

**COMPLETE AUDIT CYCLE: PERI-OPERATIVE GLYCEMIC CONTROL IN CMH LAHORE**

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**Abstract:** *Hyperglycemia is associated with an increased risk of complications in patients undergoing surgery. Hyperglycemia from diabetes must be differentiated from stress-induced hyperglycemia, which typically presents post-operatively and resolves as the surgery-induced stress subsides. It is imperative to differentiate between the two due to the severe complications of diabetic hyperglycemia, which can often be confused with its stressed induced counterpart. Good glycemic control is the best strategy to avoid post-operative complications and morbidity. An assessment of peri-operative blood glucose levels of known diabetics admitted to CMH Lahore was done, and recommendations were introduced to achieve better glycemic control. Subsequently preventing post-surgical complications, improving wound healing and overall recovery, and ultimately decreasing morbidity. The aim of the audit was the assessment of peri-operative glycemic control in known diabetics admitted for surgery in CMH Lahore. Existing problems regarding poor glycemic control were identified, and recommendations were given to rectify said problems. We aimed to study the effectiveness of glucose control due to these planned interventions. Patients were included based on eligibility criteria, and a record of the patients was updated daily on the Excel sheet using the glucose control audit tool (attached below). The highest BSR reading per day was added. Good or poor glycemic control was determined by the highest BSR readings on post-op days 0, 1, and 2. If 2 or more readings met the criteria for good glycemic control, the patient was labeled to have good glycemic control. In Cycle 1, patients were managed peri-operatively with insulin as per the sliding scale. 13% of patients had good glycemic control on this regimen. Interventions were introduced for Cycle 2, with the recommendation of altering insulin/drug regimens as per NHS/ADA guidelines. 16.6% of patients were found to achieve good glycemic control; however, it was noted that these recommendations were not followed consistently. Based on the results, it can be concluded that the management of inpatient diabetes is a team effort, interventions recommended using established guidelines should be followed stringently, and existing protocols should be updated accordingly. Proper management of inpatient hyperglycemia starts with each team member performing their respective role to their best; this is vital in preventing post-operative complications associated with poor glycemic control.*

**Keywords:** Hyperglycemia, Diabetes, Stress-Induced Hyperglycemia, Post-Operative Complications, Glycemic Control, Insulin, NHS/ADA Guidelines, Inpatient Diabetes, Wound Healing, Morbidity.

**Introduction**

Diabetes mellitus is one of the most prevalent chronic diseases in the world, and Pakistan, a South Asian country with a population of over 220 million, has seen a marked increase in the number of patients diagnosed with this condition. A survey in 2018 utilising Glycated hemoglobin levels (HbA1C) reported that the prevalence of type 2 diabetes across Pakistan was 16.98% and prediabetes was 10.91%. These numbers are significantly higher than those found in the only previous national survey performed in 1999 using the Oral Glucose tolerance test (OGTT) (Aamir et al., 2019). Hyperglycemia in patients with diabetes (DM) who undergo surgery is associated

with increased rates of surgical site infection (SSI), myocardial infarction, stroke, and death (Kotagal et al., 2015). Along with having a prolonged stay due to complications, surgical patients with diabetes have increased mortality, and those patients who have suffered peri-operative complications continue to experience increased morbidity for several years (UK, 2020). Yet these complications are not exclusive to Diabetics, as one study reported that peri-operative hyperglycemia was associated with adverse outcomes in general surgery patients with and without diabetes (Kwon et al., 2013). This phenomenon, known as Stress hyperglycemia, typically resolves as the

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surgery-induced stress subsides. However, studies show that up to 30-60% of these patients have impaired carbohydrate intolerance when assessed by oral glucose tolerance testing after hospital discharge. In addition, 60% of patients identified with new hyperglycemia had diabetes confirmed at 1 year (Greci et al., 2003). Measuring HbA1c in patients with new hyperglycemia during hospitalisation provides the opportunity to differentiate patients with simple stress hyperglycemia from those with diabetes who were previously undiagnosed (Greci et al., 2003).

During fasting, healthy individuals maintain plasma glucose levels between 60-100 mg/dl (3.3-5.5 mmol/l). The stress of surgery and anesthesia disrupts the finely regulated balance between hepatic glucose production and peripheral glucose utilisation mediated by an increase in the secretion of counter-regulatory hormones coupled with an excessive release of inflammatory cytokines, enhancing proteolysis and lipolysis [7]. Raised levels of free fatty acids have been shown to impair insulin-stimulated glucose utilisation and interrupt the intracellular signalling cascade in skeletal muscle responsible for glucose transport (Dresner et al., 1999).

