

# Insulin to Carbohydrate Ratio Practice

## Calculating insulin doses based on Insulin to Carbohydrate Ratio and Correction Factor

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CLINICAL NUTRITION



## 2022 Virtual Diabetes Management Conference for School Nurses

Provided by Texas Children's Hospital

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- Attend at least one session of the professional development activity
- Complete the pre-conference assessment
- Complete the post-conference participant evaluation online

Print and sign your contact hour "Certificate of Successful Completion" once you have completed the online evaluation.

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### **COMMERCIAL SUPPORT**

This CNPD activity has received no commercial support.



# 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 that will be consumed.
- Allows for varying amounts of carbs at meals
- Can have different ICRs at different times of the day

# CALCULATING A DOSE OF INSULIN FOR CARBOHYDRATES

## Example 1:

Sarah's I:CHO is 1:25 (one unit of Novolog<sup>®</sup>/Humalog<sup>®</sup> for every 25 grams of carbs).

Sarah has calculated that she will be eating 75 grams of carbohydrates for breakfast.

Apply formula for Insulin to Carbohydrate Ratio (ICR).

This means one unit of Novolog/Humalog will cover this many carbohydrates.

$$\boxed{75} \div \boxed{25} = \boxed{3}$$

Number of CHO  
to be eaten at meal  
time

Insulin to  
carbohydrate  
ratio (ICR)

Units of Novolog/Humalog  
to be given to cover that  
meal.

Sarah will administer 3 units of Novolog<sup>®</sup>/Humalog<sup>®</sup> for breakfast.

# CORRECTION/SENSITIVITY FACTOR

## What is the Correction/Sensitivity Factor (ISF)?

- The Correction/Sensitivity Factor tells you how many points the blood sugar will be lowered by 1 unit of rapid acting insulin.
- Used in combination with the ICR calculation to correct high blood sugars before meals.
- The ISF can vary at different meals/times of day.

# USING THE CORRECTION/SENSITIVITY FACTOR

- Subtract the target blood sugar from the current blood sugar.
- Divide this number by the Correction/Sensitivity Factor.
- The result will tell you how many units of 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 THE CORRECTION/SENSITIVITY FACTOR

For Example:

- Sarah's blood sugar before breakfast is 200 mg/dL.
- Her Correction Factor is 40 and her 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 Sarah will need 2.5 units of rapid acting insulin to correct her blood sugar before breakfast

# PUTTING IT ALL TOGETHER

To calculate an insulin dose before meals, you will use both the ICR and ISF formulas and add the two results together.

Formula for Insulin to CHO Ratio (ICR). This means one unit of Novolog/Humalog will cover this many CHO's

$$\boxed{\phantom{000}} \div \boxed{\phantom{000}} = \boxed{\phantom{000}} = A$$

Number of CHO To be eaten at meal time      Divided by      ICR Insulin to CHO Ratio      Units of Novolog/Humalog to be given to cover that meal

Formula for CF. This means 1 unit of Novolog/Humalog will bring the blood sugar down by this many points.

$$\boxed{\phantom{000}} - 100 = \boxed{\phantom{000}} \div \boxed{\phantom{000}} = \boxed{\phantom{000}} = B$$

Blood Sugar before meal      Minus      Target      Number of points above Target number      Divided by      CF Correctic Factor      Units of Novolog/Humalog needed to CORRECT BG to bring it back to target number

Now add two doses together!

$$\text{A} + \text{B} = \boxed{\phantom{000}}$$

Total units of insulin (Humalog/Novalog) your child will receive for this meal time only

Do not round up or down until the very end!

