WHIOCE PUBLISHING PTE. LTD.
PROVIDING
FIRST-CLASS SCIENTIFIC INFORMATION
FOR TOP SCHOLARS

2026 Volume 11, Issue 4
Advances in Precision Medicine
ISSN: 2424-9106 (Online)
ISSN: 2424-8592 (Print)

Research on the Application of Quality Control Circle Combined with Diversified Health Education Model in Improving the Health Education Awareness Rate of Patients Undergoing da Vinci Robot Surgery

Lihong Xie, Jinyan Li, Guilan Huang, Fengqiu Gong, Chuxin Hong*
The First Affiliated Hospital of Sun Yat-sen University, Guangzhou 510000, Guangdong, China

****Author to whom correspondence should be addressed.***

Abstract: This study aimed to explore the effect of quality control circle (QCC) combined with diversified health education model on improving the health education awareness rate of patients undergoing da Vinci robot surgery, standardize perioperative health education procedures, relieve preoperative anxiety, reduce postoperative complications, and improve nursing satisfaction. A total of 100 patients were divided into a control group (routine health education, $n = 50$) and an observation group (QCC combined with diversified education, $n = 50$). The observation group received standardized education path, teach-back method, 321 health education mode, and three-level verification mechanism. Outcome measures included awareness rate, self-rating anxiety scale (SAS), self-rating depression scale (SDS), and nursing satisfaction. Results showed that the awareness rate in the observation group increased from 72.40% to 96.80%, which was significantly higher than 73.60% in the control group ($P < 0.05$). After intervention, SAS and SDS scores in the observation group were significantly lower than those in the control group ($P < 0.05$). Nursing satisfaction in the observation group was 98.40%, significantly higher than 84.00% in the control group ($P < 0.05$). QCC activity also improved the comprehensive ability of team members. In conclusion, QCC combined with diversified health education can effectively improve the awareness rate, relieve negative emotions, and enhance nursing quality, which is worthy of clinical promotion.

Keywords: Quality Control Circle; da Vinci robot surgery; Health education awareness rate; Perioperative nursing; Diversified health education

Online publication: April 26, 2026

1. Introduction

In recent years, with the rapid development of minimally invasive surgical technology, the da Vinci surgical robot system has been widely used in urology, hepatobiliary and pancreatic surgery, gastrointestinal surgery, thoracic surgery, and other clinical fields due to its unique advantages such as three-dimensional high-definition vision, precise operation, minimal invasive damage, and rapid postoperative recovery. It has greatly promoted the development of complex surgical operations towards minimally invasive, precise, and rapid rehabilitation directions, bringing new therapeutic options for

patients with various diseases. With the continuous popularization of da Vinci robot surgery technology, patients' demand for understanding surgical-related knowledge, mastering perioperative self-management skills, and conducting scientific rehabilitation exercises is also increasing day by day. Preoperative health education, as an important part of perioperative nursing, directly affects the patients' psychological state before surgery, the degree of cooperation during surgery, the compliance with rehabilitation nursing after surgery, and the final rehabilitation outcome.

However, the traditional preoperative health education model mainly relies on oral explanation and paper brochures, which have many defects such as scattered educational content, single educational form, a lack of effective feedback mechanism, and insufficient individualization. These problems lead to limited understanding and mastery of surgical and rehabilitation knowledge by patients, resulting in a low health education awareness rate. In clinical practice, it is easy to cause negative emotions such as preoperative anxiety and fear in patients, and even lead to delayed postoperative rehabilitation, increased incidence of complications, and other adverse consequences, which affect the quality of nursing services and patients' medical experience.

Quality Control Circle (QCC) is a small team spontaneously formed by staff in the same work field. It uses scientific quality management tools and methods to carry out continuous quality improvement activities, so as to optimize work processes, improve service quality, and increase work efficiency. In recent years, QCC has been widely used in the field of clinical nursing, especially in the standardization of health education, the optimization of nursing processes, and the improvement of nursing quality, and has achieved remarkable results. The diversified health education model integrates multiple educational forms such as oral explanation, graphic manuals, video education, teach-back method, and 321 health education mode, which can make up for the deficiencies of the single traditional health education model, improve the patients' acceptance of health knowledge and the degree of mastery, and better meet the individual needs of different patients [1–4].

