

### Case Study #3: Critical Illness (60 points total)

You are the RD in the burn unit of your hospital. You have been consulted for a nutrition assessment of Mr. G, and you will be responsible for follow-up assessments, planning, and monitoring throughout his hospitalization.

*Initial admission information available from the medical chart:*

Mr. G, a **32 yo industrial chemist**, was severely burned over much of his trunk, arms, and back in an accident at the chemical plant where he works. After emergency first aid at the plant, he was transported by ambulance to the university hospital burn center. Mr. G was in shock when he was admitted.

Physical exam: **Pt experiencing severe pain, moderate respiratory distress.**

Unburned skin is pale and cool. BP: 90/60; P 110 and weak; RR 22 and regular; **Ht: 5'10"; pre-injury wt: 165#**

Laboratory: The following tests were ordered: CBC, blood type and cross-match, Chem 20 screening panel, ABG's, and UA.

Impression: **30% TBSA, partial and full-thickness burns over lower part of face, neck, upper back, arms, hands, and upper thighs.**

Plan: IV therapy was initiated with Ringer's lactate. A Foley catheter was inserted. Urinary output, P, and BP monitored hourly. **NPO x 24 hrs.** NG tube placed for stomach decompression. Maalox q 2 hrs through NG tube.

Initial hospital course:

- As soon as the shock was under control, Mr. G's wounds were washed, debrided, and dressed with silver sulfadiazine using fine-mesh gauze. He was given a tetanus shot and 600,000 units of procaine penicillin were administered q 12 hrs.
- After 24 hrs, Mr. G's UO was 40-50 ml/hr and bowel peristalsis had returned; patient is responsive to pain, but limited alertness; breathing & respiration normal
- By 36 hrs, a **nasoduodenal tube was placed and position of the tip verified by radiology to be past the ligament of Trietz.**
- On second day (~ 36 hours), a Nutrition Consult was ordered for feeding recommendation

Initial Assessment

Using the above information, assess the patient's nutritional needs at the time of the initial consult, on day 2 of admission.

1. Calculate Mr. G's estimated energy needs on day 2 of hospitalization, using the following methods. Show your work.

a. Quick shortcut as used by UCDCMC burn unit [35-40 kcal/kg BW] (2 pts)

2625 – 3000kCal

b. TEE using Mifflin St-Jeor formula with appropriate AF and IF (2 pts)

2800 – 3500 kCal

Source: MNT Pocket Guide pg. 3-4

c. Comment on whether these two estimates differ or are similar, and what you would use as your actual energy recommendation for this patient. Provide justification for why you selected this energy recommendation. (2 pts)

The two estimates differ by about 200 calories on the low-end and 500 on the high-end. Although neither method will be as accurate as indirect calorimetry, I would recommend the M<sub>SJ</sub> energy recommendations for Mr. G as the equation allows for both an activity and injury factor to be accounted for and better estimates his caloric needs. Since burn victims vary in the severity of the injuries they have sustained and their clinical status, the activity and injury factors that the M<sub>SJ</sub> takes into account makes it a better estimate of Mr. G's energy requirements. For example, not all burn victims will be burned as severely or confined to bed as Mr. G is and may still be able to walk, which would increase their energy requirements. The UCDCMC's quick shortcut, which is more of a static estimate, may not be able to take these clinical factors into account.

2. Calculate Mr. G's estimated protein needs on day 2 of hospitalization. Show your work. (2 pts)

150gm pro/d

Source: MNT Pocket Guide pg. 4

3. Discuss the effects of trauma on macronutrient metabolism. (3 points.)

Although there are three phases of trauma, ebb, flow, and recovery, the effects on macronutrient metabolism primarily occurs during the flow phase.

The flow phase can be broken down into two parts, the acute and adaptive flow phases. During the acute response of the flow phase, an increase in metabolic rate, proteolysis, lipolysis, and gluconeogenesis all occur due to a release of hormones in response to the trauma such as cortisol and catecholamines, which puts the body in an overall catabolic state. Protein breakdown increases in an attempt to restore the decreasing amino acid levels within the body and maintain nitrogen balance.

