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Alternative site testing: A review of blood glucose monitors

Dorothy Glavas, BSc.Phm.

Statement of objectives

Upon successful completion of this lesson, the technician should be able to:

1. Understand the advantages and disadvantages of alternate site testing as an option for blood glucose monitoring.
2. Understand which patients and circumstances are appropriate for recommending alternate site testing as a reasonable alternative to fingertip sampling.
3. Identify the various blood glucose monitors on the Canadian market capable of testing samples from alternate sites and understand the differences between these monitors.
4. As a member of the pharmacy team, advise patients on the correct use of alternate site blood glucose monitors and effective testing regimes.

Introduction

Blood glucose monitoring is an essential component of the overall treatment plan for patients with diabetes. The blood glucose monitor market has evolved tremendously since the introduction of the first Ames Glucometer in 1969. New technology in blood glucose monitors is constantly emerging, allowing patients easier sampling and more choices. Technicians and pharmacists are a great resource in educating patients with diabetes regarding the use of these monitors. For this reason, the pharmacy team needs to keep abreast of the new technology and expanding options available to patients with diabetes.

Pain is one of the biggest barriers to testing blood glucose for patients with diabetes. A patient who performs frequent testing (e.g., four times daily) may have to prick each finger several times weekly. Over time, as scar tissue

develops on the fingertips, the pain associated with testing increases. Several monitors on the Canadian market that are capable of testing blood samples taken from sites other than the fingertips (i.e., from alternate sites) will be discussed in this lesson.

Alternate site testing

Fingertips have a large concentration of blood vessels, making them an ideal spot from which to attain an adequate blood sample. However, fingertips also have an abundance of nerve endings, which can cause a high sensitivity to pain. New blood glucose monitors use much smaller samples of blood—in the order of 0.3 microlitres to 3 microlitres—versus conventional monitors that require approximately 2 microlitres to 9 microlitres. This requirement for a smaller blood sample enables patients to use alternate sites other than the fingertip to

obtain blood for monitoring.

Sites such as the forearm, upper arm, thigh, calf, abdomen and ear have been proposed as potential sampling sites for blood glucose monitoring. Thus far, the forearm and upper arm are approved sampling sites for three of the alternate site monitors available on the Canadian market (One Touch Ultra, One Touch Fast Take and Soft Tact). The Freestyle also has approval from Health Canada for sampling blood from the thigh, calf and hand, in addition to the forearm and upper arm.

Advantages

Alternate sites have fewer nerve endings than the fingertip, making sampling from these locations less painful. Some patients experience little or no pain or discomfort when these sites are used. The larger surface area of these alternate sites also reduces the incidence of scarring from repet-

itive punctures in the same region. As well, fingers are used for so many daily functions that the preservation of their integrity is important. Easier, less painful testing may enhance compliance to a diabetes treatment plan by promoting more frequent blood glucose monitoring.

Disadvantages

Since the dermis of the arm and other sites are not as vascular as the fingertip, and the rate of blood flow is approximately four to six times slower than from the fingertip and base of the thumb,¹ it may be more difficult to achieve a blood sample from these alternate sites. Bruising can sometimes occur due to the deeper puncture required.

Important caveat

Alternate site testing is a relatively new concept that has not been studied as extensively as fingertip testing. Many recent publications have looked at whether or not rapid changes in blood glucose result in clinically significant differences between capillary blood glucose values measured at the forearm versus the fingertip.^{2,5}

Under certain circumstances, the blood glucose test results from alternate sites, such as the arm, may differ significantly from those of the fingertip. These situations are most likely to occur when blood glucose is changing rapidly, such as following a meal, an insulin dose or physical activity. The reason for this difference seems to be the faster rate of blood

flow in the finger versus the arm.

There is an ongoing debate among blood glucose monitor manufacturers and healthcare providers regarding the ability of various alternate site monitors to detect rapid changes in blood glucose. A recent article on alternate site testing analyzed many of the studies that compared arm and fingertip sampling.⁶ Several studies showed a significant difference and delay in detecting rapid changes in blood glucose with the arm versus the fingertip.^{2,3}

The author of the review article concluded that healthcare professionals must be conservative in recommending alternative site testing due to the serious consequences of missed or delayed treatment of hypoglycemia (low blood glucose) and hyperglycemia (high blood glucose) for patients with diabetes.⁶ In order to minimize the risk of undetected hypoglycemia and hyperglycemia, alternate site testing of the arm should be limited to conditions of steady state glucose. These conditions include:

- a pre-meal or fasting state (more than two hours after eating);
- two hours or more after insulin injections; or
- two hours or more after physical activity.

At times of rapidly changing glucose (less than two hours after a meal, insulin injection or physical activity), the fingertip should be used, as a fingertip sample will detect the change in blood glucose more quickly. As well, if hypoglycemia is suspect-

ed, the fingertip is again the site of choice. In fact, many patients suffer from "hypoglycemia unawareness," where they do not experience the warning symptoms of low blood glucose (i.e., hunger, weakness, shaking, headache, sweating, irritability, etc.). These patients, and those who frequently experience low blood glucose, may be better using fingertip testing.

