Addressing Challenges of Point-of-Care Glucometer Monitoring: Enhancing the Accuracy of Point-of Care Glucometer: Hospital Case Study

By

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Abstract
Background and aim: *Point-of-Care Testing is clinical laboratory testing performed by healthcare providers at the patient's bedside where care is provided. This case study aims at recognizing the encountered challenges and possible solutions related to the existing blood glucose measuring process in clinical settings.* ***Methods:*** *To address these challenges leading to inaccurate blood glucose readings, an inclusive action plan has been applied. This plan comprises several key measures structured to correct practice and enhance awareness across professionals, aimed at establishing reliable and accurate blood glucose monitoring.* ***Results:*** *Implementing a comprehensive intervention plan has yielded a significant improvement in the accuracy and reliability of blood glucose results across the hospital, it also has controlled several issues that resulted in interruptions in patient care and the need for repeating the test such as improper technique, inconsistent readings, and faulty equipment that were frequently encountered by the staff. The statistical analysis of the variation between the glucometer and lab results demonstrated a significant reduction in the mean of variation, with a mean variation of 8.685 ($\pm$13.37) before the intervention and 5.95 (14.89) after the intervention, t (238) = (0.724) p-value = .032. a 17% reduction was observed in the glucometer strips utilization and 33% in the control solution.* ***Conclusion:*** *Identifying the key challenges associated with inaccurate readings enabled the development of a multifaceted action plan. The implementation of this comprehensive approach has shown a notable improvement in the accuracy and reliability of BG monitoring in the hospital.*

Keywords *Point-of-Care, laboratory testing, Glucometer*

Introduction

Point-of-Care Testing (POCT) is clinical laboratory testing performed by healthcare providers at the patient's bedside where care is provided [1]. The basic objective of POCT is to obtain a quick result so that a proper intervention can be implemented. The use of POCT results in improvements in clinical and economic outcomes [2]. It is an effective way to test blood glucose (BG) level [3]. It is also a preferable method for patients due to its feasibility and simplicity requires less amount of blood compared to venous testing [4].

Treating diabetes mellitus (DM) requires critical control of blood glucose (BG) to prevent the consequences that result from hypoglycemia and hyperglycemia, particularly when adhering to an intensive insulin schedule [5]. The accurate measurement of BG is vital for diagnosing hyperglycemia and hypoglycemia, directing treatment decisions, and evaluating

the risk [6]. However, despite the paramount importance of accurate BG measurement, healthcare settings often experience challenges in the performance of this apparently routine procedure [7].

It has been evident that monitoring BG improved outcomes in DM. If the utilized devices are not providing accurate results, then their benefits will be battered [8]. Inaccurate BG results can originate from different sources (pre-analytic, analytic, or post-analytic) [9]. For instance, technical malfunction may occur due to several factors such as fault sensors, electromagnetic interference, hardware problems, and defected or expired test strips, these technical malfunctions can affect the reliability of the measurement [10]. healthcare providers must be aware of these technical issues while performing BG tests. Adhering to the internal policy of regular checks test control, and maintenance and following

manufacturer guidelines can greatly reduce these potential malfunctions.

Proper performance is crucial for obtaining accurate BG readings. Although it is a routine procedure, every single step is important, even a simple error or missing step can result in an inaccurate reading; for example, if the healthcare provider misses the steps of cleaning and drying the skin at the puncture site or withdraw an insufficient amount of blood the obtained reading could be inaccurate [11]. Therefore, healthcare providers should exhibit a commitment to all steps while performing the procedure.

Moreover, inaccurate BG readings can originate from environmental conditions such as temperature. The glucometer, test solution, and strips are sensitive to extreme temperature [12], the range of operating temperature usually documented in the instruction manual that usually accompanied the device. It is a fundamental role for the healthcare provider to pay attention to the place where the device is stored and operated.

During routine investigation carried out through several sections in our hospital some key challenges were identified in existing BG measurement procedures including 1) inappropriately handling glucometer devices; 2) incorrectly operating the control test; 3) lack of error understanding among the staff; 4) lack of knowledge regarding the performance criteria of BG measurement procedures; 5) insufficient information in existing policy; and 6) noncompliance with existing guidelines of control test frequency.

This case study aims at recognizing the encountered challenges and possible solutions related to the existing BG measuring process in clinical settings. By presenting real-world examples. Specifically, it aims to answer the following research question; does the implementation of administrative actions and staff training improve the accuracy of point-of-care glucose monitoring?

