Revolutionizing Urinary Care: Healthcare Professionals' Perspectives on Wearable and Remote Technologies for Enhanced Patient Outcomes

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Abstract

Background: Urinary issues pose a significant burden on healthcare systems, necessitating innovative solutions to enhance patient care and alleviate provider workload. This study investigates healthcare providers' perceptions of urinary issues and the acceptability of technology in managing these conditions.

Objective: The objective of this study was to explore healthcare professionals' perceptions of urinary issues and assess their acceptance and readiness to adopt wearable and remote technologies for managing these conditions. The study aimed to identify the attributes and barriers influencing technology integration in clinical practice, utilizing established theoretical frameworks such as the Health Belief Model (HBM), Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), and Innovation Diffusion Theory (IDT).

Methods: A cross-sectional mixed methods study was conducted. A structured survey questionnaire was administered online to a sample of 256 healthcare professionals recruited through social media and personal networks. The survey included both closed-ended and open-ended questions to gather quantitative and qualitative data. Quantitative data were analyzed using descriptive statistics and multiple regression, while qualitative responses were subjected to reflexive thematic analysis.

Results: Quantitative analysis revealed strong correlations between belief agreement and factors such as health literacy (r=0.591), perceived burden (r=0.628), device attributes (r=0.650), and support services (r=0.622). Multiple regression analysis identified perceived workload (?=0.288, P=.036), device attributes (?=0.339, P<.001), and integrating technology (?=0.344, P<.001) as positively associated with belief agreement, while importance (?=-0.297, P=.011) showed a negative correlation. The survey demonstrated strong internal consistency with a Cronbach's alpha of 0.954, indicating high reliability in measuring healthcare professionals' perceptions of urinary issues and technology adoption. Qualitative analysis identified four major themes: Technology & Innovation in Patient Care, Barriers to Technology Adoption, Importance of Training and Support, and Workflow Integration. Belief agreement is the agreement with the perception that technology is efficient, their confidence in its integration, patient acceptance, its transformative potential, and the value of investing in technological solutions for managing urinary issues.

Conclusions: Healthcare workers' acceptance of technology in managing urinary issues is influenced by factors such as perceived workload, device attributes, and the ease of integrating technology into existing workflows. Addressing barriers to technology adoption, providing comprehensive training and support, and prioritizing user-centered design are crucial for successful technology integration. Future research should focus on longitudinal studies and explore the perspectives of patients and other stakeholders to gain a more holistic understanding of technology integration in urological care. Clinical Trial: N/A

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Revolutionizing Urinary Care: Healthcare Professionals' Perspectives on Wearable and Remote Technologies for Enhanced Patient Outcomes

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Keywords: Wearable Technology, Remote Technology, Urinary Issues, Healthcare Professionals, Technology Acceptance, mHealth, eHealth, Urology, Nursing, Innovation Diffusion, Health Belief Model (HBM), Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of

Technology (UTAUT), Workflow Integration, Patient Outcomes, Survey Research, Mixed Methods Research, Perceived Workload, Device Attributes, Urinary Tract Infection (UTI), Urinary Incontinence (UI)

Introduction

Urinary issues are pervasive in healthcare across multiple settings. Common urinary issues encountered by healthcare professionals include conditions such as urinary tract infection (UTI), urinary incontinence (UI), benign prostatic hyperplasia (BPH), and urinary retention (UR). The prevalence of these conditions is staggering. As of 2021, there were an estimated 4.49 billion cases of UTIs globally, representing a 66.45% increase since 1990 (He et al., 2025). The age-standardized incidence rate (ASIR) was 5,531.88 per 100,000 population, with women and older adult men experiencing the highest incidence. Approximately 20 million American women and 6 million American men experience urinary incontinence at some point in their lives, with prevalence increasing with age. In women over 30, stress incontinence affects 24 to 45 percent[1]. The significance of addressing urinary issues is multifaceted. Clinically, UTIs are the second most common type of infection in older adults, potentially leading to serious complications such as kidney failure and even death if left untreated. These conditions impose a heavy burden on patients as well as caregivers, influencing workflow management in healthcare settings. Economically, the impact is substantial. The annual economic burden of urinary incontinence alone is projected to reach $90.9 billion by 2030 if no action is taken[2].

The staggering prevalence of urinary issues underscores the critical need for innovative solutions in healthcare. As we find ourselves in an era of rapid technological advancement, the integration of technology into medical practice has become not just beneficial, but necessary, especially when confronting such widespread health concerns.

Technology integration in healthcare has emerged as a key driver in improving patient care and operational efficiency. With the increasing complexity of healthcare delivery, standalone systems are no longer sufficient to address the multifaceted challenges posed by conditions like UTIs and urinary incontinence. The integration of various healthcare technologies offers a holistic approach to patient care, enabling seamless communication between different systems and departments. In the context of urinary health, technological advancements have led to the development of innovative tools and approaches. By leveraging technology integration, healthcare workers can streamline operations, reduce administrative burdens, and focus more on delivering high-quality patient care. This approach is essential in tackling the growing prevalence of urinary conditions and improving overall healthcare efficiency.

