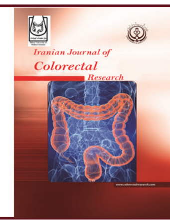
Review Article

Iran J Colorectal Res 2025;13(4):120-127.

Iranian Journal of Colorectal Research



Patient Perceptions of Minimally Invasive Robotic Surgery: A Systematic Review

Arpit Aggarwal[1], DO; Maryam Aleissa[1,2]*, MD; Saakshi Joshi[3], MD; Ernesto Drelichman[1], MD, FACS; Vijay Mittal[1], MD, FACS; Jasneet Bhullar[1], MD, M.S., FACS, FASCRS

[1]*Department of Surgery, Henry Ford Providence Hospital, Southfield, MI, USA*
[2]*Princess Nourah bint Abdulrahman University, College of Medicine, Riyadh, KSA*
[3]*Department of Internal Medicine, McLaren-Macomb, Macomb, MI, USA*

Corresponding author:
Maryam Aleissa, MD; Department of Surgery, Henry Ford Providence Hospital, Zip code: 48075, Southfield, MI, USA. **Tel:** +1 248 1234567;
Email: aleissa.86@gmail.com

Received: 2025-10-12
Revised: 2025-12-30
Accept: 2025-12-30

Abstract

Advances in digital and mechanical technologies have profoundly transformed modern surgery. Since its approval by the Food and Drug Administration in 2000, the widespread integration of robotic-assisted surgery (RAS) has created a complex ethical and political dynamic involving patients, healthcare professionals, manufacturers, and legislators. In this systematic review, we aimed to identify potential patient- and industry-related drawbacks of RAS early on and to promote public awareness of the technology. Published data on patient perceptions of RAS from 2000 to 2024 were analyzed using the PubMed gateway and Cochrane Library databases. Studies focusing on clinical outcomes or the perceptions of surgeons and healthcare workers were excluded. Extracted data included sample size, methodology, information sources, prevalent perceptions, and willingness to undergo RAS. A total of 12 studies involving 35,769 participants met our inclusion and exclusion criteria. Acceptance of RAS was higher among individuals with higher education levels and in countries where RAS is commonly practiced; however, concerns about manufacturing defects and the surgeon's experience with RAS persisted. Most participants understood that RAS offers greater precision, less pain, and enables faster recovery. However, many believed that the robot operated autonomously. Previous experience with and perceived ease of use of the robotic surgery platform were inversely associated with patients' information levels, suggesting that increased exposure may lead to a more realistic but not necessarily deeper understanding of robotic surgery. All included studies were questionnaire-based and varied in design, which may limit the generalizability of the findings. We conclude that the healthcare industry faces new challenges as innovation influences the sacred patient-physician relationship. Ethical and legal considerations, including informed consent, machine malfunction, cost-effectiveness, and troubleshooting support, affect patients' perceptions. Additionally, the media plays a significant role in shaping public understanding of RAS.
Registration: PROSPERO ID CRD42025630165.

Keywords: Robotic Surgical Procedures, Perception, Minimally Invasive Surgical Procedures

Please cite this paper as:
Aggarwal A, Aleissa M, Joshi S, Drelichman E, Mittal V, Bhullar J. Patient Perceptions of Minimally Invasive Robotic Surgery: A Systematic Review. *Iran J Colorectal Res*. 2025;13(4):120-127. doi: 10.30476/acrr.2026.108704.1265.

Introduction

Advances in digital and mechanical technologies have profoundly reshaped modern surgery, facilitating the transition from open procedures to image-guided, laparoscopic, and robotic techniques. Recently, the adoption of surgical robotics has introduced notable biases within healthcare, and public acceptance may depend on a strong physician-patient relationship and institutional collaboration.

