Diabetes Math

Insulin Dose Calculations and Carbohydrate Counting

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Texas Children's Hospital

2025 Virtual Diabetes Management Conference for School Nurses

Provided by Texas Children's Hospital

NURSING CONTINUING PROFESSIONAL DEVELOPMENT

Texas Children's Hospital is approved with distinction as a provider of nursing continuing professional development by the Texas Nurses Association, an accredited approver by the American Nurses Credentialing Center's Commission on Accreditation.

This NCPD activity awards up to 6.5 contact hours.

REQUIREMENTS FOR SUCCESSFUL COMPLETION

To receive contact hours for this nursing continuing professional development activity, the participant must:

- Register for the continuing professional development activity
- Attend at least one session of the professional development activity
- Complete the pre-conference survey
- Complete the post-conference evaluation

Print your "Certificate of Successful Completion" once you have completed the post-conference survey online .

LEARNING OUTCOMES

- At the conclusion of this conference, 80 % of attendees will be able to name one concept learned on the post conference survey as it relates to care of the child with diabetes.
- At the conclusion of this conference, 80 % of attendees will demonstrate increased knowledge as evidenced by an increase in scores on the post conference survey when compared to the pre-conference survey.

RELEVANT FINANCIAL RELATIONSHIPS

Explanation: a relevant financial relationships occurs when an individual has an opportunity to affect or impact educational content with which he or she may have a relationship with an ineligible company or a potentially biasing relationship of a financial nature.

All planners and presenters/authors/content reviewers must disclose the presence or absence of a relevant financial relationship relative to this activity. All potential relationships are mitigated prior to the planning, implementation, or evaluation of the continuing education activity. All activity planning committee members and presenters/authors/content reviewers have had their relevant financial relationships assessed, identified and mitigated by the Nurse Planner.

Daniel DeSalvo, MD: Consultant/advisory board: Dexcom and Insulet. Grant/research support: FDA Pediatric Device Consortium, NIH/NIDDK, National Science Foundation, Helmsley Charitable Trust, Insulet, Medtronic. Other/Patents: D3 hypoglycemia prediction algorithm. The relevant financial relationships have been mitigated.

Rebecca Hutchinson, BSN, RN, CDCES: Insulin pump trainer: Insulet and Tandem. The relevant financial relationships has been mitigated.

No relevant financial relationships were identified for any other individuals with the ability to control content of the activity.

Enduring Material Expiration Date: 12/31/2025

****Applicable for learners who view the activity recording after the live session & claim contact hours****

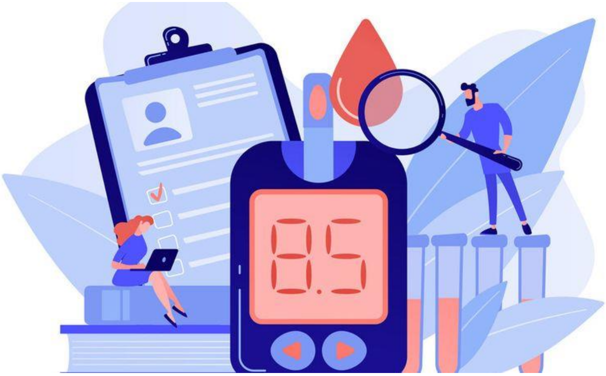
OBJECTIVES

- Discuss how to calculate insulin doses using insulin to carb ratio (ICR) and Correction Factor/ Insulin Sensitivity Factor (ISF)
- Discuss insulin calculations using a set dose
- Practice basic carbohydrate counting

INTENSIVE INSULIN MANAGEMENT

Intensive Insulin Management (IIM) uses two math equations to calculate an insulin dose.

- Insulin to Carbohydrate Ratio (ICR)
- Correction Factor and Target blood glucose (T).
- These doses are individualized per patient and can vary throughout different times of the day.
- Insulin pumps use these same equations to calculate insulin doses



INSULIN TO CARBOHYDRATE RATIO

What is an insulin to carbohydrate ratio (ICR)?