How Technology Can Help

Technology offers promising solutions for managing urinary issues more effectively. Electronic alerts in electronic health records have been shown to significantly reduce catheter-associated urinary tract infections (CAUTIs). Researchers have developed mobile uroflowmetry technology and urination log apps that use AI and acoustic analysis to assist in diagnosing urinary diseases[3]. Wearable sensing devices and IoT technologies can collect and analyze urination information for personal healthcare services and disease management. Overall, the use of easy-to-operate sensing technology is currently underutilized in addressing these common issues.

Our study addressed wearable and remote sensing technologies for urinary issues, however, we also addressed general healthcare technology exposure and acceptability. This approach allowed us to gain a comprehensive understanding of healthcare providers' perceptions and readiness to adopt new technologies in their practice and the attributes of those technologies. The survey explored healthcare

providers' exposure to various technologies, both specific to urinary care and in general healthcare settings. This helped us assess their familiarity with different technological solutions and how this exposure might influence their acceptance of new technologies.

Factors Impacting Technology Acceptance

Previous research has found that technology is more likely to be accepted if there are fewer financial constraints, appropriate training, proper integration into current systems, and adequate technical support[4]. However, barriers to technology adoption include cost, efficient implementation and integration, and effective training. Broader considerations such as resistance to change and lack of workflow integration can also impact the efficiency of work and technology adoption.

Addressing Gaps and Research Goals

This study aims to fill gaps in previous research by investigating healthcare providers' perceptions of urinary issues and exploring the utilization of technology for managing these issues. The research questions are:

1. How do healthcare providers perceive urinary issues, and what are their views on utilizing technology for managing these issues?
2. What is the level of acceptance and readiness among healthcare providers toward adopting healthcare technology for treating and managing urologic issues?
3. What attributes and barriers influence the clinical integration and utility of healthcare technologies for urinary issue management?

By addressing these research questions through a cross-sectional survey, the study seeks to understand the major barriers and facilitators identified by healthcare workers across multiple healthcare settings. This understanding will help facilitate the adoption of new technology, ultimately improving patient care and reducing the burden of urinary issues on healthcare systems. This study aims to investigate healthcare providers' perceptions of urinary issues and explore the utilization of technology for managing these conditions. The research employs a comprehensive survey designed to capture healthcare workers' views across multiple healthcare settings. The survey was developed through a rigorous process, beginning with an extensive literature review to identify key themes and gaps in current knowledge. This was followed by consultations with subject matter experts in urology, nursing, and health technology to ensure the survey's content validity.

Theoretical Underpinnings

This study employs four prominent theoretical frameworks to understand and predict the adoption of health technologies for managing urinary issues: the Health Belief Model (HBM), the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), and the Innovation Diffusion Theory (IDT).

The Health Belief Model, originally developed to explain health behaviors, focuses on individuals' perceptions of health risks and the benefits of taking action. It has been successfully applied to understand preventive behaviors in urinary tract infections and other health contexts[5].

The Technology Acceptance Model, particularly its extended versions, emphasizes perceived usefulness and perceived ease of use as key determinants of technology adoption. TAM has been widely used to investigate the acceptance of digital health technologies among healthcare professionals and patients[6].

The Unified Theory of Acceptance and Use of Technology integrates elements from various technology acceptance models. In healthcare settings, UTAUT has demonstrated that performance expectancy is a strong predictor of intention to use mobile health technologies[7].

Innovation Diffusion Theory (IDT), developed by Everett Rogers, explains how new ideas or technologies spread within a social system over time. In healthcare, IDT has been applied to understand the adoption of various technologies, considering factors such as relative advantage, compatibility, and complexity[8].

These theories provide complementary perspectives on technology adoption in healthcare settings, offering a comprehensive framework for understanding and promoting the acceptance of urinary health technologies among both patients and healthcare workers.

Methods

A cross-sectional study was conducted utilizing a structured survey questionnaire developed to collect data from a variety of healthcare professionals including nurses, physicians, nurse practitioners, and other patient-facing professionals. The survey included both closed-ended and open-ended questions to capture a wide range of perspectives and experiences. Pilot testing was conducted with a small group of healthcare workers to refine the survey's clarity, relevance, and ease of use. The final survey instrument covers a range of topics, including healthcare workers' experiences with urinary issues, their attitudes towards various technologies for urinary management, perceived barriers and facilitators to technology adoption, and demographic information. By administering this carefully crafted survey, the study seeks to provide valuable insights into the current landscape of urinary care and the potential for technological interventions to improve patient outcomes and healthcare efficiency

This study employed reflexive thematic analysis to examine responses to open-ended survey questions[9,10]. This approach was chosen for its flexibility and ability to capture nuanced meanings within qualitative data without relying on quantification.

Recruitment

For this study, participants were recruited through a combination of social media platforms, specifically Reddit, and personal networks. The recruitment process aimed to gather a diverse sample representative of the target population.

Reddit, a widely used online forum and community platform, was utilized for recruitment to reach a broad and varied demographic. The research team identified relevant subreddits that aligned with the survey’s topic, ensuring a population with interests and experiences related to the study. Recruitment posts were created, which included a brief description of the survey's purpose, eligibility criteria, estimated time commitment, and a link to the survey. To maximize visibility and engagement, posts were shared in multiple subreddits, and follow-up comments were provided to address questions and encourage participation. In some cases, moderators of specific subreddits were contacted in advance to ensure that the study met subreddit guidelines and was not perceived as spam.