The concept of three-dimensional (3D) virtual reality, which involves enhancing human perception through immersive computer-generated environments, originated in NASA laboratories in the 1960s (1). This idea came to fruition decades later with Dr. Fisher's development of a head-mounted telerobotic system (2). Surgical applications of these technologies garnered interest, with pioneers such as Phil Green, PhD, and Joseph Rosen, MD, developing the first robotic-assisted prototypes in the 1980s (1). Current systems are based on similar principles, where a surgical unit and its manipulating arms are controlled remotely by a surgeon from an ergonomic telepresence workstation (1). Around the same time, fields like neurosurgery experienced a clinical breakthrough with the creation of the Animation Puma 200 robotic system, which integrated with computed tomography programming to facilitate stereotactic cerebral biopsies. Since then, surgical technology has flourished through advancements in engineering, clinical experience, and commercialization (3). In 2020, robotic-assisted minimally invasive surgery (MIS) sales exceeded USD 5.4 billion; with a compound annual growth rate of 10%, sales are estimated to reach USD 16.7 billion by 2031 (4). Gastrointestinal procedures have accounted for the largest share of robotic surgery cases over the past 20 years (4). While the technical and cosmetic benefits of robotic-assisted MIS have created a lucrative market, it is imperative to evaluate machine safety, clinical outcomes, and platform experience through the ethical and legal lens of safe practice.

Robotic-assisted MIS offers patients the potential to replace traditionally large abdominal incisions in colorectal, hepatobiliary, and abdominal wall operations with multiple small incisions measuring 8 or 12 mm. Initially developed for pelvic procedures by urologists, its advantages, such as ease of operation, precise rotational dexterity, and 3D visualization, quickly led to its adoption by gynecological and gastrointestinal surgeons (1). Additionally, this technology may improve access to advanced surgical procedures in rural areas through telerobotic operation.

The demand for robotic-assisted surgery (RAS) has increased the number of competitors in the United States from a single Food and Drug Administration (FDA)-approved manufacturer in 2000 to eight, five of which were registered in 2021 (5). Despite the rapid expansion of RAS and the growing number of platforms entering the market, significant gaps remain in patient understanding and acceptance of this technology. Most studies have focused on technical performance, clinical outcomes, and healthcare provider perspectives, while patient-centered views remain less clearly defined. Available surveys suggest that patients may harbor misconceptions, uncertainty, or distrust regarding how robotic systems function, their potential risks, and the degree of surgeon control during surgery (6-8). As shared decision-making becomes an integral component of modern surgical care, understanding patient perceptions, including trust, expectations, and concerns, is essential for informed consent and meaningful engagement. Accordingly, this systematic review aims to synthesize existing evidence on patient perceptions of RAS to clarify current knowledge gaps and inform future strategies to improve patient education, communication, and acceptance.

Methods

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Figure 1).

Protocol and Registration: The review protocol was prospectively registered in the PROSPERO database (PROSPERO registration number is CRD42025630165). The PubMed gateway and Cochrane Library databases were used for this review. The search aimed to include observational studies (cross-sectional surveys, cohort studies, and qualitative studies) that explored patient or public perceptions of RAS between 2005 and 2024. The time frame was selected to capture the period during which RAS transitioned from early adoption to widespread clinical implementation, reflecting the evolution of both surgical technology and patient exposure to robotic platforms. Studies focusing on clinical outcomes, surgeons' or healthcare workers' perceptions, as well as editorials and commentaries, were excluded. Only public and patient-reported data were extracted for analysis. This decision was made to maintain a clear and consistent focus on patient and public perceptions, which was the primary objective of the review. Healthcare professionals' perspectives may be influenced by factors such as technical expertise, institutional resources, and professional training, and therefore represent a fundamentally different viewpoint.

In studies reporting perceptions from both the public and healthcare workers, only the public-facing data were extracted and analyzed. This approach ensured conceptual homogeneity across the included studies and minimized interpretive bias related to professional or institutional perspectives. The search terms included "robotic surgery," "patient