The consequences of not educating our patients about this caveat can be very serious. Missed hypoglycemia can lead to morbidity and even death, while untreated hyperglycemia can increase the risk of complications from diabetes (such as heart and kidney disease). As members of the pharmacy team, technicians have a responsibility to educate patients about the precautions for alternate sampling sites.

Further study is needed to determine and confirm whether certain patient groups or circumstances exist where alternate site testing should not be performed.

A REVIEW OF ALTERNATE SITE MONITORS

One Touch Ultra and One Touch Fast Take (Lifescan)

The One Touch Ultra and One Touch Fast Take are approved for performing alternate site testing on the forearm or upper arm. Both the Ultra and the Fast Take monitors require a very small amount of blood (1.0 microlitres and 1.5 microlitres, respectively), an essential characteristic for alternate site testing. Using the arm for testing requires the technician and/or

pharmacist to counsel patients on proper technique since blood flow in the arm is not as extensive as in the fingertip. Massaging the area on the arm for a few seconds prior to testing helps to increase blood flow to the site.*

As well, the lancing device used to prick the finger or arm requires the use of a special clear cap that is inserted onto the lancing device. This clear cap allows the patient to cup and attain a good seal over the puncture area, applying more pressure in order to make sampling on the arm easier.

Patients should be counselled to press and hold the lancing device to the arm for several seconds. It may also be advisable to set the lancing device to a deeper puncture depth (i.e., higher number) if the patient continues to find it difficult to achieve an adequate blood sample. A soft, fleshy area on the arm away from bone and free from visible veins and excess hair should be selected. The topside of the upper arm is usually a better choice than the underside of the arm, since the top has many blood vessels and bruising is lessened.

Both the Ultra and the Fast Take provide quick results (5 seconds and 15 seconds, respectively). The suggested retail price of these monitors is \$20 to \$30. These systems are able to perform 14- and 30-day averages of blood glucose concentrations and have a memory of 150 tests. Other features include date/time function and data downloading with computer software.

Lifescan has testing guidelines for patients opting for alternate site testing using the Ultra and Fast Take, and acknowledges that a difference in fingertip and arm testing may occur. The company promotes using the arm only when glucose levels are not changing rapidly.

A new Lifescan Ultra Smart monitor is expected on the mar-

CE Faculty

CE Coordinator:

Margaret Woodruff
B.Sc.Pharm., MBA;
Professor, Pharmacy
Technician Program
Humber College, Etobicoke,
Ontario

Author:

Dorothy Glavas, BSc.Pharm.

Community Pharmacist and
Pharmacist Consultant
Windsor, Ontario

Reviewer:

Valerie Connors
Pharmacy Technician
Instructor, Pharmacy
Technician Program,
New Brunswick Community
College, Saint John

Clinical Editor:

Lu-Ann Murdoch, B.Sc.Pharm.

For information about CE marking, please contact Mayra Ramos at (416) 764-3879 or mramos@rmpublishing.com. All other inquiries about Tech Talk CE should be directed to Karen Welds at (416) 764-3922 or kwelds@rmpublishing.com.

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ket this spring. This monitor shares the same strip technology and testing procedures as the Ultra. However, the new monitor is a blood glucose meter and electronic logbook in one. The system is very user-friendly and allows patients to detect on screen trends and patterns while tracking their blood glucose readings and other factors that can affect blood glucose (e.g., exercise, health, medication and food). For example, the monitor can automatically identify any out-of-range results so that the user can add comments pertaining to these results.

FreeStyle (Therasense)

The FreeStyle glucose monitor is now available in Canada. This monitor allows testing not only on the forearm and upper arm, but also on the thigh, calf, hand (fleshy part) and fingertip. The FreeStyle boasts the smallest blood sample of all monitors available in Canada (0.3 microlitres). Dual sample fill target areas that draw blood into the strip make it easy to fill from the right- or left-hand side.

Patients should be instructed to massage or vigorously rub the alternate site until it is warm prior to lancing. This rubbing may in some cases minimize the differences between the alternate site and fingertip readings.*

An audible alarm sounds when the strip has acquired enough blood. On average, the result will appear on the display in 15 seconds.

Additional features of the monitor include a memory of 250 tests, date/time function and data downloading capabilities with computer software. The suggested retail price of the monitor is \$39.95.

Therasense advises patients of the potential differences between the arm and the finger-

tip and promotes fingertip testing for patients who suspect a low blood glucose or who have hypoglycemia unawareness.

Soft Tact (Medisense)

The Soft Tact is an alternate site meter that requires 2 microlitres to 3 microlitres of blood. This particular device features a built-in vacuum pump that helps the user attain a seal over the area and draws blood to the surface to attain a sample. This vacuum increases circulation to the arm and helps to mimic the blood flow of the fingertips.

Once the vacuum begins, the lancet is released and the blood is then automatically transferred to the test strip. When sufficient blood is obtained, the test automatically starts and a beep is heard. At this point, a 20-second countdown to the test result occurs. The total time from placing the device on the arm to obtaining a test result is 40 seconds.