In addition to Reddit, recruitment was extended through the research team's personal networks, including professional and academic connections. Invitations were sent via email, direct messaging, and personal referrals to individuals who met the study's eligibility criteria. These communications contained details of the survey, emphasizing confidentiality, voluntary participation, and potential benefits. To promote a snowball sampling effect, participants were encouraged to share the survey link with individuals in their networks who might be eligible to participate.

Ethical Considerations

The study was conducted in compliance with ethical guidelines and was approved by the Institutional

Review Board (IRB) of San Jose State University. Prior to recruitment and data collection, all study procedures were reviewed and determined to meet the ethical standards for research involving human participants.

Data Collection and Analysis

The survey will be administered online using a Qualtrics survey platform, with an estimated completion time of 15 minutes per participant.

Statistical analyses were conducted using SPSS. Descriptive statistics, including means, standard deviations, frequencies, and percentages, were used to summarize participant demographics and key survey variables. To compare differences in perceptions across demographic groups, independent sample t-tests were performed for binary variables (e.g., gender) and one-way ANOVA for categorical variables with more than two groups (e.g., age groups, professional roles).

To examine associations between healthcare providers' perceptions of urinary issues and their acceptance of technology, Pearson's correlation coefficients were calculated. Additionally, multiple linear regression analyses were conducted to assess predictors of technology acceptance, with independent variables including perceived usefulness, ease of use, financial constraints, and institutional support.

Cronbach's alpha was computed to assess the internal reliability of survey subscales, with a threshold of 0.70 considered acceptable for reliability.

Responses to open-ended questions were collected from survey participants (N =256). These responses were compiled into a single document, with identifying information removed to maintain participant anonymity. The analysis followed reflexive thematic analysis methodology from Braun and Clark[10]. This methodology began with a thorough reading and re-reading of all survey responses. During this phase, initial observations and potential areas of interest were noted, allowing for a deep engagement with the data.

Following familiarization, initial codes were generated inductively from the data. This process involved identifying and labeling relevant features of the responses that appeared interesting or meaningful in relation to the research questions. Codes were created and modified throughout the analysis as new insights emerged. As coding progressed, potential themes were identified by examining the codes and considering how they might combine to form broader patterns of meaning. These initial themes were reviewed and refined, with attention paid to their internal homogeneity and external heterogeneity. Themes were then reviewed in relation to the coded extracts and the entire dataset. This process involved checking that the themes worked in relation to both the coded data extracts and the full dataset. Themes were refined, split, combined, or discarded as necessary to ensure they accurately reflected the data. Each theme was then clearly defined and named. This step involved identifying the essence of what each theme was about and determining what aspect of the data each theme captured. Detailed analyses were written for each theme, considering how it fits into the broader overall story in relation to the research questions. The final phase involved weaving together the analytic narrative and data extracts to tell a coherent and persuasive story about the data. This narrative was contextualized in relation to existing literature. Throughout the analysis process, several strategies were employed to enhance the trustworthiness of the finding including reflexivity, thick and rich description, peer debriefing and research team review. Upon completion of the analysis, the findings were presented to a research team for critical examination as well as iterative check-ins for peer debriefing. Their feedback was incorporated to enhance the credibility and depth of the analysis[9,10].

Measurement

The survey questions were developed using Unified Theory of Acceptance and Use of Technology (UTAUT), Innovation Diffusion Theory (IDT) and health belief model. The core tenets of these theories were used to identify a list of barriers, facilitators, and facets of acceptability for assessment in this survey.

The survey questions were developed using validated constructs from the Unified Theory of Acceptance and Use of Technology (UTAUT), the Technology Acceptance Model (TAM) and the Health Belief Model (HBM) to assess factors influencing acceptance of technology for caregiver working with patients with urinary concerns.

UTAUT constructs measured were performance expectancy, the extent to which individuals believe that using the technology/surgery will improve health outcomes; effort expectancy, the perceived ease or difficulty of adopting the technology; and social influence, the impact of peers or medical professionals on the individual's decision. Each construct was assessed using a Likert scale (e.g., 1 = Strongly Disagree to 7 = Strongly Agree), adapted from the validated UTAUT questionnaire[11].

HBM constructs measured were perceived severity, the perceived seriousness of the health condition requiring intervention (urinary issues in the case of this survey); perceived benefits, the extent to which the individual believes the intervention will be beneficial (technology); perceived barriers, concerns about risks, cost, accessibility, cues to action, and external factors (e.g., physician recommendations, peer experiences) influencing decision-making. HBM variables were assessed using a validated questionnaire adapted from Champion and Skinner's study[12].

We utilized Innovation Diffusion theory (IDT) to develop a question measuring the perceptions of innovation adoption specifically looking at attributes of technology effectiveness and receptiveness of technology[13]. Specific likert scale questions came from a study by Rogers et al.[14].

For clarity, we defined each of the variables in the statistical analysis and related those constructs to the questions in the survey and the model as associated surveys that questions were associated with (*Table 1*). Additionally, Belief agreement is the agreement with the perception that technology is efficient, their confidence in its integration, patient acceptance, its transformative potential, and the value of investing in technological solutions for managing urinary issues.

