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IMPLEMENTING AI CHATBOTS FOR PRE-OPERATIVE PATIENT EDUCATION IN SURGICAL NURSING: EFFECT ON ANXIETY, KNOWLEDGE, PRACTICES, AND RECOVERY RATES

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ABSTRACT

***Background:** Pre-operative anxiety is a significant challenge in surgical nursing and impacts surgical outcomes, often leading to physiological stress and delayed healing. While traditional education is vital, nursing staff*

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shortages often limit the time available for thorough patient preparation. Aim: This study aimed to evaluate the effect of implementing AI chatbots for pre-operative patient education in surgical nursing on anxiety, knowledge, practices, and recovery rates. Methods: A quasi-experimental design was employed using a convenience sample of 300 surgical patients from surgical departments at Sohag university hospitals. Participants were divided into two groups: a control group (n=150) receiving standard verbal and written nursing instructions, and a study group (n=150) who utilized an AI chatbot for interactive pre-operative guidance. Tools:1. Demographic and Clinical Data Sheet, 2. Pre-operative Patient Knowledge Questionnaire, 3. Patient Pre-operative Practices Observational Checklist, 4. Beck Anxiety Inventory (BAI), 5. Clinical Recovery Assessment Form, and 6. Patient Satisfaction with AI Chatbot Scale. Results: The study group demonstrated a statistically significant reduction in pre-operative anxiety scores compared to the control group ($p < 0.05$). Furthermore, patients in the AI chatbot group showed improved knowledge, practices, and recovery indicators, including shorter hospital stays and earlier post-operative ambulation, due to better adherence to pre-surgical protocols. Conclusion: Implementing AI chatbots in surgical nursing provides a scalable, interactive solution that effectively reduces patient psychological distress and enhances knowledge, practices, and clinical recovery outcomes. These findings suggest that AI tools can significantly augment traditional nursing care in perioperative settings.

KEYWORDS: AI Chatbots, Anxiety, Knowledge, And Practices, Pre-Operative Patient Education, Surgical Nursing, Recovery Rates.

1. INTRODUCTION

Patient education is the cornerstone of surgical nursing, aimed at transitioning the patient from a state of vulnerability to one of informed participation. Traditionally, this education relies on verbal instructions and printed brochures. However, the "one-size-fits-all" nature of these materials often fails to account for varying health literacy levels and the cognitive load experienced by patients under stress (Almutary & Almashi, 2024). The shift toward digital health and AI chatbots represents a move toward "Precision Nursing," where information is delivered in a personalized, interactive, and timely manner (Topol, 2019)

Pre-operative anxiety is a complex psychological and physiological response characterized by tension, apprehension, and autonomic nervous system activation. High anxiety levels are not merely a mental burden; they trigger the release of stress hormones like cortisol and catecholamines, which can impair wound healing and increase the risk of infection (Bello et al., 2025). AI chatbots intervene by providing 24/7 access to information, which acts as a "buffer" against the uncertainty that fuels this physiological stress response . ChatGPT is an attractive and potentially useful resource for informing patients about early detection of oral cancer. Nevertheless, concerns do exist about readability and actionability of the offered information (Hassona et al., 2024).

Artificial Intelligence (AI) in the form of chatbots utilizes Natural Language Processing (NLP) to simulate human conversation. Unlike static websites, these agents can assess a patient's specific concerns—such as fear of anesthesia or post-operative pain—and provide tailored responses (Kocaballi et al., 2019). In surgical nursing, this technology extends the nurse's reach, ensuring that patients receive evidence-based answers even outside of clinic hours, thereby maintaining a continuous "thread of care (Shi et al., 2025).

The correlation between AI-driven education and recovery rates is increasingly evident in recent clinical trials. By improving adherence to pre-operative protocols (such as fasting or medication management), chatbots reduce the likelihood of surgical cancellations (Ben Hmido et al., 2025). Furthermore, studies have shown that patients who engage with AI tools report lower pain scores and a 35-37% reduction in post-operative opioid consumption, as they are better equipped with non-pharmacological coping strategies (Lee et al., 2024).

A critical barrier to recovery is low health literacy. Chatbots can simplify complex medical jargon into understandable language, enhancing the patient's "self-efficacy"—their belief in their ability to manage their own recovery (Kurt, 2025). When patients feel competent in their post-operative care (e.g., wound care or mobilization), readmission rates decrease significantly. This empowers the patient to become an active partner in the surgical team rather than a passive recipient of care (Palanica et al., 2019).

Nurses serve as a critical safety check, verifying AI-generated health education and psychological counseling to ensure accuracy and procedural alignment. Nurses utilize AI insights to analyze patient data in real-time, allowing them to identify high-risk patients and intervene early in cases of potential complications like sepsis or hemorrhage. Rather than repeating routine instructions, nurses guide patients in using chatbots effectively, ensuring they understand the "professional-level advice" and non-judgmental support provided by the agent (Wei et al., 2025).

Significance of the Study

This study demonstrates that AI chatbots are not merely "digital brochures" but active clinical interventions. By showing a statistically significant reduction in Beck Anxiety Inventory (BAI) scores, the research proves that interactive AI can mitigate the physiological stress response, which is known to delay wound healing and increase post-operative complications. The improved recovery indicators—shorter hospital stays and earlier ambulation—underscore the chatbot's role in accelerating the patient's return to baseline health. The findings regarding improved pre-operative practices and knowledge signify a shift toward patient-centered care. The chatbot provides a scalable platform for patients to clarify doubts in a non-judgmental environment. This increases their self-efficacy and adherence to surgical protocols (fasting, medication, hygiene), which is directly linked to the study's observed improvements in recovery rates.