The current protocol in our hospital, CMH Lahore, is to place all patients with known DM (Type 1 or 2) on an Insulin sliding scale peri-operatively. Insulin, in particular, has a unique disadvantage, as demonstrated by Medmarx adverse drug event database, which identifies insulin alongside heparin as the two drugs most associated with adverse events due to administration errors (Santell et al., 2003). A meta-analysis indicated that applying the Insulin sliding scale alone or in combination with other anti-diabetic medications did not offer any advantages in achieving adequate glycemic control compared with other regimens. In addition, it was accompanied by a greater incidence of hyperglycemic events (Lee et al., 2015). Furthermore, more recent guidelines state that each patient should have individualised management to maintain euglycemia depending upon the type of diabetes, nature, the extent of the surgical procedure, length of pre and post-operative fasting, type and frequency of daily medication, and state of metabolic control preceding surgery (Duggan et al., 2017). Especially for type 2 Diabetics who have been on oral hypoglycemics, the approach is tailored to the specific drug they have been taking. Examples of such recommendations include that sulfonylurea and insulin secretagogues be discontinued on the day of surgery to limit the chances of hypoglycemia (Umpierrez et al., 2012) and patients undergoing procedures with the use of intravenous contrast dye or with long expected surgical times, metformin is

stopped when the preoperative fast begins, and restarted post-operatively with normal diet resumption (Inzucchi).

Assessment of peri-operative glycemic control in known diabetics admitted for surgery in CMH Lahore was done. Existing problems in the management of inpatient diabetes were recognised, patients with poor glycemic control were identified, and recommendations were given to rectify these problems. We aimed to study the effectiveness of glucose control due to these planned interventions.

## Methodology

This Clinical audit was conducted at the CMH Lahore Surgery Department from 2020 to 2022. Known diabetic patients admitted to the hospital for surgery, both male and female gender with ages above 18 years, were included in the study. Peri-operative BSR was noted in the patients (pre-op, post-op days 0, 1 & 2).

Blood sugar fasting (BSF) < 126 mg/dl OR blood sugar Random BSR < 180mg/dl is considered good glycemic control in the patients, whereas poor glycemic control was considered above these levels.

Patients were included based on these criteria, and a record of the patients was updated daily on the Excel sheet using the glucose control audit tool. The highest BSR reading per day was added. Good or poor glycemic control was determined by the highest BSR readings on post-op days 0, 1, and 2. If 2 or more readings met the criteria for good glycemic control, the patient was labeled to have good glycemic control. Phase 1 of the audit was conducted from Mid-March to Mid-April of 2021, and 37 patients were included in the study.

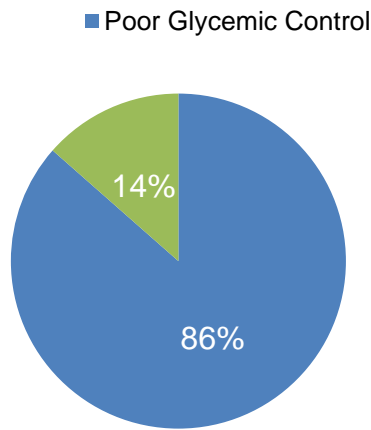
Recommendations were introduced based on the results of Phase 1, and the next audit phase was initiated. It took place from September 2021 to April 2022, and 30 patients who met the criteria were included.

## Results

For Phase 1 of the audit, 37 patients were identified as per the inclusion criteria, and their glycemic control was assessed using the glucose control audit tool. Patients who were known people with diabetes above the age of 18 were admitted to the ward for surgery. Blood sugar was recorded preoperatively, and the highest measured blood glucose was recorded on post-operative days 0, 1 and 2.

Out of the 37 patients included, 5 patients (13.5%) had achieved good glycemic control in the peri-operative period (at least on 2 of the 3 BSR readings from POD

0, 1, and 2). These patients were managed peri-operatively with insulin as per the sliding scale. (Figure 1



**Figure 1: Phase 1 shows glycemic control of patients on the existing protocol for managing diabetes in the hospital.**

Furthermore, it was observed that a proper drug history was not documented, and regular diabetic medications were not continued on admission. The morning dose of medication was often missed or not documented, there was improper BSR monitoring and charting, and the fasting period was prolonged for some patients. Patients were also not counseled or advised to follow up for the management of their diabetes after discharge.

Keeping these problems in view, a set of recommendations were introduced which hoped to improve glycemic control:

- Educate the junior doctors and nursing staff to ensure proper history taking (Diabetic/drug history)
- Ensuring the continuation of regular medication prior to surgery
- Strict 6-hourly BSR monitoring (at least 2 hours postprandial)
- Fasting period 6 hours for solids/ Diabetics on early morning OT lists
- Altering insulin/drug regimen according to NHS/ ADA guidelines (Care, 2019; Moghissi et al., 2009)
- Follow up in medical OPD after 2 weeks for diabetes management.