Table 1: Variable Definitions and Construct Triangulation

Variable	Definition	Framework
Health Literacy	The extent to which healthcare professionals understand and apply information about urinary health and related technologies.	HBM
Perceived Burden	The level of difficulty or inconvenience healthcare workers associate with managing urinary issues or adopting new urinary technologies.	UTAUT

Perceived Workload	The extent to which healthcare professionals believe that integrating urinary technology will increase their clinical responsibilities.	UTAUT
Frequency	How often healthcare professionals encounter patients with urinary concerns or use urinary technologies in practice.	IDT
Continuous Benefit	The ongoing advantages perceived by healthcare workers in adopting urinary technology for patient care.	TAM
Bladder Volume	The estimated or measured urine volume in the bladder, as assessed through various methods such as ultrasound or bio-impedance sensors.	HBM
Attribute Device	The specific features of urinary technology that healthcare workers consider important when evaluating its usefulness.	TAM
Importance	The priority healthcare workers assign to bladder health management and the role of technology in improving patient outcomes.	HBM
Concern Level	The degree of apprehension or hesitation healthcare workers have regarding the adoption of urinary technology.	HBM
Patient Receptiveness	The willingness and openness of patients to use urinary technology as part of their healthcare routine.	IDT
Integrating Tech	The feasibility and ease with which healthcare workers can incorporate bladder-monitoring technology into their workflow.	UTAUT
Support Services	The availability of technical assistance, training, and resources needed to facilitate the implementation of urinary-related technology in clinical settings.	UTAUT

Results

Quantitative Results

Reliability

To assess the internal consistency of the survey instrument, Cronbach's alpha was calculated for the Likert-scale questions (excluding demographic and open-ended responses). The analysis yielded a Cronbach's alpha of 0.954, indicating excellent internal reliability. This suggests that the survey items measuring healthcare professionals' perceptions of urinary issues and technology adoption were highly consistent in capturing the intended constructs.

Quantitative Results

Of the 256 respondents, 94 (36.7%) identified as male, 155 (60.5%) as female, 3 (1.2%) as non-binary/third-gender, 4 (1.6%) as self-described or preferred not to state. The mean age is 36.37 (ranging from 22 to 75) years with a standard deviation of 8.39 years. The majority of respondents were physicians (66.8%), registered nurses (16.4%) and allied health professionals (6.6%).

Table 2. Correlation between independent variables and the belief agreement

Variable	r	M	SD	*P*
Health Literacy	0.591	29.285	6.890	<.001
Perceived Burden	0.628	73.549	18.546	<.001
Perceived Workload	0.618	68.995	18.673	<.001
Frequency	0.497	46.714	8.108	<.001
Continuous Benefit	0.617	42.446	10.425	<.001
Bladder Volume	0.611	31.042	5.520	<.001
Attribute Device	0.650	46.403	9.514	<.001
Importance	0.572	38.436	10.614	<.001
Concern Level	0.351	30.895	5.046	<.001
Patient Receptiveness	0.612	32.615	7.912	<.001
Integrating Tech	0.479	25.321	4.393	<.001
Support Services	0.622	30.823	5.697	<.001

Table 3. Coefficients of independent variables (n = 226) in the multiple regression model of belief agreement

Variable	SE	β	t	*P*
Health Literacy	0.44	0.042	0.485	.628
Perceived Burden	0.023	0.101	0.799	.425
Perceived Workload	0.025	0.288	2.110	.036
Frequency	0.032	-0.046	-0.633	.527
Continuous Benefit	0.035	0.057	0.530	.596

Bladder Volume	0.050	0.029	0.349	.728
Device Attribute	0.034	0.339	3.458	<.001
Importance	0.037	-0.297	-2.557	.011
Concern Level	0.041	-0.030	-0.491	.624
Patient Receptiveness	0.039	0.077	0.865	<.001
Integrating Tech	0.050	0.344	5.252	<.001
Support Services	0.049	0.064	0.754	.452
Age	0.023	-0.035	-0.696	.487
Gender	0.294	-0.037	-0.759	.448
Occupation	0.089	0.053	0.954	.341

