

Demographic Factors Influencing the Knowledge, Attitudes and Practices of Nurses in Preventing Iv (Intravenous) Cannula-Related Infections among Nurses in Surgical Units

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Abstract

This study examined the demographic factors influencing nurses' knowledge, attitudes, and practices (KAP) in preventing IV cannula-related infections in surgical units of selected Rizal Provincial Hospitals, Philippines. Guided by the Knowledge, Attitudes, and Practices (KAP) Framework and supported by Reason's Swiss Cheese Model, Bandura's Social Cognitive Theory, and Benner's Novice to Expert Theory, the study investigated the relationship between demographic characteristics and infection prevention behaviors among nurses. A descriptive correlational research design was employed. Respondents were selected through random sampling, and data were collected using a structured questionnaire adapted from the Peripheral Intravenous Catheter Mini Questionnaire. Descriptive and inferential statistics were used to analyze the data. The findings revealed that nurses demonstrated very high levels of knowledge, strongly positive attitudes, and very high levels of practice in preventing IV cannula-related infections. Significant relationships were found between age and knowledge, and between length of clinical experience and both knowledge and attitudes. IV-related training was significantly associated with knowledge, while sex showed no significant relationship with knowledge, attitudes, or practices. No demographic factor significantly influenced practice. Although respondents exhibited strong competencies in infection prevention, lower scores were observed in knowledge of antiseptic concentration, clinically indicated catheter removal, hand hygiene consistency, antiseptic drying time, and documentation practices. The study concludes that effective prevention of IV cannula-related infections requires both individual competence and sustained organizational support. Continuous competency-based education, regular audits, structured supervision, and reinforcement of evidence-based practices are recommended to further strengthen infection prevention performance. The study supports SDG 3 (Good Health and Well-Being), SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), and SDG 16 (Peace, Justice and Strong Institutions). Its sustainability contribution lies in enhancing patient safety, healthcare quality, workforce development, and institutional capacity for infection prevention and control.

Keywords: Clinical Experience; Infection Prevention; Intravenous Cannula-Related Infections; Knowledge, Attitudes, and Practices; Nurses; Patient Safety; Peripheral Intravenous Cannula; Surgical Units

1. Introduction

Intravenous cannulation is a fundamental nursing procedure in surgical units, supporting fluid therapy, medication administration, and emergency interventions. Despite its routine use, peripheral intravenous cannula (PIVC) insertion and maintenance remain associated with complications such as phlebitis, infiltration, local infection, catheter failure, and bloodstream infection. These complications contribute to increased morbidity, prolonged hospitalization, higher healthcare costs, and reduced patient safety (Berger et al., 2021). Evidence suggests that adherence to aseptic technique, routine monitoring, standardized maintenance procedures, and continuing professional education are essential in preventing IV cannula-related infections (Bayoumi et al., 2022). Given the central role of nurses in IV therapy management, understanding their knowledge, attitudes, and practices (KAP) and the factors influencing these domains is critical to improving outcomes in surgical units.

1.1 Background of IV Cannula-Related Infection Prevention among Nurses in Surgical Units

Peripheral intravenous cannulation is one of the most frequently performed clinical procedures in surgical settings. Surgical patients are particularly vulnerable to IV cannula-related complications because of frequent medication administration, prolonged procedures, postoperative immobility, multiple infusions, and repeated line manipulation. These factors increase the risk of contamination, device failure, and infection. Consequently, nurses' competence in insertion, maintenance, monitoring, and timely removal of IV cannulas directly influences patient safety and quality of care (Gorski et al., 2021; Marsh et al., 2021). The Knowledge, Attitudes, and Practices (KAP) framework provides a useful approach for evaluating nurses' infection prevention behaviors. Research indicates that adequate knowledge alone does not ensure safe practice;

positive attitudes, professional accountability, and organizational support are equally important determinants of compliance with infection prevention standards (Alhumaid et al., 2021; Kim & Park, 2021)