Gluconeogenesis rates also increase, leading to higher glucose production in conjunction to higher circulating levels of insulin and lower tissue sensitivity to insulin, resulting in insulin resistance in the liver and peripheral tissues. The combination of the two results in hyperglycemia as glucose is not being properly shuttled into the appropriate body tissues. Lastly, lipolysis is increased in conjunction with blunted fat oxidation, leading to higher circulating levels of free fatty acids in the blood and eventually results in hypertriglyceridemia.

During the acute portion of the flow phase, the body's metabolism begins to slowly return back to normal and is marked by a reduction in metabolic rate, proteolysis, lipolysis, and gluconeogenesis, which occurs due to a decrease in the aforementioned hormones that induced their increase. At this point, the body begins to shift towards an anabolic state to begin rebuilding the nutrient stores and tissues that it lost during the acute phase.

**Source(s):** NUT116B Nutritional Management of Trauma Guest Lecture, NUT116BL Critical Illness Lecture, Source: Practical guidelines for nutritional management of injury and recovery (Prelack K, et al.)

- 4. Based on the patient's needs, consider the enteral formula to recommend**
  - a. Describe two desirable features or characteristics of the type of formula you would select and recommend. (refer to the UCD TF lecture) (2 pt)**
  - b.**
    1. Moderate-High Energy Density: Since Mr. G is in a hypermetabolic state, his energy needs are significantly elevated and will need a more energy dense formula

2. Moderate-High Protein content: Mr. G's protein requirements are also significantly elevated as his body is currently in a highly catabolic state and nitrogen balance is negative. From the UCD TF lecture, a standard formula with intact proteins or one with hydrolyzed proteins/semi-elemental with small peptides for better absorption may be beneficial for Mr. G.

Source: NUT116BL UCD Tube Feeding Guest Lecture

- c. Give one example of an appropriate enteral formula meeting these characteristics, using the formulary provided on the course Smartsite.(1pt)

Goal:

2800-3500kCal

2800-3500mL fluid

110-150g pro

<u>TF Volume (mL)</u>	2640-3300mL
<u>Kcal</u>	2800-3560kCal
<u>Protein (g)</u>	116-145g pro
<u>Fluid (mL)</u>	2220-2820mL H <sub>2</sub> O
<u>Water flushes</u>	115-215mL q 4 hrs. to meet fluid requirements

Source: UCSF Formulary

5. Mr. G is on IV Famotidine (Pepcid). What type of medication is this & why is it being used? Why do you think this was used instead of the alternative Cimetidine liquid to be put down the feeding tube? (Use the FMI text for this question) (2 pts)

Famotidine (Pepcid) is a Histamine H<sub>2</sub> receptor antagonist that is used to decrease the amount of acid produced in the stomach. It was likely prescribed to prevent ulcers from forming in Mr. G's stomach and intestinal tract.

Famotidine was most likely used over liquid Cimetidine because the latter is known to precipitate tube feedings, which may lead to clogging or occlusion of the tube as well as also containing alcohol, which may increase the amount of acid produced in the stomach.

**Source:** Food Medication Interactions (pg. 166-167)

**6. Describe 3 ways you could determine the adequacy of your recommendations for energy and protein intake for this burn patient. (In other words, what will you monitor to decide if your recommendations are adequate, and why?) (3 points)**

1. Monitoring the long-term weight trends of the burn patient over the course of their healing is one way to determine the adequacy of our energy recommendations. Although weight will most likely shift in the acute phase of trauma due to shifts in fluids and other clinical factors, it should eventually stabilize as the patient moves towards the recovery phase. At this point, a new baseline weight can be established and if our energy recommendations are adequate, weight gain should be observed in the patient over time.
2. Nitrogen balance is a method that can be used to determine if the burn patient's protein intake is adequate. A neutral or positive nitrogen balance may not be possible in the acute phases of trauma, which is characterized by an overall catabolic state in the body. However, if our protein recommendations are adequate, an upward trend towards positive nitrogen balance should be observed over time.
3. Monitoring serum proteins such as prealbumin and C-reactive protein is another method to determine if the burn patient's protein intake is sufficient. Prealbumin is a good indicator of a patient's protein status because if dietary protein is low, amino acids from body tissues must be oxidized for fuel and result in a decrease in prealbumin.