*b = coefficient. Covariates controlled in the model

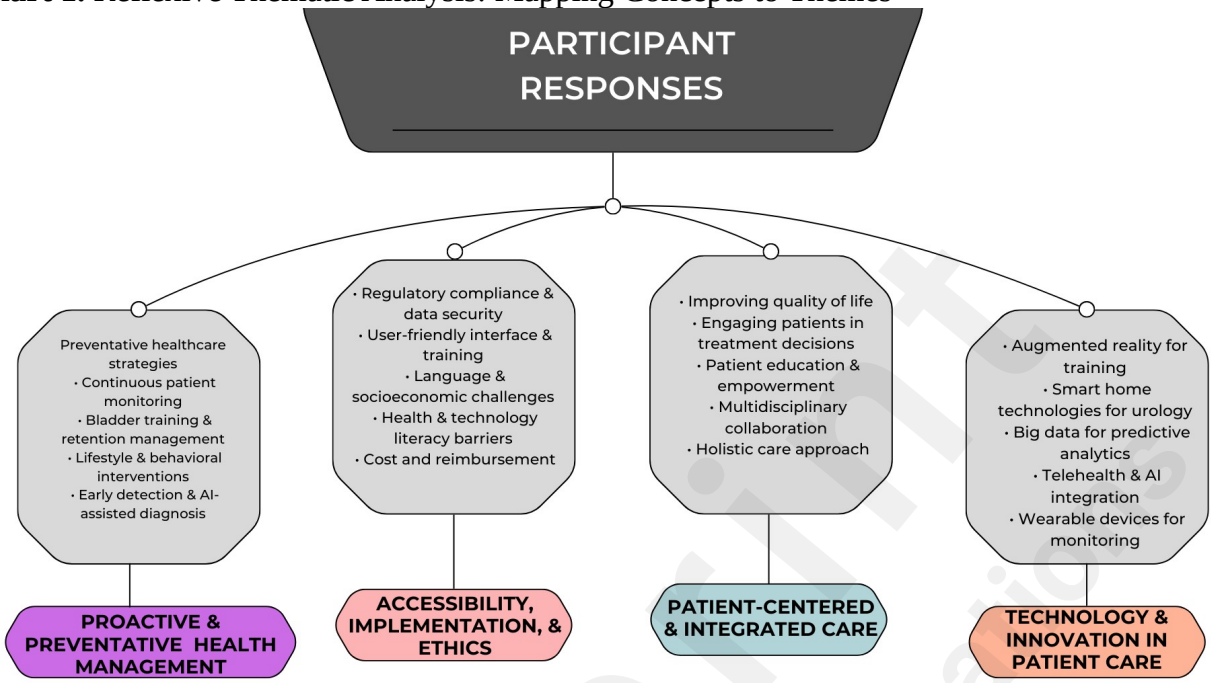
The bivariate analysis (*Table 2*) indicated health literacy (r=0.591, <.001), perceived burden (r=0.628, <.001), perceived workload (r=0.618, <.001), continuous benefit (r=0.617, <.001), bladder volume (r=0.611, <.001), device attribute (r=0.650, *P*=<.001), patient receptiveness (r=0.612, *P*=<.001), and support services (r=0.622, *P*=<.001), and to have a strong correlation to belief agreement.

The multiple regression analysis (*Table 3*) shows the correlation between the independent variables and belief agreement. Perceived workload (β=0.288, *P*=.036), device attributes (β=0.339, *P*= < .001), and integrating technology (β=0.344, *P*= < .001) are positively associated. Importance (β= -0.297, *P*=.011) was negatively correlated with belief agreement.

Qualitative Results

Using reflexive thematic analysis, the data were coded (Chart *1*) and these codes led to the development of four major themes that were identified from the open-ended responses of the survey questions.

Chart 1. Reflexive Thematic Analysis: Mapping Concepts to Themes



**Technology & Innovation in Patient Care → Orange; Patient-Centered & Integrated Care → ◯ Blue; Accessibility, Implementation, & Ethical Considerations → ◯ Red; Proactive & Preventative Urological Health Management → Purple*

The first theme is *Technology & Innovation in Patient Care*. This theme captures the specific technologies being applied, their role in diagnostics, treatment, and monitoring, as well as broader trends like data analytics and advancements in medical devices. This encompasses the specific technologies mentioned (AI, wearables, telemedicine, robotics, 3D printing, smart devices) and their applications in diagnostics, treatment, monitoring, and training. It also includes data analytics, cloud computing, and advances in medical devices and therapies. Participants acknowledged that technology is becoming an integral part of patient care with new technology coming about quickly, they stated "New technology is coming out fast and furious. This will be great for patients who do not want surgical options due to age or comorbidities." Multiples participants emphasized the use of wearable devices and remote technologies for monitoring health issues as a major trend stating "Wearable devices and mobile apps can track patients' urinary patterns and other relevant metrics in real-time, allowing doctors to adjust treatment plans promptly" and "Wearable devices and smart home technologies could allow for continuous monitoring of urinary patterns, hydration levels, and symptoms, providing real-time feedback to both patients and healthcare providers." Finally other non-invasive technologies were mentioned as allowing early detection of serious health issues with a participant stating "Advances in imaging technologies and biomarkers may lead to more accurate and non-invasive diagnostic methods, allowing for earlier detection of urinary conditions."

Theme two was identified as *Patient-Centered & Integrated Care*. This combines the themes of patient engagement, holistic care, multidisciplinary approach, and addressing stigma/mental health. It emphasizes personalized treatment, patient education, empowerment, and the importance of considering the psychological and social aspects of health. “Effective management of urinary issues

often requires a team approach, involving urologists, primary care physicians, nurses, and sometimes mental health professionals, particularly for conditions like incontinence that can affect emotional well-being." The idea that urinary issues are complex and require a multifaceted approach was addressed. It was stated that "Urinary issues often have physical, psychological, and social components. A holistic management plan that addresses all these aspects can improve patient outcomes and quality of life." Other participants acknowledged that education and tailoring care are important for positive outcomes stating "Engaging patients in their own care decisions and tailoring treatments to their individual needs can lead to better adherence and satisfaction." and "Increasing awareness about urinary health issues can help reduce stigma and encourage patients to seek help sooner. Educational programs can empower patients with information on prevention and management strategies".

