

## Guideline for Intravenous Insulin Infusion in the Adult ICU Patient Goal Blood Glucose (BG) = 80-120 mg/dL

### General Guidelines:

- **Standard drip:** 100 Units/100 ml NS via an infusion device.
- **All patients should start the drip when BG is over 120 mg/dL.**
- Insulin infusions should be discontinued when a patient is medically stable and 2hrs after subcutaneous administration of long-acting glargine insulin. (Then proceed to Transition from IV to SQ insulin protocol)
- Patients with Type 1 diabetes will require insulin at all times.

### Intravenous Fluids:

- If patient is unable to have enteral feeding, he will need a minimum of 5grams of glucose per hour in addition to KCl (20 meq/L). This can be provided through intravenous fluid (the type and rate of which is to be determined by the primary service depending of the underlying disease) or through TPN.

### Initiating the Infusion:

- **Algorithm 1:** Start here for most patients. **(Note exceptions to start in Algorithm 2)**
- **Algorithm 2:** Start here if patient with glucose  $\geq 600$  mg/dl, s/p CABG, s/p solid organ transplant or islet cell transplant, receiving glucocorticoids, or patient with diabetes receiving over 80 units/day of insulin as an outpatient.
- **Algorithm 3:** For patients not controlled on Algorithm 2. PATIENTS RARELY START HERE.
- **Algorithm 4:** For patients not controlled on Algorithm 3. PATIENTS RARELY START HERE.
- **Algorithm 5:** For patients not controlled on Algorithm 4. PATIENTS RARELY START HERE.

Algorithm 1		Algorithm 2		Algorithm 3		Algorithm 4		Algorithm 5	
BG	Units/hr	BG	Units/hr	BG	Units/hr	BG	Units/hr	BG	Units/hr
<b>&lt;60 = Hypoglycemia</b> (See below for treatment)									
<60	Off	<60	Off	<60	Off	<60	Off	<60	Off
60-79	0.1	60-79	0.2	60-79	0.5	60-79	0.7	60-79	1.5
80-109	0.2	80-109	0.5	80-109	1	80-109	1.5	80-109	3
110-119	0.5	110-119	1	110-119	2	110-119	3	110-119	6
120-149	1	120-149	1.5	120-149	3	120-149	5	120-149	9
150-179	1.5	150-179	2	150-179	4	150-179	7	150-179	12
180-209	2	180-209	3	180-209	5	180-209	9	180-209	15
210-239	2	210-239	4	210-239	6	210-239	12	210-239	18
240-269	3	240-269	5	240-269	8	240-269	16	240-269	24
270-299	3	270-299	6	270-299	10	270-299	20	270-299	30
300-329	4	300-329	7	300-329	12	300-329	24	300-329	38
330-359	4	330-359	8	330-359	14	330-359	28	330-359	46
>360	6	>360	12	>360	16	>360	32	>360	54

Changing the Algorithm:

- Keep the same rate within the same algorithm if the glucose level is at goal (80-120 mg/dl), or if glucose is below goal but not hypoglycemic.

### **Guideline for Intravenous Insulin Infusion in the Adult ICU Patient (continued)**

- Moving to a greater algorithm: If glucose 121-180 mg/dl, stay in the same algorithm but adjust the rate accordingly, and recheck BG in 1 hour. If glucose fails to decrease by at least 30 mg/dl in that hour, than move to the next greater algorithm.
- If the glucose is above 180 mg/dl and has failed to change at least 60 mg/dl within 1 hour, than move to the next greater algorithm.
- Moving to a lesser algorithm: If the glucose < 60 mg/dl then turn drip off. (See treatment of Hypoglycemia).

Patient Monitoring:

- Hourly monitoring may be indicated for critically ill patients even if they have stable blood glucose levels.
- For more stable patients, check BG every hour until it is within goal range for 4 hours, then decrease to every 2 hours of 4hrs, and if remains stable may decrease to every 4 hours. If BG >200 twice, increase monitoring to every hour, until stable within goal range.

Treatment of Hypoglycemia (BG under 60 mg/dL).

- Hold insulin drip.
- Treat:
  - If patient can take PO, give 15 grams of fast acting carbohydrate (4oz fruit juice/ non diet soda/ 8 oz milk/ 3-4 glucose tablets)
  - If NPO, Give Dextrose 50% inj 25 ml IV Push
- Recheck BG every 15 minutes and repeat above if blood glucose remains less than 60mg/dL.
- Restart drip once blood glucose is greater than 80 mg/dL. Restart drip with next lower algorithm (see moving to a Lesser Algorithm). If already on Algorithm 1, reduce Algorithm 1 by half. If pt a known type 2, consider discontinuing insulin drip.

When Patient is Able to Eat:

- After the patient eats, give an additional SQ bolus of rapid-acting insulin (lispro/aspart), 1 unit for every 10 g carbohydrate consumed. ( Refer to Appendix A Carbohydrate Count list for clear/full liquid diets.) This is in addition to continuing the IV infusion. For patients eating solid food, they should be started on a Diabetic diet for carb counting purposes. ( Refer to Appendix B Grams Carbohydrate for General Diet).