# ICR AND ISF ORDERS IN TCH DIABETES SCHOOL PACKET

## Intensive Insulin Management (IIM)

**\*\*Verify with parent on whether student eats breakfast at home or school\*\***

|   |   |
|---|---|
| Medication:                                   | Humalog/Novolog/Apidra/Fiasp Before Meals, PRN  |
|   | <b>**Verify with parent on whether student eats breakfast at home or school**</b>   |
| Dosage:                                       | <p><b>Intensive Insulin Management</b></p> <p>The meal dose is calculated based on two formulas:</p> <ol style="list-style-type: none"> <li>1. Insulin dose for food<br/>(Total Carbohydrates eaten ÷ Insulin to Carb Ratio)</li> <li>2. Insulin dose for high blood sugar before meal<br/>[(Current blood sugar - target blood sugar) ÷ Correction Factor]</li> <li>3. Total meal dose = #1 plus #2</li> </ol> |
| Meal Dose (Use Insulin Carb Ratio):           | <b>1 unit for every 6 grams of carbohydrate</b>   |
| Correction Factor:                            | <b>1 unit for every 25 mg/dL above target BG of 100mg/dL</b>  |
| Frequency of Use:                             | Daily   |
| Administer:                                   | Subcutaneous Injection by syringe or insulin pen, or pump   |
| Condition for which medication is prescribed: | Diabetes Mellitus   |
| Medication may cause:                         | Hypoglycemia  |
| Emergency Instructions:                       | Treat hypoglycemia and hyperglycemia according to the algorithms "Treatment of Low Blood Sugars" and "Treatment of High Blood Sugars" included in this packet.  |
| Meal Planning:                                | School staff to verify with parents current number of carbohydrates for each meal.  |
| Parental Management:                          | Family educated on dose adjustments. Refer to "Parental Management of Diabetes" section.  |

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# A NOTE ON ROUNDING

- Add together the results from ICR calculation and ISF calculation ***before*** rounding.
- If ***0.5 or higher*** round ***up*** to the next whole number\* (i.e. 10.8=11)
- If ***below 0.5*** round ***down*** to the nearest whole number\* (i.e. 10.3=10)
  - \* If student uses **half unit insulin pens**, you can round to the nearest half unit (i.e. if result of ICR and ISF calculation is 4.6, round to 4.5).
  - \*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).

**LET'S WORK ON SOME SCENARIOS  
TOGETHER...**

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# EXAMPLE #1

Clara comes to the school clinic before lunch to take her insulin. Her blood sugar reading is **144 mg/dL**. She is going to eat **68 grams** of carbs for lunch. Her school packet lists her insulin doses as: **ICR 1:8, Correction Factor 25, Target 100**. She does not use half unit insulin pens. Calculate her dose of insulin for lunch.

- Grams of carbs  $\div$  ICR = number of units of insulin for the food
- $68 \div 8 = \mathbf{8.5 \text{ units}}$
- $$\frac{\text{Current blood sugar} - \text{Target blood sugar}}{\text{Correction Factor}} = \text{number of units for correction}$$
- $$\frac{144 - 100}{25} = \mathbf{1.76 \text{ units}}$$
- Total insulin dose for the meal =  $8.5 + 1.76 = 10.26 = \mathbf{10 \text{ units}}$

# EXAMPLE #2

Carlos arrives in your clinic to take his insulin before breakfast. His blood sugar is **241 mg/dL** and he plans to eat **39 grams** of carbs. His school packet orders are: **ICR 1:10, Correction Factor 30, Target 100**. He does not use half unit insulin pens. Calculate his dose of insulin for breakfast.

- Grams of carbs  $\div$  ICR = number of units of insulin for the food
- $39 \div 10 = \mathbf{3.9 \text{ units}}$
- $\frac{\text{Current blood sugar} - \text{Target blood sugar}}{\text{Correction Factor}} = \text{number of units for correction}$
- $\frac{241 - 100}{30} = \mathbf{4.7 \text{ units}}$

Total insulin dose for the meal =  $3.9 + 4.7 = 8.6 = \mathbf{9 \text{ units}}$

# EXAMPLE #3

Abby is in the school clinic to take her insulin before lunch. Her CGM is showing her blood sugar is **180 mg/dL** and she is going to eat **75 grams** of carbs for lunch. Her insulin doses are: **ICR 1:15**, **Correction Factor 50**, **Target 120**. She does not use half unit insulin pens. Calculate her dose of insulin for lunch.

