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Glucose meters, insulin pens and lancing devices: helping patients select appropriate tools to avoid diabetes complications

by Susan Halasi, MScPhm, RPh



Learning objectives

Upon completion of this lesson, the pharmacy technician will gain knowledge of the following:

1. The prevalence of diabetes in Canada and its long-term health effects
2. Canadian Diabetes Association (CDA) guidelines for monitoring the disease to achieve plasma glucose targets
3. Which glucose meters and insulin pens are best suited for specific patient needs
4. Customizing lancing devices to meet individual patient requirements and encourage better glucose meter usage
5. The role of the technician in supporting patients with diabetes to help better control their illness

Introduction

In 2009, a survey taken by the Canadian Chronic Disease Surveillance System reported that 2.4 million Canadians (6.8%) had diabetes.⁽¹⁾ In 2013, expert clinicians

noted that more than 9 million people live with diabetes or pre-diabetes in this country.⁽²⁾

More than 50% of the people diagnosed with this illness (1.2 million people) were between the ages of 25 and 64 years. Analysis of the

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data revealed that overall prevalence (number of people with the disease at a given time) was higher in men (7.2%) than women (6.4%). Labrador, Newfoundland, Nova Scotia and Ontario have the highest prevalence; Alberta, Nunavut, and Quebec the lowest. Diabetes is an illness with powerful implications, striking people in the prime of their lives.⁽¹⁾

Long-term diabetes complications

The impact of diabetes on the general health of patients is distressing. At all age groups, people with diabetes experience at least two times higher mortality than those without the illness. Although the disease itself does not typically lead directly to death, the complications associated with this disorder do. The most common cause of death in individuals with type 2 diabetes is cardiovascular disease (heart attack, stroke and peripheral vascular disease).⁽¹⁾ Diabetes is the leading cause of blindness, end-stage renal disease and non-traumatic amputation in Canadian adults.⁽²⁾



Cardiovascular disease occurs two to four times more often in patients with diabetes than in those without the illness.⁽²⁾ Diabetes has been associated with premature narrowing of the arteries, resulting in unstable angina and acute heart attack.⁽¹⁾

Poor blood glucose control leads to blindness from diabetic retinopathy, cataract formation and glaucoma. Hyperglycemia causes injury to small blood vessels in the retina of the eye, resulting in vision loss due to bleeding or retinal detachment.⁽¹⁾

High blood glucose harms the kidneys by damaging the vessels that filter blood in this organ (known as diabetic nephropathy). Diabetes patients whose blood glucose levels are routinely elevated can go on to develop end-stage renal failure, and are 12 times more likely to be hospitalized from this complication than those in the general population.^(1,2)

Elevated blood glucose reduces blood flow to nerves. As a result, toxins are not removed from the extremities, and there is insufficient oxygen available to support nerve structure and function (identified as diabetic neuropathy). These patients experience pain, tingling and numbness, particularly in the soles of their feet. They often develop non-healing ulcers and deep-seated bone infections. Compared with the general population, patients with diabetes have more than 20 times the risk of non-traumatic lower limb amputation. Diabetic neuropathy has also been linked to erectile dysfunction and delayed stomach emptying.^(1,2)

Other complications of diabetes that impact quality of life include oral disease, mental illness and respiratory disorders. Patients with diabetes are prone to gingivitis and periodontal disease. In addition to affecting gums, this illness places patients at greater risk of developing cavities and

TABLE 1 - CDA recommended self-monitoring of blood glucose in diabetes patients^{(2)*}