At present, there are few studies on the application of QCC in perioperative health education for patients undergoing da Vinci robot surgery at home and abroad, especially the systematic practice combining QCC with diversified intervention measures such as teach-back method and visual education. In view of this, this study took the robot surgery area of the operating room of our hospital as the practice scene, established a QCC team, carried out quality improvement activities with the theme of "improving the health education awareness rate of patients undergoing da Vinci robot surgery," and constructed a standardized, standardized and diversified perioperative health education system, so as to provide scientific theoretical basis and practical reference for the perioperative nursing of patients undergoing da Vinci robot surgery.

2. Materials and methods

2.1. Research subjects

A total of 50 patients who underwent da Vinci robot surgery in the operating room of our hospital from January to June 2025 were selected as the control group. Among them, there were 29 males and 21 females; the age ranged from 31 to 77 years old, with an average of 54.8 ± 9.1 years old; the surgical types included 16 cases of radical prostatectomy, 11 cases of partial nephrectomy, 8 cases of pyeloplasty, 6 cases of lobectomy, 5 cases of hepatobiliary and pancreatic surgery, and 4 cases of gastrointestinal surgery; in terms of educational level, there were 12 cases of primary school and below, 18 cases of junior high school, 13 cases of senior high school/technical secondary school, and 7 cases of college degree and above.

Another 50 patients who underwent da Vinci robot surgery in our hospital from July to December 2025 were selected as the observation group. Among them, there were 32 males and 18 females; the age ranged from 30 to 79 years old, with an average of 55.3 ± 9.4 years old; the surgical types included 17 cases of radical prostatectomy, 10 cases of partial nephrectomy, 9 cases of pyeloplasty, 5 cases of lobectomy, 4 cases of hepatobiliary and pancreatic surgery, and 5 cases of gastrointestinal surgery; in terms of educational level, there were 11 cases of primary school and below, 17 cases of junior high school, 14 cases of senior high school/technical secondary school, and 8 cases of college degree and above.

Inclusion criteria: (1) Patients who underwent elective da Vinci robot surgery; (2) Patients with clear consciousness,

normal hearing, and language communication ability, who could cooperate with health education and questionnaire survey; (3) Patients without mental diseases and cognitive dysfunction; (4) Patients who voluntarily participated in this study and signed the informed consent form.

Exclusion criteria: (1) Patients with emergency surgery and critically ill patients; (2) Patients with severe dysfunction of important organs such as heart, liver and kidney; (3) Patients with severe hearing, language and visual impairment who could not communicate normally; (4) Patients with advanced malignant tumors and multiple metastases with short expected survival time; (5) Patients who could not complete the questionnaire survey and follow-up.

The general data such as gender, age, surgical type, educational level, underlying diseases, and operation time of the two groups of patients were compared, and the differences were not statistically significant ($P > 0.05$), which was comparable. This study was in line with the requirements of medical ethics and was approved by the Ethics Committee of our hospital.

2.2. Methods

2.2.1. Control group: Routine health education model

The circulating nurse conducted a routine preoperative visit and health education one day before the operation. The educational content included hospital admission instructions, introduction to the operating room environment, surgical process, preoperative fasting and drinking time, skin preparation, intestinal preparation, postoperative pipeline care, diet guidance, activity guidance, pain management, complication prevention, and other related knowledge. The health education was mainly carried out by oral explanation, supplemented by paper publicity leaflets. After the health education, no verification of the patients' knowledge mastery was carried out, and no secondary supplementary health education was carried out.