1.2 Themes and Insights on Nurses' Knowledge, Attitudes, and Practices in Preventing IV Cannula-Related Infections

The literature consistently identifies IV cannula-related complications as a persistent global patient safety concern. Although catheter-associated bloodstream infections occur less frequently than other complications, catheter failure, phlebitis, infiltration, and extravasation remain highly prevalent worldwide (Marsh et al., 2021; Bayeh et al., 2023; Webster et al., 2021; Chopra et al., 2021). These complications are influenced by patient factors, device characteristics, medication exposures, and healthcare system conditions (Kaphan et al., 2024). Evidence further demonstrates that nursing-related factors significantly affect IV therapy outcomes. Variations in knowledge, attitudes, and practices are associated with differences in adherence to catheter care bundles, infection prevention measures, and complication rates (Kim & Park, 2021; Nordin, 2023). Studies consistently identify training, workload, staffing levels, organizational culture, supervision, resource availability, and workflow inefficiencies as major determinants of compliance with best practices (Jiménez-Martínez et al., 2024; Al Moteri et al., 2024). Research also emphasizes the importance of continuous competency development, simulation-based training, mentorship, and organizational support in improving nurses' performance in IV cannula care (Massey et al., 2023; Kim & Park, 2021). Positive attitudes toward infection prevention enhance adherence to protocols, whereas burnout, inadequate staffing, and weak safety cultures contribute to unsafe practices (Baptista Chaves, 2024; Jiménez-Martínez et al., 2024).

1.3 Global, National, and Local Context of IV Cannula-Related Infection Prevention in Surgical Nursing Practice

Globally, international organizations such as the World Health Organization, the Centers for Disease Control and Prevention, and the Infusion Nurses Society advocate evidence-based standards for IV cannula insertion, maintenance, surveillance, and removal (World Health Organization, 2024; Centers for Disease Control and Prevention, 2024; Gorski et al., 2021). These standards emphasize aseptic technique, chlorhexidine skin antisepsis, routine assessment, clinically indicated catheter removal, and continuous professional education. Regional studies in Southeast Asia similarly report variable rates of IV cannula-related complications and identify staffing limitations, resource constraints, and inconsistent adherence to guidelines as significant contributors to adverse outcomes (Kaphan et al., 2024; Nordin, 2023; Baptista Chaves, 2024). In the Philippines, hospitals generally adopt international standards for IV therapy through institutional protocols, infection prevention programs, and the National Standards in Infection Prevention and Control for Health Facilities issued by the Department of Health (Department of Health, 2022). However, implementation challenges remain, including staffing shortages, inconsistent access to recommended supplies, variability in continuing education, and differences in policy enforcement. Local audits and studies indicate that while Filipino nurses demonstrate strong commitment to patient care and infection prevention, gaps persist in technical knowledge, documentation practices, site assessment, and adherence to updated guidelines.

1.4 Theoretical and Conceptual Foundations of Nurses' Knowledge, Attitudes, and Practices in IV Cannula Infection Prevention

This study is anchored on the Knowledge, Attitudes, and Practices (KAP) framework, which posits that knowledge influences attitudes and, together, these factors shape professional behavior and practice. The framework supports the examination of how nurses' understanding of infection prevention, perceptions of responsibility, and clinical behaviors interact to influence IV cannula-related outcomes. The study is further supported by Reason's Swiss Cheese Model (Reason, 2000), which explains how adverse events occur when multiple organizational and human-system safeguards fail simultaneously. Applied to IV cannula care, the model highlights the interaction of staffing, policies, training, supervision, and clinical practice in preventing infection and catheter-related complications. Bandura's Social Cognitive Theory (Bandura, 1986) reinforces the role of self-efficacy, observational learning, and environmental influences in shaping nurses' infection prevention behaviors. Benner's Novice to Expert Nursing Theory (Benner, 1984) provides additional support by recognizing that clinical competence develops through experience, education, and continuous professional growth. Collectively, these theories explain how demographic factors, organizational conditions, knowledge, attitudes, and professional experience influence nurses' practices in preventing IV cannula-related infections.

1.5 Research Gaps on Demographic Factors Influencing Nurses' Knowledge, Attitudes, and Practices in Surgical Units

Despite extensive international literature on IV cannula-related infection prevention, important gaps remain. Existing studies frequently focus on general hospital populations, intensive care settings, or specific clinical outcomes, with relatively limited attention to surgical units. Furthermore, research examining the combined influence of demographic characteristics, knowledge, attitudes, and practices among nurses remains insufficient. In the Philippine context, published evidence specifically addressing surgical nurses' KAP regarding IV cannula-related infection prevention is limited. Available studies often focus on institutional audits or broader infection control issues rather than comprehensive analyses of factors affecting nurses' infection prevention behaviors. This lack of localized evidence limits the development of

targeted interventions suited to the realities of surgical units. The present study addresses these gaps by examining nurses' knowledge, attitudes, and practices regarding IV cannula-related infection prevention and determining how demographic and professional factors influence these domains. Findings may support evidence-based interventions, policy improvements, and capacity-building initiatives aimed at reducing preventable complications and enhancing patient safety.