Notify the physician:

- For any blood glucose change greater than 100 mg/dL in one hour.
- For blood glucose over 360 mg/dL.
- For any blood glucose requiring the administration of 50 ml Dextrose 50%

Author: Division of Endocrinology, Department of Medicine and Multidisciplinary ICU Committee September 2004.

Modified from Trence et al. J Clin Endocrinol Metab 88:2430-37,2003.

## Appendix A:

### Grams Carbohydrate For Clear and Full Liquid Diets

Comment [L1]: 7/12/04

When patients on IV insulin drips begin oral nutrition, it may destabilize the BG level obtained when patient was NPO. If oral feeding is attempted, administer an additional SC bolus of rapid acting insulin (lispro/aspart), 1 Unit for every 10 grams carbohydrate consumed, after the meal in addition to continuing the IV insulin infusion

<u>Clear Liquid</u>	Each serving		
Apple Juice	15 grams	Apple Juice	15 grams
Broth	0 grams	Creamer`	2 grams
Cranberry Juice	15 grams	Decaf Coffee	0 grams
Fruit Ice	20 grams	Grape Juice	15 grams
Grape Juice	15 grams	Regular Gelatin	17 grams
Popsicle	36 grams	12 oz Regular Sprite	38 grams
Regular Gelatin	17 grams	Orange Juice	15 grams
12 oz Regular Sprite	38 grams	Sugar Sub	0 grams
Sherbet	27 grams	Strained Cereal	15 grams
Sugar Sub	0 grams	Strained Soup	15 grams
Tea	0 grams	Vanilla Ice	
12 oz Gatorade	21 grams	Cream	17 grams
		Whole Milk	12 grams
		Yogurt	17 grams
		12 oz Gatorade	21 grams
		Chocolate Milk	26 grams

### Full Liquid

### Each

S Developed in collaboration with Jill Whitney R.D.,  
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## Appendix B:

### Grams Carbohydrate For General Diet

All the foods eaten will affect blood glucose. There are three major nutrients in food that affect blood glucose: carbohydrates, protein and fat. After a meal, the carbohydrate raises the blood glucose level more than protein or fat. Including a set amount of carbohydrates at each meal and snack helps to keep blood glucose in the target range. Starching foods such as bread, pasta, rice and cereals; fruits and fruit juices that contain natural sugars; milk and yogurt that also contain natural sugars (milk-sugar does not taste sweet); and desserts and sweets are all considered carbohydrate foods.

**The following food portions contain approximately 15 grams of carbohydrate**

FOOD	AMOUNT
Animal cracker	½ cup
Apple juice	½ cup
Apple, small	1
Apples, dried	½ cup
Applesauce, unsweetened	½ cup
Apricots, canned	8 halves
<b>B</b> agel	½ (1 oz.)
Baked beans	1/3 cup
Banana	1 small or ½ regular size (4 oz.)
Beer (regular)	12 oz.
Biscuit (2 ½ inches across)	1
Blackberries	¾ cup
Black-eyed peas	1/3 cup
Blueberries	¾ cup
Bran cereal	½ cup
Bread (white, wheat, Pumpernickel, Rye)	1 slice
Bread (Light = 40 calories/slice)	2 slices
Brownie, unfrosted	2 (2/3 oz.)
<b>C</b> ake, unfrosted	2 inch square
Cantaloupe, small	1/3 melon or 1 cup cubes
Cereal, cooked	½ cup
Cereal, ready to eat	¾ cup
Cherries, canned	½ cup
Cherries, fresh	12 (3 oz.)
Chips, potato	12-18 (1 oz.)
Chips, tortilla	6-12 (1 oz.)
Chow mein noodles	½ cup
Cookie, fat free	2 small
Cookie, with crème filling, small	1
Corn	½ cup
Corn on the cob, medium	1 (5 oz.)
Cornbread, 2 inch cube	1

