Biochemical data**

	Increase	Decrease
BMI[a]	Edema	Dehydration
Albumin[b]	Dehydration	Inflammatory disease
		Liver cirrhosis
		Renal failure
		Edema
Transferrin[c]	Iron deficiency anemia	Inflammatory disease
	Dehydration	Liver cirrhosis
		Renal failure
		Edema
Prealbumin[d]	Renal failure	Inflammatory disease
	Dehydration	Liver cirrhosis
		Edema

Diet and Nutrition in Critical Care (2014)

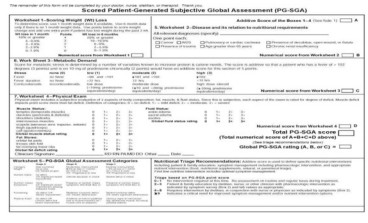
- Albumin → Half life = 20 days. Low in malnutrition, also in infection, burns, fluid overload, hepatic failure, cancer, nephrotic syndrome.
  Low specificity marker (Alb < 3.5 g/dL)
  Mild 3.1-3.5 / moderate 2.1-3.0 / severe <2.0
- Transferrin → Half-life = 10 days. Low in protein energy malnutrition, but also affected by iron status
- Prealbumin → Half-life = 2-3 days. Low in malnutrition, also in infections, liver failure and increased in renal failure
- CRP → Positive acute phase reactant. Helps determine whether above proteins are reduced because of inflammatory process or due to inadequate substrate, as in malnutrition.

S Bharadwaj et al; Gastroenterol Rep (2016)

Pre-ICU care nutrition assessment

Subjective Global Assessment (SGA)

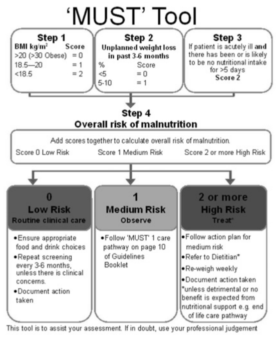
- Developed in 1987 and widely used in Cancer patients
- Simple clinical bedside tool which assess nutritional status based on features of the history and physical examination
- Identifying malnutrition and identifying patients for nutritional support
- **Questionnaire**
  - Weight loss
  - Dietary intake
  - Presence of GI symptom
  - Functional capacity
- **Physical examination**
  - SC fat
  - Muscle wasting
  - Edema
  - Ascites



Pre-ICU care nutrition assessment

Malnutrition Universal Screening Tool (MUST)

- Screening malnutrition for all adults
- Combines weight status, weight loss history, nutritional intake and the effect of acute disease
- Simple screening tool



Pre-ICU care nutrition assessment

Nutritional Risk Index (NRI)

- Combines 2 nutritional indicators : **albumin and weight**
- Nutrition Risk Score (NRI): (1.519 × serum albumin, g/L) + {41.7 × present weight (kg)/ideal body weight (kg)
- Risk stratification
  1) Severe risk (NRI<83.5)
  2) Moderate risk (NRI 83.5–97.5)
  3) Mild risk (NRI 97.5-100)
  4) No risk (NRI > 100)

Nutritional Risk Screening (NRS 2002)

- The NRS-2002: developed from an analysis of controlled trials and included recent dietary intake, weight loss, disease severity, and age to identify patients' nutrition risks.
- Nutrition screening for the risk of adverse outcome of outcome in the ICU
- A score of >3 is considered to be high nutrition risk.

Table 1 Initial screening

		Yes	No
1	Is BMI <20.5?		
2	Has the patient lost weight within the last 3 months?		
3	Has the patient had a reduced dietary intake in the last week?		
4	Is the patient severely ill ? (e.g. in intensive therapy)		

Yes: If the answer is 'Yes' to any question, the screening in Table 2 is performed.
No: If the answer is 'No' to all questions, the patient is re-screened at weekly intervals. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.