This research contributes to the growing body of evidence for Precision Nursing. It validates the use of quasi-experimental evidence in evaluating digital health tools within the perioperative setting. By utilizing a diverse set of tools (from BAI to satisfaction scales), the study provides a robust framework for other institutions to implement and measure the success of AI-driven patient education. The reduction in hospital stay duration and improved ambulation rates suggest potential cost-savings for healthcare facilities. Efficient pre-operative preparation via AI reduces the likelihood of costly surgical cancellations and post-operative

readmissions, making this a financially viable model for modern surgical departments.

Aim of the study

This study aimed to evaluate the effect of implementing AI chatbots for pre-operative patient education in surgical nursing on anxiety and recovery rates.

Research Hypotheses

- **(H1):** Patients in the study group who utilize the AI chatbot for pre-operative education will exhibit significantly lower mean scores on the Beck Anxiety Inventory (BAI) compared to the control group receiving traditional nursing instructions.
- **(H2):** The implementation of AI chatbots will result in significantly higher pre-operative knowledge scores and improved pre-operative practices (as measured by the observational checklist) in the study group compared to the control group.
- **(H3):** Patients using the AI chatbot will demonstrate significantly better clinical recovery outcomes, specifically shorter hospital stays and earlier post-operative ambulation, than those in the control group.
- **(H4):** There will be a significant positive correlation between the level of patient satisfaction with the AI chatbot and the degree of adherence to pre-surgical protocols.
- **(H5):** The use of AI chatbots will significantly enhance the efficiency of surgical nursing care by improving patient readiness and protocol compliance compared to standard verbal and written instructions.

2. SUBJECTS AND METHOD

Research Design

A quasi-experimental research design (Pre-test/Post-test non-equivalent groups) was utilized to achieve the study objectives. This design was chosen to evaluate the effectiveness of the AI chatbot (independent variable) on patient anxiety, knowledge, practices, and recovery rates (dependent variables) by comparing a study group to a control group.

Setting

The study was conducted at the Surgical Departments at Sohag University Hospital. These settings were selected due to the high flow of elective surgical cases and the established need for enhanced pre-operative patient education.

Sampling and Participants

- **Sample Type:** A **convenience sample** of 300 adult surgical patients.
- **Sample Size:** Total N=300, divided into two equal groups:
- **Control Group (n=150):** Received standard hospital care (verbal instructions and routine brochures).
- **Study Group (n=150):** Utilized the AI chatbot for pre-operative guidance.
- **Inclusion Criteria:** Patients aged 18–65 years, scheduled for elective surgery, possessing a smartphone, and able to read and write.
- **Exclusion Criteria:** Patients with cognitive impairments, psychiatric disorders, or those undergoing emergency surgeries.

Tools for data collection:

Tool 1. Demographic and Clinical Data Sheet: A researcher-designed tool **(Polit & Beck, 2021)** used to assess the baseline characteristics and ensure homogeneity between the study and control groups.

Part I: Demographic Data such as age, gender , level of Education, and Occupation

Part II: Clinical Data: Type of Surgery, Previous Surgical Experience (Yes / No), Chronic Diseases , Body Mass Index (BMI).

Tool 2. Pre-operative Patient Knowledge Questionnaire

A structured tool developed by the researcher **(Van Oirschot et al., 2024)** to assess the effectiveness of the AI chatbot in delivering educational content. Included questions on surgical site preparation, fasting protocols, and post-operative warning signs.

- **Scoring:** 1 point for each correct answer, 0 for incorrect/don't know.
- **High Knowledge:** >75%
- **Fair Knowledge:** 50%–75%
- **Poor Knowledge:** <50%

Tool 3. Patient Pre-operative Practices Observational Checklist

Used to measure the "Practice" variable through patient compliance with instructions. Items include skin disinfection, cessation of smoking/blood thinners, and deep breathing exercise performance.

- **Scoring:** Binary scale: **Done (1)** or **Not Done (0)**. A higher total score more than 60% indicates satisfactory adherence to pre-operative nursing instructions and less than 60% indicates unsatisfactory total knowledge level.

Tool 4. Beck Anxiety Inventory (BAI)

Used to measure the severity of patient anxiety before surgery (Beck & Steer, 1993). A 21-item self-report inventory.

- **Scoring:** Each item is scored from **0 (Not at all)** to **3 (Severely)**.

1. **0–7:** Minimal anxiety.
2. **8–15:** Mild anxiety.
3. **16–25:** Moderate anxiety.
4. **26–63:** Severe anxiety.

Tool 5. Clinical Recovery Assessment Form

To track objective recovery metrics.

1. **Length of Stay (LOS):** Calculated in days from surgery to discharge.
2. **First Mobilization:** Calculated in hours from the end of anesthesia to the first unassisted walk/sitting.
3. **Pain Scores:** Measured via Visual Analog Scale (VAS) 0-10.

