



Original Research Article

Evaluation of Diabetes Knowledge Among Healthcare Residents and Nurses Across Multiple Hospitals in Pakistan

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Abstract: **Background:** Adequate knowledge of diabetes management among healthcare professionals is essential, as a large proportion of hospitalized patients present with diabetes or related complications. Inadequate understanding may lead to poor glycemic control and adverse clinical outcomes. This study aimed to assess and compare the level of diabetes-related knowledge among registered nurses and resident trainees from internal medicine, family medicine, and surgery working in tertiary care hospitals, Pakistan. **Methods:** A cross-sectional multicenter study was conducted using a validated questionnaire comprising 21 open-ended items addressing key aspects of diabetes awareness and management. The tool was adapted with permission from a previously conducted study at Thomas Jefferson University Hospital, Philadelphia. Participants included resident trainees from internal medicine, family medicine, and surgery, as well as registered nurses. Knowledge scores were analyzed and further stratified according to specialty and level of training. **Results:** A total of 381 participants completed the survey, including 169 internal medicine residents, 27 family medicine residents, 86 surgical residents, and 99 registered nurses. Overall, performance on knowledge-based questions was suboptimal, with a mean correct response rate of $50\% \pm 21$. No significant difference was observed between internal medicine and family medicine residents ($64\% \pm 14$ vs. $60\% \pm 16$; $p = 0.47$). Surgical residents and nurses demonstrated comparatively lower scores ($40\% \pm 16$ and $31\% \pm 15$, respectively), reflecting notable gaps in both inpatient and outpatient diabetes management knowledge. Knowledge levels among family medicine and surgical residents did not significantly improve with increased training duration ($p = 0.47$ and 0.80). However, internal medicine residents showed significant improvement between the first and second years of training ($p = 0.03$), with no additional gains thereafter. Nurses particularly demonstrated limited knowledge regarding inpatient diabetes management, with a mean score of $40\% \pm 20$. **Conclusion:** This study highlights substantial knowledge deficiencies in diabetes management among resident trainees and nursing staff in tertiary care hospitals. The findings underscore the urgent need for structured educational initiatives and continuous professional development programs to strengthen diabetes care practices and improve patient outcomes in clinical settings.

Keywords: Diabetes mellitus; diabetes management; healthcare professionals; resident trainees; registered nurses; knowledge assessment; tertiary care hospitals; inpatient diabetes care; medical education; Pakistan.

INTRODUCTION

The global burden of diabetes mellitus has increased substantially over the past few decades, making it

one of the most pressing public health challenges worldwide. According to international estimates, hundreds of millions of individuals are currently

living with diabetes, with the disease contributing to a significant number of annual deaths. In Pakistan, the prevalence continues to rise at an alarming rate, and projections indicate that the country will rank among the top nations affected by diabetes in the coming years.

Beyond its high prevalence, diabetes in Pakistan often develops at a comparatively younger age, affecting individuals during their most productive years and placing considerable strain on individuals, families, and the healthcare system. The absence of a comprehensive national health insurance structure further intensifies this burden, as most patients must bear treatment expenses out of pocket. The economic cost of routine outpatient care for diabetes is substantial, and these costs escalate further when hospital admissions and complications are considered.

Given this context, healthcare professionals play a critical role in ensuring safe, effective, and evidence-based diabetes management. Appropriate glycemic control has been consistently associated with improved clinical outcomes and reduced complications. Resident physicians and nurses, who are directly involved in patient care across inpatient and outpatient settings, must therefore possess adequate knowledge and clinical competence to manage diabetes effectively. This need is particularly important because many hospitalized patients—regardless of their primary diagnosis—have diabetes as a comorbid condition, which can complicate treatment and recovery if not properly addressed.

