

Matching Patients to Devices: Diabetes Products Are Not One-Size-Fits-All

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Think about the last time you went to buy a new car. Did the dealer tell you, “This is the car we sell, so this is what you get”? Or, did he or she ask about your needs—size, style, price range, features—and try to find you a good match? If the dealer wanted to keep you as a customer, he or she surely took the latter approach.

Now think about medical devices for your patients with diabetes. Doesn't this deserve some thought as well? After all, we are not talking about a car; we are talking about equipment needed to maintain health and, perhaps, sustain life. Just as certain types of cars are better suited for certain people, some blood glucose meters, insulin pumps, pen devices, and continuous glucose monitors are better matches for certain patients. Recommending the same medical device to everyone who walks into your office does a disservice to your patients and may set you up for poorer clinical outcomes and time wasted on troubleshooting.

The following is a discussion of the features of various diabetes management devices, the advantages they offer, and the types of patients who are most likely to benefit from them.

Blood Glucose Meters

There are dozens of blood glucose meters on the market, and the number of companies producing them has reached double digits. There is no one

meter that works best for everyone. Different meters meet the needs of different people. Following are some of the features that should be considered when recommending a meter to a particular client.

Size. Large meters are well suited for people with limited dexterity and those who mostly check their blood glucose levels at home. Small meters are optimal for those who carry their meter with them and check frequently throughout the day.

Screen size. This is also an issue, particularly for patients with limited vision. Before offering or recommending a meter to patients with limited vision, show them a sample and make sure they can read the numbers and prompts on the screen.

Voice modulation. This feature is available on a growing number of meters. Consider recommending these devices to clients who are unable to see well enough to use a traditional meter.

Download capability. This feature is helpful for patients who do not record their readings by hand. Most major meter manufacturers offer free software or Web-based services for downloading their meters, and some even have a built-in USB port. Many generic meters are not downloadable. Ask patients who use these devices to download their meters before their office visit and to bring in specific reports or make sure you have the

capability to download their meters in your office.

Sample size. This is an important issue for many meter users. Smaller is always better, but not always necessary. Almost all modern meters require $\leq 1 \mu\text{l}$ blood. However, for patients seeking less painful alternate-site testing (on the arm or leg, for example), a meter that requires $\leq 0.5 \mu\text{l}$ is best.

Data logging. This is the latest high-tech meter feature. Some meters allow users to enter their insulin/medication doses, food/carbohydrate intake, exercise, and other daily events into their meter. Although few people actually use this feature, it can be helpful to those with a keen interest in detailed data analysis. In particular, the ability to mark readings as pre- or post-meal can be helpful to clinicians and patients looking to emphasize postprandial glucose control.

Instant communication. A meter's ability to communicate instantly with secondary devices such as insulin pumps can provide added benefits for certain patients. Using a meter that communicates directly with a pump (or pump programmer) ensures accurate and consistent data entry for mealtime bolus insulin calculations.

Ketone testing capability. This is a desirable feature for pediatric patients, pregnant women, insulin pump users, and anyone at higher risk for diabetic ketoacidosis. A few meters allow users to check blood ketone levels on the same device that measures

blood glucose levels by using ketone test strips.

Insurance coverage. Whether test strips are covered by health insurance may be the deciding factor in selecting a meter for many patients. However, most major health plans (public and private) offer multiple options at the various coverage tiers. Terms of coverage change periodically as wheeling and dealing takes place within the industry, so check at least once a year to see which meters are given preferred coverage within the plans you encounter most.

Low hematocrit accuracy. Anemia can affect how well some strips work. Patients who might be prone to severe anemia, such as those with advanced renal disease, need a meter that reads glucose accurately with a low hematocrit level. The product information for each meter will list the hematocrit range at which it will provide accurate readings.

Enzyme technology. Caution is needed for patients on peritoneal dialysis or those receiving intravenous immune globulin. The enzyme technology used by certain test strips (those using a glucose dehydrogenase pyrroloquinolinequinone [GDH-PQQ] reagent) can produce falsely elevated blood glucose levels when exposed to maltose, galactose, or xylose. The U.S. Food and Drug Administration warns that patients receiving intravenous immune globulin or peritoneal dialysis solutions containing icodextrin should be advised to avoid these types of strips, which include some Roche (Accu-Chek) strips produced before 2012, Abbott (Freestyle) strips made before 2010, and current Home Diagnostics TRUEtest strips.

Continuous Glucose Monitors

Continuous glucose monitoring (CGM) devices provide continuous glucose readings, graphic displays of trends in glucose levels, and alarms

for glucose values that fall above or below a pre-programmed target range. The systems have been shown to be effective for those trying to tighten glycemic control while avoiding frequent or severe hypoglycemia.¹ Most private health insurance plans offer some degree of coverage for CGM, particularly for patients who use insulin and have a history of severe hypoglycemia and hypoglycemia unawareness.