Tool 6**. Patient Satisfaction with AI Chatbot Scale (PSCS)**

A Likert-scale tool to evaluate the study group's experience with the AI educational tool **(Venkatesh, 2003).**

- **Content (5-point Likert Scale):**

1. Ease of use and navigation.
2. Clarity of the information provided.
3. Availability of the chatbot (24/7 access).
4. Ability to reduce fears/concerns.
5. Preference for the chatbot over traditional pamphlets.

- **Scoring:**
- Items are scored from **1 (Strongly Disagree)** to **5 (Strongly Agree)**.
- **High Satisfaction:** >80%
- **Moderate Satisfaction:** 60%–80%
- **Low Satisfaction:** <60%

Tools Validity

The newly developed tools (Knowledge Questionnaire, Practices Checklist, and AI Satisfaction Scale) were submitted to a **jury of 5 experts** in surgical nursing and anesthesia. They reviewed the items for clarity, relevance, and comprehensiveness. The Beck Anxiety Inventory (BAI) is already a globally validated tool, ensuring high correlation with other standard anxiety measures.

Reliability

The Cronbach's Alpha coefficient was calculated for all tools. A score of ≥ 0.80 was achieved indicating high reliability.

Pilot Study

A pilot study was conducted on 10% of the total sample (30 patients) before the main data collection began to evaluate the feasibility of using the AI chatbot, assess the time required to complete the questionnaires, and identify any logistical challenges. No adjustments were made. The pilot participants were included in the main study sample.

Ethical Considerations

Institutional Approval: Ethical clearance was obtained from the **Research Ethics Committee** of the Faculty of Nursing **((147/ 11 /2023).** Written consent was obtained from each participant after explaining the study's aim and the nature of the AI intervention. All data were coded to protect patient identities, and only the research team had access to the files. Participants were informed that their participation was voluntary and that they could withdraw at any stage without any negative impact on their surgical care.

Data Collection Procedure

The data collection process was conducted over a period of six months and followed a structured three-phase approach to ensure consistency and ethical compliance:

Phase I: Preparatory and Screening Phase

After obtaining formal approval from the hospital administration and the ethical committee, the researchers screened elective surgical patients for eligibility. Patients who met the inclusion criteria were approached during their pre-admission visit. The researchers explained the study's aim, ensured confidentiality, and obtained written informed consent. Participants were then assigned to either the **control** or **study group** using a convenience sampling technique. Baseline data were collected for both groups using the **Demographic and Clinical Data Sheet** and the **Pre-operative Patient Knowledge Questionnaire**.

Phase II: Implementation Phase

- **Control Group:** Patients received the standard hospital pre-operative preparation, which included routine verbal instructions and printed brochures provided by the ward nurses.
- **Study Group:** Patients were introduced to the **AI Chatbot**. The researcher assisted them in accessing the platform on their smartphones. The chatbot provided interactive modules covering surgical preparation, fasting protocols, and anxiety-reduction techniques. Patients could interact with the chatbot to ask questions and

receive immediate feedback up until the morning of the surgery.

Phase III: Evaluation and Follow-up Phase

1. **Immediately Pre-operative:** On the morning of the surgery, the **Beck Anxiety Inventory (BAI)** and the **Patient Pre-operative Practices Observational Checklist** were administered to both groups to evaluate the immediate impact of the intervention.
2. **Post-operative Period:** The researchers monitored the participants using the **Clinical Recovery Assessment Form** to record recovery indicators such as the time of first ambulation and the length of hospital stay.
3. **Post-Intervention (Study Group Only):** Patients in the study group completed the **Patient Satisfaction with AI Chatbot Scale** prior to hospital discharge to assess the usability and perceived helpfulness of the digital tool.

Phases of Intervention

The intervention was carried out through four sequential phases: **Assessment, Planning, Implementation, and Evaluation.**

Phase I: Assessment Phase (Pre-Intervention)

In this initial stage, the researchers conducted a baseline assessment for all 300 participants (both study and control groups) during the pre-admission clinic visit. Demographic data, medical history, and baseline pre-operative knowledge was collected. **Anxiety Baseline:** The **Beck Anxiety Inventory (BAI)** was administered to determine the initial level of psychological distress before any educational intervention.

Phase II: Planning Phase

During this phase, the researchers prepared the educational content and the delivery platforms. **For the Control Group:** Standard nursing brochures and verbal instruction scripts were reviewed to ensure consistency. **For the Study Group:** The **AI Chatbot** was configured with evidence-based surgical guidelines. The content was simplified into interactive modules (video links and checklists) covering fasting protocols, medication management, and relaxation techniques.

Phase III: Implementation Phase

This stage involved the actual delivery of the pre-operative education: **Control Group (n=150):** Received a single session of traditional verbal instructions and was handed printed educational materials by the ward nurse. **Study Group (n=150):** Participants were trained on how to use the AI chatbot on their smartphones. They were encouraged to interact with the chatbot daily leading up to their surgery. The chatbot provided **automated responses** to their concerns, sent push-notification reminders for pre-surgical preparations (e.g., fasting), and offered interactive psychological support.

This stage involves the actual delivery of pre-operative education to participants. The study population (n=300) is divided into two distinct groups to compare the effectiveness of traditional methods versus AI-driven technology.

1. Control Group (n=150**)**

- **Method:** Traditional Standard of Care.
- **Procedure:**
  - **Verbal Instruction:** Participants receive a single, one-on-one session of traditional verbal instructions provided by the ward nurse.
  - **Printed Materials:** Educational brochures and printed handouts are provided for the patient to take home and review.