Patient situation	SMBG recommendation
Pre-diabetes	Daily monitoring not usually required
Treated with lifestyle or oral agents (meeting glycemic targets)	Daily monitoring not usually required
Treated with lifestyle or oral agents (not meeting glycemic targets)	Monitor two or more times daily to assist in lifestyle and medication changes until glycemic targets are met
Using insulin four or more times daily	Monitor as often as insulin is given
Using insulin less than four times daily	Monitor at least as often as insulin is given
Using an insulin pump	Monitor as instructed by healthcare provider
Pregnant/planning pregnancy	Monitor as instructed by healthcare provider
Sick days	Monitor as instructed by healthcare provider
Initiating new medication with potential for hyperglycemia (e.g., corticosteroids)	Monitor at least twice daily or as instructed by healthcare provider
Occupation requiring alertness	Monitor as instructed by healthcare provider or employer
Using medication known to cause hypoglycemia (e.g., glyburide, repaglinide)	Monitor at times when symptoms of hypoglycemia occur or have previously occurred
Newly diagnosed diabetes (within last six months)	Monitor as instructed by healthcare provider at different times of day to learn the effects of various meals, exercise or medications on blood glucose

*Adapted from the Canadian Diabetes Association clinical practice guidelines. SMBG—self-monitoring of blood glucose.

TABLE 2 - Glucose meter selection considerations⁽⁴⁻¹⁴⁾

Patient need/constraint	Desired glucose meter feature	Potential choices*
Dexterity problems	Choose product with an ergonomic grip (e.g., easy-to-hold non-slip rubber edges) Select a device that eliminates strip handling (i.e., strips are contained in a drum or foil disk)	Accu-Chek Aviva [®] /Aviva Nano [®] ; Breeze 2 [®] ; Free Style Freedom Lite [®] ; iTest [™]
Financial restrictions [†]	Consider a device that a) uses strips covered by insurer or with lower strip cost/100 b) is powered by AAA batteries rather than the lithium type c) uses strips with longer expiration dating (i.e., most strips have a 90-day expiration)	Lower strip cost/100: TRUEtrack [®] ; SideKick [®] ; various in-house brands Devices using AAA batteries: Oracle [®] ; Accu-Chek Compact Plus [®] /Mobile [®] ; OneTouch Ping [®] / UltraSmart [®] Strips with longer than 90-day expiry dating: Bayer Contour [®] /Contour Link [®] /One-Touch Verio [®] products
Fingertip sensitivity	Select a device that a) allows testing from forearm, upper arm, palm, thigh or abdomen (alternate site testing), as well as fingertips b) requires a small blood sample size, as a shallower lancing depth is required	Accu-Chek Aviva/Nano/Compact Plus/Mobile [®] ; Bayer's Contour [®] /Contour Link/Contour Next [®] ; Free Style Freedom Lite [®] /Lite [®] ; iBGStar [®] ; iTest [™] ; Nova Max Plus [®] /Link [®] ; OneTouch Ping [®] /Ultra2 [®] /UltraMini [®] /UltraSmart [®] ; Oracle/ Oracle Onyx [®] ; Precision Xtra [®] ; TRUEbalance/2go/result/track [®]
Ketone alert (patient routinely has high blood glucose levels)	Choose device that warns patient of excessively high blood glucose levels, preventing ketoacidosis	Precision Xtra BG & Ketone [®] ; Oracle [®] ; TRUEresult [®]
Portability	Suggest a meter that is lightweight and small enough to fit into a purse or pocket	Accu-Chek Aviva Nano [®] ; iBGStar [®] ; iTest [™] ; OneTouch UltraMini [®] ; TRUE2go [®]
Rapid result (5 seconds or less)	Propose a device that a) requires a small sample size b) has a fast test result (4 seconds)	Small drop size (0.3 mL): Accu-Chek Mobile [®] ; Free Style Freedom Lite/Lite [®] ; Nova Max/Link [®] Fast results available in 4 seconds: iTest [™] ; TRUEresult/ TRUE2go [®]
Simplicity	Choose a meter that requires no coding, reminder alarms, or downloadable features	Bayer Contour Next EZ [®] ; Free Style Freedom Lite [®] ; Sidekick [®] ; TRUE2go [®]
Technical features	Meter has large memory, downloadable features (includes USB port) with 7- through 90-day glucose averaging; programmable reminder to test function, can flag out of range pre- and post-readings	Most meters will provide these features except for Bayer Contour Next EZ [®] ; Sidekick [®] ; TRUE2go [®]
Technical support availability	Most manufacturers offer service during extended business hours (i.e., 8 AM-8 PM); several have 24-hour support	All products have a website with troubleshooting feature; check insert for individual manufacturer availability
Undergoing peritoneal dialysis	Meter strip cannot interact with icodextrin in peritoneal dialysis solution, otherwise the reading will be falsely elevated due to presence of maltose in the dialysis solution	DO NOT RECOMMEND THE FOLLOWING PRODUCTS: All Accu-Chek meters; All Freestyle meters; TRUEresult/ TRUE2go [®]
Using insulin pump	Meter specifically designed for patients using a pump	Guardian Real Time CM [®] ; Bayer Contour Link [®] ; Nova Max Link [®] ; OneTouch Ping [®]
Visually impaired	Opt for a meter with large display, backlighting (some meters may have both features) or vocal announcement	Large display: Bayer Breeze 2 [®] / Contour [®] ; Free Style Freedom Lite [®] /Lite [®] / InsuLinx [®] ; OneTouch Ultra2 [®] /UltraSmart [®] ; iTest [™] ; Precision Xtra [®] ; TRUEresult [®] /TRUEtrack [®] Backlit display: Accu-Chek Aviva Nano [®] /Compact Plus [®] ; Free Style Lite [®] / InsuLinx [®] ; OneTouch Ultra2 [®] /Verio IQ [®] ; BGStar [®] /iBGStar [®] ; iTest [™] Voiced results: Accu-Chek Compact Plus [®] ; Oracle [®]

