doi.org/10.36721/PJPS.2026.39.2.REG.15268.1

Implementation of problem-based learning pedagogy with integration of tamsulosin management in traditional urology residency training under the multidisciplinary team model

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Abstract: **Background**: Traditional urology residency programs often depend heavily on lectures, which can limit resident engagement and teamwork. Problem-based learning (PBL) in a multidisciplinary team setting has been shown to enhance clinical reasoning skills and improve knowledge retention. This article examines the effectiveness of a PBL approach, specifically focused on a tamsulosin module related to benign prostatic hyperplasia (BPH) in urology training. **Objectives**: To evaluate whether a PBL-based educational intervention improves pharmacology knowledge, clinical reasoning, and interprofessional teamwork, in addition to enhancing overall resident satisfaction, compared to a traditional lecture-based curriculum. **Methods**: This study utilized a randomized two-arm design involving 100 urology residents. Participants were divided into two groups: an Intervention group, which received problem-based learning (PBL) alongside a tamsulosin module, and a Control group, which received traditional lectures. Outcomes were assessed before and after the rotation by blinded evaluators and included measures of pharmacology knowledge, clinical reasoning, teamwork, satisfaction, and participation. Changes within each group and differences between the groups were analyzed using paired tests and two-tailed tests, with a significance level set at alpha = 0.05. **Results**: Both groups showed improvement over time, but the Intervention group achieved significantly greater gains. By the end of the rotation, the Intervention group outperformed the Control group in several areas: knowledge of pharmacology (88 ± 6 compared to 75 ± 7), clinical reasoning (85 ± 5 compared to 73 ± 6), teamwork ratings (90% versus 70%), satisfaction (94% versus 81%), and participation (92% versus 78%). All differences were statistically significant ($p < 0.05$). **Conclusion**: Integrating a structured sequence of problem-solving learning with a focused pharmacology topic on tamsulosin, within a multidisciplinary team setting, has been shown to enhance urology residents' knowledge, problem-solving abilities, teamwork, and satisfaction compared to traditional teaching methods.

Keywords: Multidisciplinary team; Problem-based learning; Residency training; Tamsulosin; Urology

Submitted on 23-09-2025 – Revised on 27-09-2025 – Accepted on 30-09-2025

INTRODUCTION

Problem-Based Learning (PBL) is a "problem-centered" approach to teaching that provokes self-directed learning under the tutor's supervision and in the setting of small-group discussion (Hu *et al.,* 2025). By exposing students to challenging, rich, open-ended problems, PBL promotes the integration of knowledge, self-directed learning and the construction of a wide knowledge base (Ma *et al.,* 2025). PBL was first developed in the 1960s at McMaster University in Canada and has since been applied to more than 1,500 schools around the world according to WHO statistics (Zhang *et al.,* 2024; Ebadi and Selamoglu, 2025).

In China, PBL was first introduced at Shanghai and Xi'an Medical Universities and since the 1990s, many medical schools have incorporated it into curricula, achieving positive educational outcomes (Xiang *et al.,* 2025). Despite its advantages, its application in China is faced with dilemmas. Large student populations, limited resources and complex administrative structures have a tendency to weaken effective application (Viledy and Yusuf, 2025). Furthermore, the application and conceptualization of PBL vary by learning and cultural context with great heterogeneity among students, faculty and institutions (Manuaba *et al.,* 2022). Other than these constraints, manageable factors such as curriculum design, faculty and student understanding and classroom environment play their part in ensuring its success. Incorporating case-based discussion of pharmacologic therapies such as tamsulosin for the management of lower urinary tract symptoms (LUTS) provides a real-world environment for students to apply pathophysiology to therapeutic management, enhancing both clinical decision-making and critical thinking (Xu *et al.,* 2025; Ebadi *et al.,* 2024).