1.6 Alignment of IV Cannula Infection Prevention among Surgical Nurses with Relevant Sustainable Development Goals (SDGs)

This study aligns primarily with:

SDG 3 – Good Health and Well-Being, by promoting safer healthcare practices, reducing healthcare-associated infections, preventing avoidable complications, and improving patient outcomes through evidence-based nursing care.

SDG 4 – Quality Education, through its emphasis on professional development, competency-based training, continuing education, and lifelong learning among nurses.

SDG 8 – Decent Work and Economic Growth, by addressing workforce factors such as staffing, workload, professional competence, and workplace conditions that influence quality healthcare delivery.

SDG 16 – Peace, Justice, and Strong Institutions, through strengthening institutional policies, accountability systems, infection prevention programs, and evidence-based healthcare governance.

1.7 Importance of the Study to Multidisciplinary Sustainability, Patient Safety, and Healthcare Quality

The study contributes to public health sustainability by supporting strategies that reduce infection-related morbidity, complications, and healthcare costs. It advances healthcare system sustainability by identifying modifiable factors that improve quality of care, patient safety, and resource utilization. The study also supports educational sustainability through evidence that may guide nursing curricula, competency assessments, and continuing professional development programs. From a socio-economic sustainability perspective, reducing IV cannula-related complications can decrease hospitalization costs, improve treatment efficiency, and lessen the burden on healthcare institutions and patients. Finally, the study contributes to institutional and policy sustainability by generating evidence that can strengthen infection prevention policies, clinical governance mechanisms, workforce development initiatives, and quality improvement programs within surgical units and healthcare organizations.

2. Material and methods

2.1 Research Design

The study employed a descriptive correlational research design to examine relationships among variables without manipulating the research environment. Correlational designs are appropriate for identifying the direction and strength of associations among naturally occurring variables while not implying causation (Creswell and Creswell, 2023). This design enabled the researcher to determine the levels of nurses' knowledge, attitudes, and practices regarding IV cannula infection prevention and to assess their relationship with demographic and workplace characteristics. Similar approaches have been utilized in studies examining peripheral intravenous catheter care and infection prevention practices (Dessalegn et al., 2024). The design is also widely used in nursing research to investigate relationships among professional characteristics, safety attitudes, and compliance with infection control measures.

2.2 Locale of the Study

The study was conducted in selected Rizal Provincial Hospitals in Rizal Province, Philippines. These government-operated hospitals provide secondary and tertiary healthcare services to diverse urban and peri-urban populations. Their surgical units manage high patient turnover, elective and emergency procedures, and frequent intravenous therapy requirements, making them appropriate settings for investigating IV cannula-related infection prevention. The hospitals employ nurses with varying educational backgrounds, clinical experiences, and training exposures. The setting also reflects operational challenges common in Philippine public healthcare institutions, including staffing shortages, fluctuating nurse-to-patient ratios, workflow bottlenecks, and occasional supply limitations, which may influence adherence to infection prevention practices (Al Moteri et al., 2024).

2.3 Respondents of the Study

The respondents consisted of staff nurses assigned to the surgical units of selected Rizal Provincial Hospitals. These nurses were directly involved in intravenous cannula insertion, maintenance, monitoring, and documentation. Eligible participants included full-time or contractual nurses with at least six months of continuous experience in surgical units and direct responsibilities related to intravenous therapy. Nurses on extended leave, those holding administrative positions without direct patient care responsibilities, and newly hired nurses with less than six months of surgical unit experience were excluded.

2.4 Sample and Sampling Procedure

Random sampling was used to select respondents, ensuring that every eligible nurse had an equal chance of participation. The required sample size was computed using Slovin's Formula based on the total number of surgical unit nurses at the time of data collection. This approach minimized selection bias and enhanced sample representativeness. Inclusion and exclusion criteria were applied to ensure that participants possessed adequate exposure to IV cannula management and could provide reliable information regarding their knowledge, attitudes, and practices.

