Insulin Therapy: The Question This Issue

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Note: The goal of this section of *Insulin* is to provide answers to frequently asked questions regarding insulin therapy in diabetes. Readers are encouraged to submit their own questions by visiting www.InsulinJournal.com or by e-mailing insulin@elsevier.com. One or more questions will be addressed each issue.

Question:
When a patient's blood sugar levels are high, I like to give them extra insulin in the form of a "sliding scale," but there seems to be considerable debate about using insulin in such a fashion. Some experts dislike it. Why is the use of sliding-scale insulin so controversial?

Answer:
A sliding scale is an insulin regimen that uses a short-acting or bolus insulin (regular, lispro, aspart, or glulisine insulin) given retrospectively in response to an elevated blood sugar level. There is significant controversy surrounding the use of sliding-scale insulin mainly due to its *misuse*. It makes sense to administer extra short-acting insulin when a patient's blood sugar levels are high. The goal of insulin therapy is to mimic the body's normal physiology as much as possible. Normal β-cells produce extra insulin in response to high blood sugar levels. Thus, it is correct to give extra bolus insulin when the blood sugar levels are high. This concept is not controversial.

The controversy and dislike for the sliding scale stem from its inappropriate use. It has been common practice during hospitalization to place patients with diabetes on a sliding-scale insulin regimen only and to stop their previous oral medications or scheduled insulins. As the following case shows, a patient on this regimen will have significant fluctuations in blood glucose levels, especially if the patient has type 1 diabetes.

Case: A 44-year-old woman with type 1 diabetes for 23 years is hospitalized for complaints of abdominal pain, nausea, and vomiting. Because the patient is not eating much, all her scheduled insulins (neutral protamine Hagedorn [NPH] and lispro) are withheld, and she is placed on a "sliding scale" (see first scale from left in **Table I**). **Table II** shows her resulting blood sugar levels. This approach is analogous to watering a plant based on a scale as shown in **Table III**. Thus, a "sliding scale" used inappropriately can lead to very poor control of the patient's disease. The term is disliked by many endocrinologists and diabetologists.

As the above discussion suggests, a scale based on insulin should never be used alone but in addition to an existing therapy, which provides a patient with basal-bolus coverage (with oral medications, insulins, or a combination of each). This is additional insulin or supplemental insulin. Thus, the author prefers the use of the term *supplemental insulin scale* or *correction scale*. The use of the term *sliding scale* is strongly discouraged.

Table I. Correction scale/supplemental insulin scale.

Approximate total daily dose, U	35	70	105	140	350
Correction factor, mg/dL	50	25	17	12	5
No. of units for 50-point drop	1	2	3	4	10
Blood sugar, mg/dL	*	†			
151–200	1	2	3	4	10
201–250	2	4	6	8	20
251–300	3	6	9	12	30
301–350	4	8	12	16	40
351–400	5	10	15	20	50

*Most patients with type 1 diabetes need this scale.
†Majority of patients with type 2 diabetes need this scale unless taking >70 to 80 units of insulin.

Table II. Patient's blood sugar levels while on a "sliding-scale" insulin regimen.

		Breakfast	Lunch	Dinner	Bedtime
Day 1	Sugars	141 mg/dL	335 mg/dL	89 mg/dL	290 mg/dL
	Insulin	None	8 units	None	6 units
Day 2	Sugars	381 mg/dL	76 mg/dL	261 mg/dL	121 mg/dL
	Insulin	8 units	None	6 units	None
Day 3	Sugars	>600 mg/dL			

Table III. Hypothetical watering schedule for a plant.

Amount of Dehydration	Amount of Water
No dehydration	No water
Some dehydration	Some water
More dehydration	Lots of water
Complete dehydration	A whole lot of water

Question:

How do I write a correction scale?

Answer:

Not all patients are created equal, and not all patients have the same sensitivity to 1 unit of insulin. Patients with type 1 diabetes are more sensitive to insulin and will respond to a lower-dose correction scale; patients with type 2 diabetes need more insulin to reduce blood sugar levels.

The "1700 rule" helps determine the decrease in the blood glucose level with 1 unit of insulin (commonly called the *correction factor*). If 1700 is divided by the total daily dose (anticipated or current), the result will be the decrease in the blood glucose level using 1 unit of insulin. For example, our patient with type 1 diabetes has a total daily dose of 34 units; dividing 1700 by 34 equals 50. Hence, 1 unit of insulin would bring her blood sugar down by 50 points. Thus, the first correction scale in **Table I** should be used.

The author suggests a somewhat easier-to-use rule of his own: the rule of 35. Dividing the total daily dose by 35 gives us the number of units we would write for each 50-point elevation of blood sugar above 150 mg/dL. For example, if a patient's total daily dose is 105 units, his or her supplemental scale would read as 151–200 mg/dL, 3 units (105/35 = 3).

Here are some useful points about the correction scale:

- A correction scale is never used for a long-acting or basal insulin. In the author's experience, many patients start doing it incorrectly with insulin glargine, detemir, and NPH.
- Some patients may require a correction scale at bedtime. The author typically prefers a lower-dose scale if the patient is able to understand and work with 2 different scales.
- For patients who are not achieving target blood glucose levels with a correction scale, the lower limit of the scale could be decreased to 120 or 100 mg/dL.
- At best, a correction scale is one that is never used; that is, the patient's blood sugar levels are very well controlled. If a patient consistently needs a correction scale, the baseline regimen may need to be altered.
- The author starts subtracting a few unit(s) of bolus insulin for blood sugar levels <80 mg/dL for patients on scheduled bolus insulin, if the patient can understand the concept.
- A correction scale can be changed as often as needed—one scale does not fit a person at all times since a number of variables can affect a patient's insulin sensitivity.

Summary:

- The term *correction scale* or *supplemental insulin* is preferred over *sliding-scale insulin*.
- A correction scale should almost never be used alone.
- A correction scale should be tailored to a patient, and the 1700 rule helps determine the scale.