CRP will increase as an acute response to injury of tissues, such as burns, but will subside as the patient recovers. While CRP is elevated, the liver does not produce as much prealbumin so it is expected to see a lower level during the acute phase of trauma. However, If the the patient's protein intake is adequate, prealbumin will trend upwards as CRP decreases.

**Source:** Practical guidelines for nutritional management of injury and recovery (Prelack K, et al.)

### Ongoing Assessments

It is now day 10 post-injury and you have the following additional information available:

- Some wounds are still open (new estimate: **15% TBSAB**). More surgery for skin grafting is scheduled in the next week.
- Diet order during the past week has been changed by MD to: Jevity 1.5 @ 60 ml/hr, plus PO intake as tolerated.
- You have conducted kcal counts for the past 3 days. They show that pt is taking 100 kcals/day by oral intake, in addition to TF. Nursing I/O's indicate that the full TF volume is being delivered each day.
- The patient tells you it is difficult for him to eat by mouth due to pain, and that he doesn't have much of an appetite, he refuses to try eating for now.
- **Current BW: 70 kg**, no significant edema
- Current labs: albumin 2.7 g/dL, prealbumin 8 mg/dL, UUN 23 g/24 hr

**7. Re-assess Mr. G's estimated energy, protein, and fluid needs using the current information available.**

a. **Energy: (1 pt)**

1830-2700kCal/d

b. **Protein: (1 pt)**

115-150gm pro/d

c. **Fluid: (1 pt)**

1830-2700 fluid/d

**Source:** MNT Pocket Guide pg. 4

8. Calculate the energy, protein, and fluid provided by the current TF regimen.  
Show your work

a. **Energy: (1 pt)**

2160KCal

b. **Protein: (1 pt)**

90gm pro

c. **Fluid: (1 pt)**

1090mL H<sub>2</sub>O

Source: MNT Pocket Guide pg. 4

**9. Calculate Mr. G's nitrogen balance at day 10. (1 point)**

Nitrogen Balance: -12.6

Source: MNT Pocket Guide pg. 4

**10. Interpret the results of the nitrogen balance study. Is current TF order adequate to meet estimated protein needs? (2 points)**

The results of the nitrogen balance study suggest that the amount of nitrogen being excreted by Mr. G is higher than his current nitrogen intake. A negative nitrogen balance means that his body is in a catabolic state and his current TF order is not adequate to meet his estimated protein needs.

**11. Write one PES statement that you will use in your note below: (3 pts)**

Inadequate energy intake (NI-1.2) r/t inadequate enteral nutrition infusion (NI-2.2) AEB loss of 5kg bodyweight from pre-injury weight and negative nitrogen balance study.

**12. Write an ADIME note for your day 10 follow-up assessment of Mr. G. Hints: Be sure to evaluate his current anthropometrics (and any trends seen), current kcal/pro needs, adequacy of the current diet order (including both the TF and PO intake), and current labs. What do the anthropometric and biochemical data reveal? Is the current diet order adequate and realistic for the patient? Write two PES statements that reflect your assessment. In addition to the PES statement in Q 11, write one more PES statement and include both in your note. In the Plan section, make *very specific* nutrition support and monitoring recommendations for this patient at this point in time. (23 points)**

**a. Assessment:**

- a. Patient History: 32 yo M admitted to burn unit for severe burns over a majority of his trunk, arms, and back totaling 30% TBSA. Nutrition consult ordered for feeding recommendations. Currently on enteral tube feedings with limited PO intake of 100 kcals/d. Pt. reports that oral intake is difficult due to severe mouth pain.

b. MD Diet Order/RX: NPO × 24 hrs., enteral feeding through nasoduodenal tube afterwards (Jevity 1.5 @ 60 ml/hr, plus PO intake as tolerated)

c. Anthropometrics:

- i. Age: 32yo
- ii. Sex: M
- iii. Ht.: 5'10", 177.8cm
- iv. CBW: 154#, 70kg
- v. UBW: 165#, 75kg
- vi. IBW: 76kg
- vii. %IBW: 93%
- viii. Current BMI: 22.14 (Normal)

d. Weight Hx:

- i. Before injury, pts weight was 75kg. After being in hospital for 10 days, pt. has lost 5kg, or 7% weight loss. 7% unintentional weight loss in a little over a weeks' time is considered to be severe weight loss.

e. Labs:

- i. TBSAB: 15% (IF: 1.0-1.5)
- ii. Albumin: 2.7g/L (Low; inflammation, inadequate protein status)
- iii. Prealbumin: 8mg/dL (Low; tissue damage, inflammation, inadequate protein status)
- iv. UUN: 23g/24hr (High; inadequate protein intake)
- v. Nitrogen balance study: -12.6 (Low; body is in catabolic state)

f. Medications:

- i. Maalox q 2 hrs through NG tube

g. Estimated Nutrient Needs (based on 70kg CBW)

- i. Energy: 1830-2700kCal/d
- ii. Protein: 115-150gm pro/d
- iii. Fluid: 2280-3000 mL/d

h. Current Nutrient Intake

- i. TF Intake: 2160 kcal
- ii. PO: 0 kcal (pt. refuses to try eating due to severe pain)
- iii. Total Energy Intake: 2160 kcal
- iv. Fluids: 1090 mL
- v. CHO: 300g (55% kcal)
- vi. Protein: 90gm (16% kcal)
- vii. Fat: 70g (29% kcal)



b. Diagnosis:

- a. PES #1: Inadequate energy intake (NI-1.2) r/t inadequate enteral nutrition infusion (NI-2.2) AEB 7% unintentional weight loss (severe) since being admitted into hospital.
- b. PES #2: Inadequate protein intake (NI-5.7.1) r/t increased protein needs due to trauma resulting in 15%TBSAB AEB EPR of 115-150gm/d with enteral formula providing only 90gm, negative nitrogen balance of -12.6, low prealbumin and albumin lab values, and UUN of 23g/24hrs.

c. Intervention:

- a. Overall MNT Goal: To prevent further wt. loss, increase Kcal intake to obtain positive energy balance and re-gain lost bw of 5kg as well as increase protein intake to achieve at least neutral nitrogen balance.
- b. Recommendations: Continue TF through NG, change formula to Osmolite 1CAL @ 115ml/hr to provide 2760mL TF volume, 2950Kcal, 2320mL H<sub>2</sub>O, 120g pro. Provide 115ml water flushes q 4 hours to meet daily fluid requirements.
  - i. Calculations:

Osmolite 1CAL @ 115mL/hr	
	<u>Total:</u>
<u>TF Volume (mL)</u>	2760mL/d
<u>Kcal</u>	2950Kcal
<u>Protein (g)</u>	120gm
<u>Fluid (mL)</u>	2320mL
<u>Water flushes</u>	680mL / 6 flushes → 115mL q 4 hrs. to meet fluid requirements

d. Monitoring/Evaluation:

- a. Reach >90% of calculated enteral delivery volume of 2760mL/d from Osmolite 1CAL
- b. Measure weight E3D and continue monitoring to prevent additional wt. loss and make sure that energy intake is adequate for weight to begin moving towards IBW of 166#

- c. Monitor prealbumin and albumin levels to assess protein status and adequacy; begin moving towards neutral and ideally, positive nitrogen balance
- d. Monitor pt.' PO intake and tolerance as they recover

Signature: \_\_\_\_\_

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13. It is now 3 weeks since admission and he is now in a transitional care unit. Mr. G's wounds are closed and healing well. He is interested in trying to eat more foods orally and his appetite is returning. How could his current continuous TF regimen (the one recommended in your note above) be modified to provide approximately 1000 kcal/day and not interfere with his intake at meal times? Make recommendations for an appropriate transitional TF plan/order and how to monitor. Make a specific recommendation for both the TF plan and monitoring. (6 points)

His current TF regiment can be modified to provide about 1000 kcal/day by changing the TF volume to 950mL/day. In order to not interfere with his PO intake at meal times, I would recommend that Mr.G transition from continuous to cyclic feeds at 160mL/hr for 6hrs. given at night (12:00-6:00am) while he is sleeping.