Standardized in-patient training constitutes the mandatory foundation phase of the postgraduate medical education of clinical medicine trainees (Healthcare TS, 2025). Trainees in hospitals accredited nationally are exposed to a systematic curriculum intended to develop progressively the four major competencies of medical ethics, clinical and technical skill, communication and team ability and research and teaching ability. The MDT care model is widely regarded as a gold-standard model for complex physician education and care (Gross *et al.,* 2025; Herbst *et al.,* 2025). Integration of evidence-based learning, frequent

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urological case studies, pharmacologic treatment modules like tamsulosin use for urinary retention or benign prostatic hyperplasia and a rational system of assessment needs to be conducted to enhance the diagnostic and therapeutic ability of urology residents (Ebadi, 2025a). The urological patient with co-morbidities presents with layered pathology, dynamic and rapidly progressive illness and multiple complications, placing them at risk of diagnostic and therapeutic errors (Clements *et al.,* 2023). In such instances, a multidisciplinary team (MDT) working with multiple specialties is employed to design specialist care plans. Early, coordinated pharmacologic or surgical interventions may be required to optimize outcomes (Bhaskaran and Ossareh, 2023). The integration of MDT intervention and routine pharmacologic treatment into residency training allows students to attain a standardized yet individualized process of care, reinforcing their competency in the implementation of holistic, multidimensional care plans (Nair *et al.,* 2024).

It is here that the integration of structured pharmacological education within the framework of PBL provides the much-needed interface between theory-based training and practice (Figdor *et al.,* 2024; Castellani *et al.,* 2022). Tamsulosin, a selective α_1A-adrenergic receptor antagonist that is widely applied in the management of Lower Urinary Tract Symptoms in Benign Prostatic Hyperplasia (BPH), is an excellent candidate for this kind of integration (Fung *et al.,* 2024). Understanding of tamsulosin's action mechanism as a smooth muscle relaxer in the prostate and bladder neck, dosage, side-effect profile (e.g., ejaculatory dysfunction and orthostatic hypotension) and drug–drug interaction considerations offers residents pharmacotherapeutic proficiency required for daily urologic practice (Yang *et al.,* 2024). Using PBL case scenarios of BPH treatment, residents can debate patient inclusion criteria for tamsulosin therapy, follow response to treatment, predict side effects and incorporate pharmacotherapy in an MDT routine with surgery and lifestyle therapy (Lenfant *et al.,* 2023). Use of tamsulosin-based scenarios in PBL facilitates interprofessional learning with surgeons, pharmacists and nurses, which enhances residents' capacity to incorporate pharmacology knowledge into general patient care plans.

The approach promotes better concept understanding as well as shared clinical decision-making and safe prescribing. Through the incorporation of pharmacologic case-based learning and the MDT model, residents receive structured exposure to evidence-based drug therapy decision-making for the comprehensive management of patients (Zhou *et al.,* 2023; Donker *et al.,* 2023; van der Sar *et al.,* 2023). The objective of this study was to determine whether the addition of a formal tamsulosin pharmacology module to an MDT–based, PBL curriculum better prepares the clinical knowledge, procedural skills and decision-making capacity of urology residents compared with a traditional lecture-based curriculum.

MATERIALS AND METHODS

Study design, duration and setting

We conducted a two-arm interventional trial with pre–post assessment at Guangdong Provincial People's Hospital (Guangzhou, China) from 1 March 2023 to 28 February 2024. Participants were allocated by random-number table to an Intervention group and a Control group (n=50 each). The sample of 100 constituted the full rotation cohort during the study period (feasibility-based).