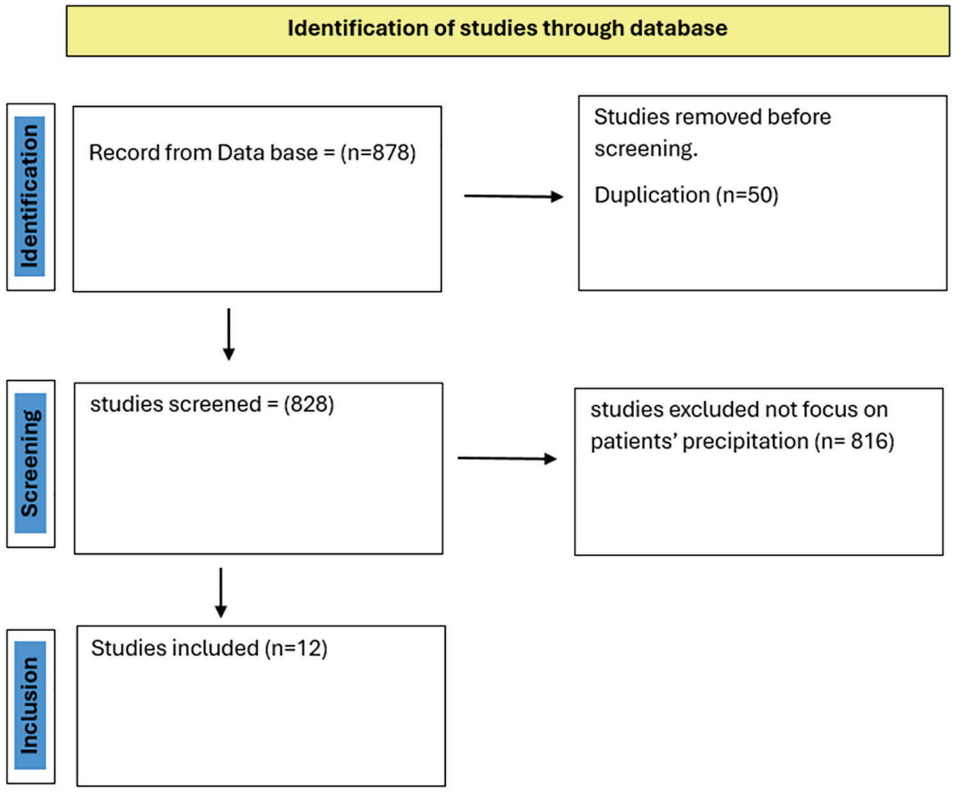


Figure 1: PRISMA flow diagram showing the process of study identification, screening, eligibility assessmen, and final inclusion of articles evaluating patient perceptions of robotic-assisted surgery (2000-2023).

perception," "trust," and "informed consent." A detailed search string is provided in Supplementary Appendix 1.

Two independent reviewers screened the titles and abstracts. Full-text articles were then assessed for eligibility, with any disagreements resolved by consensus. Data extraction was conducted independently using a standardized form. Extracted data included study population size, data collection methods, sources of information, prevalent perceptions, and the percentage of individuals willing to undergo RAS. The primary outcomes were patient perceptions, acceptance rates, and factors influencing trust or reluctance toward RAS. Secondary outcomes included knowledge gaps and sources of information.

Results were summarized descriptively and organized into tables by country, acceptance rate, and thematic perceptions.

Risk of Bias Assessment

The Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies was used to assess the risk of bias. This tool evaluates eight domains: (1) clear inclusion criteria, (2) detailed description of study subjects and setting, (3) valid and reliable measurement of exposure, (4) use of standard criteria for outcome measurement, (5) identification of confounding factors, (6) strategies to address confounding, (7) valid and reliable measurement of outcomes, and (8) appropriateness of statistical analysis. Two independent reviewers performed the assessment, and any disagreements were resolved by consensus. Each domain was rated as "Yes," "No," "Unclear," or "Not Applicable." Studies were categorized as having a low risk of bias (≥6 'Yes' responses), moderate risk (4–5 'Yes' responses), or high risk (≤3 'Yes' responses).

Results

Study Selection and Characteristics

The initial search revealed 878 articles. Fifty studies were excluded due to duplication, and an additional 816 were excluded because they did not focus on patients' perceptions. A total of 12 studies met our inclusion and exclusion criteria and were subjected to further analysis. The cumulative number of patients across all the included articles was 35,769 participants. The participant distribution was notably skewed, with one large multinational study (6) (n=25,132) comprising 70.2% of the overall sample. The following eleven studies comprised a total sample size of 10,637 persons.

Five studies originate from the United States, while two studies each come from Kuwait, Saudi Arabia, Canada, Spain, Singapore, and the UK. (Table 1).

Acceptance Rate

Overall, acceptance of RAS ranged from 6.4% to 50%, with a pooled mean acceptance rate of approximately 36% across all studies. The lowest acceptance rate was reported by Chu et al. at 6.4%; this study involved female patients who had pelvic organ disorders with limited prior exposure to robotic technology.