- Grams of carbs  $\div$  ICR = number of units of insulin for the food
- $75 \div 15 = \mathbf{5 \text{ units}}$
- Current blood sugar – Target blood sugar = number of units for correction

Correction Factor

- $\frac{180 - 120}{50} = \mathbf{1.2 \text{ units}}$

50

Total insulin dose for the meal =  $5 + 1.2 = \mathbf{6.2 = 6 \text{ units}}$

# EXAMPLE #4

Jack is in the school clinic to receive his insulin before breakfast. His blood sugar is **63 mg/dL** and his lunch contains **47 grams** of carbs. After you treat his low blood sugar, the re-check is **91 mg/dL**. His insulin doses are: **ICR 1:25, Correction Factor 80, Target 100**. He does not use half unit insulin pens. Calculate his dose of insulin for breakfast.

- Grams of carbs  $\div$  ICR = number of units of insulin for the food
- $47 \div 25 =$  **1.88 units**
- No need to calculate correction factor since current BG is below target.

Total insulin dose for the meal = **1.88 = 2 units**

# EXAMPLE #5

Steven is in the school clinic to receive his insulin before lunch. His blood sugar **192 mg/dL** and his lunch contains **68 grams** of carbs. His insulin doses are: **ICR 1:30, Correction Factor 100, Target 150**. He uses half unit insulin pens. Calculate his dose of insulin for lunch.

- Grams of carbs  $\div$  ICR = number of units of insulin for the food
- $68 \div 30 = \mathbf{2.26 \text{ units}}$
- $\frac{\text{Current blood sugar} - \text{Target blood sugar}}{\text{Correction Factor}} = \text{number of units for correction}$
- $\frac{192 - 150}{100} = \mathbf{0.42 \text{ units}}$

Total insulin dose for the meal =  $2.26 + 0.42 = \mathbf{2.68 = 2.5 \text{ units}}$

# PRACTICE QUESTION #1

Kendall is in your clinic to take her insulin before lunch. She needs help calculating her dose of insulin. Her current blood sugar is **126 mg/dL**. Her lunch contains **48 grams** of carbs. Her ICR is **1:12**, **Correction factor 30**, **Target 100**. How much insulin will she need for lunch?

- A. 4 units
- B. 3 units
- C. 5 units
- D. 7 units

# PRACTICE QUESTION #1 – CORRECT ANSWER

Kendall is in your clinic to take her insulin before lunch. She needs help calculating her dose of insulin. Her current blood sugar is **126 mg/dL**. Her lunch contains **48 grams** of carbs. Her ICR is **1:12**, **Correction factor 30**, **Target 100**. How much insulin will she need for lunch?

A. 4 units

B. 3 units

**C. 5 units – Correct Answer ( 4 units for food + 0.86 unit correction = 4.86 = 5 units)**

D. 7 units

# PRACTICE QUESTION #1 RATIONALE

Formula for Insulin to CHO Ratio (ICR). This means one unit of Novolog/Humalog will cover this many CHO's

$$\boxed{48} \div \boxed{12} = \boxed{4} = A$$

Number of CHO To be eaten at meal time      Divided by      ICR Insulin to CHO Ratio      Units of Novolog/Humalog to be given to cover that meal

Formula for CF. This means 1 unit of Novolog/Humalog will bring the blood sugar down by this many points.

$$\boxed{126} - \boxed{100} = \boxed{26} \div \boxed{30} = \boxed{0.86} = B$$

Blood Sugar before meal      Minus      Target      Number of points above Target number      Divided by      CF Correctic Factor      Units of Novolog/Humalog needed to CORRECT BG to bring it back to target number

Now add two doses together!

$$\boxed{4} + \boxed{0.86} = \boxed{4.86 = 5}$$

A      B      Total units of insulin (Humalog/Novalog) your child will receive for this meal time only

Do not round up or down until the very end!

# PRACTICE QUESTIONS #2

Mason comes to the clinic to receive his insulin before breakfast. He says he feels shaky and his CGM reading is 59 mg/dL. 15 minutes after treating his low blood sugar, it is now 102 mg/dL. He is going to eat 39 grams of carbs for breakfast. His ICR is 1:18, Correction Factor 45, Target 110. He uses half unit insulin pens. How much insulin does he need for breakfast?