CGM systems provide a much more sophisticated and complex set of data than blood glucose meters, but selecting a system is much simpler because the options are limited. Since Abbott announced its withdrawal from the CGM market in the United States, only two choices remain: the devices from Medtronic and Dexcom.

Medtronic products. Medtronic offers two CGM products. The Guardian is a stand-alone CGM system that is not incorporated with a Medtronic insulin pump. Medtronic's latest model insulin pump, called the Revel, has a built-in radio receiver and can display the sensor data right on the Medtronic pump screen. The major advantage of the Revel is that it incorporates insulin pump and CGM data into one system; users do not have to carry around a separate receiver to display their CGM data.

Another unique aspect of the Medtronic CGM devices is their predictive alerts, which let users know if a high- or low-threshold glucose level is expected to be crossed in a given period of time. Data analysis from CGM systems is a crucial part of their functionality. Medtronic CGM devices download through Macintosh or PC computer systems to a Web-based program (Carelink) that provides a series of charts, graphs, and statistics that

can be accessed easily by health care providers.

On the downside, Medtronic CGM devices are relatively complicated to set up and use and may be problematic for patients who are not technologically savvy. CGM sensor insertion can be uncomfortable for sensitive individuals, and the alarms often go unnoticed, which can be a major issue for parents of young CGM users. The accuracy of Medtronic sensors also lags behind its competitors, with a tendency to err above fingerstick blood glucose values, particularly when hypoglycemia is approaching.

The Dexcom Seven Plus is a free-standing CGM system that is not yet integrated with an insulin pump in the United States. The sensors are more comfortable to insert and last about twice as long as Medtronic sensors. Built-in adhesive holds the sensor in place for a week or longer, which is a nice feature for athletic users. Dexcom is also relatively simple to set up and use. The display on the receiver is large and bright, and the alerts (both audible and vibratory) are strong enough to be noticed by most people even when they are sleeping. This makes it a good choice for patients with limited vision and deep sleepers. Alerts can let the user know when the glucose has crossed a specific threshold or is rising or falling quickly.

On the down side, although the system is generally accurate, particularly in the hypoglycemic range, medications containing acetaminophen (such as Tylenol products) will trigger a false high glucose measurement for several hours. But the major drawback to the Dexcom system is that the display is not yet integrated into an insulin pump. For patients who already wear a pump, carrying around another device

(the CGM receiver/display) can be inconvenient.

Because there are pros and cons to each CGM system, it is worthwhile to ask patients which aspects of CGM are most important to them—Accuracy? Convenience? Simplicity? Comfort? Loudness? The costs for these systems are similar both for start-up equipment and sensors (on a per-day basis). However, some health plans may favor one system over another, so checking with patients' insurance providers may be a good place to start.

Insulin Pens

Familiarize yourself with the full line of pens from each of the three major insulin manufacturers so that you can tailor the pen type to each patient's needs. The major difference among pens (other than the type of insulin each contains) is the dosing increment. Disposable pre-filled insulin pens containing 300 units of insulin are the simplest to use but do not dose in less than full-unit increments. Nondisposable, or durable, pens use replaceable insulin cartridges. Some (the Luxura and NovoPen Jr) allow for dosing in half-unit increments. This half-unit dosing feature is desirable for patients who take < 30 units daily and hence are more sensitive to small dosage changes.

Another durable pen (the Humira) features an electronic memory with a small display showing the amount and time of the last dose administered. Patients with memory impairment, as well as those who depend on others to administer their insulin, may benefit from this feature. And although durable pens require a few more steps to put together each time the cartridge needs to be replaced, their plunger mechanism is smoother and easier to

press, which can be an advantage for patients with limited hand strength.

Insulin Pumps

Once patients purchase an insulin pump, they will be connected at the hip (literally) for the next 4–5 years (or longer) before their insurance will cover a new one. Most insulin pumps carry a 4-year warranty, but some health insurance plans (such as Medicare) will not replace them for at least 5 years. At that time, they should take a look at all pumps on the market and decide which best fits their needs. Before recommending a particular type of insulin pump, providers and their patients should do their homework and think it through. Ultimately, the choice of pump should be the patients'.

All insulin pumps have certain core features. All are small, battery-operated devices that deliver both basal and bolus insulin. All allow users to program temporary basal adjustments and prolonged bolus delivery. All are priced similarly, although pumps using a disposable pod or patch cost less up front but more over the life of the durable programming device. All are safe, featuring an array of alerts or alarms and mechanisms to prevent accidental insulin overdosage. And all pump manufacturers provide one-on-one technical training on pump features, a minimum 4-year warranty, and around-the-clock customer support for technical pump problems. Further pump training including insulin adjustment will need to come from the health care team.