Table 1: Summary of Reviewed Studies on Patient Perceptions of Robotic-Assisted Surgery

Author (Year)	Country	Sample Size (n)	Study Design/ Population	Acceptance Rate (%)	Key Findings on Knowledge and Perception Gaps	Conclusions
Ahmad et al., 2016 (13)	USA	101	Cross-sectional survey (general public)	45	Limited understanding of robotic autonomy and cost implications.	Acknowledged minimally invasive approach.
Chu et al., 2019 (14)	USA	176	Cross-sectional survey (women with pelvic organ prolapse before counseling)	6.4	Fifty-six percent had no prior information about RAS. The primary sources were the internet and advertising.	Low baseline knowledge and media-driven awareness underscore the need for comprehensive pre-operative counseling.
McDermott et al., 2019 (2020 print) (15)	UK	25	Qualitative semi-structured interviews (general public)	30	Women expressed greater safety concerns and lower trust than men.	Gender differences influence trust and acceptance.
Buabbas et al., 2020 (16)	Kuwait	1087	Cross-sectional survey (general public)	35.4	Forty percent did not know how surgical robotics works. Only 3.3% understood the surgeon's role.	Public awareness of RAS is limited; media is the dominant information source.
Aldousari et al., 2021 (17)	Kuwait	256	Cross-sectional survey (patients)	45	Nearly half (49%) were unsure how robots operate. Precision and less pain were perceived as advantages.	Higher educational attainment was associated with greater acceptance; misconceptions about automation persist.
Torrent-Sellens et al., 2021 (6)	Spain (28 European nations)	27901	Cross-sectional Eurobarometer survey (general public)	50	Trust and positive attitudes declined with greater exposure. Limited information reduced confidence.	Public trust in RAS is fragile; education and transparency are needed to align perception with clinical reality.
Anania et al., 2021 (18)	USA	2659	Cross-sectional survey (general public)	40	Perceived value, familiarity, and fear of surgery predicted willingness. Openness and education improved acceptance.	Psychological factors shape choices more than clinical knowledge; trust and emotional comfort are key.
Muaddi et al., 2022 (19)	Canada/ USA	≈2600	Cross-sectional experiment	36.6	The term "robotic" increased fear scores.	Terminology and framing influence comfort and acceptance; education may reduce anxiety.
Chan et al., 2022 (14)	Singapore	472	Cross-sectional outpatient survey	35.2	Fifty-three percent believed RAS is automated. Media was the primary information source. Education improved acceptance.	Misconceptions about autonomy and safety limit acceptance; clinician communication is critical.
Arshad et al., 2024 (8)	UK	216	Cross-sectional online survey (general public)	42	Fears of technology failure and misconceptions about autonomy were common.	Information significantly increased comfort ($p < 0.0001$)
Algethami et al., 2023 (20)	Saudi Arabia	1879	Cross-sectional national online survey (general public)	41.6	Only 49% recognized the surgeon's role.	Public awareness in KSA limited, targeted media and education essential.
Thalib et al., 2025 (21)	Saudi Arabia	>1000	Cross-sectional bilingual national survey (general public)	47	Higher education and income were associated with better awareness. Language barriers and limited exposure reduced trust.	Nationwide education and transparent cost policies needed to build confidence in RAS.