- A. 1.5 units
- B. 2 units
- C. 0 units because his blood sugar is low and he feels shaky
- D. 2.5 units

## PRACTICE QUESTION #2 – CORRECT ANSWER

Mason comes to the clinic to receive his insulin before breakfast. He says he feels shaky and his CGM reading is **59 mg/dL**. 15 minutes after treating his low blood sugar, it is now **102 mg/dL**. He is going to eat **39 grams** of carbs for breakfast. His **ICR is 1:18, Correction Factor 45, Target 110**. He uses half unit insulin pens. How much insulin does he need for breakfast?

- A. 1.5 units
- B. **2 units – Correct Answer (  $39/18 = 2.16$  units )**
- C. 0 units because his blood sugar is low and he feels shaky
- D. 2.5 units

# PRACTICE QUESTION #2 RATIONALE

Formula for Insulin to CHO Ratio (ICR). This means one unit of Novolog/Humalog will cover this many CHO's

$$\boxed{39} \div \boxed{18} = \boxed{2.16} = A$$

Number of CHO To be eaten at meal time      Divided by      ICR Insulin to CHO Ratio      =      Units of Novolog/Humalog to be given to cover that meal

Formula for CF. This means 1 unit of Novolog/Humalog will bring the blood sugar down by this many points.

$$\boxed{\phantom{000}} - \boxed{100} = \boxed{\phantom{000}} \div \boxed{\phantom{000}} = \boxed{\phantom{000}} = B$$

Blood Sugar before meal      Minus      Target      =      Number of points above Target number      Divided by      CF Correctic Factor      =      Units of Novolog/Humalog needed to CORRECT BG to bring it back to target number

No need to calculate because BG is below target

Now add two doses together!

$$\textcircled{2.16} + \textcircled{\phantom{00}} = \boxed{2}$$

A      +      B      =      Total units of insulin (Humalog/Novalog) your child will receive for this meal time only

Do not round up or down until the very end!

# PRACTICE QUESTION #3

Danielle is in the school clinic to receive her insulin before lunch. Her blood sugar reading is **180 mg/dL**. Her lunch contains **60 grams** of carbs. Her **ICR is 1:20, Correction Factor 60, Target 100**. How much insulin does she need for lunch?

- A. 3 units
- B. 2 units
- C. 1 unit
- D. 4 units

## PRACTICE QUESTION #3 CORRECT ANSWER

Danielle is in the school clinic to receive her insulin before lunch. Her blood sugar reading is **180 mg/dL**. Her lunch contains **60 grams** of carbs. Her **ICR is 1:20, Correction Factor 60, Target 100**. How much insulin does she need for lunch?

A. 3 units

B. 2 units

C. 1 unit

**D. 4 units – Correct Answer (3 units for food + 1.3 unit for correction = 4.3 = 4 units)**

# PRACTICE QUESTION #3 RATIONALE

Formula for Insulin to CHO Ratio (ICR). This means one unit of Novolog/Humalog will cover this many CHO's

$$\boxed{60} \div \boxed{20} = \boxed{3} = A$$

Number of CHO To be eaten at meal time      Divided by      ICR Insulin to CHO Ratio      Units of Novolog/Humalog to be given to cover that meal

Formula for CF. This means 1 unit of Novolog/Humalog will bring the blood sugar down by this many points.

$$\boxed{180} - \boxed{100} = \boxed{80} \div \boxed{60} = \boxed{1.3} = B$$

Blood Sugar before meal      Minus      Target      Number of points above Target number      Divided by      CF Correctic Factor      Units of Novolog/Humalog needed to CORRECT BG to bring it back to target number

Now add two doses together!

$$\boxed{3} + \boxed{1.3} = \boxed{4.3 = 4}$$

A      B      Total units of insulin (Humalog/Novalog) 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 **359 mg/dL**. Following her school packet instructions, you check her ketones and they are small. She plans to eat **70 grams** of carbs for lunch. Her **ICR is 1:8, Correction Factor 30, Target 100**. How much insulin does she need for lunch?

- A. 18 units
- B. 17 units
- C. 16 units
- D. 9 units, but she should not eat carbs because her blood sugar is high

# 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 **359 mg/dL**. Following her school packet instructions, you check her ketones and they are small. She plans to eat **70 grams** of carbs for lunch. Her **ICR is 1:8, Correction Factor 30, Target 100**. How much insulin does she need for lunch?