Inadequate understanding of essential aspects of diabetes care, such as insulin pharmacology, medication management, and emergency response to glycemic disturbances, can lead to suboptimal patient outcomes. Healthcare providers must be equipped to recognize and manage diabetes-related emergencies across all hospital units. Although previous research has examined diabetes knowledge among healthcare professionals globally, limited evidence is available regarding the knowledge levels of resident trainees and nurses in Pakistan.

Therefore, assessing the current level of diabetes-related knowledge among these healthcare providers is crucial for identifying gaps and informing targeted educational strategies. This study aimed to evaluate knowledge related to both inpatient and outpatient diabetes management among trainees in internal medicine, family medicine, and surgery, as well as registered nurses. The goal was to identify areas requiring educational reinforcement and to support the development of structured training programs that can enhance the quality of diabetes care and reduce disease-related complications.

MATERIAL AND METHODS

Research Design and Methods

This study employed a cross-sectional, multicenter design to evaluate diabetes-related knowledge among healthcare providers working in tertiary care settings. Data were collected using a pretested and validated questionnaire comprising 21 open-ended questions addressing key aspects of diabetes awareness and management. The instrument demonstrated acceptable reliability, with a test–retest coefficient of 0.71, and was adapted with permission from an earlier study conducted at an academic medical center in the United States. The questionnaire covered three major domains: outpatient management, pharmacological therapy, and inpatient diabetes care. To ensure contextual relevance, the instrument underwent content validation by a multidisciplinary team including endocrinologists and nurses with expertise in diabetes education. An independent panel consisting of an endocrinologist, an endocrine trainee, and a nurse educator reviewed the questionnaire qualitatively for clarity, relevance, and alignment with the training curriculum of residents and nurses. No major concerns were identified, and the tool was deemed appropriate for the study population. A pilot study was conducted in one institution using a separate group of trainees and nurses who were not included in the final sample. This step helped evaluate the clarity and difficulty level of the questionnaire and ensured its feasibility for use in the main study. The finalized questionnaire was administered across five tertiary care teaching hospitals in , Pakistan, using a non-probability purposive sampling approach. Participants included internal medicine residents, family medicine residents, surgical residents, and registered nurses working in clinical wards or attending academic meetings. Ethical approval for the study was obtained from the relevant institutional review committee, and informed consent was obtained from all participants prior to data collection. Data collection was conducted during working hours, with participants completing the questionnaire under supervision after receiving a detailed explanation of the study objectives. To maximize participation, many respondents were approached following teaching sessions. The questionnaire required approximately 15 minutes to complete, and all responses were recorded anonymously to maintain confidentiality. **Sample Size** The required sample size was determined to ensure adequate statistical power for detecting meaningful differences in knowledge scores among study groups. Based on an anticipated mean percentage score difference of 7 between four participant categories, a total sample of 410 was estimated to achieve 80% power at a 5% level of significance. The between-group standard deviation was calculated at 2.05, while the within-group standard deviation was assumed to be 14.

After accounting for a potential nonresponse rate of 15%, the final target sample size was increased to 472 participants.

Statistical Analysis

Data were analyzed using SPSS software. Descriptive statistics were used to summarize participant characteristics and knowledge outcomes. Frequencies and percentages were reported for categorical variables, such as correct responses to guideline-based items, while quantitative variables—particularly overall knowledge scores—were presented as mean values with standard deviations.

Open-ended responses were analyzed using a content analysis approach. Initial coding was developed by the research team, including an endocrinologist and a diabetes nurse educator, after carefully reviewing all responses. Answers were classified as correct (score = 1) or incorrect (score = 0), while incomplete or unclear responses were left uncoded in a small proportion of cases. Coding reliability was

subsequently evaluated independently by study investigators to ensure inter-rater agreement.

Unanswered questions were treated as incorrect responses due to the open-ended nature of the questionnaire and the assumption that participants lacked the relevant knowledge. Total scores were calculated by summing individual item scores and converting them into mean percentage values.