RAS: Robotic-assisted surgery

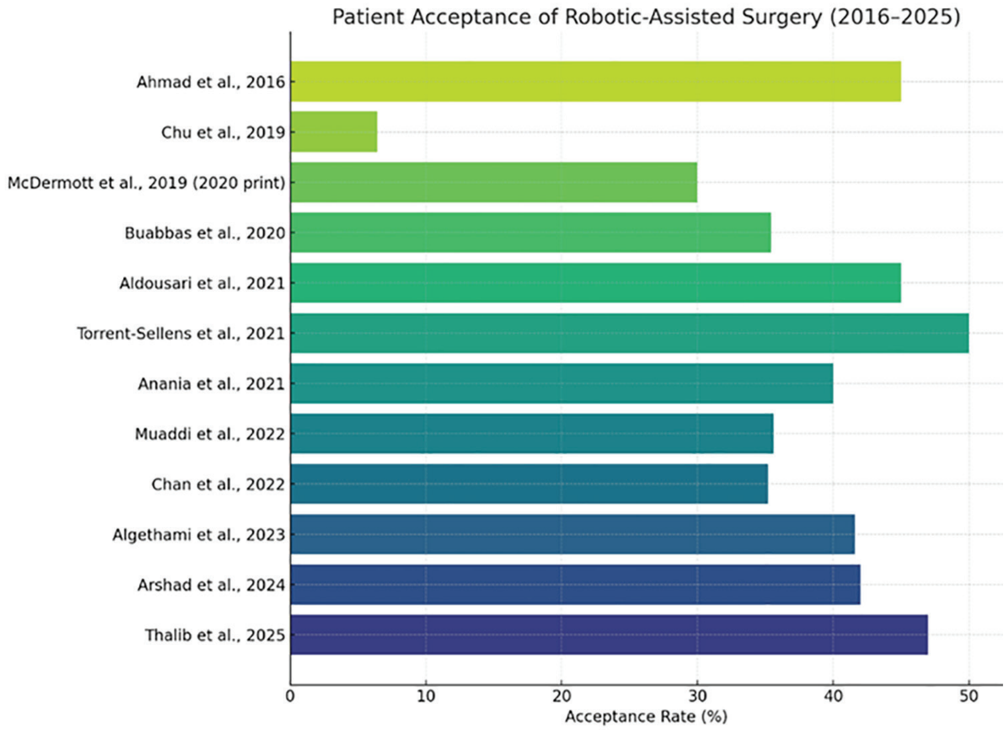


Figure 2: Graph showing the acceptance rate per study over the years.

There has been a slight upward trend in acceptance rates in studies published after 2020, likely due to the broader integration of robotic platforms and increased public familiarity. However, this improvement remains minimal (Figure 2). Although the global use of robotic surgery has markedly increased since 2016, public acceptance has changed only modestly, suggesting that increased exposure alone has not proportionally enhanced public trust or willingness to undergo an RAS procedure (Table 1).

Factors Influencing Acceptance

Participants perceived RAS as more precise, less painful, and associated with faster recovery. However, the primary barriers to acceptance included fear of robotic malfunctions, high costs, and surgeon inexperience. Our review found that participants with higher education levels were more likely to trust RAS. Additionally, men reported higher acceptance rates compared to women (Table 1).

Knowledge Gaps

Most studies report a knowledge gap among participants regarding the surgeon's role in the RAS. Only 3.27% (Buabbas, 2020) and 49% (Algethami, 2023) of participants understood the surgeon's critical role in RAS.

Fifty-three percent of respondents believed that robots operate independently (Chan, 2022), and 40% to 49% lacked awareness of robotic functionality (Buabbas, 2020; Aldousari, 2021). Educational campaigns significantly improved acceptance by clarifying these misconceptions (Arshad, 2022). Media (TV and the Internet) served as the primary source of information in all studies; however, persistent knowledge gaps indicated its inadequacy.

Healthcare specialists were cited in only two studies (Chu, 2019; Torrent-Sellens, 2021), highlighting their limited role in patient education. The largest study cohort included 25,132 participants from 28 European countries. The findings revealed that as individuals became more familiar with robotic systems, their trust in robotic surgery decreased. In the regression model, factors related to information, perception, and attitude exhibited negative coefficients, indicating that increased knowledge was associated with a lower perceived superiority of robotic surgery. These data suggest that heightened awareness enables patients to understand that robotic procedures, despite their technological sophistication, are not inherently better to alternative minimally invasive methods in terms of safety or outcomes (Table 1).

Risk of Bias and Study Quality

The quality of most studies was moderate, with common risks stemming from non-probability sampling methods (such as online or clinic convenience sampling), limited survey validation, and incomplete control of confounding variables. Two studies reduced the confounding by performing multivariable models, and one adapted randomization alongside a validated psychometric outcome. Most studies clearly described eligibility criteria and settings. The qualitative study demonstrated moderate quality, employing appropriate methodology but with limited sampling breadth. Detailed study-level assessments are summarized in Table 2.

Table 2: Risk of Bias (RoB) Summary Using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies.

