Diabetes Educator Guide to Blood Glucose Meter Selection and Monitoring for Accuracy and Safety

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The diabetes educator can play an important role in assisting patients with choosing the best blood glucose meter (BGM) to fit their needs and optimize accuracy and safety. There is a wide variety of BGMs on the market and patients are often at the mercy of their prescriber and insurance company when making a choice.

In addition to teaching the patient appropriate techniques that will improve accuracy regardless of BGM, diabetes educators should address barriers (physical abilities, mental status, insurance coverage, etc.) to help patients choose a BGM with features that best support individual needs. With the typical life of a meter being 3 to 5 years, the diabetes educator's role is critical in helping the patient select a BGM that has features that will enhance his/her care.

Meter Selection

To make sure the device is matched to patient need, consider if the following features may be helpful:

- High contrast display that assist with visual impairments/low vision
- Talking meter for visual impairments
- Test strip and meter size and shape for individuals with dexterity impairments
- Lancet function and needle removal for issues with manual dexterity
- Alternate site monitoring possibilities
- Portability of meter for monitoring multiple times a day
- Affordability and access (insurance coverage/copays)
- Ability to assist with insulin dosage calculations (bolus calculator)
- Uploading capabilities
- Interaction with a smart phone app

Note: Diabetes Forecast magazine provides an annual review of current meters that can be helpful in guiding decision-making regarding meter selection.

Self-monitoring of blood glucose (SMBG) provides feedback on the effectiveness of the treatment plan, assists with the evaluation of glycemic control, and identifies hypoglycemia and hyperglycemia, which may be associated with higher morbidity and mortality rates.[1] Equally important, but perhaps less obvious, is that SMBG effectively engages the patient in his or her own self-care.[2]

Meter Accuracy

It is also important to consider meter accuracy. Current Food and Drug Administration (FDA) standards require 95% of all SMBG results to be within +/- 15% of the comparator results across the entire claimed measuring range of the device and that 99% of all SMBG results are within +/- 20% of the comparator results across the entire claimed measuring range of the device.[8] Although personal blood glucose meters need to meet these FDA standards, meters and the test strips used by people with diabetes are

more likely to experience varied storage and handling conditions compared to devices used in professional settings, posing additional risks to accuracy. Patients who use the meters may not have been trained and may not know how to identify or address erroneous results.

Common questions asked: How can you tell if there is a problem with meter accuracy? Does the HbA1c resemble the BGM data? Are the results written in a log and not downloaded from the meter? A download of the meter will provide results from all blood glucose checks, including time of day, when the meter is correctly set to time and date. The use of external control solutions allows users to periodically check that the SMBG and test strips are working together properly and that the device is performing correctly. See Appendix A for more information on examples of sources of SMBG errors.

Meter Safety

SMBG typically uses capillary whole blood from fingertips or alternate anatomical sites. As such, use of these devices on multiple patients may lead to transmission of Human Immunodeficiency Virus (HIV), Hepatitis C Virus (HCV), Hepatitis B Virus (HBV), or other blood borne pathogens. [8] It is critical that patients are advised not to share their meter or lancet with any other individual and to follow the cleaning, disinfecting and appropriate infection control measures for their respective meter. The following references are recommended for further information:

* "FDA Public Health Notification: Use of Fingerstick Devices on More than One Person Poses Risk for Transmitting Bloodborne Pathogens: Initial Communication" (2010) http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/ucm224025.htm

* CDC website on "Infection Prevention during Blood Glucose Monitoring and Insulin Administration" http://www.cdc.gov/injectionsafety/blood-glucose-monitoring.html

Blood Glucose Data Interpretation

It is important that the educator discuss varying blood glucose targets pre and post meal, medications and activity to assist the patient with appropriate blood glucose interpretation. Insulin action, including dosage and duration, are also important education opportunities to prevent over dosage or stacking of insulin. Other factors that can influence blood glucose results include carbohydrate intake, physical activity, illness, medications (e.g. steroids), injection sites, alcohol, menstrual cycles, breastfeeding and weight changes. See Appendix B for a list of known or potential interferents for SMBG.

When a patient receives an unexpected high or low blood glucose result, he/she should be informed of the importance of re-checking the blood glucose result, ensuring washing of hands and thoroughly drying his /her finger for the blood glucose sample.

Meter Downloads and Reports

It is also important to address the ability to download BGM's both from the patient's home and at the office. Having reliable BGM data to help evaluate a patient's therapy should be a standard part of the his or her appointment. Home download capabilities can promote self-management decisions, save time at the appointment and allow the patient to transmit data to the educator between appointments for assistance with therapy. Also, consideration for meters that have automatic cloud upload of blood glucose data reduces meter download burden for the patient and improves blood glucose data certainty for the diabetes care team.

