In-Patient Glucose Point of Care Testing
Anne A. Igbokwe, MD
CAP Point of Care Testing Committee

Point of care testing (POCT) for glucose levels is a common procedure performed numerous times a day in different medical settings worldwide. Since the introduction of the first portable blood glucose meter in 1969 by the Ames division of Bayer™, POCT has revolutionized the care of hospitalized patients and diabetics. This has been achieved by manufacturing small, easy-to-use devices that increase the speed and frequency with which glucose concentrations can be measured, enabling rapid initiation of care for these patients.

For inpatient care, central laboratory testing of plasma glucose—extremely accurate and precise—remains the gold standard. However, its main disadvantage is that this analysis is remotely located from the patient, thereby increasing the time for starting treatment based on test results. POCT glucose devices deliver rapid and relatively precise glucose measurements performed on whole blood at the patients’ bedside. Glucose POCT devices are regarded as satisfactorily precise for the monitoring of many glycemic disorders (including diabetes mellitus) but not sufficiently precise to establish the initial diagnosis of the condition. A recent (2007) College of American Pathologists proficiency testing survey of nearly 42,500 laboratories showed that the most commonly used devices were, in decreasing order, the Roche Comfort Curve series, the Abbott Precision line, the LifeScan Surestep, the Bayer Ascensia range and the recently introduced Nova Statstrip.

The advantages of the POCT devices are self-evident. The most obvious is the ease of more frequent glucose monitoring to allow better glycemic control in the hospital and in the home, thus reducing the morbidity and mortality associated with glycemic disorders. When used appropriately, POCT devices are invaluable tools for patient care; however, limitations do exist and constitute a pitfall for the unwary.

One of these limitations concern glucose plasma values as compared to whole blood values. Variance seen in the plasma concentration may be as much as 12% to 15% higher than whole blood values. This is a reflection of the water content of red blood cells, which is lower than plasma, thus resulting in dilution of the glucose concentration. Many devices deal with this issue by plasma-calibrating the specimen; this is achieved by comparing the patient’s whole blood test result to a previously determined laboratory plasma value and then mathematically converting this to an equivalent plasma value. Inherent problems with this technique include the use of differing calibration methods by various manufacturers, as well as factors like hematocrit and basic specimen matrix effect, which can also affect the calculated plasma result. These drawbacks can lead to markedly varying glucose results on the same specimen, which in turn can lead to differing insulin doses.¹,²

Fasting glucose concentrations in capillary blood (POCT) are slightly higher than in venous blood, but the disparity between the two can translate into statistically significant differences (up to 70 mg/dl) in postprandial specimens. This occurs because the postprandial capillary specimens are glucose-rich due to not having delivered their glucose load to the tissues, while, conversely, the venous specimens are glucose-poor post-systemic samples. Several other blood variables can also affect the readings obtained from POCT glucose meters, including extremes of hematocrit, glucose values, pO2 (especially with glucose oxidase-based electrochemical methods), temperature and humidity.³ Recent publications have addressed concerns as to the use of POCT glucose monitoring in intensive care units; but in patients with shock, diabetic ketoacidosis or dehydration, it must be remembered that the capillary specimens may not be representative of central blood glucose levels.⁴

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In these situations, Khan et al suggests sending a concurrent serum or plasma sample to the central laboratory whenever a hypoglycemic or hyperglycemic reading is observed. Certain medications have also been postulated to hinder performance by interfering with the principles of instrument operation (e.g., maltose- and fructose-containing medications can interfere with meters using the dehydrogenase method).

Failure to fastidiously adhere to the manufacturer’s instructions regarding appropriate quality control (QC) measures, (e.g., improper handling of the test strips and the equipment leading to analytic error), is one of the main concerns when using glucose POCT. Many inpatient devices have safety features incorporated to prevent their use without proper QC. However, this does not stop the use of wet, expired or otherwise damaged test strips; over manipulation of the patient’s fingertip during collection to encourage blood flow; or dilution of the sample by unevaporated alcohol or fluid from IV lines. Good laboratory practices are essential for the optimal function of all glucose meters.

Glucose POCT revenue in 2005 was $2.4 billion in the US, and new technologies are constantly being introduced. Implantable sensor devices for continuous glucose monitoring (every one to five minutes) that last three to seven days have been approved by the FDA and will allow for even stricter glycemic control with less discomfort for the patient. Non-invasive methods based on Raman spectroscopy and Optical Coherence Tomography (OCT) are under development.

For a variety of reasons, there is a growing trend to decentralize patient testing and care, decrease turnaround time as well as an increased emphasis on algorithm-based treatment that demands rapid test results and decision making. These factors, as well as cost containment efforts and technological advances, continue to increase the number of POCT devices that are available. This means that we, as physicians, will have to become even more familiar with these tools and their limitations, in order to provide our patients the best care possible.

References