Unlike other alternate site meters on the market, this integrated system does not require a separate step of applying the blood to the test strip. It can also be preloaded with a test strip and lancet and used up to eight hours later. Beyond eight hours, the strip's integrity is compromised by exposure to heat and light, and a built in timer prevents the test from proceeding. This feature may be particularly useful for visually impaired patients.

Soft Tact has a secondary test port (Port 2) to use when testing fingertip samples, when the battery is too low to run the vacuum, for testing control solutions, and for downloading data to a personal computer. The Soft Tact also has nine language capabilities and holds up to 450 results in its memory. The suggested retail price of \$299 may be an access barrier for some patients.

Medisense maintains that their studies show that Soft Tact "provides clinically acceptable results in fasting and rapidly changing post-prandial [meal] situations where glucose needs to be monitored." However, Medisense warns patients that if hypoglycemia is suspected, the secondary test port (Port 2) for fingertip testing should be used.

A TEAM APPROACH TO EDUCATING PATIENTS

Pharmacists and technicians can effectively work as a team to educate patients with diabetes regarding self-monitoring and the use of blood glucose monitors. The technician can be instrumental in demonstrating the technical functions and features of the monitor, while the pharmacist can reinforce the therapeutic issues related to diabetes management.

The pharmacy team should consider various factors in the selection of an appropriate monitor for a particular patient. Some of these factors include cost, ease of use, size of monitor, sampling site and data management capability. Asking patients about the frequency of their blood glucose testing and

any concerns they may have regarding testing helps to identify patients who may be experiencing barriers or challenges to monitoring.

Discussion/Summary

Technicians and pharmacists are in an ideal position to talk with patients with diabetes regarding new options in alternate site blood glucose meters. Patients should be educated regarding the procedure of using an alternate site, the features of these monitors and the caveats of using sites other than the fingertip. During times of rapidly changing glucose there may be differences in detecting these changes when using alternate sites.

When glucose is not changing rapidly, alternate site monitors are a viable option to make day-to-day management of diabetes easier and enhance compliance with blood glucose monitoring. These monitors offer virtually painless glucose testing, which may encourage more frequent testing. More frequent testing may lead to better glucose management and fewer complications due to diabetes.

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*Note that for the above three monitors, rubbing or massaging the alternate test area may help bring blood to the surface more easily but won't completely eliminate the difference in test results between fingertip and arm.

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QUESTIONS

1. Which of the following characteristics do NOT describe fingertip testing?

- a) Large supply of blood vessels makes attaining a blood sample easier than alternate sites.
- b) Repeated punctures can cause scarring.
- c) More nerve endings in the fingertip make it less painful.
- d) None of the above.
- e) All of the above.

2. The advantages of alternate site testing include:

- a) Rich abundance of blood vessels, making attaining a sample easier.
- b) Less pain than fingertip testing.
- c) Larger surface area reduces likelihood of scarring.
- d) All of the above.
- e) Both b) and c) are correct.

3. Alternate sites approved

by Health Canada for the Ultra, FastTake and SoftTact include:

- a) Thigh
- b) Forearm and upper arm
- c) Calf
- d) Abdomen
- e) All of the above

4. A difference between fingertip and arm readings may occur during times of rapidly changing glucose because:

- a) The arm has fewer nerve endings.
- b) The fingertips have a larger blood supply.
- c) The patient did not adequately massage the arm.
- d) The rate of blood flow in the finger is four to six times faster than the arm.

5. Which of the following blood glucose meters requires the least amount of blood?

- a) OneTouch Ultra
- b) OneTouch FastTake

- c) FreeStyle
- d) SoftTact

6. Which of the following blood glucose meters does not require separate steps of lancing the site and applying blood to the test strip?

- a) OneTouch Ultra
- b) OneTouch FastTake
- c) FreeStyle
- d) SoftTact
- e) None of the above

7. Times of rapidly changing glucose include:

- a) Less than two hours after a meal.
- b) Less than two hours after physical activity.
- c) Less than two hours after an insulin injection.
- d) None of the above.
- e) All of the above.

8. Which of the following situations are appropriate times for alternate site testing?

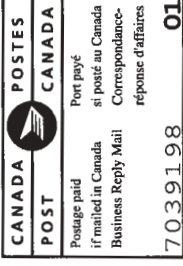
- a) Three hours after a meal.
- b) During a suspected low blood glucose.
- c) One hour pre-meal.
- d) In a fasting state.
- e) All of the above except b).

9. "Hypoglycemia unawareness" refers to patients who:

- a) Do not understand how to treat low blood glucose.
- b) Do not experience any of the warning signs or symptoms of low blood glucose.
- c) Feel very ill when their blood glucose levels are low.
- d) None of the above.

10. Which of the following factors govern patient selection of a blood glucose monitor?

- a) Cost
- b) Sampling site
- c) Size of meter
- d) Computer-download capability
- e) All of the above



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Mayra Ramos
Fax: (416) 764-3937 or
email: mayra.ramos@rci.rogers.com

Quebec Pharmacie and L'actualite Pharmaceutique
Stephane Paradis
Fax: (514) 843-2183
email: stephane.paradis@rci.rogers.com