- The ICR tells you how many grams of carbohydrates are covered by 1 unit of rapid acting insulin.
- Used before meals and sometimes snacks to calculate how much insulin is needed to cover the food.
- Allows for flexibility in amount of carbs at meals.
- Must be able to count the carbs.
- Can have different ICRs at different times of the day.

CALCULATING A DOSE OF INSULIN FOR CARBOHYDRATES

Example 1:

Sarah's ICR is 1:25 (one unit of rapid/ultra rapid acting insulin for every 25 grams of carbs).

Sarah has counted that she will eat 75 grams of carbohydrates for breakfast.

75	÷	25	=	3	=	A
Number of CHO to be eaten at meal time	divided by	ICR (insulin to CHO ratio)		Units of rapid-acting insulin to be given to cover that meal		

Sarah will administer 3 units of rapid acting insulin for breakfast.

CORRECTION/SENSITIVITY FACTOR

What is the Correction Factor or Insulin Sensitivity Factor (ISF)?

- The Correction Factor tells you how many points the blood sugar will be lowered by 1 unit of rapid/ultra rapid acting insulin.
- Used in combination with the ICR calculation to correct high blood sugars before meals.
- The Correction Factor can vary at different meals/times of day.
- Typically not recommended to give correction if the last dose of insulin was < 3 hours prior.
    - Insulin pumps will keep track of insulin on board (IOB)

USING CORRECTION FACTOR

- First you must know the current blood sugar (either from CGM or finger stick).
- Subtract the target blood sugar from the current blood sugar.
- Divide this number by the Correction Factor.
- The result will tell you how many units of rapid/ultra rapid acting insulin are needed to bring the current blood sugar down to the target blood sugar.

$$\frac{\text{Current Blood Sugar} - \text{Target Blood Sugar}}{\text{Correction Factor}} = \text{Correction Insulin Dose}$$

USING CORRECTION FACTOR

For Example:

- Marco's blood sugar before breakfast is 200 mg/dL.
- His Correction Factor is 40 and Target Blood Sugar is 100.

$$\frac{\text{Current Blood Sugar} - \text{Target Blood Sugar}}{\text{Correction Factor}} = \text{Correction Insulin Dose}$$

- 200 – 100 = 100
- 100/40 = 2.5
- This means Marco will need 2.5 units of rapid/ultra rapid acting insulin to correct the blood sugar before breakfast.

PUTTING IT ALL TOGETHER

To calculate an insulin dose before meals, you will use both the ICR (A) and Correction Factor (B) formulas and add the two results together.

Step 1

	÷		=		=	A
Number of CHO to be eaten at meal time	divided by	ICR (insulin to CHO ratio)		Units of rapid-acting insulin to be given to cover that meal		

Step 2

	-		=		÷		=		=	B
Blood glucose before meal	minus	Target		Number of points above target number	divided by	CF Correction Factor		Units of rapid-acting insulin needed to **CORRECT** blood glucose to bring it back to target number		

Step 3

	+		=		
A	add	B		Total units of rapid-acting insulin your child will receive for this meal time only	**Do not round up or down until the very end!**

RULES ON ROUNDING

Add together the results from ICR calculation and Correction Factor calculation ***before*** rounding.

- If the student does **NOT use half unit insulin pens**, round to the nearest ***whole*** unit (i.e. if the result of the calculation is 4.6, round to 5).
- If student does use **half unit insulin pens**, you can round to the nearest ***half*** unit (i.e. if result of ICR and Correction Factor calculation is 4.6, round to 4.5).
  - If ***0.5 or higher*** round ***up*** to the nearest whole number (i.e. 3.8 = 4)
  - If ***below 0.5*** round ***down*** to the nearest whole number (i.e. 3.3 = 3)

SAMPLE DIABETES SCHOOL ORDER

Intensive Insulin Management (IIM)

