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RESEARCH ARTICLE

Current Challenges and Advances in Urological Practice: A Path Toward Enhanced Patient Outcomes

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ABSTRACT

Background: Urology has quickly progressed with breakthroughs like minimally invasive surgery, robotics, and artificial intelligence, enhancing diagnosis, treatment, and patient care. Nonetheless, unequal access, scarce resources, and insufficient research data persist as significant challenges, particularly in Bangladesh. This stuyd assesses existing progress and obstacles in urological practice and their effects on patient results and healthcare provision. Methods: This cross-sectional study using mixed methods took place in the department of Urology in Bangladesh Medical University from January to December 2025 with 150 participants, comprising both patients and healthcare providers. Data were gathered via questionnaires, interviews, and hospital records, and examined using SPSS and thematic analysis. Ethical consent and informed approval were secured. Results: In this study, older men were more prevalent, with urolithiasis and BPH being the most frequent. Endoscopic surgery had the highest usage, with minimal complications (22.5%) and readmission rates (7.5%). Key obstacles included expense (71.7%) and late presentation (61.7%). Providers indicated shortages in equipment (70%), workforce (66.7%), training (60%), and finances (63.3%). Minimally invasive surgery enhanced results (AOR 2.48), whereas delays and comorbidities deteriorated them. The overall results were positive, yet significant gaps remain. Conclusion: Minimally invasive procedures enhance urological results, whereas late presentation and comorbid conditions degrade them. Nonetheless, shortages in finances, personnel, and equipment continue to be significant obstacles. Enhancing resources and accessibility is crucial for advancing care.

INTRODUCTION

Urology has quickly progressed because of the increasing burden of urological diseases and advancements in technology. It has become a rapidly evolving field increasingly influenced by minimally invasive procedures, robotics, artificial intelligence, and advanced imaging to enhance diagnosis and treatment results [1,2]. Urology increasingly deals with intricate elderly patients, where frailty, comorbidities, and functional condition—not just age—affect surgical risk. This has resulted in a movement towards personalized, risk-oriented care utilizing geriatric evaluations and collaborative decision-making [3,4]. In low- and middle-income countries (LMICs), insufficient access to specialists and advanced technology exacerbates the challenge, underscoring global inequalities and the necessity for urology to harmonize innovation with fair, sustainable care [5,6].

Artificial intelligence is reshaping urology by enhancing diagnosis, forecasting, and treatment strategies, especially in urological cancers. In spite of obstacles such as data inconsistency, restricted validation, and ethical issues, it is anticipated to significantly contribute to improving accuracy and effectiveness in future healthcare [7,8]. Digital health solutions like telemedicine, mobile applications, and remote monitoring have enhanced accessibility, efficiency, and patient satisfaction in urology, particularly post-COVID-19, and are beneficial for managing chronic conditions such as urolithiasis and BPH [9,10]. Digital twins are virtual models of patients that replicate disease and treatment reactions to aid in personalized urological decision-making, yet they remain in development [11].

Even with progress in urology, significant challenges persist, such as unequal access, elevated costs, workforce shortages, and inconsistent expertise impacting results. Emerging technologies such as AI hold promise yet are constrained by bias, poor validation, and ethical issues. In general, numerous innovations do not achieve routine implementation because of economic and infrastructure obstacles, underscoring the necessity for more robust evidence and backing from the health system [12,13].

Research in Bangladesh indicates an increasing prevalence of urological conditions such as prostate cancer and urolithiasis, alongside a gradual enhancement in diagnostic and minimally invasive treatments in tertiary medical facilities [14]. In Bangladesh, urological studies predominantly consist of small, single-center research with inadequate information on long-term results and the practical application of contemporary technologies. There are still gaps in comprehending how limited resources and unequal access influence patient care. This research seeks to assess advancements and obstacles in urological practice and their effects on results to enhance future service provision.

METHODOLOGY

Study Design and Setting

This was a hospital-based cross-sectional analytical study with a mixed-method approach conducted in a Bangladesh Medical University. The study was carried out in the Department of Urology over a period of one year from January 2025 to December 2025. The hospital is a referral center providing comprehensive urological services, including outpatient care, inpatient management, endoscopic procedures, laparoscopic surgery, and open surgical interventions.

Study Population

The study population consisted of two groups: (1) adult patients receiving urological care and (2) healthcare providers involved in urological service delivery.

A total of 150 participants were included, comprising 120 patients and 30 healthcare providers (urologists, resident doctors, and nurses).