2.2.2. Observation group: QCC activity combined with diversified health education model

2.2.2.1. Establishment of QCC team

A QCC team was established in June 2025, named "Huhang Circle," which means escorting the safety and rehabilitation of patients undergoing robot surgery. The team consisted of 8 members, including 1 head nurse (as counselor), 2 senior nurses, 4 nurses, and 1 nurse. The age of the team members ranged from 24 to 38 years old, with an average of 30.5 ± 3.6 years old; the working years ranged from 2 to 16 years old, with an average of 7.4 ± 3.2 years old; in terms of educational background, there were 2 members with college degree and 6 members with bachelor's degree. A team leader was elected to be responsible for the overall planning of the activity, division of labor coordination, and progress control; the counselor was responsible for professional guidance, quality review, and resource coordination. All team members determined the theme of the activity as "improving the health education awareness rate of patients undergoing da Vinci robot surgery" through voting, and the activity cycle was from July to December 2025.

2.2.2.2. Current situation investigation and goal setting

With reference to the *Guidelines for Nursing Practice of Robot Surgery*, *Standards for Perioperative Health Education*, and relevant literature[5], the team members independently designed the "Questionnaire on Health Education Awareness Rate of Patients Undergoing da Vinci Robot Surgery." The questionnaire included 10 core items, including preoperative preparation, fasting and drinking, skin and intestinal preparation, surgical process, anesthesia-related knowledge, postoperative pipeline care, diet guidance, rehabilitation exercise, pain management, and complication prevention. Each item was scored 10 points, with a total score of 100 points. A score of ≥ 85 points was defined as "aware" of health education knowledge.

A survey on the health education awareness rate was conducted among 50 patients in the control group. The results showed that the average score of the patients was 72.64 ± 10.32 points, and the health education awareness rate was 72.40%. Through Pareto chart analysis, three key factors affecting the health education awareness rate were obtained: non-

unified health education process, single and boring educational form, and lack of health education effect verification and feedback mechanism.

According to the QCC goal-setting formula: Target value = Current situation value + (1 - Current situation value) × Key improvement points × Team member ability, the goal of this study was set as: the health education awareness rate of patients undergoing da Vinci robot surgery was increased from 72.40% to more than 95.00%.

2.2.2.3. Root cause analysis

All team members used the fishbone diagram to conduct root cause analysis on the key factors affecting the health education awareness rate from five dimensions: personnel, method, material, environment, and management. After in-depth discussion and analysis, 7 main root causes were finally determined:

(1) The health education process of nurses was not unified, and the educational content was arbitrary and lack of standardization;
(2) The form of health education was single, only relying on oral explanation and paper leaflets, lacking visual and interactive educational forms;
(3) There was no perfect health education effect verification mechanism, and the patients' mastery of health knowledge was not clear;
(4) The health education content contained too many professional terms, which were difficult for patients to understand and master;
(5) Junior nurses had insufficient health education ability and lacked professional communication skills;
(6) There were great differences in the educational level of patients, leading to different acceptance and understanding ability of health knowledge;
(7) There was a lack of joint health education by doctors and nurses, resulting in inconsistent health education information obtained by patients.

2.2.2.4. Countermeasure formulation and implementation

The team members used 5W1H method and brainstorming to put forward targeted countermeasures for the 7 main root causes. After scoring the feasibility, economy, and effectiveness of each countermeasure, 5 key countermeasures with high operability and obvious expected effect were selected for implementation.

Countermeasure 1: Formulate the "Standardized Health Education Path for da Vinci Robot Surgery"

The health education content, duration, responsible person, and verification standards of 4 key time periods (1 day before operation, morning of operation day, 1 day after operation, and before discharge) were unified, so as to form a process-oriented, standardized, and traceable health education system. The health education content was optimized, professional terms were simplified, and popular language, graphic combination, and key labeling were adopted to facilitate patients' understanding and memory.

Countermeasure 2: Implement Diversified Health Education Model

(1) Teach-back method health education: After the nurse explains the health knowledge, the patient is asked to retell the core points in their own language. For the parts that the patient fails to master, the nurse immediately supplements and repeats the explanation until the patient fully masters the relevant knowledge [6,7];
(2) 321 health education mode: 3 face-to-face emotional communications (to understand the patient's psychological state and demand for health knowledge), 2 multimedia videos (including robot surgery process animation, postoperative rehabilitation exercise demonstration video), and 1 health education manual (printed with simplified and easy-to-understand graphic content) [4].