Verify with parent on whether students eats breakfast at home or school

Medication:	Humalog/Novolog/Apidra/Fiasp/Lyumjev Before Lunch **Verify with parent on whether student eats breakfast at home or school**
Dosage:	Intensive Insulin Management The meal dose is calculated based on two formulas: 1. Insulin dose for food (Total Carbohydrates eaten ÷ Insulin to Carb Ratio) 2. Insulin dose for high blood glucose before meal [(Current blood glucose - target blood glucose) ÷ Correction Factor] 3. Total meal dose = #1 plus #2
Meal Dose (Use Insulin Carb Ratio):	1 unit for every 10 grams of carbohydrate
Correction Factor:	1 unit for every 30 mg/dL above target blood glucose of 100 mg/dL
Frequency of Use:	Daily
Administer:	Subcutaneous Injection by syringe or insulin pen, or pump

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SET DOSE + CORRECTION FACTOR

- Sometimes used for Type 2 DM or if there is difficulty with carb counting
- Does not allow for flexibility in carbs at meals
- Typically must eat a specific amount of carbs to match the insulin dose

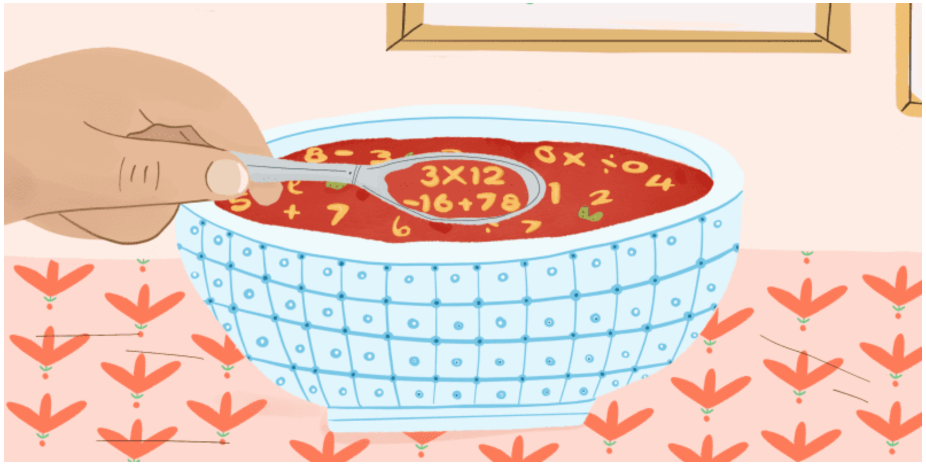
SET DOSE + CORRECTION FACTOR

- Example – 12 units + Correction Factor 30, Target 100
- First step is calculate the correction factor then add this to the set dose of 12 units

230	-	100	=	130	÷	30	=	4.3=4 units	=	B
Blood glucose before meal	minus	Target		Number of points above target number	divided by	CF Correction Factor		Units of rapid-acting insulin needed to **CORRECT** blood glucose to bring it back to target number		

12 + 4 =16 units total

CARBOHYDRATE COUNTING



- Carbs are necessary!
- Have the biggest impact on blood glucose level compared to protein and fat.
- Learning how to identify and count carbs is a basic diabetes management tool.
- Children can learn how to count carbs with help from parents and caregivers.
- Look at nutrition facts label, online database, school district menu, or ask parents to label food.

CARB CONTAINING FOODS

- Breads and starches
  - Pasta, rice, cereals, bread, tortillas, crackers, chips, breaded meat, beans
- Fruit and fruit juice
- Starchy vegetables
  - Corn, potatoes, peas
- Milk and yogurt
- Drinks
  - Regular sweetened sodas or sports drinks
- Condiments
  - Syrup, honey, jelly, BBQ sauce, ketchup, etc.