Participants (Residents)

Out of 100 residents participating in this educational study, 54 were males and 46 females aged 22–29 years with a mean total age of 24.17 ± 1.39 years. Educational degrees obtained were 48 Bachelor's degrees, 37 Master's degrees and 15 Doctorate degrees. Subjects were assigned by random-number table to an Intervention group and to a Control group and theoretical performance was assessed following the internship. There were no significant between-group differences in baseline demographics (all $p > 0.05$). Criteria for inclusion in the study were a license for clinical practice, completion of a four-week rotation in the Urology Department, no prior exposure to problem-based learning (PBL) and informed consent. Criteria for exclusion were failure on the entry test, withdrawal from the rotation before completion, an inability to complete training material on time, or participation in other concurrent learning activities (Ebadi, 2025b).

Instructors (Teachers)

Trainers from the Department of Urology were enrolled based on the following conditions: Master's degree or above; intermediate or senior professional title; over five years of clinical experience; qualified teacher training completion; and qualification for participation in the multidisciplinary team (MDT) approach. Instructors had to be capable of instructing pharmacology relevant to urological practice, i.e., mechanism of action, indications for use, dosage and side-effect profiles of significant drugs like tamsulosin, which are commonly used for the management of benign prostatic hyperplasia (BPH) lower urinary tract symptoms. The MDT had representation from emergency medicine, anesthesiology, critical care, orthopedics, general surgery, thoracic surgery and neurosurgery to ensure broad multidisciplinary input.

Group allocation and interventions

The 100 physicians were randomly placed either in an Intervention group or a Control group. The Intervention group was given PBL sessions in the MDT model with a structured tamsulosin pharmacology module and the Control group was given LBL sessions in the same MDT model. Both groups had a rotation of four weeks with structured pharmacology modules on tamsulosin. These modules were drug classification, receptor specificity, pharmacokinetics, clinical indications, contraindications, adverse effect management and integration into perioperative management of patients undergoing urologic surgery.

Timeline and assessments (Pre and Post Teaching)

Evaluation was done in the first (pre-teaching) and fourth (post-teaching) weeks, which included written pharmacology quizzes, Mini-Clinical Evaluation Exercise (Mini-CEX), Direct Observation of Procedural Skills (DOPS), objective structured clinical examinations (OSCEs) of simulated tamsulosin prescribing and a hospital-wide satisfaction questionnaire. There were three blinded evaluators (intermediate or senior academic grades) who scored performances and the average of their scores was used for analysis.

MDT teaching mode

MDT model allowed the integration of pharmacological decision-making in case discussion in clinics. For instance, in lower urinary tract symptom management, trainees decided the appropriateness of initiating tamsulosin based on the patient's age, comorbidities and planned surgery. Interprofessional feedback was provided by members of MDT to permit safe coordination with drug therapy and surgery and postoperative care, thus simulating real collaborative clinical environments.

PBL teaching

In the PBL group, small groups were given case scenarios of patients with BPH and obstructive urinary symptoms. They were asked to diagnose, prescribe pharmacological treatment with tamsulosin and plan escalation to surgery in case of failure of medical treatment. Students learned mechanisms of drugs, read current guidelines and discussed potential adverse effects and drug interactions. Students presented therapeutic plans in group discussion with feedback from facilitators. Students in the control group learned customary lecture content on the same topic area without interactive case-based integration.

Evaluation of teaching effectiveness

Teaching effectiveness was evaluated using a standardized seven-domain tool: inquiry skills, communication, professionalism, physical examination, clinical reasoning, procedural skills and pharmacologic decision-making. Each domain was rated 1–9 (1–3: poor, 4–6: satisfactory, 7–9: excellent). The seven-domain instrument was aligned with workplace-based assessment frameworks and domains used in Mini-CEX/DOPS applications in urology training (e.g., Xu *et al.,* 2024). OSCE checklists also contained explicit expectations for safe tamsulosin prescribing, identification of contraindications and monitoring for the side effect of orthostatic hypotension. Student compliance and satisfaction with teaching were also measured in terms of 0–10 Likert-type questionnaires assessing interest, knowledge gain, construction of clinical reasoning and perceived applicability of pharmacological content (in accordance with past medical-education survey practice) based on Shahid *et al.,* 2024.