To monitor if the transitional plan is effective, Mr. G's weight, inputs and outputs, and labs (ie. albumin, prealbumin, BUN), and nitrogen balance should be monitored weekly and compared to baseline values. An effective regiment should see Mr. G's weight, PO intake, and nitrogen balance trending upward and BUN decreasing.

## Calculations Page

1.  $165\text{lbs} / (2.2\text{lb/kg}) = 75\text{kg}$   
 $75\text{kg} * (35-40 \text{ Kcal/kg BW}) = 2625 - 3000\text{kcal}$

$$\begin{aligned} \text{MSJ (Men): } & (10 * \text{wt. [kg]}) + (6.25 * \text{ht. [cm]}) - (5 * \text{age}) + 5 * \text{AF} * \text{IF} \\ & = (10 * 75\text{kg}) + (6.25 * 177.8\text{cm.}) - (5 * 32) + 5 * \text{AF} * \text{IF} \\ & = 750 + 1100 - 160 + 5 * \text{AF} * \text{IF} \\ & = 1700 * \text{AF} * \text{IF} \\ & = 1700 * 1.1 \text{ (Confined to bed)} * 1.5-1.85 \text{ (TBSA: 20-40\%)} \\ & = 2800 - 3500 \text{ kcal} \end{aligned}$$

2. Protein needs = bw (kg) \* Stress Factor  
 $75\text{kg} * (1.5-2\text{g/kg/d}) \text{ [Post-Surgical PTs/Burns/Cancer/BMT]} = 115-150\text{gm pro/d}$

4.

Osmolite 1CAL (Abbott): Whole Protein/Low Residue Enteral Formula		
	Calculation:	Total:
<u>TF Volume (mL)</u>	$2800-3500\text{Kcal} / (1.06 \text{ Kcal/mL})$	2640-3300mL
<u>Kcal</u>	$2640-3360\text{mL formula} * (1.06 \text{ Kcal/mL})$	2800-3560Kcal
<u>Protein (g)</u>	$2.64-3.3\text{L} * (44\text{g pro/L})$	116-145g pro
<u>Fluid (mL)</u>	$2640-3360\text{mL formula} * (84\% \text{ Free H}_2\text{O})$	2220-2820mL H <sub>2</sub> O
<u>Water flushes</u>	$3500\text{mL total fluid needs} - (2220-2820\text{mL H}_2\text{O from formula})$	680mL-1280mL / 6 flushes → 115-215mL q 4 hrs. to meet fluid requirements

$$\begin{aligned} 7a. \text{MSJ (Men): } & (10 * \text{wt. [kg]}) + (6.25 * \text{ht. [cm]}) - (5 * \text{age}) + 5 * \text{AF} * \text{IF} \\ & = (10 * 70\text{kg}) + (6.25 * 177.8\text{cm.}) - (5 * 32) + 5 * \text{AF} * \text{IF} \\ & = (700) + (1110) - (160) + 5 * \text{AF} * \text{IF} = 1660 * \text{AF} * \text{IF} \\ & = 1660 * (1.1) \text{ [Confined to bed]} * (1.0-1.5) \text{ [TBSA up to 20\%]} \\ & = 1830-2700\text{kcal/d} \end{aligned}$$