Table 2 Final screening

Impaired nutritional status		Severity of disease (≈ increase in requirements)	
Absent Score 0	Normal nutritional status	Absent Score 0	Normal nutritional requirements
Mild Score 1	Wt loss >5% in 3 mths or Food intake below 50–75% of normal requirement in preceding week	Mild Score 1	Hip fracture* Chronic patients, in particular with acute complications: cirrhosis*, COPD*. *Chronic hemodialysis, diabetes, oncology*
Moderate Score 2	Wt loss >5% in 2 mths or BMI 18.5 – 20.5 + impaired general condition or Food intake 25–60% of normal requirement in preceding week	Moderate Score 2	Major abdominal surgery* Stroke* *Severe pneumonia, hematologic malignancy*
Severe Score 3	Wt loss >5% in 1 mth (>15% in 3 mths) or BMI <18.5 + impaired general condition or Food intake 0-25% of normal requirement in preceding week in preceding week.	Severe Score 3	Head injury* Bone marrow transplantation* *Intensive care patients (APACHE>10).*
Score:	+	Score:	= Total score
Age	if ≥70 years: add 1 to total score above	= age-adjusted total score	

Score ≥3: the patient is nutritionally at-risk and a nutritional care plan is initiated
Score <3: weekly rescreening of the patient. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.

NRS-2002 is based on an interpre-tation of available randomized clinical trials. *indicates that a trial directly supports the categorization of patients with that diagnosis. Diagnoses shown in *italics* are based on the prototypes given below. **Nutritional risk** is defined by the present **nutritional status** and risk of impairment of present status, due to **increased requirements** caused by stress metabolism of the clinical condition.

A nutritional care plan is indicated in all patients who are (1) severely undernourished (score = 3), or (2) severely ill (score = 3), or (3) moderately undernourished + mildly ill (score 2 + 1), or (4) mildly undernourished + moderately ill (score 1 + 2).

Prototypes for severity of disease
Score = 1: a patient with chronic disease, admitted to hospital due to complications. The patient is weak but out of bed regularly. Protein requirement is increased, but can be covered by oral diet or supplements in most cases.
Score = 2: a patient confined to bed due to illness, e.g. following major abdominal surgery. Protein requirement is substantially increased, but can be covered, although artificial feeding is required in many cases.
Score = 3: a patient in intensive care with assisted ventilation etc. Protein requirement is increased and cannot be covered even by artificial feeding. Protein breakdown and nitrogen loss can be significantly attenuated.

Clinical Nutrition (2003) 22(4): 415–421

Nutritional Risk in Critically Ill (NUTRIC)

- NUTRIC score was developed in studies of critically ill patient populations.
- Proposed, based on age, severity of disease reflected by the APACHE II and Sequential Organ Failure (SOFA) scores, co-morbidities, days from hospital to ICU admission, and including or not inflammation assessed by the level of interleukin 6.
- A score of ≥ 5 is considered to be high nutrition risk.

Table 1: NUTRIC Score variables

Variable	Range	Points
Age	<50	0
	50 - <75	1
	≥75	2
APACHE II	<15	0
	15 - <20	1
	20-28	2
	≥28	3
SOFA	<6	0
	6 - <10	1
	≥10	2
Number of Co-morbidities	0-1	0
	≥2	1
Days from hospital to ICU admission	0 - <1	0
	≥1	1
IL-6	0 - <400	0
	≥ 400	1

Table 2: NUTRIC Score scoring system: if IL-6 available

Sum of points	Category	Explanation
6-10	High Score	➢ Associated with worse clinical outcomes (mortality, ventilation). ➢ These patients are the most likely to benefit from aggressive nutrition therapy.
0-5	Low Score	➢ These patients have a low malnutrition risk.

Table 3. NUTRIC Score scoring system: If no IL-6 available*

Sum of points	Category	Explanation
5-9	High Score	➢ Associated with worse clinical outcomes (mortality, ventilation). ➢ These patients are the most likely to benefit from aggressive nutrition therapy.
0-4	Low Score	➢ These patients have a low malnutrition risk.

*It is acceptable to not include IL-6 data when it is not routinely available; it was shown to contribute very little to the overall prediction of the NUTRIC score.

Crit Care. 2011;15(6):R268.

Management nutrition during ICU care

Clinical Guidelines

Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.)