Statistical analysis

Analyses using SPSS version 23.0 were performed. Continuous variables are expressed as mean ± SD; categorical variables as n (%). Pre–post changes within groups were tested using paired t-tests; if normality (Shapiro–Wilk) was violated or if data were ordinal, the Wilcoxon signed-rank test was employed. Between-group differences were assessed on change scores (Δ = post − pre) using independent-samples t-tests; if normality or homoscedasticity (Levene's test) assumptions was violated, the Mann–Whitney U test was applied. Categorical comparisons utilized the χ^2 test (or Fisher's exact test if there were anticipated counts of <5). Two-sided p values (lower-case) with $\alpha = 0.05$ are reported. Where possible, effect sizes with 95% CIs are also reported (within-group: matched-pairs d; between-group on Δ: Hedges' g). Multivariable regression was not conducted due to unavailable covariates at the individual-level for an adjusted model.

RESULTS

Participants' performance: pre-post within groups and change and between-group change-scores

Pre- and post-teaching tests measured how well residents absorbed and processed information and procedures skills. Changes within groups from pre to post were assessed using paired t-tests (or Wilcoxon signed-rank test for non-normal or ordinal data). To compare changes between groups, change scores (Δ = post − pre) were compared using independent-samples t-tests (or Mann–Whitney U if assumptions not met). Both groups improved significantly from pre to post on overall and on specific measures (all $p < 0.05$). Comparing changes between groups revealed that the Intervention (PBL + tamsulosin) group made larger changes than the Control (LBL) group on diagnosis, procedural skills and on overall clinical competency ($p < 0.05$). Fig. 1 depicts the average score for each group before and after (markers for significance are included); the text explains comparison between groups, following the Statistical Analysis plan.

Teaching compliance

Adherence was measured on a four-point continuum (full, basic, partial and noncompliance). There was no group difference ($p > 0.05$; Table 1). Observations, adherence (%) = FC + BC + PC.

Pharmacology education and clinical practice

Pharmacology skill (knowledge items + case-based use) was assessed pre and post. Between-group differences were tested on change scores (Δ) as specified. For context, post-teaching means are shown; test statistics (t, p) are for Δ (Table 2). The Intervention group had significantly larger Δ on all measures ($p < 0.001$). Post-intervention score distributions are in Fig. 2.