* List of meters is not exhaustive; other options available.

† Individual province or territory may subsidize cost of monitoring supplies (contact local Canadian Diabetes Association branch).

TABLE 3 - Insulin pen delivery options

Patient need/constraint	Desired pen feature	Insulin available as a cartridge	Appropriate pen*
Dexterity problems	Opt for a device that contains a preloaded cartridge and is disposable	Humulin® (N) Humalog® (lispro, Mix25, Mix50) Novolin ge insulins NovoRapid® (aspart) Lantus® (glargine) Apidra® (glulisine)	Humulin Kwikpen™ (N) Humalog Kwikpen™ (lispro, Mix25, Mix50) NovoRapid FlexTouch™ SoloSTAR® SoloSTAR®
Dial-back capability#	Look for this feature to reduce wasted doses	The following pens have the dial back feature: Humulin/Humalog Kwikpen™ ; HumaPen® Luxura™; NovoPen4®; NovoRapid FlexTouch™; ClikSTAR/SoloSTAR®	
Insulin sensitivity/ small dose (<i>child, athlete</i>) or large dose (> 60 units)	If patient is insulin sensitive, choose a device that can be set at increments of 0.5 units For patients requiring single doses beyond 60 units, choose a device that can dial up to 80 units	Insulin sensitivity: HumaPen® Luxura™ HD; JuniorSTAR®; NovoPen Echo® Higher single-dose capability: NovoRapid FlexTouch™; ClikSTAR/SoloSTAR®	
Ecological concerns	Recommend reusable pens, which are more eco-friendly	Precision HumaPen® Luxura/Luxura HD™; NovoPen4®/ Echo®; ClikSTAR®; HumaPen®Savvio™†	
Visually impaired	Suggest a pen that has dark numbers on a white background and audible clicking when dialing a dose	Dark numbers on white background: HumaPen® Luxura™; Humalog Kwikpen™; NovoPen4®; ClikSTAR/ SoloSTAR® Audible click on dialing dose: All pens have this feature	

* List of pens is not exhaustive; other options available.