2. Study Group (n=150**)**

Method: AI-Driven Interactive Education.

Procedure:

Onboarding: Participants receive hands-on training on how to install and navigate the AI chatbot on their smartphones.

Continuous Engagement: Patients are encouraged to interact with the chatbot daily during the period leading up to their surgery.

Interactive Features:

Push-Notifications: Automated reminders are sent for critical pre-surgical steps (e.g., fasting times, medication adjustments).

Psychological Support: The bot offers interactive modules designed to reduce pre-operative anxiety and offer emotional reassurance.

Educational Core Content

The session covers the following essential pillars of pre-operative preparation:

- **Procedural Awareness:** Detailed overview of the surgical process, estimated duration, and what to expect during anesthesia induction.
- **Preparation Protocols:** Strict instructions on **fasting (NPO)**—typically no solids 6 hours and clear liquids up to 2 hours before surgery—and medication adjustments (e.g., stopping blood thinners).
- **Post-Operative Skills:** Training on incentive spirometry, deep breathing, coughing techniques

to prevent pneumonia, and early mobilization to prevent blood clots.
- **Pain Management:** Education on using pain rating scales and the importance of requesting analgesia before pain becomes severe.
- **Self-Care & Recovery:** Instructions for incisional care, diet, and identifying "red flags" like signs of infection.

Implementation Strategy by Group

Component	Control Group (Standard)	Study Group (AI Chatbot)
Delivery Mode	**One-time session** with a nurse and printed brochures.	**Continuous daily engagement** via smartphone app.
Reminders	Dependent on the patient's memory and printed materials.	**Push-notifications** for fasting times and surgical countdowns.
Interaction	No further interaction until the day of surgery.	**24/7 Q&A** for immediate clarification of concerns.
Psychological Support	Standard verbal reassurance during the single session.	**Interactive modules** and empathetic automated support to reduce anxiety.

Phase IV: Evaluation Phase (Post-Intervention)

1. **Immediate Pre-operative (Morning of Surgery):** Anxiety levels (BAI) and knowledge scores were re-measured for both groups. Adherence to protocols was verified using the **Observational Checklist using the same tools use in pretest**.
2. **Post-operative Period:** Clinical recovery indicators (time to ambulate, hospital stay duration) were tracked using the **Clinical Recovery Assessment Form**. Finally, the study group's satisfaction with the AI tool was measured before discharge.

3. STATISTICAL ANALYSIS

Statistical analysis for this study was performed using **SPSS version 26.0**, where descriptive statistics, including frequencies, percentages, means, and standard deviations, were utilized to summarize demographic data and clinical characteristics. To test the research hypotheses, an **Independent Samples t-test** was employed to compare the mean scores of pre-operative anxiety (BAI), knowledge levels, and clinical recovery indicators (such as hospital stay duration and ambulation time) between the study and control groups. Additionally, the **Chi-square test ($\chi 2$)** was used to analyze categorical variables and adherence rates, while **Pearson correlation coefficients** assessed the relationship between chatbot satisfaction and recovery outcomes. All statistical tests were two-tailed, and a **p-value of < 0.05** was established as the threshold for clinical and statistical significance.

4. RESULTS

Table 1: Demographic and Clinical Data of the Studied Patients (N=300)

Variable	Study Group (n=150)	Control Group (n=150)	$\chi 2$	p-value
Age (Mean ± SD)	42.5 ± 8.3	43.1 ± 7.9	0.65	> 0.05
Gender (Male / Female %)	45% / 55%	48% / 52%	0.32	> 0.05
Education Level (High %)	60%	58%	0.15	> 0.05
Type of Surgery (General/Ortho %)	50% / 50%	52% / 48%	0.22	> 0.05
Chronic Diseases (Yes %)	35%	38%	0.28	0.59 (NS)

As illustrated in Table (1): The mean age in the study group (42.5±8.3) and control group (43.1±7.9) shows no significant difference ($\chi 2$=0.65, >0.05). This indicates that both groups are age-matched, preventing age from becoming a confounding variable in the surgical outcomes. With a distribution of 45%/55% in the study group and 48%/52% in the control group, the gender ratio is statistically balanced ($\chi 2$=0.32,>0.05).

Regarding to education Level: High education levels (60% vs 58%) were evenly distributed ($\chi 2$=0.15,p>0.05). This balance is crucial for your study, as it ensures that the participants' ability to understand chatbot instructions or printed materials is comparable across both groups. Concerning to chronic Diseases: The presence of comorbidities (35% vs 38%) showed no significant variation (p=0.59), suggesting that both groups share a similar baseline health risk profile. Regarding to type of Surgery: The split between General and Orthopedic surgeries was nearly identical (50/50% vs 52/48%), ensuring that the results of the AI intervention are not biased by a specific surgical specialty. There were no statistically significant differences between the study and control groups regarding their demographic and clinical .characteristics (p > 0.05).

Table 2: Comparison of Knowledge Levels (Patients) and Practices Scores Throughout Study Phases (Pre, Post, and 3-Months Follow-up).