CARBOHYDRATE COUNTING

Nutrition Facts

Serving Size ¾ cup (28g)
Servings Per Container about 22

Amount Per Serving	Honey Nut Cheerios	with ½ cup skim milk
Calories	110	150
Calories from Fat	15	15
	% Daily Value**	
Total Fat 1.5g*	**2**%	**2**%
Saturated Fat 0g	**0**%	**0**%
Trans Fat 0g		
Polyunsaturated Fat 0.5g		
Monounsaturated Fat 0.5g		
Cholesterol 0mg	**0**%	**1**%
Sodium 160mg	**7**%	**9**%
Potassium 115mg	**3**%	**9**%
Total Carbohydrate 22g	**7**%	**9**%
Dietary Fiber 2g	**8**%	**8**%
Soluble Fiber less than 1g		
Sugars 9g		
Other Carbohydrate 11g		
Protein 2g		

1. Look at serving size
2. Use Total Carbohydrate

ALWAYS READ NUTRITION FACTS LABEL IF AVAILABLE

Sugar free does not = carbohydrate free

Nutrition facts

12 servings per container
Serving size 1 cookie (19g)

Amount per serving	
Calories	**80**
	% Daily Value*
Total Fat 4.5g	**6%**
Saturated Fat 1g	**5%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 70mg	**3%**
Total Carbohydrate 13g	**5%**
Dietary Fiber 0g	**0%**
Total Sugars 0g	
Includes 0g Added Sugars	**0%**
Sugar Alcohol	**5g**
Protein 1g	
Vitamin D 0mcg	0%
Calcium 0mg	0%
Iron 0.6mg	4%
Potassium 0mg	0%

LET'S DO SOME CALCULATIONS TOGETHER

EXAMPLE #1

Marlee comes to the school clinic before lunch to take her insulin. Her blood sugar reading is 198 mg/dL. Her lunch has 42 grams of carbs. Her school packet insulin orders are: ICR 1:10, Correction Factor 35, Target blood sugar 100. Calculate her dose of insulin for lunch.

- Grams of carbs ÷ ICR = number of units of insulin for the food
- 42 ÷ 10 = **4.2 units**
- $\frac{\text{Current blood sugar – Target blood sugar}}{\text{Correction Factor}}$ = number of units for correction
- 198 – 100 = 98/35 = **2.8 units**
- Total insulin dose for the meal = 4.2 + 2.8 = 7 units

EXAMPLE #2

Sterling arrives in your clinic to take his insulin before breakfast. His blood sugar is 226 mg/dL and he plans to eat 65 grams of carbs. His school packet orders are: ICR 1:5, Correction Factor 18, Target blood sugar 100. Calculate his dose of insulin for breakfast.

- Grams of carbs ÷ ICR = number of units of insulin for the food
- 65 ÷ 5 = **13 units**
- $\frac{\text{Current blood sugar} - \text{Target blood sugar}}{\text{Correction Factor}}$ = number of units for correction
- $\frac{226 - 100}{}$ = 126/18 = **7 units**

Total insulin dose for the meal = 13 + 7 = 20 units

EXAMPLE #3

William is in the school clinic to receive his insulin before lunch. His blood sugar is 280 mg/dL. For lunch he brought a turkey sandwich, a bag of chips, and an applesauce cup. He needs help counting the carbs in his lunch. His insulin doses are: ICR 1:30, Correction Factor 100, Target blood sugar 120 mg/dL. He uses half unit insulin pens. Calculate his dose of insulin for lunch.

- Sandwich = 30 grams carbs (15 grams per slice of bread)
- Bag of chips = 15 grams carbs
- Applesauce cup = 12 grams carbs
  - Total carbs in lunch = **57 grams**

- Grams of carbs ÷ ICR = number of units of insulin for the food
- 57 ÷ 30 = **1.9 units**

- <u>Current blood sugar – Target blood sugar</u> = number of units for correction

- 280 – 120 = 160/100 = **1.6 units**

Total insulin dose for the meal = 1.9 + 1.6 **= 3.5 units**

EXAMPLE #4

Ava is in the school clinic to take her insulin before lunch. Her blood sugar is 356 mg/dL and she has moderate ketones*. Her lunch contains 54 grams of carbs. Her insulin doses are: ICR 1:12, Correction Factor 40, Target blood sugar 100 mg/dL. She uses half unit insulin pens. Calculate her dose of insulin for lunch.