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ESPEN Guideline

ESPEN guideline on clinical nutrition in the intensive care unit

Pierre Singer[a,*], Annika Reintam Blaser[b,c], Mette M. Berger[d], Waleed Alhazzani[e], Philip C. Calder[f], Michael P. Casaer[g], Michael Hiesmayr[h], Konstantin Mayer[i], Juan Carlos Montejo[j], Claude Pichard[k], Jean-Charles Preiser[l], Arthur R.H. van Zanten[m], Simon Oczkowski[e], Wojciech Szczeklik[n], Stephan C. Bischoff[o]

Nutrition requirements

Energy requirements (using the Harris-Benedict equation)[a]

Harris-Benedict equation

Men : $BEE(kcal/day) = 66.5 + [13.75 \times weight(kg)] + [5.0 \times height(cm)] - [6.78 \times age(years)]$

Women : $BEE(kcal/day) = 655 + [9.56 \times weight(kg)] + [1.85 \times height(cm)] - [4.68 \times age(years)]$

Stress factors (surgery or injury): 1.2, activity factors (bed ridden): 1.0

Energy requirements

$$\text{Energy requirements}(kcal/day) = BEE(kcal/day) \times \text{stress factors} \times \text{activity factors} = BEE(kcal/day) \times 1.2 \times 1.0$$

Energy requirements (using REE value in sick elderly patients)[b]

$$\text{Energy requirements}(kcal/day) = REE(kcal/day) = 20(kcal \cdot kg^{-1} \cdot day^{-1}) \times weight(kg)$$

Protein requirements[c]

$$\text{Protein requirements}(g/day) = \text{protein requirements per kilogram of body weight}(g \cdot kg^{-1} \cdot day^{-1}) \times weight(kg) = 1.2 - 1.5(g \cdot kg^{-1} \cdot day^{-1}) \times weight(kg)$$

Water requirements[d]

$$\text{Water requirements}(mL/day) = \text{urine output}(mL/day) + \text{insensible water losses}(mL \cdot kg^{-1} \cdot day^{-1}) \times weight(kg) = \text{urine output}(mL/day) + 10(mL \cdot kg^{-1} \cdot day^{-1}) \times weight(kg)$$

BEE Basal energy expenditure, *REE* resting energy expenditure

Diet and Nutrition in Critical Care (2014)

Energy requirement in ICU

A3b. Based on expert consensus, in the absence of IC, we suggest that a published predictive equation or a simplistic weight-based equation (25–30 kcal/kg/d) be used to determine energy requirements. (See section Q for obesity recommendations.)

Q5. Based on expert consensus, we suggest that, for all classes of obesity, the goal of the EN regimen should not exceed 65%–70% of target energy requirements as measured by IC. If IC is unavailable, we suggest using the weight-based equation 11–14 kcal/kg *actual body weight* per day for patients with BMI in the range of 30–50 and 22–25 kcal/kg *ideal body weight* per day for patients with BMI >50. We suggest that protein should be provided in a range from 2.0 g/kg ideal body weight per day for patients with BMI of 30–40 up to 2.5 g/kg ideal body weight per day for patients with BMI ≥40.

2016 SCCM & ASPEN guidelines

Table 5 Estimated calorie and protein requirements in critical illness

BMI	Estimated calorie requirements	Estimated protein requirements
<30	25–30 kcal/kg	1.2–2.0 g/kg actual weight
30–40	11–14 kcal/kg actual body weight, 22–25 kcal/kg ideal body weight	≥2.0 g/kg ideal body weight
>40		≥2.5 g/kg ideal body weight

Diet and Nutrition in Critical Care (2014)

Energy: 25-30 kcal/kg/d

Obese patient: 11-14 kcal/kg/d or

22-25 kcal/kg (ideal body weight)/d

Nutritional monitoring

- **Indirect calorimetry**
  - Standard for measuring energy expenditure in NeuroICU
  - Measuring patients' breathing or respiratory gas exchange
    - Gas sampling at proximal ET tube every 1 minute
  - respiratory quotient [RQ (the ratio of CO2 produced to O2 consumed)] as well as the resting energy expenditure (Jequier and Felber 1987)
  - RQ value (VCO2/VO2)
    - **RQ 0.8–0.9: normal**
    - RQ 0.9-1.0: carbohydrate metabolism
    - RQ = 1.0+: overfeeding of carbohydrates
    - RQ = 0.7: the oxidation of fats – starvation and underfeeding
- resting energy expenditure (REE): 19-22 Kcal
  - REE = VCO2 X 8.19