A. 18 units

**B. 17 units (8.75 units for food + 8.63 units for correction = 17.38 = 17 units)**

C. 16 units

D. 9 units, but she should not eat carbs because her blood sugar is high

# PRACTICE QUESTION #4 RATIONALE

Formula for Insulin to CHO Ratio (ICR). This means one unit of Novolog/Humalog will cover this many CHO's

$$\boxed{70} \div \boxed{8} = \boxed{8.75} = A$$

Number of CHO To be eaten at meal time      Divided by      ICR Insulin to CHO Ratio      Units of Novolog/Humalog to be given to cover that meal

Formula for CF. This means 1 unit of Novolog/Humalog will bring the blood sugar down by this many points.

$$\boxed{359} - \boxed{100} = \boxed{259} \div \boxed{60} = \boxed{8.63} = B$$

Blood Sugar before meal      Minus      Target      Number of points above Target number      Divided by      CF Correctic Factor      Units of Novolog/Humalog needed to CORRECT BG to bring it back to target number

Now add two doses together!

$$\boxed{8.75} + \boxed{8.63} = \boxed{17.38 = 17}$$

A      B      Total units of insulin (Humalog/Novalog) your child will receive for this meal time only

Do not round up or down until the very end!

# PRACTICE QUESTION #5

Jacob comes to the clinic before lunch to take his insulin. His blood sugar is **155 mg/dL**. He plans to eat **45 grams** of carbs for lunch. His **ICR is 1:15, Correction Factor 50, Target 100**. How much insulin does he need for lunch?

- A. 4 units
- B. 3 units
- C. 3.5 units
- D. 5 units

# PRACTICE QUESTION #5- CORRECT ANSWER

Jacob comes to the clinic before lunch to take his insulin. His blood sugar is **155 mg/dL**. He plans to eat **45 grams** of carbs for lunch. His **ICR is 1:15, Correction Factor 50, Target 100**. How much insulin does he need for lunch?

- A. 4 units – Correct Answer ( 3 units for food + 1 unit for Correction)**
- B. 3 units
- C. 3.5 units
- D. 5 units

# PRACTICE QUESTION #5 RATIONALE

Formula for Insulin to CHO Ratio (ICR). This means one unit of Novolog/Humalog will cover this many CHO's

$$\boxed{45} \div \boxed{15} = \boxed{3} = A$$

Number of CHO To be eaten at meal time      Divided by      ICR Insulin to CHO Ratio      Units of Novolog/Humalog to be given to cover that meal

Formula for CF. This means 1 unit of Novolog/Humalog will bring the blood sugar down by this many points.

$$\boxed{155} - \boxed{100} = \boxed{55} \div \boxed{50} = \boxed{1.1} = B$$

Blood Sugar before meal      Minus      Target      Number of points above Target number      Divided by      CF Correctic Factor      Units of Novolog/Humalog needed to CORRECT BG to bring it back to target number

Now add two doses together!

$$\boxed{3} + \boxed{1.1} = \boxed{4.1 = 4}$$

A      B      Total units of insulin (Humalog/Novalog) your child will receive for this meal time only

Do not round up or down until the very end!

# PRACTICE QUESTION #6

Caleb 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 says he does not know if he can eat anything. His lunch contains **60 grams** of carbs. His **ICR is 1:10, Correction Factor 35, Target 100**. How do you proceed?

- A. Give him lunch and administer 13 units of rapid acting insulin.
- B. Give him water and administer 6 units of rapid acting insulin.
- C. Call the diabetes educator for further instructions on insulin dosing and notify the parent.
- D. Re-check the ketones in 3 hours.

# PRACTICE QUESTION #6- CORRECT ANSWER

Caleb is in the school clinic to take his insulin before breakfast. His blood sugar is **376 mg/dL**. Urine ketones are large. He complains of nausea and says he does not know if he can eat anything. His lunch contains **60 grams** of carbs. His **ICR is 1:10, Correction Factor 35, Target 100**. How do you proceed?

- A. Give him lunch and administer 13 units of rapid acting insulin.
- B. Give him water and administer 6 units of rapid acting insulin.
- C. Call the diabetes educator for further instructions on insulin dosing and notify the parent. – Correct Answer**
- D. Re-check the ketones in 3 hours.



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**COMMENTS/QUESTIONS?**