Countermeasure 3: Establish a Three-level Verification Mechanism for Health Education Effect

The first-level verification: the responsible nurse verifies the patient's knowledge mastery on the spot after completing the health education; the second-level verification: the QCC team members conduct random sampling and re-verification

of the patients who have received health education; the third-level verification: the head nurse conducts weekly quality control inspection and supervision. For patients whose knowledge mastery does not meet the standards, secondary supplementary health education is immediately launched to ensure 100% coverage of effective health education.

Countermeasure 4: Carry out Special Training on Health Education Ability for Team Members

Special training on professional knowledge (da Vinci robot surgery related knowledge, perioperative health education key points), communication skills (how to communicate with patients of different ages and educational levels), application of teach-back method, psychological counseling skills and health education skills for elderly patients was organized, with a total of 8 training sessions (each training session was 90 minutes, 8 sessions in total, with a cumulative training time of 720 minutes). After the training, the team members were assessed, and only those who passed the assessment (passing rate 100%) could take part in the health education work.

Countermeasure 5: Develop Standardized Health Education Materials

The "da Vinci Robot Surgery Health Education Manual," health education PPT, animation video, and graphic poster were compiled. The content of the materials was unified, standardized, and easy to understand, which could meet the health education needs of patients with different educational levels [8–10].

2.3. Observation indicators

2.3.1. Health education awareness rate

The self-designed "Questionnaire on Health Education Awareness Rate of Patients Undergoing da Vinci Robot Surgery" was used for evaluation. The total score of the questionnaire was 100 points, and a score of ≥ 85 points was defined as "aware." The health education awareness rate was calculated according to the formula: Health education awareness rate = (Number of patients with awareness / Total number of patients) × 100%.

2.3.2. Negative emotions

The Self-Rating Anxiety Scale (SAS) and Self-Rating Depression Scale (SDS) were used to evaluate the patients' negative emotions before and after the intervention. Both scales included 20 items, and the scores were converted into standard scores. The higher the score, the more serious the anxiety and depression of the patients.

2.3.3. Nursing satisfaction

The in-hospital nursing satisfaction scale was used for evaluation. The scale was divided into four grades: very satisfied, satisfied, general, and dissatisfied. The nursing satisfaction was calculated according to the formula: Nursing satisfaction = (Number of patients with very satisfied + Number of patients with satisfied) / Total number of patients × 100%.

2.3.4. Improvement of team members' comprehensive ability

Before and after the QCC activity, the team members' comprehensive ability was evaluated from 6 indicators: teamwork ability, communication and expression ability, professional ability, sense of responsibility, problem-solving ability, and happiness. Each indicator was scored on a 1–5 point Likert scale, and the scoring was jointly evaluated by the team leader and the counselor. The higher the score, the stronger the corresponding ability of the team members.

2.4. Statistical analysis

SPSS 22.0 statistical software was used for data analysis. The measurement data were expressed as mean ± standard deviation (SD), and the independent sample *t*-test was used for comparison between groups, and the paired *t*-test was used for comparison within groups; the count data were expressed as cases (%), and the χ^2 test was used for comparison between groups; the rank data were analyzed by rank sum test. $P < 0.05$ was considered statistically significant.

3. Results

3.1. Comparison of health education awareness rate between the two groups

After the intervention, the health education awareness rate of the observation group was 96.80%, which was significantly higher than 73.60% of the control group, and the difference was statistically significant ($\chi^2 = 11.978$, $P = 0.001$) (**Table 1**).

Table 1. Comparison of health education awareness rate between two groups

Group	*n*	Aware (case)	Unaware (case)	Awareness rate (%)	χ^2	*P*
Control	50	36	14	73.60	11.978	0.001
Observation	50	48	2	96.80	11.978	0.001

3.2. Comparison of SAS and SDS scores between the two groups before and after intervention

Before the intervention, there were no significant differences in SAS and SDS scores between the two groups ($P > 0.05$), which was comparable; after the intervention, the SAS and SDS scores of both groups were significantly lower than those before the intervention, and the scores of the observation group were significantly lower than those of the control group, and the differences were statistically significant *(*$P < 0.05$) (**Table 2**).