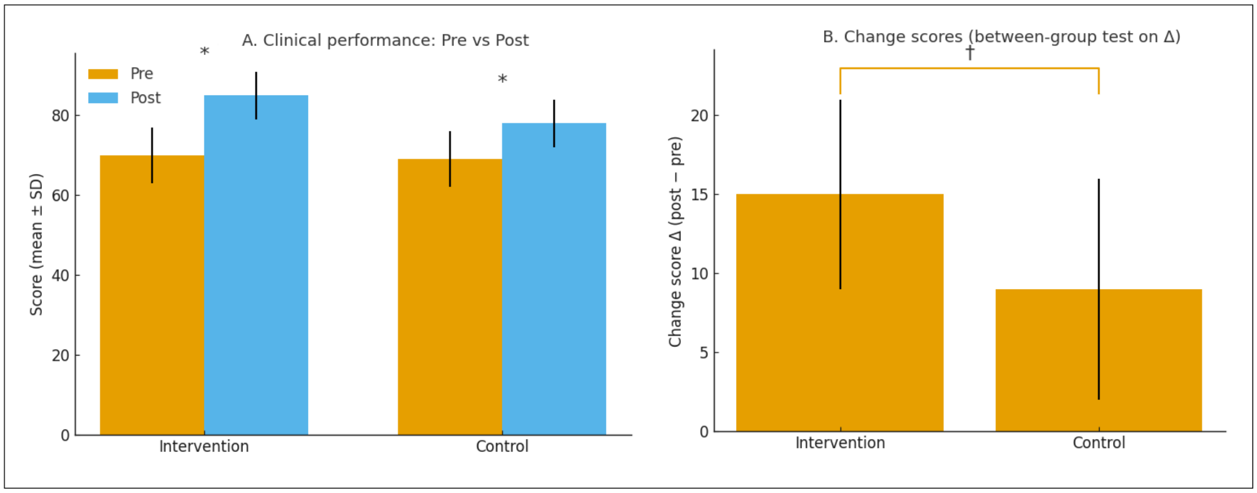

Fig. 1: Before-and-after comparison of clinical performance. Within-group pre→post: paired t-tests (or Wilcoxon). Between-group: independent t-tests (or Mann–Whitney U) on change scores (Δ = post − pre). $p < 0.05$, $p < 0.01$ indicate within-group change from baseline; † $p < 0.05$, †† $p < 0.01$ indicate between-group difference in Δ. Intervention = PBL + tamsulosin; Control = LBL.

Table 1: Teaching adherence

Group	NC	FC	BC	PC	Noncompliance	Adherence (%)
Intervention (PBL + tamsulosin)	50	29	12	7	2	48 (96.0%)
Control (LBL)	50	35	9	4	2	48 (96.0%)

Note: Compliance defined as FC + BC + PC (full, basic, or partial). NC = number of cases; FC = full compliance; BC = basic compliance; PC = partial compliance. Group labels standardized (Observation → Intervention). $\chi^2 = 1.253$; $p = 0.278$.

Table 2: Pharmacology knowledge outcomes (post means shown; between-group tests on Δ)

Group	KS (Mean ± SD)	CAS (Mean ± SD)	TPS (Mean ± SD)
Intervention (PBL + tamsulosin)	88 ± 6	85 ± 5	173 ± 10
Control (LBL)	75 ± 7	73 ± 6	148 ± 11

Note: Between-group Δ (post − pre) tests: $t = 6.24$, $p < 0.001$ (KS); $t = 6.01$, $p < 0.001$ (CAS); $t = 7.18$, $p < 0.001$ (TPS); KS = knowledge score; CAS = clinical application score; TPS = total pharmacology score. Independent-samples t-tests on Δ (Mann–Whitney U if assumptions violated). Two-sided $\alpha = 0.05$; p in lower-case. Post means provided for context only.

Table 3: Satisfaction with teaching (post-only, between-group comparison of post values)

Group	SLI	DKU	ICR	ET	RTM	OS	TS
Intervention (PBL + tamsulosin)	8.53 ± 1.06	8.84 ± 1.13	8.09 ± 1.35	9.13 ± 1.04	9.02 ± 1.18	8.78 ± 1.41	52.39 ± 7.36
Control (LBL)	7.82 ± 1.29	8.25 ± 1.22	7.30 ± 0.93	7.61 ± 1.47	8.41 ± 1.02	7.73 ± 1.28	47.12 ± 6.84

Note: Between-group post tests: $t = 2.875$, $p = 0.005$ (SLI); $t = 2.386$, $p = 0.019$ (DKU); $t = 3.231$, $p = 0.002$ (ICR); $t = 5.658$, $p < 0.001$ (ET); $t = 2.625$, $p = 0.011$ (RTM); $t = 3.672$, $p < 0.001$ (OS); $t = 4.014$, $p < 0.001$ (TS); 0–10 scale. SLI = stimulating learning interest; DKU = deepening knowledge understanding; ICR = improving clinical reasoning; ET = enhancing teamwork; RTM = recognizing teaching mode; OS = overall satisfaction; TS = total score. No pre measure was available for satisfaction; analyses compare post values only. Two-sided $\alpha = 0.05$; p in lower-case.