Study (year)	Design	1	2	3	4	5	6	7	8	Overall RoB	Justification
Ahmad et al., 2016 (13)	Cross-sectional survey (general public)	Y	Y	U	U	U	N	U	Y	Moderate–High	Small convenience sample; unvalidated items; mainly descriptive and bivariate analyses.
Chu et al., 2019 (14)	Cross-sectional survey (pelvic organ prolapse patients; pre-counseling)	Y	Y	U	Y	U	N	U	Y	Moderate–High	Clear outcomes (knowledge score); no multivariable control; instrument reliability not reported.
McDermott et al., 2019 (2020 print) (15)	Qualitative interviews	NA	NA	NA	NA	NA	NA	NA	NA	Moderate (qualitative)	Appropriate design and analysis; limitations in sampling and reflexivity.
Buabbas et al., 2020 (16)	Cross-sectional survey (general public)	Y	Y	U	U	U	N	U	Y	Moderate–High	Large bilingual sample; modest internal consistency; no adjustment for confounding.
Aldousari et al., 2021 (17)	Cross-sectional survey (patients)	Y	Y	U	U	U	N	U	Y	Moderate–High	Patient subgroup reported; instrument not validated; bivariate comparisons only.
Torrent-Sellens et al., 2021 (6)	Cross-sectional survey (multinational general public)	Y	Y	Y	U	Y	Y	U	Y	Moderate	Probability sampling, adjusted models, and attitudinal constructs lack external validation.
Anania et al., 2021 (18)	Cross-sectional survey (U.S. public; MTurk)	Y	Y	U	U	Y	Y	U	Y	Moderate	Robust predictive modeling; convenience sampling; bespoke scales.
Muaddi et al., 2022 (19)	Cross-sectional vignette experiment (general public)	Y	Y	Y	Y	U	Y	Y	Y	Low–Moderate	Randomized wording; validated fear scale; generalizability limited to platform/sample.
Chan et al., 2022 (14)	Cross-sectional survey (surgical outpatients)	Y	Y	U	U	Y	Y	U	Y	Moderate	Clear eligibility; adapted (unvalidated) survey; multivariable regression addresses confounding.
Arshad et al., 2024 (8)	Cross-sectional survey (UK public)	Y	Y	U	Y	Y	U	U	Y	Moderate	Appropriate nonparametric analyses; self-selected sample; no formal instrument validation.
Algethami et al., 2023 (20)	Cross-sectional survey (Saudi Arabia public)	Y	Y	Y	U	Y	N	Y	Y	Moderate	Good internal consistency; confounders described but not adjusted in multivariable models.
Thalib et al., 2025 (21)	Cross-sectional survey (Saudi Arabia public; nationwide)	Y	Y	U	U	Y	Y	U	Y	Moderate	National coverage and logistic regression; psychometric details were limited in-cohort.

Y: Yes; N: No; U: Unclear; NA: Not applicable; JBI (cross-sectional) items include: (1) clear inclusion criteria; (2) description of setting and participants; (3) valid and reliable measurement of exposure; (4) use of standard criteria for outcome assessment; (5) identification of confounders; (6) strategies to address confounders; (7) valid and reliable outcome measurement; and (8) appropriate statistical analysis.

Discussion

The success of robotic-assisted MIS depends on the complex ethical and legal interplay among patients, healthcare staff, industry, and legislators. First, the novelty and appeal of RAS may mislead uninformed patients into assuming that the operation is autonomous or semi-autonomous. The average acceptance rate ranged between 20% and 25%, and several studies in this review confirmed that misunderstanding surgeon control remains one of the main deterrents to patient trust (6). RAS is heavily marketed by industry through advertising campaigns and promotional materials, which substantially shape public perceptions. Our research indicated that the media served as the predominant source of knowledge regarding robotic surgery across all included studies; nevertheless, it often disseminated incomplete or biased information. This prevalent reliance on media highlights the necessity for physicians, hospitals, and public health authorities to adopt a more proactive approach in delivering accurate and balanced education regarding RAS. Media narratives should enhance, not replace, evidence-based patient counseling, thereby mitigating misconceptions about robotic autonomy and surgical safety.

A 2021 European survey by Torrent-Sellens indicated a lack of trust in robotic-assisted machines, attributed to the public's limited information, perceptions of the technology, and attitudes toward the platform (6). A Canadian quantitative study reported increased work responsibilities and more advanced workflow processes for medical personnel, while also highlighting the scarcity of published insights into patient perspectives (7). The authors recommended enhancing patient understanding through education, clarifying the platform's utility, and promoting autonomy in decision-making (7). Autonomous and semi-autonomous robotic devices are increasingly used across various surgical fields, which may contribute to patient confusion (9).