Sampling Technique

Consecutive sampling was used. All eligible patients attending the urology outpatient department, inpatient ward, and follow-up clinic during the study period were included until the required sample size was achieved. Healthcare providers were purposively selected based on their

involvement in urological patient management and minimum six months of departmental experience.

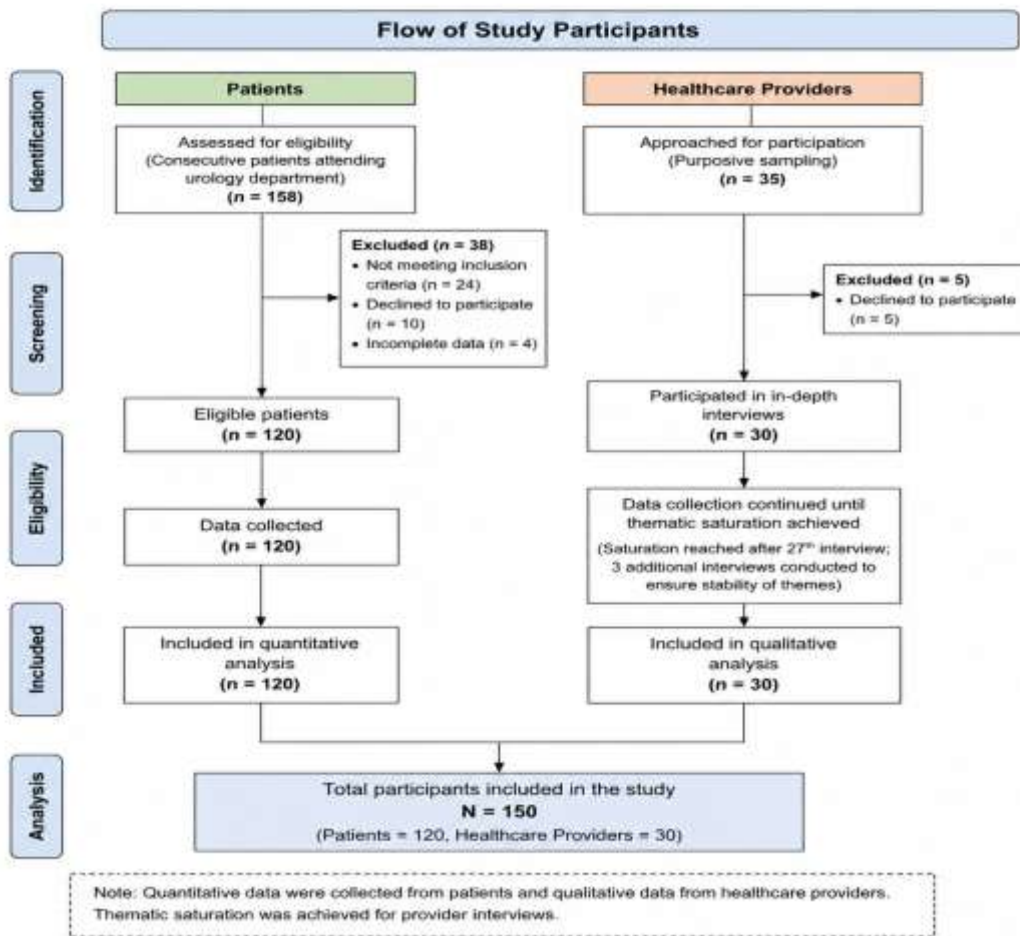

Figure 1: Flow of Study Participants

Data Collection Procedure

Data were collected over 12 months using a pretested semi-structured questionnaire, structured interview guides, and review of hospital medical records. For patients, face-to-face interviews were conducted to collect information on sociodemographic characteristics, clinical presentation, comorbidities, treatment experiences, and satisfaction levels. Clinical data including diagnosis, type of urological disease, type of procedure (open, endoscopic, laparoscopic), perioperative details, complications, duration of hospital stay, and readmission were extracted from hospital records, operation theatre registers, and discharge summaries.

For healthcare providers, qualitative data were collected through in-depth interviews focusing on clinical practice patterns, availability of advanced technologies, workload, training opportunities, and perceived challenges in urological service delivery. Interviews were conducted in a private setting, audio-recorded with consent, and later transcribed for thematic analysis. Data collection continued until thematic saturation was achieved, defined as the point at which no new themes or concepts emerged from consecutive interviews.

Data Quality Assurance

The data collection tool was pretested prior to the study. Daily supervision and verification of collected data were performed to ensure completeness and consistency. Cross-checking with hospital records was done to minimize information bias.