Carbohydrate

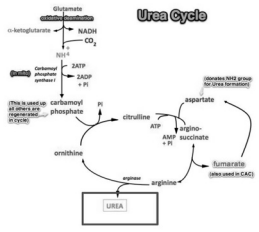
- Majority of non-protein calories and main source of cellular energy
  - 50-60% of total calories (70-90% of non-protein calories)
- 5g/kg/day of carbohydrate is metabolized.
- Enteral nutrition: 4 kcal/g in disaccharide and polysaccharide
- Parenteral nutrition: 3.4/g in dextrose
- Total glucose load: 3.5-5 mg/Kg/24hrs depending severity of stress

Protein

- Essential molecules in all cell activity and most important macronutrients
  - Supporting immune function, Repair mechanism, and maintaining lean body mass
- Protein requirement
  - Typically 0.5g/Kg (0.08 g nitrogen) protein: unstressed people
  - 1.2-1.5g/Kg (ideal body weight): acute stressful status
    - ➢ Considering renal function: 0.6-0.8 g/Kg in CRF
- Monitoring method
  - **Nitrogen balance**: comparison between nitrogen intake and nitrogen loss from the body

  → index of growth/anabolic status of the body

Nitrogen balance



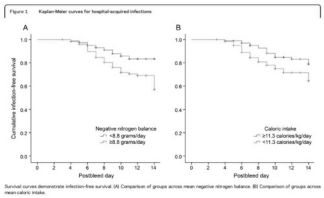
- Measured at intervals of 2-3 days

- Nitrogen balance: using 24 hrs UUN (urinary urea nitrogen)
  - Nitrogen balance= nitrogen (intake-excretion)
  - **Protein intake/6.25 – 24 hrs UUN + 4**
    - 4g: feces or skin loss
    - 6.25: nitrogen 15-18% in protein
  - UUN
    - < 6g: normal
    - 6-12g: mild
    - 12-18g: moderate
    - > 18g: severe catabolism
  - Nitrogen balance
    - **Positive balance: maintaining nutrition**
    - **Negative balance: increased protein supplement**
      - ✓ Synthesis < degradation
    - **Target: positive balance 4-6 g**

Protein balance and outcome in ICU

Inflammation, negative nitrogen balance, and outcome after aneurysmal subarachnoid hemorrhage

Neurology 2015;84:680–687

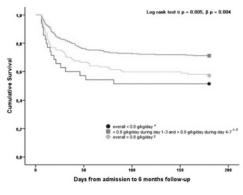


Negative NBAL and underfeeding after SAH are influenced by inflammation and associated with an increased risk of HAI and poor outcome.

Original article

Timing of PROTein INtake and clinical outcomes of adult critically ill patients on prolonged mechanical VENTilation: The PROTINVENT retrospective study

Neurology 2015;84:680–687



Low protein intake is associated with the highest mortality risk.

Nutrition support therapy: EN vs. PN?

B1. We recommend that nutrition support therapy in the form of early EN be initiated within 24–48 hours in the critically ill patient who is unable to maintain volitional intake.

B2. We suggest the use of EN over PN in critically ill patients who require nutrition support therapy.

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Early EN start

EN > PN

More nutrition needed patients: EN with PN

- EN supports the functional integrity of the gut
  - Food in gut: activated pathogenic microorganism in the gut and mucosa cell
  - maintaining tight junctions between the intraepithelial cells
  - stimulating blood flow
  - inducing the release of trophic endogenous agents (cholecystokinin, gastrin, bombesin, and bile salts)

EN vs PN

Early EN vs delayed EN in mortality

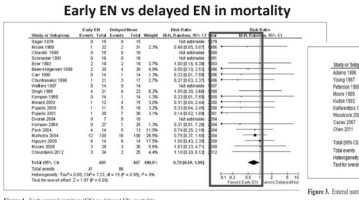

Figure 1. Early enteral nutrition (EN) vs delayed EN, mortality.

EN vs PN in infection

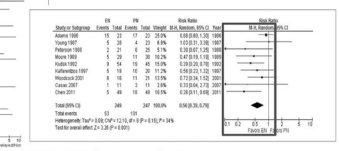

Figure 3. Enteral nutrition (EN) vs parenteral nutrition (PN), infectious complications.

