

UNMASKING THE SILENT BURDEN: ENHANCING CKD AWARENESS IN MEDICAL STUDENTS AND INTERNS MANAGING DIABETES

Pharmaceutical Science

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ABSTRACT

Background: Chronic kidney disease (CKD) is a major complication of type 2 diabetes mellitus (T2DM), yet its early recognition and management often receive inadequate attention in clinical education. Medical students and interns are future gatekeepers of diabetic care, making their awareness of diabetic kidney disease (DKD) critical. **Objective:** To assess and compare the knowledge, attitudes, and practices (KAP) of final-year medical students and house surgeons regarding CKD in T2DM, and to evaluate the impact of a structured educational intervention. **Methods:** A cross-sectional, questionnaire-based study was conducted among 149 undergraduate students and 68 medical interns at a tertiary care medical college in India. Undergraduates completed pre- and post-test KAP assessments following a focused training session on CKD management. Interns were assessed during their clinical practice. Data were analysed using SPSS v25.0. **Results:** Undergraduate students showed statistically significant improvements across all 20 KAP indicators post-intervention ($p < 0.05$). Key areas of improvement included knowledge of CKD staging, indications for SGLT2 inhibitors, and metformin use in renal impairment. Interns demonstrated stronger real-world application in clinical decision-making but lagged in some updated guideline-based knowledge. Comparative analysis revealed that structured teaching was effective in narrowing these knowledge gaps. **Conclusion:** The study highlighted the positive impact of targeted training on medical student awareness of CKD in diabetes. It also underscored the need for continual medical education that bridges theoretical knowledge with clinical application. Curricular integration of CKD-related competencies is essential to prepare medical graduates for the growing burden of diabetic kidney disease.

KEYWORDS

Diabetes Mellitus, CKD Awareness, Medical Education, Medical Students, House Surgeons, KAP Study.

INTRODUCTION

Chronic kidney disease (CKD) was recognized as one of the most common and serious complications associated with type 2 diabetes mellitus (T2DM), contributing significantly to global morbidity and healthcare burden. The global burden of type 2 diabetes mellitus (T2DM) has reached epidemic proportions, with the International Diabetes Federation (IDF) estimating over 537 million adults currently affected—a figure projected to rise to 783 million by 2045.[1] Diabetes accounted for approximately one-third to one-half of all end-stage renal disease (ESRD) cases worldwide [2]. The progression of diabetic kidney disease (DKD) from early renal impairment to ESRD often led to poor clinical outcomes and increased healthcare costs.[3]

To guide early diagnosis and effective intervention, international organizations such as the kidney disease: Improving Global Outcomes (KDIGO) and the American Diabetes Association (ADA) had developed specific guidelines for the management of CKD in patients with diabetes. [4,5] These guidelines emphasized the routine use of the estimated glomerular filtration rate (eGFR) and urine albumin-to-creatinine ratio (UACR) as key parameters in the CKD Screening Index. These indicators enabled clinicians to classify disease severity and implement timely management strategies.[6]

The introduction of newer pharmacologic agents, particularly sodium-glucose co-transporter 2 (SGLT2) inhibitors and renin-angiotensin-aldosterone system (RAAS) inhibitors, offered significant therapeutic advances. These medications had demonstrated renoprotective effects even in patients with reduced kidney function, highlighting their relevance in clinical practice. [7,8]

Despite these developments, knowledge gaps persisted among medical trainees in areas such as guideline familiarity, risk assessment, and practical management of CKD in diabetic patients.[9] As future physicians, medical students were expected to play a critical role in early identification and management of chronic diseases. [10] Therefore, assessing their knowledge, attitudes, and practices (KAP) related to T2DM and CKD became essential to improve future healthcare outcomes. [11]

This study aimed to evaluate the awareness, perceptions, and clinical

orientation of final-year medical students regarding diabetic kidney disease through a structured and validated KAP questionnaire. The findings were expected to highlight educational gaps and guide future curricular improvements for better integration of CKD management practices in undergraduate medical training.

MATERIALS AND METHODS

Study Design and Setting:

This was a cross-sectional, questionnaire-based survey conducted at JSS Medical College & Hospital, Mysuru. The study population included medical interns and second-year undergraduate students.

Study Tools:

Two validated, structured questionnaires were used:

- A 20-item KAP questionnaire on CKD and drug knowledge related to diabetes (for interns and students) covering knowledge (Q1–10), attitude (Q11–15), and practice (Q16–20).
- The KAP (Knowledge, Attitude, and Practice) survey adapted from Gheewala et al. (2018) to assess awareness and management of CKD in diabetic patients. It evaluated knowledge of CKD risk and screening, attitudes toward early detection and medication adherence, and practices related to medication timing and disease management. [12]
- A pre- and post-intervention assessment was conducted for undergraduates following a structured training session, whereas interns were evaluated within the context of their clinical practice.

Sample Size:

A total of 149 medical students and 68 interns participated in the study.

Scoring and Data Collection:

Each correct or positive response was scored as 1. Responses were aggregated and converted into percentages per respondent group.

3. Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS v25. Descriptive statistics (mean $\pm$ SD, percentages) were computed. Group differences were evaluated using:

- Chi-square tests for categorical variables.

- Independent t-tests or Mann-Whitney U tests for mean score comparisons.
- A-p-value < 0.05 was considered statistically significant.

RESULTS

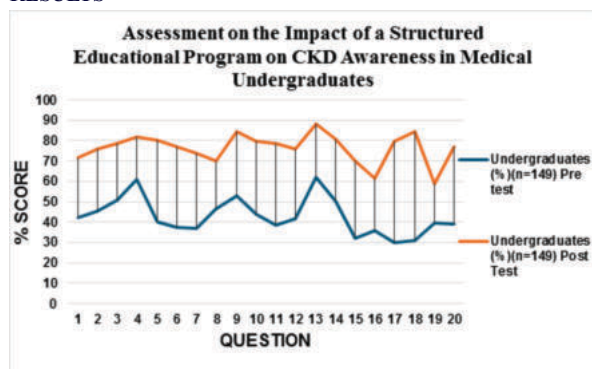


Figure 1: Assessment of CKD Awareness in Medical Undergraduates (Pre- and post-test)

(Shows changes in CKD knowledge among medical undergraduates before and after an educational session, highlighting significant improvement in awareness through structured learning.)

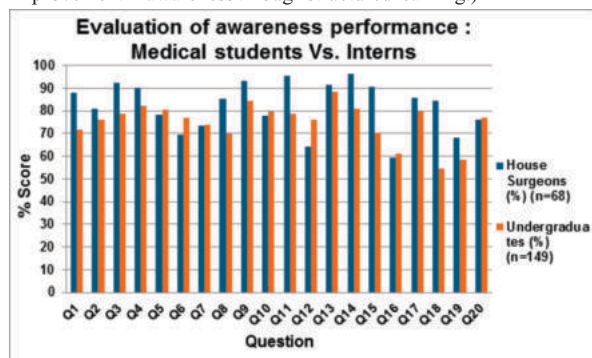


Figure 2: Structured Evaluation of Undergraduate Post-Training Performance Versus Clinical Setup Survey Outcomes Among Interns

(Compares interns' CKD knowledge after training with actual clinical practice responses, revealing gaps between theoretical understanding and practical application in real-world settings.)

Table 1: Group-wise Comparison of Mean Knowledge Scores Post-Training: Undergraduates and Interns

Group	No. of participants (N)	Mean $\pm$ SD	Mean Difference (U - H)	Mean Score %	p-value
Undergraduates (Post-training) (n=149)	149	16.13 $\pm$ 2.21	-5.67	62.32%	< 0.0001
House Surgeons (Interns) (n=68)	68	12.46 $\pm$ 2.03	—	80.65%	—

DISCUSSION

This study set out to evaluate how well final-year medical students and house surgeons understand and manage chronic kidney disease (CKD) in patients with type 2 diabetes mellitus (T2DM)—a complex, yet increasingly common combination that continues to challenge healthcare systems worldwide. By using a structured questionnaire before and after an educational intervention, we gained insights not only into what these future doctors know, but also how they think and act when faced with CKD-related scenarios. The findings were both encouraging and thought-provoking. [13, 14]

After the educational intervention, undergraduate students showed a significant improvement across all domains—knowledge, attitude, and practice. Looking closely at the question-wise responses, we see a clear pattern. Questions like Q1 (diagnostic criteria for CKD), Q2 (staging of CKD), Q3 (key lab tests), and Q5 (role of SGLT2 inhibitors) all saw large gains in correct responses post-training. For instance, correct responses for Q1 increased from 42.5% to 71.9%, and

Q5 rose from 40.3% to 80.4. This suggests that structured teaching is highly effective in reinforcing core concepts, especially in areas where students may have only a superficial understanding from lectures or textbooks. [15, 16]

Notably, questions requiring more advanced clinical reasoning—such as Q6 (metformin use in CKD) and Q7 (management of albuminuria)—demonstrated significant improvement among undergraduates following the training. These questions moved from 37.4% to 77.2% and 36.8% to 74%, respectively. This indicates that even topics traditionally considered more nuanced or clinical can be grasped well by undergraduates if taught effectively. Q10, which assessed knowledge of antihypertensive choices in diabetic CKD, also saw a significant jump from 44.1% to 79.5% ($p = 0.0015$), reflecting improved understanding of guideline-driven therapy. [17, 18]

The attitudinal questions (Q11–Q15) also revealed striking shifts. For example, Q11 ("Do you believe CKD is preventable with good management?") improved from 38.7% to 78.7%, while Q15 ("Do you support routine CKD screening in diabetics?") went from 32.3% to 70.3%. These numbers suggest that beyond knowledge, the training also helped reinforce the importance of proactive and preventive care. Given that attitudes influence long-term clinical behaviour, these findings are particularly encouraging.