† Available July 1, 2014; smaller, lighter format than Luxura™

Pen allows patient to dial back if they have overshoot the dose

salivary disorders, leading to tooth loss. The stress of dealing with a chronic illness has been shown to affect mental health.⁽¹⁾ The prevalence of clinical depression in the diabetic population is around 30%, with 10% suffering from a major depressive disorder. Many diabetes patients, particularly those with type 2 diabetes, are obese and at greater risk of developing osteoarthritis, chronic obstructive pulmonary disease, obstructive sleep apnea and hypertension.⁽²⁾

In pregnancy, glucose crosses the placenta freely, exposing the fetus to glycemic levels similar to those seen in the mother. Women with pre-gestational diabetes (either type 1 or type 2 diabetes present before pregnancy) are more likely to have a baby born with congenital malformations, due to consistently elevated blood glucose. Patients who develop diabetes during pregnancy (gestational diabetes) have higher rates of hypertension. Their babies tend to be large for gestational age, resulting in early delivery or requiring caesarian section at delivery. These complications often result in poorer neonatal

health or death. Thus, close supervision of such patients is advised in order to prevent problems during labour and delivery.⁽²⁾

Achieving optimal blood sugar levels in people with diabetes can help prevent these complications, and improve their quality of life.

Recommendations for self-monitoring of blood glucose (SMBG)

The CDA encourages most patients with diabetes to check their blood glucose levels. If they have not been seen by a diabetes educator, patients will wonder how often they should monitor their blood glucose. SMBG allows the patient to be aware of high or low readings at any given time. It also indicates whether certain lifestyle choices or medications affect their glucose levels, and is instrumental in managing diabetes to minimize complications. The CDA clinical practice guidelines strongly suggest a discussion with a diabetes educator about frequency of blood glucose monitoring at the time of diagnosis, and the type of meter best suited for a particular individual.^(2,3)

Table 1 outlines recommended SMBG frequency for specific situations. Patients with complicated drug regimens or special circumstances (i.e., pregnancy, shift worker, illness) are advised to contact their healthcare provider to customize a testing pattern. In order to ensure accuracy of blood glucose meter readings, results should periodically be compared with a simultaneous sample analyzed in a laboratory. This comparison, using venous fasting plasma glucose, should be done annually, or when patient's symptoms of glycemic control do not match meter readings.

Tailoring the devices to the patient

Diabetes affects individuals of all ages and walks of life. Therefore, customizing the blood glucose meter to each individual improves the chances of using the device as recommended. Features of various blood glucose meters include display size and lighting, the need to code each new batch of test strips, ability to use sites other than the fingertips for testing (i.e., alternate site testing), size and weight of the meter, blood

sample size required, speed of test result, memory capacity, and technical support provided by the manufacturer. Table 2 lists patient needs, meter features to fit those needs and specific meters that meet those requirements.

For patients who wish the convenience and discretion of an insulin pen delivery device, rather than withdrawing from a vial or administering insulin from a pre-filled syringe, there are a number of factors to consider. Dexterity, vision impairment, incremental dose adjustment and dial-back capability (i.e., ability to reduce a dose, if patient overshoots the mark) are features to look for in selecting a suitable pen. Table 3 addresses these considerations and provides examples of products meeting these requisites.

There are several disadvantages associated with the use of insulin pens. Regardless of which pen is selected, patients must use the insulin cartridge designed for that device. Pens are generally more expensive to use than syringes or vials, as there is a potential for drug wastage. Insulin can be wasted upon priming the device, and leakage of the drug can occur if



a pen is recapped with the needle still in place. Insulin compression or expansion can lead to dosage errors when the device is stored in rapidly changing climate conditions.⁽³⁾ If a larger than normal dose is required (i.e., greater than 60 units), some devices may not be able to deliver it as a single dose.

Lancing devices are also subject to individual preference. A lancing device may be a part of a SMBG kit; however, if the patient is not content with their device, they

may be unwilling to use it as often as they should. Table 4 suggests factors to consider when recommending a lancing device, and possible choices available.

Role of the pharmacy technician

Pharmacy technicians have a vital part to play in helping diabetes patients control their illness. Their role consists of education, encouragement and referral.

When patients question the need for frequent monitoring of their blood glucose, pharmacy technicians can point out the harm caused by persistently elevated blood glucose. Explaining the complications that arise from poor glycemic control may go a long way to encouraging use of a device.