Management of diabetes is a team effort, and these recommendations outline the role of each member in ensuring hyperglycemia is being dealt with adequately.

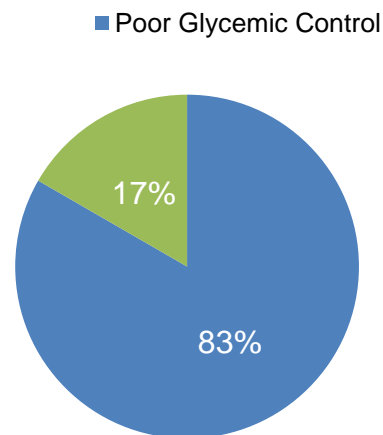
Surgical residents were to ensure a correct anti-diabetic drug regimen was in place for diabetic patients admitted for surgery. Insulin-dependent patients were to receive basal, prandial, and correctional insulin rather than be managed as per a sliding scale. The fasting period was to be no more than 6 hours. On the day of the operation, the morning dose of metformin was omitted, and those on injectable were to receive 60% of morning NPH Insulin.

House officers were recommended to obtain a complete diabetic and drug history from patients admitted to the surgical ward preoperatively. They had to ensure that patient charts were updated 6 hourly with BSR readings. In the case of inadequate blood sugar control, they were to remind seniors to alter diabetic therapy. On the day of the operation, the morning dose of metformin was omitted, and those on injectable were to receive 60% of morning NPH Insulin.

Nurses were to ensure 6 hourly BSR monitoring and follow the advised basal, prandial, and correctional insulin regimen for insulin-dependent patients.

Patients, especially those with poor glycemic control, were advised to follow up in the medical OPD 2 weeks after discharge.

Following these recommendations, Phase 2 of the audit was initiated. 30 patients were evaluated using the glucose control audit tool attached below. Out of these, 5 patients (16.6%) were found to have good glycemic control (Figure 2).



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**Figure 2: Phase 2 shows an increase of 3.6% in patients with good glycemic control after recommendations were introduced.**

It was also observed that 14 patients were placed solely on insulin as per the sliding scale for peri-

### Discussion

Recognition of a patient's diabetic status, their home diabetes medication and insulin regimens, and their baseline glycemic control are important to determine insulin needs and sensitivity in the hospital, especially in the peri-operative period.

Insulin is used to achieve adequate glycemic targets due to the association of worse peri-operative outcomes in patients with hyperglycemia.

As per the sliding scale, insulin is routinely employed for this purpose; although this may be sufficient for stress-induced hyperglycemia, it is not recommended for type 2 diabetics. A basal-bolus correctional insulin protocol tailored to the patient's needs has proved efficacious for diabetic patients undergoing surgery (Wei and Wexler, 2012). This regimen closely mimics the physiologic basal insulin release, and the rate of hyperglycemic and hypoglycemic episodes is thus reduced. It has also been shown to reduce post-operative complications related to wound healing and infections (Duggan et al., 2017).

The results of our audit showed that insulin, as per the sliding scale, was still being used as the standard therapy for managing peri-operative hyperglycemia. After the recommendations were given to manage hyperglycemia according to NHS/ADA guidelines, 16.6% of patients had good glycemic control, a 3.6% increase from phase 1. Even though there was an increase in the percentage of total patients with good glycemic control in phase 2 of the audit, it was noted that hyperglycemia, in some patients, was still being managed with sliding scale insulin despite the recommendations of following the NHS/ADA guidelines.

### Conclusion

This audit gave recommendations about peri-operative hyperglycemia management, which improved the total number of patients with good glycemic control. This was done by following a systematic approach via the recommended NHS/ADA guidelines.

Knowledge about the latest evidence-based treatment guidelines should be studied and disseminated among all medical staff, be it the ones who are prescribing the medicine or the ones who are administering it. Good communication about management plans is vital, and a clear communication channel must be established between caregivers to serve the patient in the best way

operative glycemic control. The remaining 16 were placed on a regimen of insulin as per a sliding scale and Insulin 70/30, in addition to oral anti-diabetic drugs for those already taking them.

possible. Due to patient load, it is understandable sometimes to forget or miss certain aspects of patient care, such as charting multiple blood glucose levels, but the whole team's collective responsibility is to hold each other accountable in the patient's best interest.

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### Conflict of interest

The authors declared absence of conflict of interest.

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