So why consider more than one type of pump? In keeping with our car analogy, style, performance, and subtle features still count. Some pumps have attributes that make

them a better match for certain individuals.

Cartridge/reservoir volume. Some pumps hold as little as 180 units of insulin, whereas others hold as much as 300 units. Because most pump users change their infusion set every 3 days, it is important to have enough insulin in the reservoir to last that long.

Screen legibility. As we have heard a thousand times on cell phone commercials, what good is the phone if the calls don't go through? Similarly, what good is a pump if users cannot make out what is on the screen? Some pumps feature low-contrast, black-on-green displays with small characters, whereas others feature full-color screens with excellent contrast. If possible, keep a few demonstration pumps in your office for patients to check for clarity before placing an order.

Bolus calculations. All insulin pumps have a built-in bolus calculator to assist users in determining precise bolus doses based on their blood glucose, grams of carbohydrate consumed, and insulin on board (IOB, the remaining active insulin from their previous dose). Two of the three major pumps can connect to carbohydrate-counting databases, and all of the pumps have the ability to track IOB. Patients who take > 25 units of insulin at meals or need > 1 unit for every 5 g carbohydrate consumed will benefit from a pump that allows for large dose delivery and calculation of insulin-to-carbohydrate ratios in 0.1-g increments.

Alarm volume. All pumps alert users when there are problems that need to be addressed. But once again, if patients cannot hear or feel the alarm, what good is it? Some pumps beep louder and vibrate stronger than others, so have samples available in your office for patients to try out.

Water resistance. Patients who spend a considerable amount of time

in or around water are best suited to have a fully waterproof—not merely splash-resistant—pump.

Links to other devices. Some pumps receive wireless signals from blood glucose meters, making the bolus calculation process easier. However, different pumps link with different meters. If patients prefer a certain meter type (or must use a specific type because of insurance coverage limitations), take that into account when recommending a pump.

As noted above, for patients who use or plan to use a CGM device, certain pumps serve as a display for the CGM data, thus eliminating the need to carry a separate receiver/display for CGM. This is a major convenience for prospective pump users and should be considered when selecting a pump.

Finally, a few insulin pumps offer the convenience of remote-control programming. Although not everyone needs this feature, remote programming may be desired by caregivers of young pump users or patients who wear their pump on an undergarment.

Downloadability. All insulin pumps are downloadable, but the quality of the programs and their system requirements varies considerably. Some will only download to a PC; others download to either Macintosh or PC computers. Increasingly, pumps are also downloadable to Web-based

programs. In most cases, the data can be downloaded at home and viewed by (or transmitted to) a clinician. Depending on how much you and your individual patient plan to make use of data downloads, the software features deserve attention when selecting a pump.

Aesthetics. Pumps vary based on a number of aesthetic/lifestyle parameters, including color options, clip/case quality, physical dimensions, tubing versus tubeless (patch), and general appearance. Given that patients will be living with their pump more or less continuously for many years, they deserve to choose a pump that suits their tastes.

Insurance coverage. Given the cost of insulin pumps and disposable supplies, perhaps this should be the first consideration. Most major insurance companies will cover any pump, but some offer preferred pricing for manufacturers with whom they have direct contracts, and some, such as Medicare, still do not cover patch-type pumps.

Being a matchmaker is not such a bad job; we do it every time patients walk in, tailoring their treatment to their needs, background, and resources. It is important to do the same thing when it comes to recommending any of the growing array of diabetes self-management devices on the market.

When your device manufacturers' sale representatives drop in, ask them to teach you about the unique aspects of their products. Understanding these tools fully is every bit as important as knowing the complete profiles of the medications you prescribe. Give them a half hour, if necessary, to go over their products in detail, and ask if they can leave samples. Or better yet, use the device yourself for a week or two so you can offer patients your personal insights. Just imagine the looks of appreciation on your patients' faces when you steer them toward a product that truly solves a problem or tell them about features they may have overlooked. Keep in mind that device features continue to evolve, and new ones come to market on a regular basis. Keep abreast of what is available so you can best counsel and support your patients.

Attention to such details is all in a day's work for a clinician-matchmaker.

REFERENCE

¹Bergental RM, Tamborlane WV, Ahmann A, Buse JB, Dailey G, Davis SN, Joyce C, Peoples T, Perkins BA, Welsh JB, Willi SM, Wood MA; STAR 3 Study Group: Effectiveness of sensor-augmented insulin-pump therapy in type 1 diabetes. *N Engl J Med* 363:311–320, 2010

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