The pharmacy technician can promote glucose meter usage by questioning patients on their particular needs (i.e., visual disability, dexterity, tight glycemic control, simplicity, technical support), then suggesting products that might suit their requirements. Should a patient wish to switch to an insulin pen device for discretion or convenience, the pharmacy technician can help them sort through the range of products available. Assisting patients with

TABLE 4 - Lancets and lancing devices

Patient need/constraint	Desired feature (lancet)	Potential choices*	Desired feature (lancing device)	Potential choices*
Financial restrictions	Choose product replaced free of charge if there is a problem	All Accu-Chek® lancets; All BD Ultra-Fine lancets	Choose product replaced or repaired free of charge	All Accu-Chek® devices; EZ Health Oracle™; FreeStyle®
Less pain on testing	Suggest a high gauge (33G); opt for product with tribevel tip	33 G: BD Ultra-Fine™; iTest™ Ultra-Thin; Nova Sureflex™; One Touch® Delica Tribevel tip: Accu-Chek® Softclix/FastClix; EZ Health™; MPD™	Suggest device with adjustable skin penetration (8 or more depth settings)	Accu-Chek® Softclix/Multiclix ⁽¹¹⁾ ; iBGStar® ⁽⁸⁾ ; iTest™ ⁽⁸⁾ ; One Touch® ⁽⁹⁾
Versatility	Select product with universal fit for most lancing devices	Abbott lancets; BD Ultra-Fine™; EZ Health™; FreeStyle®; TRUE Plus®	Choose device fitting most lancets	As for lancets
As part of a kit	Several manufacturers provide a small (usually 10) quantity of lancets as part of a kit	All Accu-Chek® lancets; iTest™ System; One Touch® System;	As for the lancets	All Accu-Chek® devices sold as a kit; EZ Health™; Freestyle®; iTest™ System; One Touch® System
Dexterity problems	Opt for pre-loaded drum that is disposable	Accu-Chek® Softclix/FastClix; iTest™ System	Select ergonomic design	Microlet2 Adjustable®; TRUEdraw®
Allow alternate site drawing of blood (i.e., other than the fingertips)	Not applicable	Not applicable	Choose device designed for alternate site testing	All Accu-Chek®; Microlet2 Adjustable®; Nova Surfex™; One Touch® UltraSoft

* List of lancets and lancing devices is not exhaustive; other options available.

proper disposal of needles and lancets by providing a sharps container also promotes safer SMBG.

If a patient is experiencing problems with any aspect of monitoring blood glucose, the pharmacy technician should refer them to the pharmacist for further evaluation. The pharmacist can suggest next steps for the patient, including support in troubleshooting their glucose meter, and actions to take if their lancing devices or pens are malfunctioning. If the problem cannot be corrected in the pharmacy, then the patient can be referred to his or her healthcare provider.

Summary

Diabetes is a chronic disease with potentially devastating consequences to everyday life. By controlling blood glucose, debilitating

complications can be postponed, quality of life improved and the likelihood of premature death reduced. Pharmacy technicians can play a valuable role in helping patients control blood glucose by suggesting devices that match their lifestyle.

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QUESTIONS

Please select the best answer for each question and answer online at www.CanadianHealthcareNetwork.ca for instant results.

1. Which of the following statements is incorrect:

- a) Elevated blood glucose damages the liver and kidneys
- b) Poor blood glucose control in patients with diabetes leads to retinopathy
- c) Cardiovascular disease occurs two to four times more often in patients with diabetes
- d) Hyperglycemia reduces blood flow to nerves resulting in diabetic neuropathy

2. For patients with diabetes, complications associated with their illness may include the following:

- a) Mental health issues, particularly depression
- b) Erectile dysfunction
- c) Constipation due to delayed stomach emptying
- d) All of the above

3. Women with gestational diabetes need to be closely supervised because

- a) Their baby may have a lower birth weight than normal
- b) They are at greater risk of developing hypertension
- c) They are at risk of developing low blood pressure
- d) They are at risk of an overdue baby

4. It is advisable to refer diabetes patients using insulin to a diabetes educator if

- a) They are a shift worker
- b) They are pregnant
- c) They are experiencing an illness or infection
- d) All of the above situations

Linda is a 45-year-old patient who is newly diagnosed with type 2 diabetes. She has been advised by her physician to use diet and exercise to get her blood sugar under control. He wants her to buy a glucose meter and start testing her blood sugar. Her appointment with the diabetes educator is not for another six weeks, so she needs help selecting a device. You notice that she uses a cane to walk and that the knuckles on her right hand are swollen and irregular.