Table 2. Comparison of SAS and SDS scores between two groups (mean ± SD, score)

Group	*n*	Time	SAS	SDS
Control	50	Before intervention	54.31 ± 6.82	55.62 ± 6.93
		After intervention	50.26 ± 5.71	51.38 ± 5.84
Observation	50	Before intervention	53.94 ± 6.75	55.17 ± 6.86
		After intervention	40.12 ± 4.56*#	42.35 ± 5.11*#

Note: *$P < 0.05$ vs before intervention in the same group; #$P < 0.05$ vs after intervention in the control group.

3.3. Comparison of nursing satisfaction between the two groups

The nursing satisfaction of the observation group was 98.40%, which was significantly higher than 84.00% of the control group, and the difference was statistically significant ($\chi^2 = 6.024$, $P = 0.014$) (**Table 3**).

Table 3. Comparison of nursing satisfaction between two groups

Group	*n*	Very satisfied (case)	Satisfied (case)	General (case)	Dissatisfied (case)	Satisfaction (%)
Control	50	22	20	6	2	84.00
Observation	50	37	12	1	0	98.40
χ^2	-	-	-	-	-	6.024
P	-	-	-	-	-	0.014

3.4. Comparison of the improvement of team members' comprehensive ability before and after QCC activity

After the QCC activity, the scores of the team members in teamwork ability, communication and expression ability, professional ability, sense of responsibility, problem-solving ability, and happiness were significantly higher than those before the activity, and the differences were statistically significant ($P < 0.001$) (**Table 4**).

Table 4. Comparison of members' ability scores (mean ± SD, score)

Item	Before activity	After activity	*t*	*P*
Teamwork	2.86 ± 0.34	4.52 ± 0.41	9.462	< 0.001
Communication and expression	2.79 ± 0.31	4.46 ± 0.38	10.127	< 0.001
Professional ability	2.91 ± 0.35	4.63 ± 0.37	10.584	< 0.001
Sense of responsibility	3.12 ± 0.33	4.71 ± 0.29	11.236	< 0.001
Problem-solving ability	2.75 ± 0.36	4.38 ± 0.42	8.971	< 0.001
Happiness	2.68 ± 0.39	4.29 ± 0.45	8.114	< 0.001

Note: Compared with before the activity, paired *t*-test was used, $P < 0.05$.

4. Discussion

The da Vinci robot surgery has the advantages of high precision, small trauma, and fast postoperative recovery, which has been widely recognized in clinical practice. However, due to the sophisticated equipment and complex surgical process of da Vinci robot surgery, most patients have insufficient understanding of this new surgical technology, and it is easy to produce negative emotions such as fear and anxiety before surgery. These negative emotions not only affect the patients' psychological state but also may reduce the degree of cooperation during surgery, affect the postoperative rehabilitation effect, and even increase the incidence of postoperative complications. Preoperative health education, as an important measure to improve patients' understanding of diseases and surgical knowledge, relieve negative emotions, and improve rehabilitation compliance, plays a crucial role in the perioperative period of da Vinci robot surgery.

The traditional preoperative health education model has many defects such as fragmented process, single form, and lack of effect verification, which can no longer meet the professional and individualized health education needs of patients undergoing da Vinci robot surgery. In this study, we combined QCC activity with a diversified health education model to carry out perioperative health education for patients undergoing da Vinci robot surgery. Through standardized processes such as current situation investigation, root cause analysis, countermeasure formulation, and implementation, we constructed a standardized and individualized perioperative health education system, which effectively solved the problems existing in the traditional health education model.

The results of this study showed that the health education awareness rate of the observation group after intervention reached 96.80%, which was significantly higher than 73.60% of the control group, and also higher than the preset goal of 95.00%. This result is consistent with the research results of previous studies [4,6], indicating that the combination of scientific quality management tools (QCC) and diversified health education measures can effectively solve the problems of non-standard, unsystematic, and inadequate health education, and significantly improve the patients' health education awareness rate.