The third theme that was identified was *Accessibility, Implementation, & Ethical Considerations*. This encompasses the challenges and barriers to technology adoption, including cost, health equity, digital literacy, data security/privacy, and the need for user-friendly interfaces, training, and validation. It also highlights the importance of vendor reliability and support. Participants identified cost as a major concern and specifically emphasized the importance of reimbursement stating "To get our providers on board there has to be good reimbursement, ease of use (for providers and patients), and the data needs to be easy to access and interpret"; “Biggest concern, as always, is funding and reimbursement. Insurance companies dictate what is best for any patient or any patient-facing healthcare worker”: "Accessibility and reimbursement (are the biggest facilitators of technology adoptions)" and "Money, money, money, and staffing (again are the biggest facilitators of technology adoption) ". Finally, participants emphasize ease of use, and health literacy stating "Health literacy, technology literacy, affordability (for both patients and the hospital/clinic that I work for), language barriers" and "Technologies must be intuitive and user-friendly for both patients and providers. This helps ensure smooth adoption and minimizes frustration".

The fourth and final theme identified from the open-ended questions was *Proactive & Preventative Urological Health Management*. This consolidates the themes of prevention, early diagnosis, regular check-ups, and long-term management of chronic conditions. It emphasizes the importance of early intervention, lifestyle modifications, and continuous monitoring to improve outcomes and quality of life. Some healthcare professionals felt more frequent monitoring in home settings could be useful stating "I believe that monitoring bladder volume more regularly at home would give us much better information to base results on than just the occasional post void residual when at the clinic or in the hospital” and "Wearable devices and smart home technologies could allow for continuous monitoring of urinary patterns, hydration levels, and symptoms, providing real-time feedback to both patients and healthcare providers." Summary of all themes can be seen in *Table 4*.

Table 4: Qualitative Reflexive Thematic Analysis Results

Theme	Description	Key Findings
Patient-Centered & Integrated Care	Emphasizes patient engagement, holistic care, multidisciplinary collaboration, and addressing mental health and stigma in urinary care.	Patient education programs help reduce stigma and improve adherence to treatments; holistic management enhances outcomes.

Technology & Innovation in Patient Care	Explores specific technologies in patient care, such as AI, wearables, telemedicine, and their roles in diagnostics, treatment, and monitoring.	Wearable devices and mobile apps enhance real-time monitoring; smart home technologies enable continuous tracking of urinary patterns.
Proactive & Preventative Urological Health Management	Focuses on early diagnosis, lifestyle modifications, continuous monitoring, and long-term management of chronic urinary conditions.	Frequent bladder volume monitoring at home supports early detection; non-invasive technologies improve patient outcomes.
Accessibility, Implementation, & Ethical Considerations	Identifies barriers to technology adoption, including cost, health equity, digital literacy, data security, training needs, and vendor reliability.	Financial constraints and reimbursement are primary concerns; usability and health literacy influence adoption rates.

Discussion

Principle Results

The findings of this study highlight key factors influencing belief agreement regarding the implementation of bladder monitoring and urinary technology. The bivariate analysis demonstrated strong correlations between belief agreement and multiple factors, including health literacy, perceived burden, perceived workload, continuous benefit, bladder volume, device attributes, patient responsiveness, and support services. These relationships suggest that both individual and systemic factors play significant roles in shaping attitudes toward integrating bladder monitoring technologies.

The strong relationship between health literacy shows that healthcare professionals with higher health literacy are more likely to agree with the belief that technology is beneficial for managing urinary issues. This suggests that understanding urinary conditions and available technological solutions fosters confidence in their integration and use. Those who can interpret and apply health information effectively may also be more open to adopting new tools. The relationship with perceived burden demonstrated that healthcare professionals who experience a higher burden when managing urinary issues tend to support technology adoption more strongly. This makes sense, if urinary care is seen as challenging and time-consuming, tools that could ease this burden (such as wearable bladder sensors) are more appealing. Regarding workload, the relationship between workload and agreement shows that those who perceive their workload as high may recognize the potential of technology to reduce clinical burdens. Additionally, If healthcare professionals also see continuous, long-term advantages of using urinary technology (such as ongoing patient monitoring, reduced complications, and better data collection), they are more likely to support its implementation. The correlation between bladder volume and belief agreement likely stems from the perceived need for accurate, non-invasive bladder monitoring. Those who frequently assess bladder volume may see the value in advanced technology for continuous or more accessible measurement. The strongest correlation in the bivariate analysis was the relationship to device attributes. This means that the more healthcare professionals perceive the device as having useful and effective features (such as ease of use, accuracy, or integration with existing workflows), the more they agree

that technology is beneficial for urinary care. This indicates that the attributes of the device play a crucial role in acceptance. Regarding patient receptiveness, this indicates that if healthcare professionals feel that patients will be receptive towards technology, they are more likely to accept it. Finally, support services are essential. The bivariate analysis suggests that without adequate support, healthcare professionals are less likely to accept technology and have concerns about failures of the technology. The strongest relationships were found with device attributes, perceived burdens, and support services, which means that the design and usability of the device, the urgency of addressing urinary care burdens, and the availability of technical assistance are key determinants in acceptance.

The multiple regression analysis further refined these associations, identifying perceived workload, device attributes, and technology integration as significant positive predictors of belief agreement. This suggests that when a device is perceived as having favorable attributes and is seamlessly integrated into existing workflows, belief agreement toward its use increases. Additionally, perceived workload was positively associated with belief agreement, which may indicate that healthcare professionals recognize the potential of such technologies to alleviate their clinical burden by improving efficiency and patient management.

