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ORIGINAL ARTICLE

Variability of Blood Glucose Meters for Patient Self-Testing: Analysis of the Article by Brazg and Coauthors

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Abstract

The article by Brzag and coauthors in this issue of *Journal of Diabetes Science and Technology* reports a competitive accuracy performance study for a branded meter in comparison with six low-cost meters currently available in the United States. It highlights several important topics: (1) the need for more stringent post-marketing requirements for blood glucose meters after launch and (2) low-cost meters use older technologies and their manufacturers do not usually seriously invest in new technology or constant quality assurance efforts. This may explain the study results, which show superior performance of the branded meter. Finally, the article pinpoints to the "quality versus price" dilemma faced by the prescribing physician and their patients in daily routine, which may be additionally aggravated by budget constraints and prescription rules in reimbursed markets.

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In their article about variability of blood glucose meters for patient self-testing in this issue of *Journal of Diabetes Science and Technology*, Brazg and coauthors[1] compared seven blood glucose meters with respect to their compliance with the current and the proposed new International Organization for Standardization (ISO) 15197 standards for glucose meter performance.[2,3] This article is a typical example of a series of current and upcoming industry-sponsored articles that try to demonstrate the compliance of the flagship sponsor meter with the current and proposed new draft ISO guidelines in comparison with competitive meters. Frequently, the selected competitive meters are low-cost meters, which are expected to potentially perform within the current ISO guideline but are also expected to fail the new and more strict draft ISO acceptance criteria.

This is indeed also the outcome of the work by Brazg and coauthors,[1] who choose low-cost meters available in the U.S. market and manufactured in Asia or in the United States as competitive devices. While only three out of the seven meters actually performed within the current ISO criteria, only one (the sponsor's device) also met the new criteria with all three tested strip lots. With exception of the bin with the lowest glucose values (<50 mg/dl), the study was performed in accordance with ISO requirements. The reference methods were chosen to meet the underlying enzyme technology of the tested meters, which is a common flaw in many published comparator studies. Taking the robustness of the methods and the credibility of the study results for granted, it is possible to draw several conclusions from this article, which have importance for daily clinical routine practice.

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Abbreviations: (ISO) International Organization for Standardization

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First, four of the seven tested meters failed the current ISO guidelines. This is *per se* a surprising result, because all manufacturers must have presented data to the regulatory agencies prior to device approval, where their blood glucose meters and strips met the current ISO criteria. This finding elucidates the consequences of current regulatory approval and post-marketing surveillance practice: the preapproval ISO system accuracy tests are naturally performed with devices and strips delivered by the companies since they are the only source. Once approved, however, there is no mandatory requirement for manufacturers to demonstrate further compliance with the ISO requirements. We have shown that system accuracy of flagship meters from all larger and established manufacturers fully meet the ISO criteria, even when meters and strips were purchased through regular distribution channels.[4] According to the results from Brazg and coauthors,[1] this does not necessarily seem to be the case for low-cost meters and points to a major weakness of the otherwise stringent post-marketing medical device surveillance requirements. Shipment logistics and storage conditions have an impact on system performance in daily life that is ignored when testing for regulatory approval. From a patient safety perspective, it may be worthwhile to consider a mandatory post-marketing testing requirement for all meters, with delivery of meters and strips occurring through normal distribution channels without the possibility for the manufacturers to influence the results by directly selecting and delivering the test strips and devices.

Second, manufacturers of low-cost meters have to use older technologies, because patent protection prevents them from employing technology improvements for devices and strips as seen in the "branded" meters from larger and established manufacturers. In consequence, another factor that differentiates branded meters from low-cost meters is the lower lot-to-lot variability of the branded meter as observed by Brazg and coauthors[1] and also described by another group.[5] The low lot-to-lot variability of branded meters is in all likelihood the result of consequent technology improvement efforts and the comprehensive quality assurance work of the established glucose meter companies. In the past, I have had the privilege and opportunity to visit the strip and device production sites of many blood glucose meter manufacturers, both of branded and low-cost meters, and to discuss quality assurance issues with the respective scientists and managers. While many production sites of branded strips and meters can be found in Europe or in the United States, it is also common practice that parts or entire components of branded strips and meters are produced in the same geographic regions in Asia as the low-cost systems. However, a remarkable difference that I could observe, in general, was the larger quantity and quality of the proficiency and quality assurance tests that are undertaken by the manufacturers of the established brands prior to releasing strips and devices for commercialization and the continuous research and development efforts undertaken by these companies to constantly improve the performance of their platforms. The first step in addressing the underlying causes of lot-to-lot variability is the new requirement of mandatory testing of three strip lots when performing the system accuracy evaluation to comply with the proposed new draft ISO criteria. This requirement would theoretically eliminate many currently available meters from the market. It is very unlikely, however, that already approved and commercialized blood glucose meters will be affected in their approval status when the new ISO guideline will be put in place.

Finally, it is obvious that comprehensive quality assurance efforts and the expenditures for research and development have an impact on the end-user price of branded meters and strips. At the end of the day, it is the doctor and the patient who will make a decision about their preference for daily treatment: either a cheaper price—usually associated with a lower accuracy and precision performance—or a device and strips with higher accuracy and stable lot-to-lot performance. It is unfortunate for the patients that, in some countries, reimbursement carriers actively try to drive the prescription numbers of low-cost meters to a higher level. It is, e.g., mandatory for German physicians to prescribe a certain percentage of low-cost meters—in some geographical regions in the country, up to 10% or more. It is a distinct concern that the potential short-term savings produced by these prescription policies might ultimately be negated by higher secondary treatment expenses associated with the findings reported by Brazg and coauthors.[1]

While the article, at first glance, appears to be just another ordinary, industry-induced, simple device comparison, in my opinion, it highlights the current "economics versus quality" conflict that is placed on practicing physicians and patients worldwide.

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