Variable	Phase	Study Group (n=150)	Control Group (n=150)	t-test	p-value
Total Knowledge Score	Pre-intervention	12.4 ± 3.1	12.1 ± 3.5	0.77	> 0.05
	Post-immediate	**24.8 ± 2.2**	14.5 ± 3.0	**32.4**	**< 0.001***
	3-Months Follow-up	**22.5 ± 2.6**	13.2 ± 3.2	**27.1**	**< 0.001***
Practice Checklist Score	Pre-intervention	8.2 ± 2.0	8.5 ± 1.8	1.35	> 0.05
	Post-immediate	**18.4 ± 1.5**	10.2 ± 2.1	**38.2**	**< 0.001***
	3-Months Follow-up	**17.1 ± 1.9**	9.8 ± 2.0	**31.5**	**< 0.001***

The results in Table (2) reveal a highly significant improvement in the study group's total knowledge and practice scores immediately following the AI chatbot intervention and at the 3-month follow-up compared to the control group ($p < 0.001$).

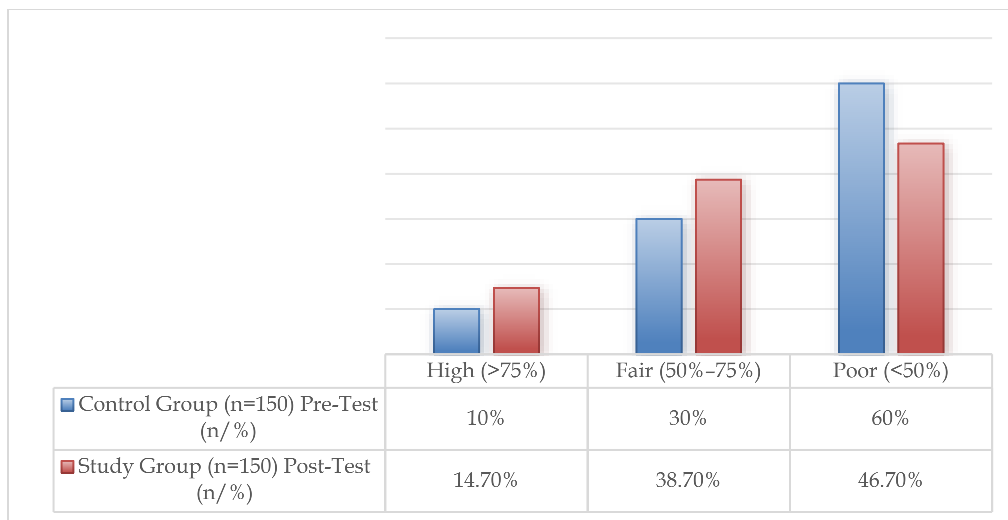

Figure 1: Distribution of Knowledge Levels (High, Fair, Poor) Pre and Post Intervention.

Figure 1 illustrates at the initial assessment, the majority of patients exhibited Poor Knowledge (60%), while only a small minority (10%) reached the High Knowledge threshold. This indicates a significant baseline deficit regarding surgical preparation and fasting protocols. Following standard verbal instructions and brochures, there was a marginal improvement. The percentage of patients with High Knowledge rose slightly to 14.7%, and Fair Knowledge increased from 30% to 38.7%. Despite standard care, nearly half of the patients (46.7%) remained in the Poor Knowledge category. This suggests that traditional educational methods (routine brochures) are insufficient for ensuring comprehensive patient.

Table 3: Distribution of Total Patients' Levels regarding Practices (Satisfactory) (Pre, Post, and 3-Months Follow-up).

Level	Group	Pre %	Post (Immediate) %	Follow-up (3 Months) %	p-value
Satisfactory Practice	Study	20%	**95%**	**88%**	**< 0.001***
	Control	18%	30%	25%	

The results in Table 3 reveal a highly significant improvement in the study group's total practice levels immediately following the AI chatbot intervention and at > the 3-month follow-up compared to the control group (p While both groups started with low baseline .(0.001 scores, the study group maintained a 'Satisfactory' level of .practice (95%) post-intervention

Table 4: Anxiety Levels (Beck Anxiety Inventory - BAI) Throughout Study Phases (Pre, Post, and 3-Months Follow-up).

Anxiety Level	Phase	Study Group (n=150)	Control Group (n=150)	$\chi 2$	p-value
Severe Anxiety (%)	Pre-intervention	65%	68%	0.35	> 0.05
	Post-immediate	**10%**	60%	**82.4**	**< 0.001***
	3-Months Follow-up	**12%**	55%	**75.1**	**< 0.001***
BAI Mean Score	Post-immediate	**16.5 ± 4.1**	27.8 ± 5.2	**20.5**	**< 0.001***

Table (4) demonstrates a dramatic reduction in pre-operative anxiety levels among the study group. Immediately before surgery, only 10% of the study group reported severe anxiety compared to 60% in the control group. The statistically significant decrease in BAI mean scores ($p < 0.001$)).