Participants were categorized by professional group (nurses and resident trainees) and years of training. Differences in proportions between specialties were assessed using the Pearson chi-square test, while differences in mean scores were analyzed using analysis of variance (ANOVA). Bonferroni post hoc testing was applied for multiple comparisons across specialties. Internal consistency of the questionnaire was confirmed with a Cronbach’s alpha coefficient of 0.81. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Of the 472 healthcare professionals invited to participate, 381 completed the questionnaire, yielding an overall response rate of 80%. Participation varied across groups, with response rates of 90% among internal medicine residents, 83% among family medicine residents, 75% among surgical residents, and 73% among registered nurses.

Table 1 Percentage of Correct Responses to Individual Questionnaire Items According to Group

	Ove rall	IMR	FP R	SR	RN	P val ue
	(n = 381)	(n = 169)	(n = 27)	(n = 86)	(n = 99)	
Correct Answers (underlined and bolded)						
Outpatient setting						
The ADA HbA1C goal for a patient with diabetes is <7%	239(63%)	146(86%)	24(89 %)	53(62 %)	16 (16 %)	<0. 00 1
According to Adult Treatment Panel III Guidelines, LDL goal in diabetes without known ischemic heart disease should be less than 100	129(34%)	84(5 0%)	20 (74 %)	13(15 %)	12(12 %)	<0. 00 1
Medications						
70/30 is mixture of 70% NPH.	216(57%)	122(72%)	15(56 %)	38(44 %)	41(41 %)	<0 .00 1
70/30 is a mixture of 30% Regular.	234(61%)	132(78%)	18(67 %)	38(44 %)	46(47 %)	<0 .00 1
70/30 is best administered before meals	339(89%)	161(95%)	24 (89 %)	70(81 %)	84(85 %)	0.0 04
Rosiglitazone should be discontinued if patient develops congestive heart failure.	221(58%)	146 (86 %)	20(74 %)	29(34 %)	26 (26 %)	<0. 00 1
Peak action of regular insulin is 2-4 hours.	163 (43	94(5 6%)	12 (44	29(34	28 (28	<0. 00

	%)	%)	%)	%)	1
In patient Setting					
Most important electrolyte to follow for a patient with DKA on insulin drip is Potassium.	324(85%)	165(98%)	26(96%)	77(90%)	56(57%)
The blood glucose decline per hour on insulin drip should be 50-100mg/dl	121(32%)	86(51%)	5(9%)	17(20%)	13(13%)
Oral glucose or juice is the preferred mode of treatment for hypoglycemic alert patient.	277(73%)	135(80%)	18(67%)	54(63%)	70(71%)
An insulin drip should be discontinued 30-120 minutes following administration of subcutaneous insulin.	128(34%)	80(47%)	7(26%)	19(22%)	22(22%)
For a patient admitted with DKA on an insulin drip IV fluids should be changed to D5 ½ NS at blood glucose level of 200.	170(45%)	121(72%)	18(67%)	18(21%)	13(13%)

Results are presented as mean ± SD and number (percentages).

Among respondents, 169 were internal medicine residents, 27 were family medicine residents, 86 were surgical residents, and 99 were registered nurses. As responses were consistent across the five participating tertiary care hospitals, data were combined for analysis. The overall mean percentage of correct responses among all participants was 50% ± 21, indicating generally limited knowledge regarding diabetes management. Internal medicine residents achieved the highest scores (65% ± 14), while surgical residents and nurses demonstrated lower performance levels (40% ± 16 and 31% ± 15, respectively). No significant difference in knowledge was observed between internal medicine and family medicine residents. Knowledge did not improve significantly with increased training duration among family medicine and surgical residents. In contrast, internal medicine residents showed improvement from the first to the second year of training, although further progression did not yield additional gains. Performance varied across knowledge domains. While a majority of participants were aware of recommended glycemic targets, fewer were familiar with lipid management goals for diabetic patients. Understanding of insulin pharmacology and oral antidiabetic medications was also limited, with less than half of participants correctly identifying peak insulin action and duration profiles.