Cornmeal, dry	3 Tbsp.
Cottage cheese	3 cups
Crackers, saltine type	6
Crackers, whole wheat	2-5 (3/4 oz.)
Crackers, round butter type	6
Cranberry juice cocktail, regular	1/3 cup
Cranberry juice cocktail, reduced calorie	1 cup
Cream of wheat, cooked	1/2 cup
Croutons	1 cup
Cupcake, frosted	1/2 small (1.5 oz.)
<b>D</b> anish	1/2 (3/4 oz.)
Dates	3
Doughnut, plain cake	1/2 medium (3/4 oz.)
Dried beans, cooked	1/2 cup
<b>E</b> nglish muffin	1/2 muffin
<b>F</b> igs, dried	1 1/2
Figs, fresh	1 1/2 large or 2 medium
Flour, dry	3 Tbsp.
French fries	16-25 (3 oz.)
Fruit cocktail	1/2 cup
Fruit juice bars, frozen, 100% juice	1 bar
Fruit juice blends, 100% juice	1/3 cup
Fruit spreads, 100% fruit	1 Tbsp.
<b>G</b> arbanzo beans	1/2 cup
Gelatin, regular	1/2 cup
Gingersnaps	3
Graham crackers (2 1/2 inch square)	3
Granola	1/4 cup
Granola bar, regular	1
Granola bar, fat free	1/2
Grape juice	1/3 cup
Grape Nuts cereal	1/4 cup
Grapefruit juice	1/2 cup
Grapefruit sections, canned	3/4 cup
Grapefruit, large	1/2 (11 oz.)
Grapes, small	17 (3 oz.)
Grits	1/2 cup
Grits, uncooked	1/2 cup
<b>H</b> amburger bun	1/2
Honey	1 Tbsp.
Honeydew melon	1 slice or 1 cup cubes
Hot dog bun	1/2
<b>I</b> ce cream, regular	1/4 cup
Ice cream, fat free	1/4 cup
Ice cream, no sugar added	1/2 cup
<b>J</b> am or jelly, regular	1 Tbsp.
<b>K</b> asha	1/2 cup

Kidney beans	½ cup
Kiwi	1 (3.5 oz.)
<b>L</b> entils	½ cup
Lima beans	2/3 cup
<b>M</b> acaroni, cooked	½ cup
Mandarin oranges, canned	¾ cup
Mango, small	½ fruit or ½ cup
Matzo	¾ oz.
Melba toast	4 slices
Milk, chocolate	½ cup
Milk, dry	1/3 cup
Milk, skim, 2%, sweet, buttermilk, goat	1 cup
Miso	3 Tbsp.
Mixed vegetables (with corn, peas, or pasta)	1 cup
Muesli	¼ cup
Muffin, small	1 (1.5 oz.)
<b>N</b> ectarine, small	1 (5 oz.)
Noodles, cooked	1/3 cup
<b>O</b> atmeal, cooked	½ cup
Oatmeal, dry	3 Tbsp.
Oats	½ cup
Orange juice	½ cup
Orange, small	1 (6.5 oz.)
Oyster crackers	24
<b>P</b> ancakes, 4 inches across	2
Papaya	½ fruit or 1 cup cubes
Pasta	1/3 cup
Pasta sauce, canned	½ cup
Peach, canned	½ cup
Peach, medium	1 (6 oz.)
Pear, canned	½ cup
Pears, large	½ (4 oz.)
Peas, green	½ cup
Pie, fruit, 2 crust	1/6 pie
Pumpkin pie or custard	1/6 pie
Pineapple juice	½ cup
Pineapple, fresh	¾ cup
Pinto beans	½ cup
Pita, 6 inches across	½
Plantain	½ cup
Plums, canned	½ cup
Plums, small	2 (5 oz.)
Popcorn	3 cups
Potato, baked, boiled	1 (6 oz.)
Potato, mashed	½ cup
Pretzels	¾ oz.

Prune juice	1/3 cup
Prunes, dried	3
Pudding, regular	1/4 cup
Pudding, sugar free	1/2 cup
Puffed cereal	1 1/2 cup
<b>R</b> aisins	2 Tbsp.
Raspberries	1 cup
Rice cakes	2
Rice milk	1/2 cup
Rice, uncooked	2 Tbsp.
Rice, white or brown, cooked	1/3 cup
Roll, small, plain	1 (1 oz.)
<b>S</b> herbet	1/4 cup
Shredded wheat	1/2 cup
Sorbet	1/4 cup
Soup, bean	1 cup
Soup, cream	1 cup
Soup, split pea	1/2 cup
Soup, tomato	1 cup
Soup, vegetable beef or chicken noodle	1 cup
Spaghetti sauce, canned	1/2 cup
Spaghetti and meatballs	1/2 cup (4 oz.)
Spite peas	1/2 cup
Strawberries, whole	1 1/4 cup
Stuffing, bread	1/3 cup
Sugar	2 Tbsp.
Sugar frosted cereal	1/2 cup
Sweet potato, yam	1/2 cup
Sweet roll	1/2 (1.25 oz.)
Syrup, light	2 Tbsp.
Taco shell, 6 inch	2
Tangerine, small	2 (8 oz.)
Tomato juice	1 1/2 cup
Tomato sauce	1 1/2 cup
Tortilla, corn, 6 inches across	1
Tortilla, flour, 6 inches across	1
<b>V</b> anilla wafers	5
<b>W</b> affle, 4.5 inch square	1
Watermelon	1 1/4 cup
Wheat germ	3 Tbsp.
White beans	1/2 cup
<b>Y</b> am, sweet potato	1/2 cup
Yogurt, frozen, fat free	1/3 cup
Yogurt, frozen, fat free, no sugar added	1/2 cup
Yogurt, frozen, low fat with fruit	1/3 cup
Yogurt, plain	3/4 cup
Yogurt, sweetened with aspartame	1 cup

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