Data Analysis

Quantitative data were analyzed using SPSS version 26.0. Descriptive statistics such as frequency, percentage, mean, and standard deviation were used. Chi-square test and independent t-test were applied for bivariate analysis. Multivariate logistic regression was performed to identify factors associated with patient outcomes. Adjusted odds ratios (AOR) with 95% confidence intervals (CI) were calculated, and $p < 0.05$ was considered statistically significant. Qualitative data from healthcare providers were analyzed using thematic analysis. Transcripts were coded, and recurring patterns were grouped into major themes reflecting systemic and clinical challenges.

Ethical Consideration

Ethical approval was obtained from the Institutional Review Board (IRB) of Bangladesh Medical University. Written informed consent was obtained from all participants. Confidentiality and anonymity were strictly maintained throughout the study.

RESULTS

1. Sociodemographic and Clinical Characteristics of Patients

Table 1 presents the baseline demographic and clinical characteristics of the study participants. Most patients were aged 51–70 years (46.7%), followed by 31–50 years (31.7%), with a smaller proportion above 70 years (14.2%) and only 7.5% aged ≤30 years, indicating a predominance of middle-aged to elderly individuals. The majority were male (76.7%) compared to females (23.3%), showing a clear male predominance. More than half of the participants were from urban areas (57.5%), followed by rural (24.2%) and semi-urban (18.3%) settings. Regarding diagnosis, urolithiasis was the most common condition (32.5%), followed by BPH (25.8%), while prostate cancer (11.7%), bladder tumor (10.0%), and other conditions (20.0%) comprised the remaining cases, indicating that stone disease and prostatic disorders were the leading clinical presentations.

Table 1: Patient Characteristics (n=120)

Variable	Category	n (%)
Age	≤30	9 (7.5)
	31–50	38 (31.7)
	51–70	56 (46.7)
	>70	17 (14.2)
Sex	Male	92 (76.7)
	Female	28 (23.3)
Residence	Urban	69 (57.5)
	Semi-urban	22 (18.3)
	Rural	29 (24.2)
Diagnosis	Urolithiasis	39 (32.5)
	BPH	31 (25.8)
	Prostate cancer	14 (11.7)
	Bladder tumor	12 (10.0)
	Others	24 (20.0)

2. Treatment Pattern and Outcomes

Table 2 shows the distribution of treatment modalities and clinical outcomes among the study participants. The most commonly performed procedure was endoscopic surgery (47.5%), followed by open surgery (35.8%) and laparoscopic procedures (16.7%), indicating a preference for minimally invasive approaches. Postoperative complications were observed in 22.5% of patients, while the majority (77.5%) had no complications. Readmission was relatively low, occurring in 7.5% of cases, whereas 92.5% did not require readmission, suggesting generally favorable short-term outcomes following treatment.

Table 2: Treatment Pattern and Outcomes (n=120)

Variable	Category	n (%)
Procedure type	Open	43 (35.8)
	Endoscopic	57 (47.5)
	Laparoscopic	20 (16.7)
Complication	Yes	27 (22.5)
	No	93 (77.5)
Readmission	Yes	9 (7.5)
	No	111 (92.5)

3. Patient-Reported Barriers

Table 3 illustrates the major challenges faced by patients during their care pathway. The most frequently reported issue was high treatment cost (71.7%), followed by delayed presentation to healthcare facilities (61.7%). More than half of the patients (52.5%) reported difficulty accessing specialist care. Other notable challenges included poor follow-up compliance (40.8%) and transportation problems (34.2%).

Table 3: Patient-Reported Challenges (n=120)

Challenge	n (%)
High treatment cost	86 (71.7)
Delayed presentation	74 (61.7)
Difficulty accessing specialist care	63 (52.5)
Poor follow-up compliance	49 (40.8)
Transportation issues	41 (34.2)

4. Healthcare Provider Perspectives (Qualitative Findings)

Table 4 presents the frequency of major themes identified from healthcare provider interviews. A total of 30 healthcare providers (urologists, residents, and nurses) participated in in-depth interviews. Analysis of qualitative data revealed four major thematic areas of challenges in urological practice. Data saturation was reached after the 27th interview; however, three additional interviews were conducted to confirm stability of themes.

Theme 1: Limited Advanced Urological Technology

Most participants reported inadequate availability of modern endourological and minimally invasive equipment, which limited optimal patient care (70.0%).