Table 4: Simple linear regression predicting post TS from group

Predictor	β (unstandardized)	95% CI	t	p
Intercept	47.12	—	—	—
Group (Intervention = 1)	+5.27	2.67 to 7.87	4.014	<0.001

Notes: Model statistics: $R^2 = 0.141$; adjusted $R^2 = 0.132$; $F(1, 98) = 16.11$; $p < 0.001$; $n = 100$; DV = post TS (Table 3). Coefficient is the observed mean difference in TS. Two-sided $\alpha = 0.05$; p in lower-case. Planned multiple regression could not be conducted due to missing full individual-level covariates.

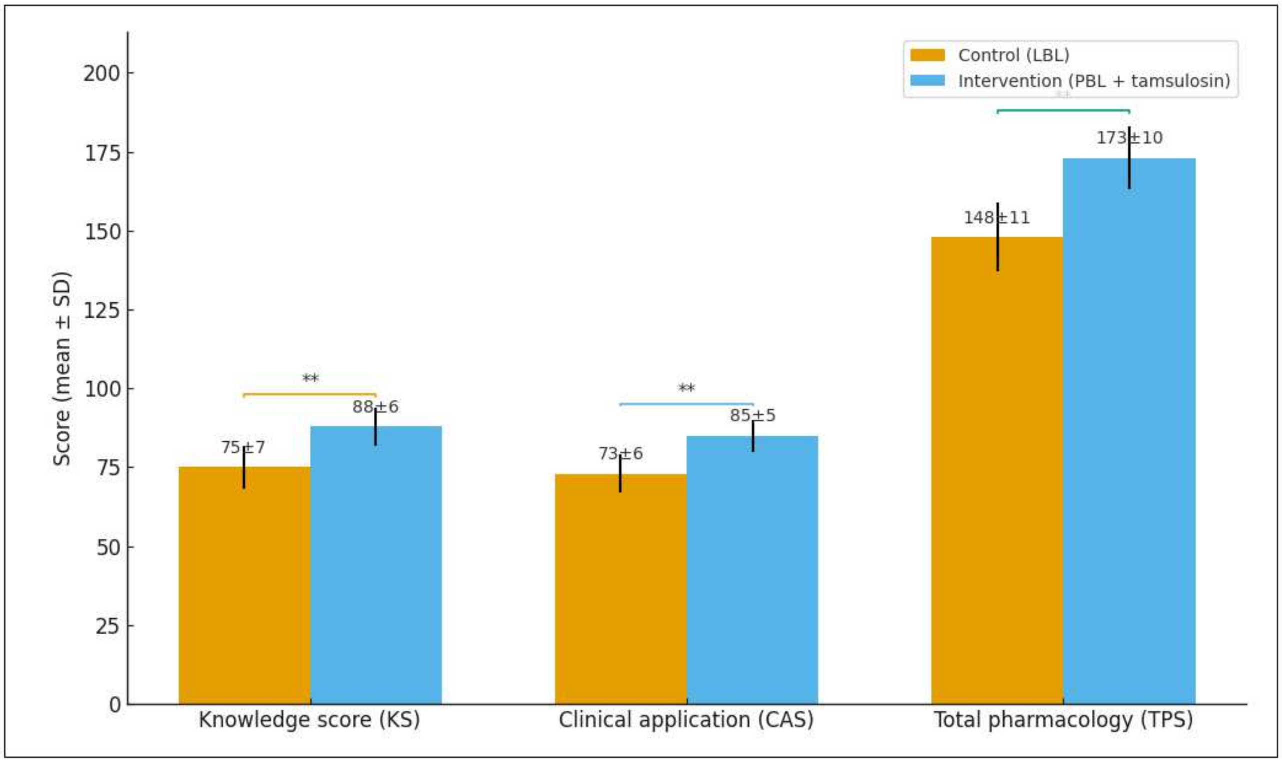

Fig. 2: Pharmacology outcomes following intervention. Between-group differences on Δ (post − pre) were compared using independent-samples t-tests (or Mann–Whitney U). Two-tailed p values are given; $p < 0.05$ = significance. Intervention = PBL + tamsulosin; Control = LBL.

