

Errors of Insulin Commission?

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All medical care providers caring for patients with diabetes have had the midnight call from an embarrassed patient who says, “Doctor, I’ve made a mistake with my insulin and took the wrong dose. What should I do?” The answer, of course, is, “Eat something, and monitor your blood glucose level.”

We can’t eliminate mistakes completely, but how can we make taking insulin safer?

Millions of people take insulin injections several times a day, and with the advent of new insulin analogs and premixed insulin combinations, the potential for errors has increased. If there is any doubt about patients’ knowledge of the kinds and actions of the insulins they take, this issue should be explored, and the opportunity to teach them should be taken to help reduce the chance of future errors.

Following are some of the more common types of insulin errors and some hints for ensuring the safety of patients who use insulin.

Mistaking Dosages of Different Insulins

Probably the most common error is when someone mixes up the dosages for two different kinds of insulin. Generally, this involves an intermediate- and a rapid-acting insulin, with the former nearly always at a higher dose than the latter. Often, patients realize their mistake immediately and can take steps to avoid severe hypoglycemia. This type of error is also suspected when patients have an unexpected low blood glucose level unrelated to their

activity or food intake and outside of their usual pattern.

This type of error can be disastrous when it is not realized, especially for patients who have little warning of dropping low blood glucose levels (hypoglycemic unawareness). Likewise, when the wrong dosage is taken of a 24-hour long-acting insulin (glargine [Lantus]), the hypoglycemic effects can be long-lasting indeed. However, a more common mistake seems to be that of taking too large a dose of a rapid-acting insulin.

Identifying Insulins by Their Appearance

The terms “cloudy” and “clear” used to be accurate in describing intermediate- (cloudy) and rapid-acting (clear) insulins. With glargine, a clear “peakless” 24-hour insulin, this is no longer true. In a recent letter in *Diabetes Care*, Adlersberg et al.¹ recount two instances of “mistaken identity” that involved patients taking the rapid-acting insulin analog lispro (Humalog) instead of glargine at bedtime. They recommend that the glargine manufacturer, Aventis Pharmaceuticals, and the Food and Drug Administration consider alternative packaging to distinguish glargine from other clear insulin preparations. Compounding this problem, there are now several cloudy pre-mixed insulins on the market that are combinations of intermediate- and rapid-acting insulins.

Drawing Up Inaccurate Doses

Another type of error can occur when people occasionally “guesstimate” the amount of insulin they are giving when

their dosage increases beyond the size of their syringe. Because insulin is such a potent medication, small amounts can make a big difference in blood glucose levels in some patients.

Confusing Various Premixed Products

Medical professionals who do not deal with insulin on a regular basis are becoming confused by all of the recent changes in insulin products. A 70/30 premixed insulin (NPH/regular) may not be recognized as different from a 50/50 (NPH/regular) or from a 75/25 (NPH/lispro). Some of these are sold in both vials and disposable insulin pens, and care must be taken that patients have received from the pharmacy what was requested on the prescription sheet. In Europe, additional premixed insulins abound, including 80/20, 90/10, and 60/40 NPH/regular, adding to the confusion. There soon may be on the U.S. market a new 70/30 mixture of NPH and aspart (Novolog), another rapid-acting insulin analog from Novo Nordisk. This could be very easily confused with the 70/30 product from Eli Lilly, which is a mixture of NPH and regular insulin.

Inappropriately Handling Insulins

Occasionally, patients comment that their rapid-acting insulin loses its effect after a week or so, i.e., it does not seem to bring their blood glucose level down as well as when it was first opened. This should be a flag to providers to investigate how they are mixing two different types of insulin. Such patients may be getting small amounts of an intermediate-acting insulin in the rapid- or short-acting insulin vial.

Another problem may be exposure of insulin to excessive heat, which can cause the insulin to become denatured and lose its effectiveness.

In addition, insulin pens, cartridges, and other devices for administering insulin are only good if they work properly and if patients know how to use them correctly.

Omitting Insulin During Illness

One of the most common mistakes patients make with insulin, and one that often leads to hospitalization, is to neglect to take their insulin when they are ill. Such patients may think that they don't need their insulin because they are nauseated or vomiting and therefore not eating. In fact, however, more insulin is often needed in times of illness.

Insulin Safety Tips

- Ask patients to bring their insulin with them to each office visit. This gives providers the opportunity not only to discuss the type of insulin they use, but also to:
 - ✓ address insulin storage (Are they leaving it in a hot car in summer? Do they use a mail-order pharmacy that may leave it on the front step in heat or extreme cold?), expiration dates, and appearance (Are there clumps or crystals in the vial (rare)? Is a clear insulin now slightly cloudy?);
 - ✓ look at the syringes they use and determine whether their current dosages fit in that size syringe;
 - ✓ discuss insulin shelf-life. Rapid-acting insulins kept at room temperature should be replaced after about 1 month. (Intermediate-acting insulins that are not refrigerated should be kept as cool as possible [$<86^{\circ}\text{F}$], but not frozen. Insulin glargine, once opened, should be stored in a refrigerator or kept as cool as possible. The 10-ml vial is good for 28 days; the

5-ml vial is good for 14 days if stored in a cool place [$<86^{\circ}\text{F}$] or 28 days if refrigerated.); and

- ✓ advise patients that all insulins need to be stored out of direct sunlight and kept from extremes of temperature.
- Make sure patients know the type of insulin they use and its action time and peak time (if any). This is different from knowing the brand name or the appearance (clear/cloudy) of their insulin.
- Review insulin procedures periodically. Most mistakes are made by veteran insulin users who have a careless moment or get distracted. Fortunately, it rarely happens more than once to the same person. When it does, suspect other issues, such as psychological problems or attention-getting behavior.
- Ask patients to demonstrate their insulin technique periodically. Make sure they know how to mix different types of insulins, and supply brochures to make your instructions easier to follow at home. Be sure patients who use glargine know that it cannot be mixed with any other insulin. We encourage people who use both rapid-acting insulin and glargine to use insulin pens for their rapid-acting doses. (Glargine must be injected traditionally.) This eliminates the possibility of mixing up the dosages for the two products. This is another approach to the problem identified by Aldersberg et al.¹
- Teach all patients who take insulin sick-day rules. This should include instructing them to take their insulin when they are ill (even if they are not eating), to check their blood glucose levels frequently, to take extra insulin as directed if they are hyperglycemic, to drink caloric fluids if they are hypoglycemic, to check for ketones if applicable, and to call the provider's office.

- Check all insulin devices and pens to make sure they are working properly, and observe patients using them. Pen and device manufacturers provide easy-to-follow directions, which should be reviewed and followed.
- Advise patients to check before leaving their pharmacy to be sure they have received the exact medications that were ordered. This is particularly important for pen devices, which may look the same but contain different doses. Hospitalized patients should ask about all the medications they are receiving—not only insulin—while in the hospital.

Patients educated in diabetes care are the best insurance that mistakes will be few and far between and that any that do occur are less likely to be severe. Referring patients to a certified diabetes educator who can teach them the basics of insulin therapy and administration and offer practical tips for preventing errors can be a smart investment for patients, their family, and their care providers.

REFERENCES

- ¹Aldersberg MA, Fernando S, Spollett GR, Inzucchi SE: Glargine and lispro: two cases of mistaken identity. *Diabetes Care* 25:404–405, 2002

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Note of disclosure: Dr. Lando is a stock shareholder in Abbott Labs and has received honoraria from Novo Nordisk and Eli Lilly and Co. Ms. Ragone has received honoraria from Aventis. All of these companies manufacture insulin or insulin-related products.