- Grams of carbs ÷ ICR = number of units of insulin for the food
- 54 ÷ 12 = **4.5 units**
- $\frac{\text{Current blood sugar – Target blood sugar}}{\text{Correction Factor}}$ = number of units for correction

- 356 – 100 = 256/40 = **6.4 units**

Total insulin dose for the meal = 4.5 + 6.4 = 10.9 **= 11 units**

**notify clinic for moderate – large ketones before giving insulin dose, per Diabetes School Order*

NOW IT'S YOUR TURN TO CALCULATE THE INSULIN DOSE!

PRACTICE QUESTION #1

Katie is in your clinic to take her insulin before lunch. Her current blood sugar is 146 mg/dL. Her lunch contains 58 grams of carbs. Her ICR is 1:12, Correction factor 35, Target 100. How much insulin will she need for lunch?

A. 4 units
B. 3 units
C. 6 units
D. 7 units

PRACTICE QUESTION #1 – CORRECT ANSWER

Katie is in your clinic to take her insulin before lunch. Her current blood sugar is 146 mg/dL. Her lunch contains 58 grams of carbs. Her ICR is 1:12, Correction factor 35, Target 100. How much insulin will she need for lunch?

A. 4 units

B. 3 units

C. 6 units – Correct Answer

D. 7 units

PRACTICE QUESTION #1 RATIONALE

58	÷	12	=	4.8	=	A
Number of CHO to be eaten at meal time	divided by	ICR (insulin to CHO ratio)		Units of rapid-acting insulin to be given to cover that meal		

146	-	100	=	46	÷	35	=	1.3	=	B
Blood glucose before meal	minus	Target		Number of points above target number	divided by	CF Correction Factor		Units of rapid-acting insulin needed to **CORRECT** blood glucose to bring it back to target number		

4.8	+	1.3	=	6.1= 6
A	add	B		Total units of rapid-acting insulin your child will receive for this meal time only

Do not round up or down until the very end!

PRACTICE QUESTIONS #2

Miles comes to the clinic to receive his insulin before breakfast. He says his legs feel weak and he is tired. His CGM reading is 59 mg/dL with a down arrow. 15 minutes after treating his low blood sugar, it is now 97 mg/dL. He is going to eat 39 grams of carbs for breakfast. His ICR is 1:15, Correction Factor 45, Target 100. He uses half unit insulin pens. How much insulin does he need for breakfast?

A. 1.5 units

B. 2 units

C. 0 units

D. 2.5 units

PRACTICE QUESTION #2 – CORRECT ANSWER

Miles comes to the clinic to receive his insulin before breakfast. He says his legs feel weak and he is tired. His CGM reading is 59 mg/dL with a down arrow. 15 minutes after treating his low blood sugar, it is now 97 mg/dL. He is going to eat 39 grams of carbs for breakfast. His ICR is 1:15, Correction Factor 45, Target 100. He uses half unit insulin pens. How much insulin does he need for breakfast?

A. 1.5 units

B. 2 units

C. 0 units

D. **2.5 units – Correct answer**

PRACTICE QUESTION #2 RATIONALE

39	÷	15	=	2.6	=	A
Number of CHO to be eaten at meal time	divided by	ICR (insulin to CHO ratio)		Units of rapid-acting insulin to be given to cover that meal		

	-	100	=		÷		=	No need to calculate because BG is below target	=	B
Blood glucose before meal	minus	Target		Number of points above target number	divided by	CF Correction Factor		Units of rapid-acting insulin needed to **CORRECT** blood glucose to bring it back to target number		

2.6	+		=	2.5
A	add	B		Total units of rapid-acting insulin your child will receive for this meal time only

Do not round up or down until the very end!