Interestingly, importance was negatively correlated with belief agreement. This inverse relationship could be related to several factors. Studies have shown that healthcare professionals often exhibit mixed attitudes toward new health information technologies. For instance, research indicates that while there is acknowledgment of the potential benefits of health information technology, barriers such as limited access to necessary infrastructure, insufficient training, and concerns about system reliability can lead to skepticism and reduced adoption rates[15,16]. Moreover, the Technology Acceptance Model (TAM) highlights that perceived usefulness and ease of use are critical factors influencing technology adoption. When healthcare professionals question the usability or reliability of a new system, even if they understand its importance, they may be less inclined to integrate it into their practice[17,18,19].

The rapid advancement of continuous health monitoring devices has raised questions about data privacy, the potential for information overload, and the psychological impact on both patients and healthcare professionals. These factors can contribute to a cautious approach toward adopting new monitoring technologies, despite their perceived importance[20].

Qualitative analysis of open-ended survey responses revealed four major, interconnected themes shaping healthcare professionals' perceptions of technology in urinary care. Firstly, a broad recognition exists regarding the necessity of Technology & Innovation in Patient Care, with participants highlighting technology's potential to enhance diagnostic accuracy, personalize treatment, and improve patient outcomes. However, this optimism is tempered by concerns about Barriers to Technology Adoption, including the high costs of implementation, inadequate training, difficulties integrating new systems with existing workflows, and anxieties surrounding data security. As one respondent noted, "The potential is definitely there, but right now, the cost and the learning curve are just too high for many smaller clinics to even consider."

Addressing these barriers requires a focus on the facilitators of technology integration. Participants emphasized the need for user-friendly designs, clear demonstrations of clinical and economic benefit, robust leadership support, and collaborative partnerships between technology developers and healthcare professionals. Critically, the perceived Impact on Workflow and Patient Interaction emerged as a key consideration. While technology offers the promise of streamlined tasks and improved communication, healthcare professionals expressed concerns about increased workload, potential disruptions to existing workflows, and the erosion of meaningful patient interactions. As

another respondent aptly summarized, "We need technology to help us, not replace us. It should make our jobs easier and improve patient care, not just add more tasks to our already overflowing plates." These interconnected themes underscore the complex interplay of factors that influence technology adoption in urological care, highlighting the importance of a holistic approach that addresses both practical and human-centered concerns

Comparison with Prior Work

This study builds upon existing literature on the adoption and integration of technology in healthcare, particularly in the context of urological care. Prior research has highlighted the potential of technology to improve patient outcomes, enhance efficiency, and reduce the burden on healthcare professionals. However, these studies have also identified significant barriers to technology adoption. Consistent with previous findings, this study confirms that perceived burden and increased workload are significant concerns among healthcare professionals. Research has consistently shown that poorly designed or implemented technologies can lead to cognitive overload, disrupted workflows, and decreased job satisfaction[21]. These frameworks emphasize the importance of perceived benefits, barriers, and self-efficacy in determining technology adoption. Prior studies have emphasized the critical role of training and support in facilitating technology integration. Effective training programs can enhance self-efficacy, minimize resistance to change, and improve the overall user experience[22,23]. This study reinforces these findings, highlighting the importance of integrating technology into existing systems and providing ongoing technical support. The positive association between device attributes and belief agreement is consistent with research on technology acceptance. User-friendly design, ease of use, and perceived usefulness are key factors that influence healthcare professionals' willingness to adopt new technologies[24]. This study acknowledges that resistance to change and lack of integration into workflows can inhibit technology integration. Prior work has explored strategies for overcoming resistance, such as involving end-users in the design process, providing clear communication about the benefits of technology, and addressing concerns about job security[25]. Prior studies have shown the impact of early detection and trend evaluation using technologies like tomography, which have increased the detection of symptomatic stones. This study supports the continued utilization of advanced technologies to improve detection and contribute to a better understanding of the increased incidence of kidney stones.

This study builds upon previous research by specifically examining healthcare professionals’ perceptions of urinary issues. This focused approach enables a deeper understanding of the unique challenges and opportunities within this area of healthcare relating to implementation of technologies. By integrating both quantitative and qualitative data, the study offers a comprehensive perspective on the factors influencing technology adoption. The qualitative analysis provides valuable insights into healthcare professionals’ experiences and viewpoints, complementing the statistical trends identified in the quantitative findings. These findings offer crucial guidance for clinicians, developers and policymakers aiming to facilitate the adoption of these innovations.

Limitations

While this study provides valuable insights into healthcare professionals' perceptions of urinary issues and the acceptability of technology for managing them, it is essential to acknowledge its limitations. There is a potential for sample bias. The participants were recruited through social media platforms (Reddit) and personal networks, which may introduce selection bias. This method might overrepresent individuals who are more tech-savvy or active online or other personal factors, potentially skewing the results. The majority of respondents were physicians (66.8%), which limits the representation of other healthcare professionals such as nurses and allied health staff, whose

perceptions may differ.

The data were collected through a structured survey questionnaire, relying on self-reported perceptions and experiences. This method is subject to recall bias and social desirability bias, as participants may provide responses, they believe are more acceptable or desirable.

The study employed a cross-sectional design, which captures data at a single point in time. This design limits the ability to establish causality or understand how perceptions and attitudes change over time. Longitudinal studies would be beneficial to track the evolution of technology acceptance and its impact on clinical practice.

While the survey captured a range of perspectives, the quantitative and qualitative data may lack the depth and context that could be obtained through more in-depth interviews or observational studies. Detailed case studies or ethnographic research could provide richer insights into the practical challenges and facilitators of technology integration in clinical settings.