Intervention

To address these challenges leading to inaccurate BG readings, an inclusive action plan has been applied. This plan comprises several key measures structured to correct practice and enhance awareness across professionals, aimed at establishing reliable and accurate BG monitoring. The action plan focused on administrative measures and training workshops. A new policy has been created, this policy outlined step-by-step the standards and anticipations for BG monitoring procedures. including Interpersonal and psychomotor skills. Apparent guidelines on the primary assessment, the importance of patient preparation, and correct interpretation and communication of readings to the relevant staff. The policy serves as a reference guide for healthcare providers, facilitating access to essential information for accurate and efficient work. It also emphasized the importance of reporting any discrepancies or technical errors, ensuring rapid corrective action.

A sequence of workshops and training courses have been held to enhance psychomotor skills and knowledge regarding BG monitoring. These workshops and training courses are structured to offer hands-on experience with the BG monitoring devices, directing on common mistakes and best practices. Healthcare providers receive training on proper procedure performance including primary patient assessment, communication, patient preparation, device operation, and procedure undertaking. They emphasized the importance of regular maintenance and appropriate device usage. It also included instructions on how to deal with common errors. Additionally, these workshops identified the physiological factors that can alter readings, such as poor circulation or dehydration, ensuring that Healthcare providers are aware of these factors.

The control test is an important measure to ensure the accuracy of the readings, control test is done by using a special solution instead of blood, previously there was no consistent policy regarding the frequency and timing of the control test, the new policy has been implemented to perform control test at the beginning of each shift for units with frequent usage, and periodically for other units according to the frequency of usage. On the one hand, this policy could ensure the regular check of the device and save resources on the other hand.

Moreover, an arrangement with the device company for monthly maintenance and calibration checks. ensuring that they are operating correctly and within specified ranges of accuracy. This preventive measure helps to recognize and resolve any potential issues before they affect patient care, adding a layer of confidence for accurate measurement.

To assess the effectiveness of this intervention program, several measures have been undertaken; regular rounds and follow-ups to observe staff performance, device handling and storing conditions. Additionally, the accuracy of the results was tested statistically by comparing the variation in the results between the glucometer and lab reference results three months before and after the intervention. Moreover, the utilization of glucometer strips and control test solution was also compared at the same intervals.

Outcomes and Evaluation

Implementing a comprehensive intervention plan, that included administration enhancement and staff training has yielded a significant improvement in the accuracy and reliability of BG results across the hospital, it also has controlled several issues that resulted in interruptions in patient care and the need for repeating the test such as improper technique, inconsistent readings, and faulty equipment that were frequently encountered by the staff, However, the training workshops equipped the staff with valuable knowledge and essential skills that have been reflected in their performance. Healthcare providers reported much more understanding of the procedure and the interpretation of the results in the context of the patient's current condition.

Besides the significant improvement in procedure performance and patient care, a substantial reduction in consumption of some related equipment such as testing strips and testing solutions after employing the new policy of control testing, the new policy was implemented to balance the need for device validation and save the equipment from unnecessary utilization, this measure indicates the cost saving that can be achieved by the administrative interventions.

Close observation by supervisors and the health education department focusing on staff performance, handling, and storage of the devices revealed noticeable improvement in their proficiency and adherence to the new policy. Additionally, the statistical analysis of the variation between the glucometer and lab results demonstrated a significant reduction in the mean of variation, with a mean variation of 8.685 ($\pm$13.37) before the intervention and 5.95 (14.89), t (238) = (0.724) p-value = .032. Moreover, a 17% reduction was observed in the glucometer strips utilization and 33% in the control solution.

Furthermore, the arrangement with the device company has ensured that all glucose monitoring devices undergo monthly calibration and maintenance checks. This preventive approach has significantly reduced the incidence of false readings due to technical failure. As evident by the comparison between the results generated by the devices and the laboratory results. Additionally, the regular check ensured the validity and the proper functioning of the devices.

Conclusion

Identifying the key challenges associated with inaccurate readings enabled the development of a multifaceted action plan. The implementation of this comprehensive approach has shown a notable improvement in the accuracy and reliability of BG monitoring in the hospital, which yielded a significant improvement in patient care and substantial cost savings.

Continuous professional development and evidence-based practice are fundamental approaches that keep staff's knowledge and skills up-to-date, warrant high-quality care, improve satisfaction, and reduce healthcare costs [13, 14]. As accurate BG monitoring plays a crucial role in directing treatment decisions, training the staff on the appropriate method of performing the procedure is critical in obtaining reliable results.

Appropriate timely inspection of medical devices is an important measure of quality control [15]. It is a continuous process in which hospitals can manage their equipment to enhance the effective and economical use of equipment [16]. regular checks and maintenance of medical equipment can ensure normal operation and improve patient care within health facilities, it can also greatly extend the service life of medical devices [17]. Including routine checks and maintenance of BG monitoring devices in the effort aimed at improving the validity and the performance has gained satisfactory rewards, this approach can be replicated and applied in other POCTs, therefore, magnifying the benefits for the patients, healthcare providers, and hospital.

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