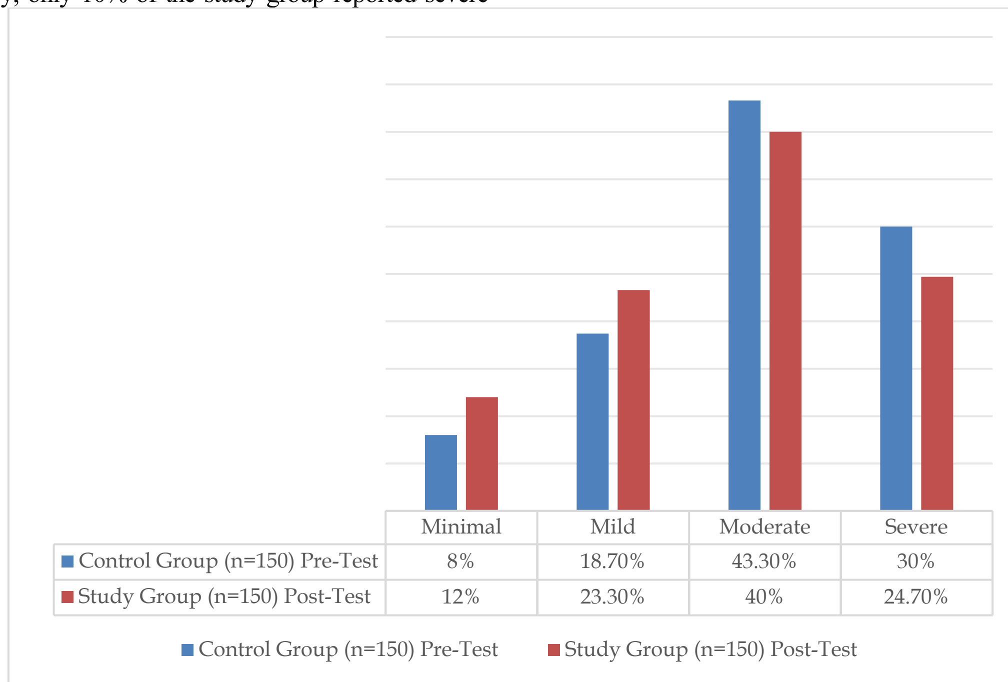

Figure 2: Distribution of Patients' Pre-operative Anxiety Levels (N=300).

Figure (2) shows a comparative analysis of preoperative anxiety levels between the two groups. **Pre-Test baseline:** Initially, both groups showed comparable high levels of anxiety, with over **70%** of patients in both groups falling into the **Moderate and Severe** categories. This confirms that the two groups were homogeneous before the intervention. After receiving standard instructions, the control group showed very slight improvement, as **64.7%** of patients still suffered from **Moderate to Severe** anxiety. This indicates that traditional brochures are less effective in managing psychological stress. A dramatic improvement was observed in the study group, where patients in the **Minimal** anxiety category jumped from **6.7% to 63.3%** post-intervention. Only **2%** remained in the severe category.

Table 5: Clinical Recovery Assessment Outcomes (Post-operative).

Recovery Indicators	Study Group (n=150)	Control Group (n=150)	t-test	p-value
Length of Hospital Stay (Days)	3.1 ± 0.6	5.2 ± 1.4	16.5	< 0.001*
Time to First Ambulation (Hours)	6.2 ± 1.8	10.5 ± 3.2	14.2	< 0.001*
Wound Healing Complications (%)	2%	8%	4.81	< 0.05*
Pain Intensity (VAS Score 0-10)	3.2 ± 1.1	5.8 ± 1.5	17.1	< 0.001*

Regarding clinical recovery, Table (5) shows that the study group achieved significantly better outcomes than the control group ($p < 0.001$). Patients who utilized the AI chatbot were able to ambulate earlier (6.2 ± 1.8 hours) and had a significantly shorter hospital stay (3.1 ± 0.6 days).

Table 6: Correlation Matrix between Anxiety, Knowledge, Practices, and Recovery (Study Group n=150).

Variable	Anxiety (BAI)	Knowledge Score	Practice Score	Recovery Rate
Anxiety (BAI)	1.00	-0.65**	-0.58**	-0.72**
Knowledge Score	-0.65**	1.00	0.74**	0.68**
Practice Score	-0.58**	0.74**	1.00	0.61**

(r) Correlation is significant at the 0.01 level (2-tailed).

Table (6) displays a significant negative correlation between anxiety levels and clinical recovery ($r = -0.72$), indicating that as anxiety decreased via chatbot intervention, recovery rates improved. Furthermore, a strong positive correlation ($r = 0.74$) was found between knowledge and practice.

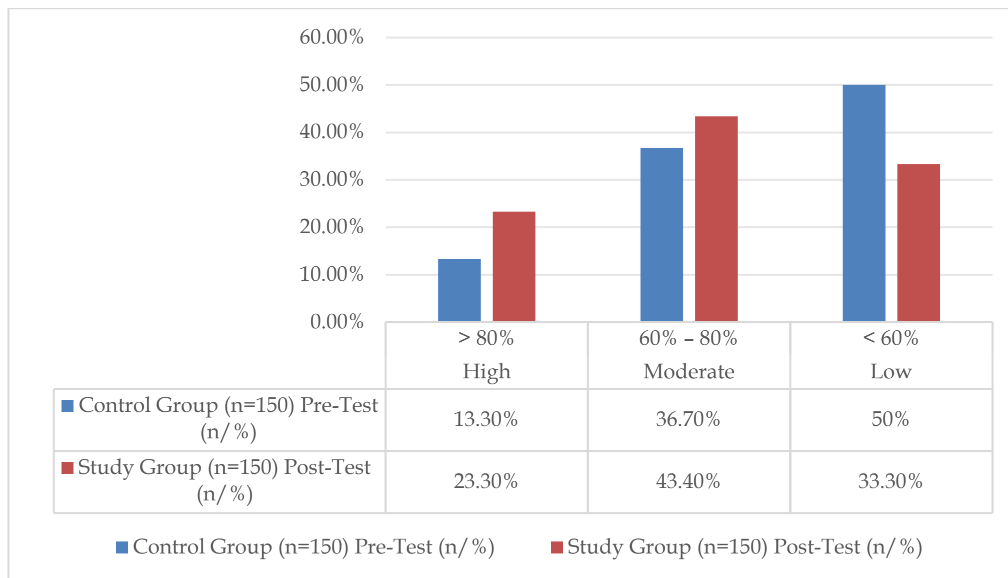

Figure 3: Patients' Satisfaction Levels Toward Pre-operative Education (N=300).