Early EN vs delayed EN in infection

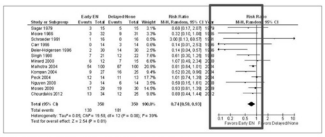

Figure 2. Early enteral nutrition (EN) vs delayed EN, infectious complications.

Early EN start

EN > PN

Monitoring daily for tolerance of EN

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Gastric residual volume

D2a. We suggest that GRVs not be used as part of routine care to monitor ICU patients receiving EN.

D2b. We suggest that, for those ICUs where GRVs are still utilized, holding EN for GRVs <500 mL in the absence of other signs of intolerance (see section D1) should be avoided.

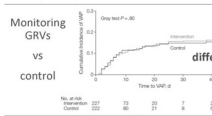
2016 SCCM & ASPEN guidelines

- **Large GRV is associated with risks of aspiration and vomiting.**
- **Hold EN for GRV > 500 mL for 6 hours**
- **Add motility drugs**

Effect of Not Monitoring Residual Gastric Volume on Risk of Ventilator-Associated Pneumonia in Adults Receiving Mechanical Ventilation and Early Enteral Feeding
A Randomized Controlled Trial
JAMA. 2013;309(3):249-256

Figure 2. Development of Ventilator-Associated Pneumonia in the Groups With (Control) and Without (Intervention) Residual Gastric Volume Measurement

Monitoring GRVs vs control



No difference in VAP

Cumulative incidence of ventilator-associated pneumonia (VAP) in both groups in the modified intention-to-treat analysis. For the analysis of time from randomization to VAP, death was handled as a competing risk. Results were similar in the per-protocol analysis.

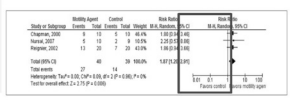


Figure 7. Motility agents vs placebo, outcome lower gastric residual volume.

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Micronutrients

TABLE 1: Micronutrients and mechanisms through which their deficiencies induce cerebrovascular alterations and increase the risk of stroke.

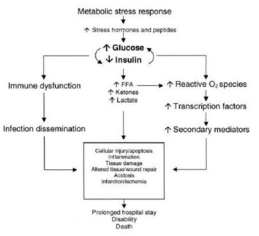
Micronutrient	Mechanism
Folic acid	
Cofactor in homocysteine metabolism	Hyperhomocysteinemia (potentially atherogenic)
B vitamins	
(i) B_6 and B_{12}: cofactors in homocysteine metabolism	(i) Hyperhomocysteinemia (potentially atherogenic)
(ii) Potentially antioxidants	(ii) Oxidative stress
Vitamin D	
(i) Controls parathormone levels	(i) Secondary hyperparathyroidism: – Insulin resistance and pancreatic b-cell dysfunction → type 2 diabetes mellitus
(ii) Suppresses cholesterol uptake by the macrophages and foam cell formation	– Activation of the rennin-angiotensin-aldosterone system → hypertension
(iii) Increases the size of high-density lipoprotein particles	– Stimulation of systemic and vascular inflammation → atherogenesis
	(ii) Atherogenesis
Vitamins A, C, and E	
Antioxidants	Oxidative stress
Zinc	
(i) Activates brain protein synthesis	(i) Neurocognitive impairment
(ii) Controls newly formed synapses	(ii) Impaired neurotransmission
(iii) Cofactor of superoxide dismutase	(iii) Oxidative stress

Stella D. Bouziana et all Nutr Metab (2011)

Glucose control

Hyperglycemia and poor outcome in critically ill patients

Mayo Clin Proc. 2003;78:1471-1478



Diabetes Care 2004 Feb; 27(2): 553-591

Level of glucose in ICU

Continuous Intravenous Insulin Infusion Reduces the Incidence of Deep Sternal Wound Infection in Diabetic Patients After Cardiac Surgical Procedures

Ann Thorac Surg 1999;67:352– 62

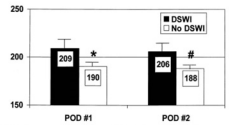


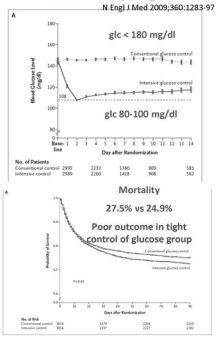
Fig 2. Daily comparison of mean blood glucose levels between patients with DSWI and those without DSWI (No DSWI). (*p = 0.02; #p = 0.01.)