The physical and logistical limitations of robotic systems, including costs and restricted vendor contracts, may not be directly apparent to patients but can influence their perceptions through related institutional decisions, such as procedure availability or out-of-pocket expenses. Patients may interpret high costs or limited access as indicators of exclusivity or inaccessibility, which can shape their attitudes toward the fairness and feasibility of RAS. Additionally, although uncommon, malfunctions involving the imaging cart, surgeon console, software/wiring, and mechanical arms have been documented (10). The FDA's MAUDE database estimates the incidence of instrument malfunctions at 13 per 10,000 cases (11). However, because data collection is voluntary and not nationally standardized, these figures are subject to limitations such as incomplete or inaccurate reporting. In 2022, surgeons across the US expressed concerns on a secure public online forum about their inability to use robotic staplers due to a software bug, and the manufacturer was criticized for its delayed response (12). We believe that publicized software issues, combined with a lack of standardization and delayed manufacturer responses, may undermine confidence, especially among patients unfamiliar with the technology.

Although challenges within the healthcare system, such as equipment setup and workflow logistics, have been reported, these issues indirectly influence patient perceptions by shaping the overall care experience, including surgical wait times, scheduling reliability, and perceived safety. Therefore, transparent communication about these behind-the-scenes factors may help patients better understand what RAS entails and the elements that contribute to its successful delivery.

Additionally, strategies focused on institutional training, on-demand manufacturer support, and collaborative, patient-centered teamwork may help alleviate systemic stress and dissatisfaction. Furthermore, as the market expands, manufacturers should continue to uphold their ethical responsibility for patient safety and invest in designing durable instruments.

It is important to acknowledge that the data in this review were derived from questionnaire-based studies, which may limit generalizability due to potential biases such as missing data or incomplete responses. Additionally, the included studies were conducted across diverse geographical regions, introducing potential cultural biases that may have influenced participants' perceptions of RAS. Furthermore, the distribution of participants was highly uneven, with 70% of the total sample size coming from a single study (Torrent-Sellens et al., 2021) (6). This disproportionate weighting may have skewed the overall descriptive statistics and regional comparisons, thereby limiting the generalizability of the pooled findings. Nevertheless, this large dataset provides valuable insights into population-level attitudes toward RAS. Conducting a meta-analysis with subgroup analyses based on age, educational background, and geographical location could enhance our understanding of the knowledge gaps and help tailor educational interventions accordingly.

Conclusion

Despite the recent widespread global adoption of RAS, public and patient acceptance rates have not increased proportionally. This apparent plateau suggests that increased clinical use does not necessarily lead to improved public understanding or trust. Although awareness of robotic surgery has expanded through media exposure and hospital marketing efforts, persistent misconceptions, particularly regarding surgeon control, system autonomy, and cost, remain. This trend highlights that technological diffusion, when not accompanied by effective public education and transparent communication, does not enhance acceptance. Consequently, the stagnation in acceptance over the past decade likely reflects a persistent informational deficit rather than skepticism toward innovation itself.

Acknowledgments

We acknowledge the English editing company Cambridge Proofreading and Editing LCC for editing this article.

Authors' Contribution

Arpit Aggarwal made substantial contributions to the conception and design of the work, as well as to the acquisition, analysis, and interpretation of data. He also contributed to drafting the work and critically reviewing it for important intellectual content. Maryam Aleissa made substantial contributions to the conception and design of the work, drafted the work and critically reviewed it for important intellectual content, gave final approval of the version to be published, and agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Saakshi Joshi provided final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring that any questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Ernesto Drelichman made substantial contributions to the conception or design of the work; the acquisition, analysis, and interpretation of data; drafting the work and critically reviewing it for important intellectual content; final approval of the version to be published; and agreement to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Vijay Mittal made substantial contributions to the acquisition and analysis of data; he provided final approval of the version to be published and ensured that the integrity of all parts of the work was appropriately investigated and resolved. Jasneet Bhullar made substantial contributions to the acquisition and analysis of data; agreed to be accountable for all aspects of the work, ensuring that any questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved; and gave final approval of the version to be published.

Conflict of interest: None declared.