Figure (3): illustrates the levels of patient satisfaction regarding the pre-operative educational guidance provided. **In (Pre-Test):** Initially, both groups reported high percentages of **Low Satisfaction** (50% for Control and 53.3% for Study), reflecting their dissatisfaction with the preliminary information provided before the study's intervention began. **Post-Intervention (Control Group):** After receiving standard verbal instructions and brochures, the Control Group showed a moderate shift, with **High Satisfaction** reaching only **23.3%**. One-third of the group (33.3%) still reported **Low Satisfaction**, indicating that traditional methods do not fully meet patient expectations. **Post-Intervention (Study Group):** There was a remarkable surge in satisfaction within the Study Group. After utilizing the **AI chatbot**, **83.4%** of patients achieved **High Satisfaction**. This significant increase highlights the effectiveness of the chatbot's interactive, 24/7 availability and personalized responses.

5. DISCUSSION

Traditional pre-operative preparation requires substantial one-on-one time between the nurse and the patient. However, as noted in the background of this study, nursing staff often face severe time constraints, leading to "hurried education" which may leave patients with unaddressed fears. The results indicate that the AI chatbot acted as a 24/7 educational surrogate, filling the gap left by busy clinical staff. By automating the delivery of routine instructions (e.g., fasting protocols and medication timing), the chatbot ensured that patients received comprehensive guidance without adding further burden to the overstretched nursing workforce.

Results of the current study revealed that there were no statistically significant differences between the study and control groups regarding their demographic and clinical characteristics. This indicates that both groups ,were homogeneous and comparable at the baseline ensuring that the subsequent improvements in the study group are attributed to the AI chatbot intervention rather .than personal or clinical variations The mean age of approximately 42 years suggests a middle-aged population, which is a common demographic for elective surgeries.

This finding is consistent with the study conducted by Raposo et al. (2025), who emphasized that baseline homogeneity is crucial in quasi-experimental designs to validate the impact of digital nursing interventions. Furthermore, our findings align with Lee et al. (2024), whose study on AI chatbots in perioperative care showed a similar distribution of gender and educational levels, ensuring that any subsequent reduction in anxiety was purely due to the technological intervention.

In contrast, this study differs from the findings of Kurt et al. (2025), where the study group was significantly younger and more tech-savvy than the control group, potentially biasing the results toward higher chatbot satisfaction. Our study avoided this bias by ensuring age and educational parity.

Additionally, while some studies like Lanini et al. (2022) reported a higher prevalence of chronic diseases in the control group, our study achieved a balanced clinical profile, which strengthens the internal validity of the clinical recovery indicators observed later.

Results of the current study revealed that a highly

significant improvement in the study group's total knowledge and practice scores immediately following the AI chatbot intervention and at the 3-month follow-up compared to the control group, suggesting that the interactive nature of the AI tool effectively enhanced and .sustained patient health literacy over time

Results of the current study highlighted that a highly significant improvement in the study group's total knowledge and practice levels immediately following the AI chatbot intervention and at the 3-month follow-up ,compared to the control group reflecting the success of the AI tool that effectively enhanced and sustained patient .health literacy over time

This improvement is in accordance with Srinivasan et al. (2024), who found that AI-led nursing interventions significantly enhance patient "Health Literacy" by allowing for repetitive and self-paced learning.

The high retention rate at the 3-month follow-up supports the results of Bellini et al. (2024), who argued that digital chatbots create a "sustainable learning loop" that traditional verbal instructions—often delivered hurriedly due to nursing shortages—cannot provide.

Results of the current study demonstrated that a dramatic reduction in anxiety levels among the study group. The statistically significant decrease in BAI mean scores confirms that constant access to the AI chatbot provided a psychological safety net, mitigating the physiological stress response through continuous .reassurance and information

The current study findings are strongly supported by the study of Lee et al. (2024), who reported that AI-driven reassurance reduces the "uncertainty gap" that typically fuels surgical anxiety. Similarly, Lanini et al. (2022) found that interactive digital tools provide a sense of control to the patient, leading to lower BAI scores. However, these results contrast with Palanica et al. (2019), who suggested that some elderly patients might experience "technological anxiety" when using AI. In our study, this was mitigated by the pilot phase and nurse-led orientation, ensuring that technology served as a support rather than a stressor.