- **Mortality: 5.0% in glc> 200 mg/dL vs 1.8% in glc ≤ 200**
- **DSWI: 2.0% in sliding scale guided intermittent subcutaneous insulin vs 0.8% in continuous intravenous insulin, CII**

Intensive versus Conventional Glucose Control in Critically Ill Patients

The NICE-SUGAR Study Investigators®

N Engl J Med 2009;360:1283-97



Target blood glucose range in adult ICU patients

H5. We recommend a target blood glucose range of 140 or 150–180 mg/dL for the general ICU population; ranges for specific patient populations (postcardiovascular surgery, head trauma) may differ and are beyond the scope of this guideline.

2016 SCCM & ASPEN guidelines

Table 1. Key clinical practice guidelines on glycemic control goals in ICU patients

Organization	Year	Target glucose (mg/dL)
European Society of Cardiology[21]	2009	140-180
American Association of Clinical Endocrinologists[22]	2009	140-180
American College of Physicians[23]	2011	140-200
Society of Critical Care Medicine[24]	2012	110-150
Joint British Diabetes Societies for Inpatient Care[25]	2015	140-180
Korean Diabetes Association[26]	2015	140-180
American Diabetes Association[27]	2018	140-180

ICU, intensive care unit.

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Glycemic control

Basal-bolus vs Sliding scale insulin

Randomized Study of Basal-Bolus Insulin Therapy in the Inpatient Management of Patients With Type 2 Diabetes (RABBIT 2 Trial)

Diabetes Care 30:2181–2186, 2007

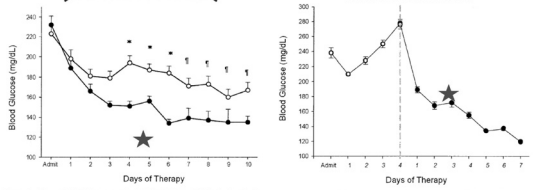

Figure 1—*Changes in blood glucose concentrations in patients treated with glargine plus glulisine (●) and with SSI (○). *P < 0.01; †P < 0.05.*

Figure 2—*Mean blood glucose concentration in subjects who remained with severe hyperglycemia despite increasing doses of regular insulin per the sliding-scale protocol (○). Glycemic control rapidly improved after switching to the basal-bolus insulin regimen (●). †P < 0.05.*

- **Treatment with basal-bolus insulin resulted in significant improvement in glycemic control compared with that achieved with the use of sliding scale insulin alone.**

Protocol for intravenous insulin infusion

- For a **basal-bolus regime**, **50% of the total insulin** requirement is usually given as **basal insulin**, and the remainder (50%) as **rapid-acting insulin**, divided equally between breakfast, lunch and evening meal (3 times).

Table 2. Modified protocol for intravenous insulin infusion, according to the Joint British Diabetes Societies for Inpatient Care[25]

Glucose (mg/dL)*	Insulin rates (mL/h)† (start on standard rate unless otherwise indicated)‡		
	Reduced rate (for use in insulin sensitive patients, e.g. ≤24 units/day)	Standard rate (first choice in most patients)	Increased rate (for insulin-resistant patients, e.g. ≥100 units/day)
<72	0	0	0
73-144	0.5	1	2
145-216	1	2	4
217-288	2	4	6
289-360	3	5	7
361-432	4	6	8
>433	6	8	10

*Blood glucose must be monitored hourly.
†50 units of insulin in 49.5 mL of 0.9% NaCl solution yields a concentration of 1 unit/mL.
‡If the patient usually takes basal insulin, continue to use basal insulin with intravenous infusion.

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Conclusion

- Evaluating nutritional status using several screening tool in Stroke patients
- Optimal nutritional support
  - Considering energy
  - Protein and carbohydrate
  - Nutritional monitoring: UUN for protein balance
- Enteral nutrition as soon as possible
- Maintaining optima glucose level: 140-180 mg/dl

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