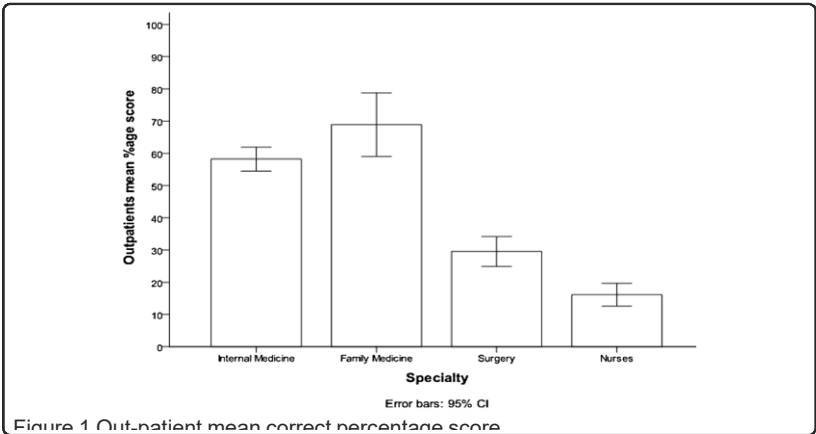


Figure 1 Out-patient mean correct percentage score

Knowledge related to inpatient diabetes management was inconsistent. Many participants recognized appropriate treatment for mild hypoglycemia and key electrolyte monitoring during diabetic ketoacidosis, yet fewer demonstrated familiarity with insulin infusion protocols and transition strategies. Nurses, in particular, showed limited understanding of inpatient management principles despite slightly better performance in this domain compared with outpatient knowledge. Post hoc power analysis indicated that the study had sufficient power to detect moderate to large effect sizes but was underpowered for identifying small differences between groups.

Discussion

Diabetes management has gained increasing attention due to its clinical complexity and growing socioeconomic

impact. Healthcare providers, particularly resident physicians and nurses, play a central role in delivering care to patients with diabetes. Assessing their baseline knowledge is essential before implementing educational initiatives aimed at improving clinical practice.

The findings of this study reveal notable gaps in diabetes-related knowledge among healthcare professionals, particularly among surgical residents and nursing staff. The overall knowledge scores were lower than those reported in several international studies, suggesting deficiencies in training and continuing professional education. Considering the high burden of diabetes in Pakistan, such gaps may adversely affect patient outcomes and healthcare delivery.