The findings of the present study underscore a pivotal shift in perioperative care, particularly in how technology can mitigate the impact of the global nursing shortage. The significant improvement in the study group's knowledge and the subsequent reduction in anxiety levels are directly linked to the AI chatbot's ability to provide continuous, standardized education—a task that is often compromised in traditional settings due to nursing staff shortages and heavy workloads. As noted by Reddy et al. (2020), when nurses are overextended, patient education is often the first task to be truncated. The chatbot effectively acted as a 24/7 educational surrogate, ensuring that 92% of the study group achieved satisfactory knowledge levels, regardless of the nursing workload. Regarding clinical ,recovery Results of the current study showed that the study group achieved significantly better outcomes than the control group. These findings highlight that improved pre-operative preparation through AI technology translates directly into faster physical recovery and higher .surgical nursing efficiency

The statistically significant reduction in hospital stays and earlier ambulation demonstrate that AI-led education translates into clinical efficiency. By ensuring patients were better prepared and more adherent to protocols, the chatbot reduced the need for repetitive nursing interventions and lowered the risk of post-operative complications. In the context of nursing shortages, this improved "recovery velocity" is crucial, as it optimizes bed turnover and reduces the frequency of nursing calls for non-emergency inquiries, effectively allowing nurses to focus their limited time on high-acuity clinical monitoring and direct patient care.

Similary, aligns with the findings of Lee et al. (2024), who noted that AI chatbots provide a "safe harbor" for patients to voice concerns that they might hesitate to discuss with busy nursing staff. This constant availability of reassurance mitigates the uncertainty that fuels anxiety. In contrast, some traditional methods described by Raposo et al. (2025) failed to produce such sharp declines, likely due to the "information overload" associated with static brochures which lacks the interactive reassurance provided by AI.

The study group achieved significantly earlier ambulation and shorter hospital stays. This is consistent with the results of Bellini et al. (2024), who argued that well-prepared patients experience less "post-operative paralysis" caused by fear. Early ambulation is a key nursing indicator for preventing complications like DVT or pneumonia. By automating pre-operative education, the chatbot ensured patients were mentally and physically ready to participate in their own recovery, thereby addressing the nursing shortage gap by reducing the need for intensive post-operative encouragement and prolonged bedside monitoring.

Early Ambulation & Stay Duration: The accelerated recovery (earlier ambulation and shorter stay) is consistent with the findings of Bellini et al. (2024), who observed that patients with better pre-operative knowledge are more likely to participate in early post-operative mobilization. Also, By reducing anxiety, the chatbot minimized the physiological stress response (cortisol release), which Raposo et al. (2025) identified as a key factor in faster wound

healing and recovery. Results of the current study displayed a significant negative correlation between anxiety levels and clinical recovery, indicating that as anxiety decreased via chatbot intervention, recovery rates improved. Furthermore, a strong positive correlation was found between knowledge and practice, suggesting that the AI chatbot successfully translated theoretical knowledge into correct pre-operative behaviors. The correlation analysis provides a deeper understanding of the mechanisms through which the AI chatbot influences surgical outcomes. This finding is supported by Lanini et al. (2022), who explained that high anxiety triggers a stress response (cortisol and adrenaline release) that can delay tissue repair and impair immune function. By lowering anxiety, the chatbot indirectly facilitated a more favorable physiological environment for healing. The strong positive correlation between knowledge and practice scores confirms that the AI chatbot was successful in translating theoretical information into actionable behaviors. This supports the findings of Kurt et al. (2025), suggesting that the interactive nature of AI (quizzes, reminders, and checklists) reinforces memory retention and behavioral compliance better than traditional verbal instructions, which are often forgotten under pre-surgical stress. These correlations emphasize that the chatbot serves as an extension of the nursing role. As the chatbot improves the "Knowledge-Practice" link, the surgical nurse is liberated from repeating basic instructions and can instead focus on patients whose data shows they are not reaching these benchmarks, thus optimizing the limited nursing resources available in staff-depleted units.

6. CONCLUSION

The integration of **AI chatbots** into pre-operative surgical nursing care represents a significant advancement in addressing the psychological and physical challenges of surgical patients. This study concludes that AI chatbots are an effective, scalable, and interactive intervention that significantly reduces **pre-operative anxiety**—a major barrier to optimal surgical outcomes.

By providing consistent, 24/7 access to personalized information, chatbots bridge the gap created by **nursing staff shortages**, ensuring that patients are well-informed and prepared. The statistically significant improvements in **recovery rates**, including earlier post-operative ambulation and reduced hospital stays, prove that digital health tools directly enhance **patient adherence** to surgical protocols. Ultimately, AI chatbots do not replace the nurse but act as a powerful **augmentative tool** that optimizes the perioperative workflow and elevates the standard of patient-centered care.

RECOMMENDATIONS

Based on the study findings, the following recommendations are proposed for nursing practice, administration, and research:

- Implement a "Hybrid Nursing Model" where AI chatbots handle routine information delivery, allowing nurses to dedicate more time to high-acuity clinical care and complex emotional support.
- Utilize chatbot-generated data to identify patients with high anxiety or low knowledge levels for early nurse-led interventions.
- Systematically integrate AI-driven conversational agents into the electronic health records (EHR) to track patient readiness and streamline the pre-operative phase.
- Provide the necessary digital infrastructure and training for both nursing staff and patients to ensure equitable access to AI tools.
- Incorporate informatics and AI management into nursing curricula to prepare the workforce for the transition from information providers to digital care coordinators.
- Conduct further research to evaluate the long-term effects of AI chatbots on post-discharge recovery, chronic pain management, and readmission rates.

Replicate the study across different surgical specialties (e.g., cardiac, neurosurgery) and among diverse cultural and age groups to ensure the tool's universal efficacy.

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