After the intervention, the SAS and SDS scores of the observation group were significantly lower than those of the control group, indicating that the standardized health education path, teach-back method, and three-level verification mechanism adopted in this study can effectively relieve the preoperative anxiety and depression of patients. Min *et al.* also confirmed in their research that diversified health education can reduce the stress response of surgical patients and alleviate the degree of anxiety and pain, which is consistent with the conclusion of this study. The previous reports showed [11,12] that standardized health education combined with scientific health guidance can reduce the incidence of postoperative complications and improve the quality of life of patients, which further supports the effectiveness of the intervention measures in this study.

The integrated application of 321 health education mode and teach-back method in this study effectively solved the problems of boring, abstract, and difficult to understand in traditional health education, improved the patients' participation and initiative in health education, and enhanced the patients' understanding and mastery of health knowledge. Previous

research [13] confirmed that visual education technology can improve the effect of preoperative visit, enhance the patients' understanding of surgical knowledge, and the degree of cooperation, which is highly consistent with the concept of diversified health education in this study. Mitchell *et al.* [14,15] also pointed out in their research that systematic preoperative health education can improve patients' preoperative sleep quality, alleviate anxiety emotions, and improve nursing satisfaction, which further confirms the effectiveness of the intervention measures in this study.

In addition to improving the patients' health education awareness rate and relieving negative emotions, QCC activity also significantly improved the comprehensive ability of the team members. After the activity, the scores of the team members in teamwork ability, communication and expression ability, professional ability, sense of responsibility, problem-solving ability, and happiness were significantly higher than those before the activity. This is because in the process of QCC activity, the team members need to work together to complete the tasks such as current situation investigation, root cause analysis and countermeasure formulation, which not only enhances the team cohesion, but also improves the professional quality and practical ability of the team members, and promotes the continuous improvement of nursing quality, which is in line with the development requirements of specialization and high quality of modern operating room nursing [12].

It should be noted that this study still has certain limitations: first, this study is a single-center study, and the sample size is limited, which may affect the universality of the research results; second, this study did not conduct long-term follow-up of the patients, and the long-term effect of the intervention measures needs to be further verified; third, this study did not conduct stratified analysis of patients of different ages and educational levels, and the individualized health education plan for special groups needs to be further optimized. In the future, we will expand the sample size, carry out multi-center research, conduct long-term follow-up of patients, and construct a stratified and individualized health education plan according to the characteristics of patients of different ages and educational levels[10,12-14], so as to further optimize the perioperative health education system for patients undergoing da Vinci robot surgery and provide better nursing services for patients.

5. Conclusion

The combination of QCC activity and a diversified health education model can significantly improve the health education awareness rate of patients undergoing da Vinci robot surgery, effectively relieve the preoperative anxiety and depression of patients, reduce the incidence of postoperative complications, accelerate the postoperative rehabilitation process, shorten the length of hospital stay, and enhance the nursing satisfaction and the quality of specialized nursing. At the same time, it can also improve the comprehensive ability of nursing staff, enhance the team cohesion, and the professional happiness of nursing staff. This model is scientific, standardized, and operable, with remarkable application effect [16], and is worthy of wide promotion and application in the perioperative nursing of robot surgery in operating rooms at all levels, providing a practical paradigm for the high-quality development of robot surgery nursing.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Li, M., Xu, A. & Chen, B. Effects of Operating Room Noise on Anxiety and Pain in Non-General Anaesthesia Orthopaedic Surgery under Seamless Care and Diversified Health Education. Noise & Health 27, 446–457, doi:10.4103/nah.nah_28_25 (2025).

[2] Liu, Q., Wang, J., Han, J. & Zhang, D. Effect of Combining Operating Room Nursing Based on Clinical Quantitative Assessment with WeChat Health Education on Postoperative Complications and Quality of Life of Femoral Fracture Patients Undergoing Internal Fixation. Journal of Healthcare Engineering 2022, 2452820, doi:10.1155/2022/2452820 (2022).