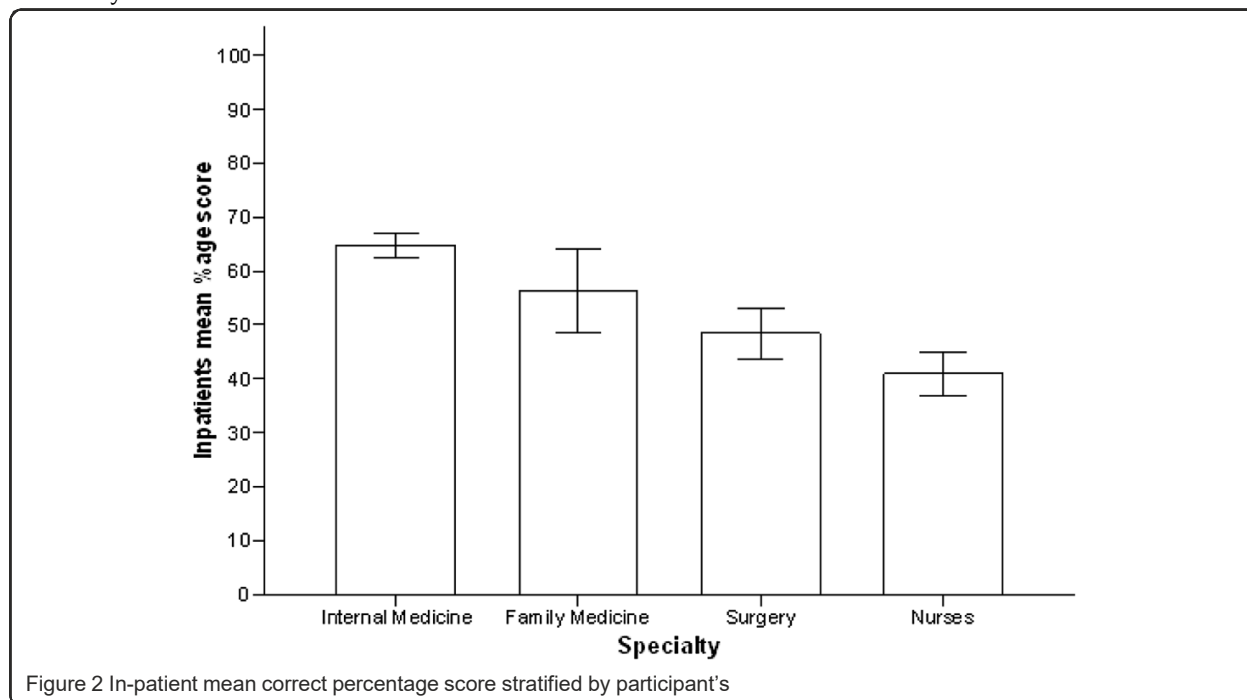


Figure 2 In-patient mean correct percentage score stratified by participant's

The improvement observed among internal medicine residents during early training highlights the positive influence of structured postgraduate education. However, the absence of continued improvement at advanced stages indicates the need for ongoing reinforcement of knowledge. Similarly, the lack of knowledge progression among family medicine and surgical residents suggests limited exposure to diabetes-focused education within their curricula. Surgical residents' limited knowledge is of particular concern, as patients with diabetes undergoing surgical procedures are at increased risk of complications if glycemic control is not optimized. Although specialist consultation may assist in management, reliance solely on endocrinology services is insufficient. Basic competency among all healthcare providers is essential to ensure safe patient care. Insulin therapy, identified as a high-risk medication, requires careful understanding of pharmacodynamics and administration protocols. The study revealed inadequate awareness of insulin profiles and newer formulations, especially among nurses, increasing the potential for medication errors. The most significant knowledge deficit was observed among nursing staff. Nurses play a critical role in monitoring, medication administration, and patient education, and their competence directly influences diabetes outcomes. Previous research has shown that appropriately trained nurses can effectively contribute to diabetes management, emphasizing the need for targeted educational interventions.

Limitations

The study had several limitations. The relatively small number of family medicine residents may limit generalizability for this group and reflects the limited availability of family medicine training programs in the local context. Additionally, the use of open-ended questions may have increased the difficulty level for participants and contributed to item nonresponse. Although the questionnaire was not originally validated for the local population, content validity was established through expert review, and internal consistency analysis demonstrated acceptable reliability. A major strength of the study is

its multicenter design, which enhances the generalizability of findings across tertiary care institutions. The satisfactory response rate also indicates strong interest among healthcare professionals in improving their knowledge of diabetes care.

CONCLUSION

This study identified significant gaps in diabetes-related knowledge among healthcare providers, particularly among surgical residents and nurses. These deficiencies may influence the quality of care delivered to patients with diabetes and highlight the urgent need for structured educational

interventions. In response to these findings, educational sessions and training programs focusing on inpatient diabetes management were initiated for residents and nursing staff. Standardized protocols and clinical algorithms were also developed to support the management of hyperglycemia in hospital settings. Plans are underway to introduce online educational modules for healthcare professionals to further address knowledge gaps. Future research should evaluate the effectiveness of these interventions through follow-up assessments to determine their impact on knowledge levels and clinical practice. Strengthening diabetes education among healthcare providers remains essential for improving patient outcomes and reducing the burden of diabetes in the healthcare system.

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