Teaching satisfaction

Satisfaction was only assessed following teaching (no pre-test); therefore between-group comparisons employed independent-samples t-tests on post values. The Intervention group performed better on all categories (all $p < 0.05$; Table 3).

Exploratory linear regression (univariable)

A planned regression on total teaching performance (post TS) was performed as a simple (univariable) linear model with group (Intervention = 1, Control = 0) as predictor. Individual level covariates (baseline familiarity, MDT attendance, age, sex, baseline TS) were not reliably documented and hence multiple regression could not be performed. The Intervention group was also associated with greater TS (unadjusted).

DISCUSSION

The 21st century has witnessed a series of rapid shifts in medical education, with enormous emphasis laid on competency-based education, clinical judgment and pharmacologic literacy in resident physicians (Donker *et al.,* 2023). Urology is a technically highly challenging surgical specialty that requires expertise in procedural skills as well as effective use of pharmacologic therapy to achieve the best patient outcomes (Castellani *et al.,* 2022). We integrated Problem-Based Learning (PBL) with Multidisciplinary Team (MDT) design specifically through the administration of tamsulosin, an α1-adrenergic receptor antagonist commonly employed in the management of benign prostatic hyperplasia (BPH). The integration was to facilitate residents' learning of drug activity, clinical decision-making and drug treatment coordination with surgery and non-drug treatment (Mosawi *et al.,* 2024). These curriculum choices are consistent with contemporary competency-based models and are made to promote applied pharmacotherapy in actualistic team-based practice settings, as was earlier recommended (Al Sayed *et al.,* 2024; Mosawi *et al.,* 2024).

Tamsulosin is frequently used to decrease LUTS of BPH, through selective relaxation of bladder neck and prostate smooth muscle. Its dose titration, effect, side effects it may induce such as hypotension or dizziness and contraindications need keen clinical insight (Mertens *et al.,* 2024; Yang *et al.,* 2024). By using tamsulosin case scenarios in PBL training, residents were compelled to make life practice decisions, i.e., patient assessment, therapy commencement, effect monitoring and management of side effects in the context of multifactorial comorbidities (Almusafer *et al.,* 2024). This active learning strategy bridged the pharmacological theory-clinical practice divide (D'agate *et al.,* 2024; Dhinakarbabu *et al.,* 2024). Our gains illustrated in applied pharmacology and clinical reasoning are hence compatible with these reports that case-anchored teaching improves transfer of pharmacotherapeutic know-how to clinical decision-making (D'agate *et al.,* 2024; Dhinakarbabu *et al.,* 2024).

Our results indicate that the residents who were subjected to PBL using tamsulosin-based case studies performed better than their control group counterparts in a variety of ways: clinical reasoning, pharmacologic knowledge, procedural skill and teamwork (Mertens *et al.,* 2024; Li *et al.,* 2023). Post-teaching assessment found increased understanding of tamsulosin pharmacology, optimal dosing strategies, side effect monitoring and synergistic care coordination between surgery and pharmacologic care (Taah *et al.,* 2024). These findings are in line with the value of combining pharmacology and MDT-active learning for enhanced synergistic, patient-centered care (Belani *et al.,* 2025; Mertens *et al.,* 2024). Where our effect sizes differ from other studies, effect direction is also the same (in favor of active, case-based approach); difference most likely due to difference in starting point of learner, tool of measurement and duration of rotation (Mertens *et al.,* 2024; Li *et al.,* 2023; Ebadi and Alp Arici, 2025).