The multiple regression analysis revealed several correlations between independent variables and belief agreement. However, correlation does not equal causation, and there may be other confounding variables not accounted for in the model.

Conclusions

This study provides valuable insights into the perceptions of healthcare professionals regarding urinary issues and the acceptability of technology for managing these issues. The findings highlight the importance of addressing perceived burden, workload, and resistance to change in order to facilitate technology integration in clinical practice. The study confirms that healthcare professionals' acceptance of technology depends on their perception of its necessity, the perceived advantages of using the technology, and concerns about usability or added workload.

Based on our findings, we can strongly conclude that the successful integration of technology for managing urinary issues hinges not only on device attributes but also on addressing perceived workload and ensuring seamless workflow integration. Specifically, our regression analysis revealed that perceived workload (β=0.288, P=.036) and integrating technology (β=0.344, P<.001) were significant positive predictors of technology acceptance, while the perceived importance of urinary issues was negatively correlated (β=-0.297, P=.011). This suggests that healthcare professionals are more likely to adopt technologies that alleviate their workload and fit easily into their existing routines, even if they do not see the issue as significant.

The qualitative data reinforces this, highlighting that while healthcare professionals recognize the potential of technology to improve patient care, they are concerned about the time and effort required to learn and implement new systems. The theme of "Barriers to Technology Adoption" underscored the importance of addressing practical challenges such as cost, training, and technical support. Overall, the qualitative analysis identified key themes related to technology and innovation in patient care, barriers to technology adoption, the importance of training and support, and the need for workflow integration. These themes underscore the complex interplay of factors that influence technology acceptance in healthcare settings.

Based on these findings, the following recommendations are made:

- User-Centered Design: Technology developers should prioritize user-centered design principles to create solutions that are intuitive, easy to use, and seamlessly integrated into existing workflows.

- Comprehensive Training and Support: Healthcare organizations should invest in comprehensive training programs and ongoing technical support to enhance self-efficacy and minimize resistance to change.
- Stakeholder Engagement: Involve healthcare professionals in the design and implementation of new technologies to ensure that their needs and concerns are addressed.
- Clear Communication: Provide clear and transparent communication about the benefits of technology, addressing concerns about job security and potential disruptions to workflow.
- Workflow Optimization: Streamline workflows to minimize the burden on healthcare professionals, ensuring that technology enhances efficiency rather than adding burdens to their workload.
- Further Research: Conduct longitudinal studies to track the long-term impact of technology adoption on patient outcomes and healthcare professionals' satisfaction. Explore the perspectives of patients and other stakeholders to gain a more holistic understanding of technology integration in urological care.
- Address Negative Correlations: Further investigate the negative correlation between the perceived importance of technology and belief agreement to understand underlying factors and tailor interventions accordingly.

By addressing these recommendations, healthcare organizations can promote the successful adoption of technology and improve the delivery of care for individuals affected by urinary issues.

In conclusion, this study illuminates the intricate dynamics influencing technology acceptance among healthcare professionals in managing urinary issues. By bridging the gap between technological innovation and clinical practice, this research offers actionable insights to drive the effective integration of technology, ultimately enhancing patient care, optimizing resource allocation, and empowering healthcare professionals to navigate the evolving landscape of urological care with confidence and competence.

The study directly addressed the research questions, showing that healthcare professionals' views on technology are generally positive when technology provides practical benefits. Their acceptance is influenced by workload and device attributes, and the key attributes and barriers to technology integration include usability, accuracy, and financial considerations.

Future research should address the limitations of this study by conducting longitudinal studies to assess the long-term impact of technology implementation on patient outcomes and healthcare costs. Additionally, exploring the perspectives of patients and other stakeholders, such as caregivers and administrators, will provide a more holistic understanding of the challenges and opportunities associated with technology integration in urological care. Finally, more specific research is needed to determine if results are different based on the different wearable technologies available. The results of this study can guide the development of targeted interventions to support technology adoption, ultimately contributing to improved patient outcomes and greater healthcare efficiency. The key to technology success lies in recognizing and addressing the multifaceted perceptions of healthcare professionals, ensuring that technology serves as a catalyst for improved outcomes and a reduced burden in the management of urinary issues.

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Abbreviations

- AI: Artificial Intelligence
- ANOVA: Analysis of Variance
- ASIR: Age-Standardized Incidence Rate
- BPH: Benign Prostatic Hyperplasia
- CAUTI: Catheter-Associated Urinary Tract Infection
- eHealth: Electronic Health
- HBM: Health Belief Model
- IDT: Innovation Diffusion Theory
- IoT: Internet of Things
- IRB: Institutional Review Board
- mHealth: Mobile Health
- MPH: Masters of Public Health
- MA: Masters of Arts
- MB: Masters of Business
- RN: Registered Nurse
- PhD: Doctor of Philosophy
- FAUNA: Fellow of the American Academy of Nursing
- SPSS: Statistical Package for the Social Sciences (although the paper doesn't explicitly introduce this one, it's standard for statistical analysis)
- TAM: Technology Acceptance Model
- UI: Urinary Incontinence
- UR: Urinary Retention
- UTI: Urinary Tract Infection
- UTAUT: Unified Theory of Acceptance and Use of Technology

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Supplementary Files