When we compared the post-training performance of undergraduates to that of clinical setup survey of house surgeons (interns), an interesting dynamic emerged. Interns scored significantly higher on Q1, Q3, Q5–Q8, Q10, Q11, Q14, Q15, and Q17–Q19. For instance, in Q1, 88.1% of house surgeons answered correctly versus 71.9% of undergraduates ($p = 0.016$), and in Q14 (on the role of patient education), 96.2% of house surgeons responded positively compared to 80.9% of undergraduates. This reinforces the value of real-world exposure in building both confidence and deeper understanding. [19, 20]

However, there were also areas where undergraduates performed comparably or even better than interns. For example, in Q6 (metformin in CKD), undergraduates' scores post-intervention were higher than those of interns (77.2% vs. 69.7%), suggesting that the educational session had a meaningful and measurable impact.

Another critical insight came from the practice-oriented questions (Q16–Q20). While both groups acknowledged the importance of screening and medication review, fewer than expected reported actively applying these practices in their clinical settings. For instance, Q20—"Do you stay updated with current CKD guidelines?"—had relatively low scores in both groups (76.9% for students vs. 78.2% for house surgeons, $p = 0.05$), underlining a key area for future focus. This is particularly concerning given that adherence to guidelines like those from KDIGO and ADA is essential for optimal patient outcomes [4, 5, 17].

To sum up, this question-wise analysis suggests that medical undergraduates benefit greatly from structured, focused learning—especially when the teaching is contextual and guideline-based. House surgeons, despite their clinical experience, may need more structured support and time for reflection to consolidate their knowledge. The data also suggests that simply being in a clinical environment does not guarantee better awareness or practice, particularly when the clinical culture may not emphasize preventive nephrology or guideline adherence. [13, 19, 20]

Going forward, medical education needs to blend the strengths of both groups: the curiosity and academic discipline of students, with the practical, patient-facing experience of house surgeons. We must also prioritize continuous education that doesn't stop at graduation. Integrating interactive workshops, clinical case discussions, and real-time feedback on practice behaviours may help reinforce both confidence and competence in managing diabetic CKD.

CONCLUSION

In conclusion, this study provided valuable insight into the knowledge, attitudes, and practices of final-year medical students and house surgeons regarding the management of chronic kidney disease (CKD) in patients with type 2 diabetes mellitus (T2DM). The educational intervention led to a marked improvement in the undergraduates' understanding, particularly in areas related to diagnostic criteria,

staging, pharmacologic management, and preventive care. This underscored the effectiveness of structured, focused teaching in reinforcing critical clinical concepts.

House surgeons, by contrast, demonstrated strengths in certain practical aspects, likely reflecting their exposure to real-world clinical settings. However, their performance also revealed gaps in theoretical knowledge and limited familiarity with established guidelines, suggesting that experiential learning alone did not ensure comprehensive preparedness.

Both groups exhibited areas for growth, particularly in translating knowledge into consistent practice and in maintaining awareness of up-to-date clinical guidelines such as those from KDIGO and the ADA. These findings highlighted the on-going need for medical education that bridges the gap between academic learning and clinical application.

A blended educational approach—one that combines timely theoretical instruction, early clinical exposure, and sustained mentorship—appeared essential to develop confident, competent physicians capable of managing the complex and chronic conditions increasingly faced in today's healthcare landscape. Preparing future doctors to meet these challenges with both competence and compassion remains a critical goal for medical educators and institutions alike.

Appendix:

Questionnaire used in this survey to assess the knowledge, attitude, and practice Chronic Kidney Disease CKD and diabetes among Health care professionals

No.	Question	Yes	No	Not Sure
Section A: Knowledge				
1	Do you know the diagnostic criteria for CKD?	☐	☐	☐
2	Are you familiar with the common stages of CKD in T2DM patients?	☐	☐	☐
3	Do you know which lab tests are used to assess kidney function?	☐	☐	☐
4	Are you aware of risk factors for CKD in diabetic patients?	☐	☐	☐
5	Do you know the role of SGLT2 inhibitors in diabetic kidney disease?	☐	☐	☐
6	Can metformin be used in patients with advanced CKD?	☐	☐	☐
7	Are you aware of how albuminuria is managed in T2DM?	☐	☐	☐
8	Do you know what eGFR means and how it is used in CKD diagnosis?	☐	☐	☐
9	Are you aware of the complications of untreated CKD?	☐	☐	☐
10	Do you know which antihypertensive drugs are recommended in T2DM with CKD?	☐	☐	☐
Section B: Attitude				
11	Do you believe CKD in diabetes is preventable with good management?	☐	☐	☐
12	Are you confident in counselling patients about CKD?	☐	☐	☐
13	Do you think early referral to a nephrologist improves patient outcomes?	☐	☐	☐
14	Do you believe patient education plays a critical role in managing CKD?	☐	☐	☐
15	Do you support routine CKD screening for all diabetic patients?	☐	☐	☐
Section C: Practice				
16	Have you been involved in CKD screening during clinical practice?	☐	☐	☐
17	Do you consider renal function when prescribing medications?	☐	☐	☐
18	Have you counselled a patient about CKD prevention or management?	☐	☐	☐
19	Do you check for nephrotoxic drug interactions when reviewing prescriptions?	☐	☐	☐
20	Do you stay updated with current CKD guidelines (e.g., KDIGO, ADA)?	☐	☐	☐

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