- 7b. Protein needs = bw (kg) \* Stress Factor

$$= 75\text{kg} \times (1.5\text{-}2\text{g/kg/d}) \text{ [Post-Surgical PTs/Burns/Cancer/BMT]} = \mathbf{115\text{-}150\text{gm pro/d}}$$

$$\mathbf{7C. \text{ Fluid req.} = 1\text{ml/1Kcal}}$$

$$= 1830\text{-}2700\text{Kcal/d} \times (1\text{ml/1Kcal}) = \mathbf{1830\text{-}2700\text{mL fluid/d}}$$

$$\mathbf{8. - \text{Jevity 1.5 @ 60ml/hr} \times (24 \text{ hr/d}) = 1440\text{mL/d total TF}}$$

$$1440\text{mL TF} \times (1.5 \text{ Kcal/mL}) = \mathbf{2160\text{Kcal}}$$

$$- 1.4\text{L TF} \times (64\text{g pro/L}) = \mathbf{90\text{gm pro}}$$

$$- 1440\text{mL TF} \times (76\% \text{ Free H}_2\text{O}) = \mathbf{1090\text{mL H}_2\text{O}}$$

$$\mathbf{9. \text{ Nitrogen Balance} = (\text{Protein Intake g/6.25}) - (\text{UNN} + 4)}$$

$$= (90\text{g pro}) / 6.25 - (23 + 4)$$

$$= \mathbf{-12.6}$$

## 12. - ADIME:

$$\mathbf{\text{Height: } 5'10'' = 70\text{in} \times (2.54 \text{ cm/in}) = 177.8\text{cm}}$$

$$\mathbf{\text{CBW: } 70\text{kg} \times (2.2\text{lbs/kg}) = 154\text{lbs}}$$

$$\mathbf{\text{UBW: } 165\# / (2.2\text{lbs./kg}) = 75\text{kg}}$$

$$\mathbf{\text{IBW: Men: } 106\text{lbs. } 1^{\text{st}} 5 \text{ ft} + 6\text{lbs. each additional in. } >5\text{ft}}$$

$$\mathbf{\text{IBW} = 106 + 60\text{lbs} = 166\text{lbs. or } 166 / (1\text{kg}/2.2\text{lb}) = 76\text{kg}}$$

$$\mathbf{\% \text{ IBW: } \% \text{IBW} = \text{CBW/IBW} = 70\text{kg}/75\text{kg} \times 100\% = 93\%}$$

$$\mathbf{\text{BMI: } \text{kg/m}^2 = 70\text{kg}/1.778\text{m}^2 = 22.14}$$

## Current Nutrient Intake:

$$\mathbf{a. \text{ Kcal: } 2160 \text{ kcal}}$$

$$\mathbf{i. 60\text{mL/hr} \times 24\text{hr/d} = 1440\text{mL}}$$

$$\mathbf{1. 1440\text{mL} \times (1.5 \text{ Kcal/mL}) = 2160\text{Kcal}}$$

$$\mathbf{b. \text{ CHO: } 300\text{g} (55\% \text{ Kcal})}$$

$$\mathbf{i. 1.4\text{L Jevity 1.5} \times (216\text{g/L}) = 300\text{g CHO}}$$

$$\mathbf{c. \text{ Protein: } 90\text{gm} (16\% \text{ Kcal})}$$

$$\mathbf{i. 1.4\text{L Jevity 1.5} \times (64\text{g/L}) = 90\text{gm pro.}}$$

$$\mathbf{d. \text{ Fat: } 70\text{g} (29\% \text{ Kcal})}$$

$$\mathbf{i. 1.4\text{L Jevity 1.5} \times (50\text{g/L}) = 70\text{g fat}}$$

## - Intervention:

Osmolite 1CAL (Abbott)@ 115ml/hr		
	<u>Calculation:</u>	<u>Total:</u>
<u>TF Volume (mL)</u>	115mL/hr * 24hr	2760mL/d
<u>Kcal</u>	2760mL * (1.06Kcal/mL)	2950Kcal

<u>Protein (g)</u>	2.76L *(44g pro/L)	120gm
<u>Fluid (mL)</u>	2760mL * (84% Free H <sub>2</sub> O)	2320mL
<u>Water flushes</u>	3000mL total fluid needs – (2320mL H <sub>2</sub> O from formula)	680mL / 6 flushes → 115mL q 4 hrs. to meet fluid requirements

13.

Goal: 1000 kcal/d from TF

Osmolite 1CAL:

- Flow Rate:  $1000\text{kcal} / (1.06\text{kcal/mL}) = 950\text{mL}/6\text{hr} \rightarrow 160\text{mL}/\text{hr}$   
cyclic feed