References

1. George EI, Brand CTC, Marescaux J. Origins of robotic surgery: from skepticism to standard of care. Jsls .2018;22(4):e2018. 00039.
2. Satava RMJTScoNA. Robotic surgery: from past to future--a personal journey. Surg Clin North Am.2003;83(6):1491-500, xii.
3. Benabid A, Cinquin P, Lavalle S, et al. Computer-driven robot for stereotactic surgery connected to CT scan and magnetic resonance imaging: technological design and preliminary results. Appl Neurophysiol. 1987;50(1-6):153-4.
4. Surgical Robotics and Navigation Market Analysis, Size, Share & COVID-19 Impact Analysis | Global | 2022-2028 | MedSuite | Includes: ENT Surgical Navigation Market, Minimally Invasive Surgery Robotics Systems Market, and 8 more. 09/22/2022. Accessed 12/25/2023 https://idataresearch.com/product/surgical-robotics-and-navigation-market/. 2025
5. Wilson M, Badani KJTUCoNA. Competing Robotic Systems: A Preview. Urologic Clinics of North America. 2020;48(1):147-50.
6. Torrent-Sellens J, Jiménez-Zarco AI, Saigí-Rubió F. Do People Trust in Robot-Assisted Surgery? Evidence from Europe. Int J Environ Res Public Health. 2021;18(23):12519.
7. Martinello N, Loshak H. Experiences with and expectations of robotic surgical systems: a rapid qualitative review. Canadian Agency for Drugs and Technologies in Health.2020.
8. Arshad S, Brar G, Xu S, et al. 222 Robotic Surgery: Public Perceptions and Current Misconceptions. British Journal of Surgery. 2022;109(Supplement_1):znac040. 20.
9. Saniotis A, Henneberg MJEiS, Politics E. Neurosurgical robots and ethical challenges to medicine. Ethics Sci Environ Politics. 2021;21:25-30.
10. Kim WT, Ham WS, Jeong W, et al. Failure and malfunction of da Vinci Surgical systems during various robotic surgeries: experience from six departments at a single institute. Urology. 2009;74(6):1234-7.
11. Ferrarese A, Pozzi G, Borghi F, et al. Malfunctions of robotic system in surgery: role and responsibility of surgeon in legal point of view. Open Med (Wars). 2016;11(1):286-91.
12. Giffen Z, Ezzone A, Ekwenna OJPO. Robotic stapler use: Is it safe?–FDA database analysis across multiple surgical specialties. PLoS One. 2021;16(6):e0253548.
13. Ahmad A, Ahmad ZF, Carleton JD, et al. Robotic surgery: current perceptions and the clinical evidence. Surg Endosc. 2017;31(1):255-63.
14. Chu CM, Agrawal A, Mazloomdoost D, et al. Patients' knowledge of and attitude toward robotic surgery for pelvic organ prolapse. Female Pelvic Med Reconstr Surg. 2019;25(4):279-83.
15. McDermott H, Choudhury N, Lewin-Runacres M, et al. Gender differences in understanding and acceptance of robot-assisted surgery. J Robot Surg.2020;14(1):227-32.
16. Buabbas AJ, Aldousari S, Shehab AAJBmi, et al. An exploratory study of public'awareness about robotics-assisted surgery in Kuwait. BMC Med Inform Decis Mak. 2020;20(1):140.
17. Aldousari SA, Buabbas AJ, Yaiesh SM, et al. Multiple perceptions of robotic-assisted surgery among surgeons and patients: a cross-sectional study. J Robot Surg. 2021;15(4):529-38.
18. Anania EC, Rice S, Winter SRJJoRS. Building a predictive model of US patient willingness to undergo robotic surgery. J Robot Surg. 2021;15(2):203-14.
19. Muaddi H, Zhao X, Leonardelli GJ, et al. Fear of innovation: public's perception of robotic surgery. Surg Endosc. 2022;36(8):6076-83.
20. Algethami RF, Alotbi MF, Alsulaimani AI, et al. Assessment of knowledge and awareness regarding robotics-assisted surgery (RAS) among Saudi population: a cross sectional study. Medical Science. 2023;27(132):1-9.
21. Irfan Thalib H, Tahir K, Shrouq Amin A, et al. Public awareness and perception of robotic-assisted surgery: a cross-sectional analysis of sociodemographic influences. Frontiers in public health. 2025;13:1662689.