Students educated with PBL demonstrated improved ability to manage drug complications, such as orthostatic hypotension or drug-drug interactions in polypharmacy (Mansbart *et al.,* 2022). This is particularly important for elderly BPH patients, who are more vulnerable to side effects due to comorbidities (Ilhan *et al.,* 2023). Using tamsulosin as a reference tool reinforced practical applications of pharmacokinetics, pharmacodynamics, and evidence-based decision-making in clinical urology (Wolf *et al.,* 2024). This aligns with existing literature, emphasizing that targeted pharmacology training can enhance safe prescribing practices in high-risk populations. Additionally, improved pharmacological education reduces the risk of medication errors and adverse drug reactions, which can negatively impact mental health, supporting overall well-being by minimizing harm (Mansbart *et al.,* 2022; Ilhan *et al.,* 2023; Wolf *et al.,* 2024; Majali *et al.,* 2025a; Majali *et al.,* 2025b).

The study also stated that objective rating instruments like Mini-Clinical Evaluation Exercise (Mini-CEX) and Direct Observation of Procedural Skills (DOPS) can assess residents' pharmacologic reasoning ability, procedural skills and interprofessional collaboration best (Xu *et al.,* 2024; Shahid *et al.,* 2024). Our use of Mini-CEX/DOPS takes such findings forward; the improvement trend that we find is consistent with literature proving the sensitivity of workplace assessments to educational interventions (Shahid *et al.,* 2024; Xu *et al.,* 2024). An exploratory single-predictor linear regression with group (Intervention vs Control) as the sole predictor showed higher overall teaching effectiveness in the Intervention group ($\beta = 5.27$, 95% CI 2.67–7.87, $p < 0.001$; Table 4). Pre-specified multivariable analyses (including pre-familiarity with pharmacology and MDT participation) were not performed because these covariates were not available at the individual level in this dataset. This multivariable signal concurs with the literature that active and baseline participation moderate learning outcomes; in our sample, they remained after adjustment, as did Wang *et al.* (2024). Educational exposure to tamsulosin pharmacology enhanced the confidence of residents with the administration of evidence-based care, tracing the interactive effect of drug-related material added to active learning systems (Wang *et al.,* 2024).

In short, the integration of tamsulosin-based clinical cases in the MDT-PBL training enriched residents' overall clinical knowledge, pharmacologic ability, procedural skill and job satisfaction. This pedagogy reflects the significance of combining intensive drug training with experiential, interdisciplinarity-based learning to maximize resident outcomes and patient safety (Patel *et al.,* 2022; Husnain *et al.,* 2023). Together, our discussion now evidently reveals where our findings aligned with current evidence; we failed to identify areas where our results deviated from the cited studies.

CONCLUSION

This study demonstrates that including tamsulosin pharmacology in a PBL–MDT curriculum increases clinical competence of urology residents. Residents achieved higher competence in pharmacologic knowledge, clinical decision making, patient assessment and BPH management, encompassing drug selection, dose adjustment and monitoring adverse effects. Including drug-specific case studies in active learning allows students to bridge the gap between theoretical and real clinical practice, producing safer, evidence-based and patient-centered care. These findings favor broader application of drug-specific PBL within standardized residency programs for the enhancement of pharmacology education and overall clinical competence. Subsequent studies can test retention on longer time scales and on patient-level health and compare pharmacology modules on other urologic drug classes to extrapolate this approach.

Acknowledgement
Not applicable.

Author’s contributions
Changzheng Zhang and Shang Huang conceptualized and designed the study. Fenglian Jiang and Xiaoyong Pu collected and analyzed the data. Changzheng Zhang drafted the manuscript. All authors critically revised the manuscript and approved the final version for publication.

Funding
This work was supported by the Guangdong Provincial Department of Finance under project number KS0120220271.

Data availability statement

Datasets available from corresponding author on reasonable request; statement

Ethical approval

This study was approved by the Ethics Committee of Guangdong Provincial People's Hospital (Guangdong Academy of Medical Sciences), Southern Medical University, Guangzhou, China (Approval No. GDUPH-2025-041). All procedures were conducted in accordance with the Declaration of Helsinki and informed consent was obtained from all participants.

Conflict of interest

The authors declare no conflicts of interest related to this study.

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