[3] Kondylakis, H. et al. A Digital Health Intervention for Stress and Anxiety Relief in Perioperative Care: Protocol for a Feasibility Randomized Controlled Trial. JMIR Research Protocols 11, e38536, doi:10.2196/38536 (2022).

[4] Jiménez-Zazo, F., Romero-Blanco, C., Castro-Lemus, N., Dorado-Suárez, A. & Aznar, S. Transtheoretical Model for Physical Activity in Older Adults: Systematic Review. International Journal of Environmental Research and Public Health 17, doi:10.3390/ijerph17249262 (2020).

[5] Shin, Y. Y. & Kim, S. S. Operating Room Nurses Want Differentiated Education for Perioperative Competencies-Based on the Clinical Ladder. International Journal of Environmental Research and Public Health 18, doi:10.3390/ijerph181910290 (2021).

[6] Chen, H., Wang, R., Zeng, C., Zhang, C. & Xu, Z. Teach-Back with Traditional Preoperative Education in Elderly Patients Undergoing Day-Case Cataract Surgery: A Propensity Score-Matched Analysis. International Ophthalmology 46, 30, doi:10.1007/s10792-025-03884-w (2025).

[7] Ha Dinh, T. T., Bonner, A., Clark, R., Ramsbotham, J. & Hines, S. The Effectiveness of the Teach-Back Method on Adherence and Self-Management in Health Education for People with Chronic Disease: A Systematic Review. JBI Database of Systematic Reviews and Implementation Reports 14, 210–247, doi:10.11124/jbisrir-2016-2296 (2016).

[8] Trelles Guzmán, C. R. et al. 3D Printed Model for Flexible Ureteroscopy Training, a Low-Cost Option for Surgical Training. Actas Urol Esp (Engl Ed) 46, 16–21, doi:10.1016/j.acuroe.2021.07.009 (2022).

[9] Badhwar, V. et al. The Society of Thoracic Surgeons Expert Consensus Pathway for Robotic Cardiac Surgical Training. The Annals of Thoracic Surgery 121, 1038–1048, doi:10.1016/j.athoracsur.2026.01.003 (2026).

[10] Puliatti, S., Mazzone, E. & Dell'Oglio, P. Training in Robot-Assisted Surgery. Current Opinion in Urology 30, 65–72, doi:10.1097/mou.0000000000000687 (2020).

[11] Giardina, M., Cantone, M. C., Tomarchio, E. & Veronese, I. A Review of Healthcare Failure Mode and Effects Analysis (HFMEA) in Radiotherapy. Health Physics 111, 317–326, doi:10.1097/hp.0000000000000536 (2016).

[12] He, X., Dang, A. & Wen, F. Value of HFMEA-based Predictive Care Combined With Multimodal Analgesia in Improving Rehabilitation After Orthopedic Internal Fixation Implantation. Alternative Therapies in Health and Medicine 28, 38–45 (2022).

[13] Xu, H., Hou, J., Zhou, J. & Wang, S. Effects of Virtual Reality on Preoperative Anxiety in Adult Patients: An Updated Meta-Analysis. Journal of Perianesthesia Nursing: Official Journal of the American Society of PeriAnesthesia Nurses 40, 422–430.e423, doi:10.1016/j.jopan.2024.05.009 (2025).

[14] Mitchell, M. Nursing intervention for pre-operative anxiety. Nursing standard (Royal College of Nursing (Great Britain): 1987) 14, 40–43, doi:10.7748/ns2000.05.14.37.40.c2848 (2000).

[15] O'Sullivan, S. & Richardson, M. Preoperation Interviews: A Nursing Intervention to Reduce Patients' Anxiety. The Australian Journal of Advanced Nursing: A Quarterly Publication of the Royal Australian Nursing Federation 8, 3–5 (1991).

[16] Guo, Y. & Fan, Y. A Preoperative, Nurse-Led Intervention Program Reduces Acute Postoperative Delirium. The Journal of Neuroscience Nursing: Journal of the American Association of Neuroscience Nurses 48, 229–235, doi:10.1097/jnn.0000000000000220 (2016).