"We still depend heavily on open surgery because advanced endoscopic instruments are not always available." (Senior resident)

Theme 2: Workforce Shortage and High Workload

Healthcare providers described excessive workload and insufficient staffing, affecting service quality (66.7%).

"One doctor has to manage too many patients in OPD and emergency, which reduces quality time per patient." (Consultant urologist)

Theme 3: Training Gaps in Minimally Invasive Surgery

Participants highlighted insufficient structured training in minimally invasive urology. Lack of structured training programs was frequently reported (60.0%).

"We need more hands-on training for laparoscopic and endoscopic procedures; otherwise, skill development is slow." (Resident doctor)

Theme 4: Financial and System Barriers

Providers emphasized that many patients cannot afford advanced treatment and often present late (63.3%).

"Most patients come very late because of cost issues and lack of awareness." (Nurse)

Table 4: Quantification of Qualitative Themes

Theme	Frequency (n/30)	%
Limited advanced equipment	21	70.0
Workforce shortage	20	66.7
Financial/system barriers	19	63.3
Training limitations	18	60.0

5. Outcome Association (Multivariate Analysis)

Table 5 shows the factors associated with patient outcomes. Minimally invasive surgery was significantly associated with better outcomes (AOR 2.48, p=0.011). In contrast, delayed presentation (AOR 0.44, p=0.022) and presence of comorbidities (AOR 0.63, p=0.041) were significantly associated with poorer outcomes. However, age above 50 years (p=0.221) and female sex (p=0.229) were not statistically significant predictors of outcome. Overall, the findings suggest that surgical approach, timely presentation, and comorbidity status are important determinants of patient outcomes.

Table 5: Factors Associated with Patient Outcomes

Variable	AOR	95% CI	p-value
Minimally invasive surgery	2.48	1.22–5.05	0.011
Delayed presentation	0.44	0.21–0.89	0.022
Comorbidities	0.63	0.31–0.98	0.041
Age (>50 years)	0.62	0.28–1.35	0.221
Female sex	0.58	0.24–1.41	0.229

6. Integrated Findings

Overall, the study demonstrated that minimally invasive urological procedures were associated with better clinical outcomes, shorter hospital stay, and fewer complications. However, both patient and provider perspectives highlighted persistent barriers including financial constraints, delayed presentation, workforce shortage, and limited access to advanced technology in a tertiary care setting.

DISCUSSION

In this study, the most prevalent urological conditions were urolithiasis and BPH, primarily impacting males, especially those between 51 and 70 years old, with a larger share from urban regions. These results align with the work of Banik and Ghosh et al., (2021). They found a pattern that matches established epidemiological trends, showing that stone disease and prostatic enlargement are more prevalent in older males and are affected by factors such as lifestyle, aging, and disparities in healthcare access [15].

Endoscopic surgery was the most prevalent, followed by open and laparoscopic, exhibiting low complication and readmission rates. These results coincide with Md A et al., (2018) who stated that endoscopic techniques are safe and efficient, enhancing perioperative results and lowering complications [16].

In this study, significant obstacles included high expenses, late presentation, challenges in reaching specialists, inadequate follow-up, and transportation problems. Comparable obstacles in low-resource environments have been extensively documented in global surgical literature, were financial limitations and restricted access to specialized care result in postponed treatment and inferior outcomes. These insights underscore that non-medical factors greatly impede prompt urological care [17,18].

Providers identified significant obstacles such as insufficient equipment, workforce deficits, lack of proper training, and budget limitations. These results coincide with Zhang et al., (2025) who indicated that healthcare professionals encounter comparable challenges related to resources, training, and systems when implementing urinary care technologies. Ultimately, enhancing infrastructure and training is essential for advancing the delivery of urological care [19].

Minimally invasive surgery enhanced results, whereas delayed presentation and comorbidities deteriorated results. In alignment with Patel et al., (2015) urologic complications are significantly affected by patient comorbidities and the severity of the disease, while minimally invasive methods lessen complications and enhance results. Generally, both the surgical technique and patient-related factors are crucial influencers of outcomes [20].

Overall, minimally invasive procedures enhance urological results, although patient factors and healthcare system obstacles continue to be major influences on overall clinical outcomes.

CONCLUSION

The study shows that minimally invasive urological techniques lead to better patient outcomes, whereas late presentation and comorbid conditions adversely impact results. Even with generally positive clinical results, major obstacles remain, such as budget limitations, postponed healthcare access, and a lack of skilled personnel and modern technology. Enhancing resources, education, and availability of prompt urological care is crucial to advance outcomes further.

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