Downloading meters doesn't have to be complicated. Many clinics do this with a downloading station, a computer loaded with the proprietary software available from meter companies, or they choose to use a more universal download software tool. For assistance downloading a device, the educator or patient can call the meter help line or the educator arrange a visit with a company representative. To become more comfortable downloading meters, a good first step would be to take demonstration meters and practice.

Summary

The diabetes educator should consider individual patient needs, the accuracy of the meter, and the features the meter offers when selecting a meter that will be best for that person. When working with patients using meters, it's important that the diabetes educator evaluate the patient's blood glucose monitoring technique and advise the patient about factors that will affect blood glucose results.

The diabetes educator should provide guidance in regards to the timing of blood glucose checks, and lead the discussion with the patient on the interpretation of the data to provide enhanced diabetes self-management and optimal clinical outcomes.

Appendix A – Examples of Sources of Error[3]

Category	Source of error or failure
Operator	Failure to follow procedure correctly, for example: • Sample contamination • Incorrect specimen collection (e.g., poor lancing technique and incorrect volume) • Application of an insufficient amount of blood to the strip or incorrect application of blood to strip • Use of a sample from an alternate site not validated by the manufacturer • Application of the specimen to the strip more than once (for example, if the user believes not enough specimen was added the first time) • Incorrect insertion of strip into meter • Inaccurate timing • Use of contaminated, outdated, or damaged strips or reagents, including calibrators or quality control materials • Failure to understand or respond to meter output • Errors in meter maintenance or cleaning • Errors in calibration or failure to calibrate or otherwise adjust the meter or check performance with quality control materials, as directed by labeling • Incorrect saving or use of stored data • Improper storage or handling of the meter, calibrators, quality control materials or test strips, or maintenance of the meter • Inadvertent changes of parameters (such as units of measurement) • Incorrect incorporation of results into overall treatment plan (prescription-use) • Use of strips not validated for use on the meter
Reagent	• Expired strips or reagents

	• Damaged or contaminated strip • Failure of strips, calibrators, or quality control materials to perform adequately • Incorrect manufacturing; product fails to conform with specifications · Incorrect dimensions of reagent strip • Interference with chemical reaction on strip (e.g., reducing substances) • Inadequate design of container for strips or other reagents; failure to prevent deterioration; failure of desiccant used to keep strips dry

Environmental	• DEVICE EFFECTS
	  • Temperature · Humidity
	  • Altitude; hyperbaric oxygen therapy conditions
	  • Electromagnetic radiation
	  • Visible light; sunlight
	• HUMAN FACTORS
	  • Lighting, glare off meter surfaces
	  • Distractions, visual and auditory
	  • Stressful conditions
	  • Limited manual dexterity

Software	• Confusing or obscure user prompts and feedback • Incorrect mathematical algorithm • Undetected or unrecognized signal errors • Timing failure • Incorrect storage of test results in memory, including matching result with correct patient or time of test • Other software failures
Hardware	• Electronic failure • Physical trauma or vibration • Damage to the device from incorrect strip dimensional tolerances (third party manufacturer) • Electrostatic discharge • Electromagnetic/radiofrequency interference • Battery reliability, lifetime, and replacement • Component(s) failure • Incorrect manufacture
System	• Physical trauma or vibration • Incorrect calibration/adjustment (between lots of strips) • Calibration failure, interference, instability or use beyond the recommended period of stability. • Labeling not geared to intended user. • Meter or operation complexity not geared to intended user • Inadequate training
Clinical	• Interference from endogenous substances • Severe conditions (e.g., dehydration, hypoxia, hyperglycemic-hyperosmolar state, hypotension or shock, ketoacidosis) • Interference from other exogenous substances (e.g., maltose intravenous solutions)

Appendix B: List of Known or Potential Interferents for SMBGs.[8]

Acetaminophen
Ascorbic acid
Conjugated Bilirubin
Unconjugated Bilirubin
Cholesterol
Creatinine
Dopamine
EDTA*
Galactose
Gentisic acid
Reduced Glutathione
Hemoglobin
Heparin*
Ibuprofen
Icodextrin
L-Dopa
Maltose
Methyldopa
Salicylic acid
Sodium
Tolbutamide
Tolazamide
Uric Acid
Xylose
Sugar Alcohols

*****The inclusion of EDTA and Heparin in this table refers to their use as therapeutic substances and not as anticoagulants for sample preparation.

**All common sugar alcohols, including but not necessarily limited to, mannitol, sorbitol, xylitol, lactitol, isomalt, maltitol should be independently tested.

AADE Patient Education Resources

https://www.diabeteseducator.org/practice/educator-tools/blood-glucose-monitoring-resources

Acknowledgements

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References

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