PRACTICE QUESTION #3

Robin is in the school clinic to receive her insulin before lunch. Her blood sugar reading is 280 mg/dL. Her lunch contains 30 grams of carbs, but she does not feel like eating. Her ICR is 1:20, Correction Factor 60, Target 100. How much insulin does she need?

A. 3 units

B. 2 units

C. 0 units

D. 4.5 units

PRACTICE QUESTION #3 CORRECT ANSWER

Robin is in the school clinic to receive her insulin before lunch. Her blood sugar reading is 280 mg/dL. Her lunch contains 30 grams of carbs, but she does not feel like eating. Her ICR is 1:20, Correction Factor 60, Target 100. How much insulin does she need?

A. **3 units – Correct Answer**

B. 2 units

C. 0 units

D. 4.5 units

PRACTICE QUESTION #3 RATIONALE

N/A	÷		=		=	A
Number of CHO to be eaten at meal time	divided by	ICR (insulin to CHO ratio)		Units of rapid-acting insulin to be given to cover that meal		

280	-	100	=	180	÷	60	=	3	=	B
Blood glucose before meal	minus	Target		Number of points above target number	divided by	CF Correction Factor		Units of rapid-acting insulin needed to **CORRECT** blood glucose to bring it back to target number		

	+	3	=	3
A	add	B		Total units of rapid-acting insulin your child will receive for this meal time only

Do not round up or down until the very end!

PRACTICE QUESTION #4

Lauren arrives in your clinic to receive her insulin before lunch. She complains of a headache. Her blood sugar reading is 302 mg/dL. Following her school packet instructions, you check her ketones and they are trace. She plans to eat 50 grams of carbs for lunch. Her ICR is 1:8, Correction Factor 30, Target 100. How much insulin does she need for lunch?

A. 12 units

B. 13 units

C. 15 units

D. Give a correction only. She should not eat lunch because she has trace ketones.

PRACTICE QUESTION #4 CORRECT ANSWER

Lauren arrives in your clinic to receive her insulin before lunch. She complains of a headache. Her blood sugar reading is 302 mg/dL. Following her school packet instructions, you check her ketones and they are trace. She plans to eat 50 grams of carbs for lunch. Her ICR is 1:8, Correction Factor 30, Target 100. How much insulin does she need for lunch?

A. 12 units

B. **13 units – Correct Answer**

C. 15 units

D. Give correction only. She should not eat lunch because she has trace ketones.

PRACTICE QUESTION #4 RATIONALE

50	÷	8	=	6.25	=	A
Number of CHO to be eaten at meal time	divided by	ICR (insulin to CHO ratio)		Units of rapid-acting insulin to be given to cover that meal		

302	-	100	=	202	÷	30	=	6.73	=	B
Blood glucose before meal	minus	Target		Number of points above target number	divided by	CF Correction Factor		Units of rapid-acting insulin needed to **CORRECT** blood glucose to bring it back to target number		

6.25	+	6.73	=	12.98= 13
A	add	B		Total units of rapid-acting insulin your child will receive for this meal time only

Do not round up or down until the very end!

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PRACTICE QUESTION #5

Kyle is in the school clinic to take his insulin before breakfast. His blood sugar is 376 mg/dL. Urine Ketones are large. He also complains of nausea and a headache. His breakfast contains 60 grams of carbs. His ICR is 1:8, Correction Factor 25, Target 100. What should you do next?

A. Administer 18 units of rapid acting insulin and let him eat breakfast.

B. Give him water and have him take a walk.

C. Call the diabetes educator/doctor's office for further instructions on insulin dosing and notify the parent.

D. Re-check the blood sugar and ketones in 3 hours.

PRACTICE QUESTION #5- CORRECT ANSWER

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REFERENCES

- Frohnert, B. I., & Chase, H. P. (2018). *A first book of understanding diabetes* (14th ed.). Children's Diabetes Foundation.
- Texas Children's Hospital Type 1 Diabetes Education Guide, 2024.

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COMMENTS/QUESTIONS?