5. You suggest a device that

- a) Has an ergonomic grip because she appears to suffer from arthritis
- b) Is small, so it can fit well into her pocket or purse
- c) Has many advanced features, including a USB cable to download appropriate levels
- d) None of the above

6. Linda wonders how often she should test her blood sugar. You suggest the following:

- a) Before and after every meal or snack
- b) Once weekly until she sees the diabetes educator
- c) Monitoring daily at different times to learn

the effects of various meals and exercise
d) Twice weekly until she sees the diabetes educator

Martha is a 26-year-old who was diagnosed with type 1 diabetes as a teenager. She has been using insulin for a decade, and has now started running marathons.

7. She would like you to suggest an insulin pen device because it is more portable than the syringe and vial she is currently using. A recommendation she would likely appreciate is a product

- a) With dial-back capability to reduce wastage
- b) That can be set at 0.5 unit increments to accommodate her needs while exercising
- c) That is disposable, with a preloaded cartridge
- d) With dark numbers on a white background that can be read in the dark

Eric, a newly diagnosed type 2 diabetes patient, is a musician who plays the piano. He was prescribed metformin 500 mg twice daily and told to monitor his blood glucose several times daily, at different times for the next few months.

8. The most appropriate glucose meter for this patient is

- a) One with an ergonomic grip

- b) A device that provides readings by voice
- c) The type that provides a result in five seconds or less
- d) A meter that allows testing at alternate sites as well as the fingertips

9. Eric would likely prefer a lancing device that

- a) Fits most lancets
- b) Adjusts for many different skin-penetration depths
- c) Uses tribevel tip lancets
- d) b and c

10. For patients with diabetes who are on disability or not covered by an insurance plan, suitable products to recommend include

- a) Glucose meters using test strips available in quantities of 100, with extended dating
- b) Glucose meters powered by lithium batteries
- c) Glucose meters as a kit with a limited number of strips in a disposable drum.
- d) None of the above

11. Patients undergoing peritoneal dialysis do not need to be concerned about the type of testing strips used with their meters.

- a) True
- b) False

James is a senior who has been suffering with diabetes for more than 30 years. He was recently diagnosed with cataracts and will be going for surgery. In the meantime he is having difficulty reading his blood glucose results.

12. To improve his SMBG you suggest

- a) Switching to a glucose meter with a large display or voice announcement
- b) Switching to a glucose meter that gives results in less than 10 seconds
- c) Switching to a glucose meter that is more portable
- d) None of the above

13. James is having his insulin drawn up and left in the fridge by a visiting nurse, but he would like the independence of using a pen. What do you suggest?

- a) A pen that confirms the dose dialed with an audible click
- b) A pen that has dark numbers on a white background
- c) a and b
- d) James is not a suitable candidate for

using a pen

14. Laura is a patient with type 1 diabetes, who likes "green" products, purchases in bulk and wants items with the least amount of outer wrap and plastic. She would probably prefer

- a) A disposable pen to administer her insulin
- b) A kit featuring a glucose meter that uses test strips in a disposable drum
- c) A glucose meter compatible with strips sold in boxes of 100 and a reusable insulin pen
- d) A glucose meter with rubber grips and a large display

15. The role of the pharmacy technician in helping patients with SMBG includes the following:

- a) Providing information on the health consequences of poor blood glucose control
- b) Suggesting appropriate devices geared to an individual's requirements
- c) Referring a patient to the pharmacist should they have questions or difficulties achieving their targets
- d) All of the above

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