2.5 Research Instrument

The study utilized a structured questionnaire consisting of two parts. The first part gathered demographic information, including age, sex, educational attainment, length of nursing experience, length of service in the surgical unit, hospital assignment, and attendance in IV therapy or infection prevention training. These variables were examined for their potential association with nurses' knowledge, attitudes, and practices. The second part was adapted from the Peripheral Intravenous Catheter Mini Questionnaire, an internationally validated instrument used to assess nurse competencies and adherence to evidence-based peripheral intravenous catheter care practices. The tool has been utilized in studies such as Amble et al. in 2025 and is grounded in the Infusion Therapy Standards of Practice published by Gorski and colleagues in 2021. The instrument contained three subscales measuring knowledge, attitudes, and practices. Responses were measured using a four-point Likert scale. Knowledge items assessed understanding of aseptic technique, skin antisepsis, catheter selection, dressing care, and clinically indicated removal. Attitude items measured beliefs regarding infection prevention and adherence to guidelines, while practice items assessed behaviors related to insertion technique, hub disinfection, site inspection, dressing changes, and documentation. The use of a standardized instrument strengthened content validity, reliability, and comparability with international studies.

2.6 Data Gathering Procedure

Data collection followed an ethical and systematic process. Approval was first secured from an accredited institutional ethics review committee and administrative permission was obtained from hospital authorities. Coordination with nursing supervisors facilitated the scheduling of questionnaire distribution. Eligible nurses were informed of the study's purpose, procedures, voluntary nature, and eligibility requirements. Written informed consent was obtained before participation. Questionnaires were administered personally by the researcher during approved schedules that did not interfere with patient care. Respondents completed the instrument privately and were provided clarification when necessary. Completed questionnaires were collected, checked for completeness, coded using numerical identifiers, and securely stored. No personal identifiers were included in the dataset. Responses were encoded into a password-protected database, while physical copies were stored securely and managed according to ethical guidelines.

2.7 Data Analysis Techniques

Descriptive and inferential statistics were used to analyze the data. Frequency counts and percentages described respondents' demographic characteristics, including age, sex, IV-related training attendance, and clinical experience. Weighted mean and standard deviation were used to determine the levels and consistency of nurses' knowledge, attitudes, and practices regarding IV cannula-related infection prevention. To determine relationships between demographic factors and the knowledge, attitudes, and practices variables, inferential statistical tests were employed. The Chi-square test of independence examined associations between categorical demographic variables and categorized knowledge, attitude, and practice levels. The Pearson product-moment correlation coefficient was used to determine the degree and direction of relationships between continuous variables, such as age and clinical experience, and KAP mean scores. These analyses were appropriate for identifying relationships among variables without experimental manipulation.

2.8 Ethical Considerations

The study adhered to the ethical principles of the Declaration of Helsinki. Participation was voluntary, and respondents were fully informed about the study's purpose, procedures, benefits, and potential risks before providing consent. Participants were assured of their right to decline or withdraw without penalty. Confidentiality was maintained through anonymization and coding of responses, and only aggregated findings were reported. The study posed minimal risk because participation involved only questionnaire completion. The principle of justice was observed through fair respondent selection using random sampling. Prior to implementation, the study protocol underwent review and approval by an accredited institutional ethics review committee. Throughout the research process, transparency, scientific integrity, confidentiality, and participant protection were maintained to ensure compliance with national and international ethical standards.

3. Results and Discussion

3.1 Demographic Factors Influencing Nurses' Knowledge, Attitudes, and Practices in Preventing IV Cannula-Related Infections

3.1.1 Age, Gender, IV-Related Training, and Length of Clinical Experience

The respondents were predominantly aged 36 years and above, followed by those aged 31–35 years. Most were female, had attended IV-related training, and had 1–5 years of clinical experience. These findings indicate that the respondents generally possessed a combination of professional maturity, training exposure, and practical experience relevant to IV cannula management. The predominance of older nurses may contribute positively to infection prevention competencies because accumulated experience strengthens clinical judgment and adherence to safety protocols. Studies have shown that older and more experienced healthcare workers demonstrate greater compliance with infection prevention standards and stronger risk perception in clinical practice (Alsulami et al. 2022; Alhumaid et al. 2021). Similarly, clinical experience enhances familiarity with vascular access complications and promotes adherence to recommended practices (Alp et al. 2022). Although training exposure was high among respondents, evidence suggests that continuing competency assessment and organizational reinforcement remain necessary to sustain effective practice (Massey et al., 2023; Gorski et al., 2021). Gender differences appear less influential than organizational and professional factors in determining infection prevention behaviors (World Health Organization, 2024). Overall, these demographic characteristics provide important context for understanding variations in nurses' knowledge, attitudes, and practices (Marsh et al., 2021; Jiménez-Martínez et al., 2024).

3.2 Levels of Knowledge, Attitudes, and Practices in Preventing IV Cannula-Related Infections

3.2.1 Knowledge on IV Cannula-Related Infection Prevention

The nurses demonstrated a very high overall level of knowledge regarding IV cannula-related infection prevention. The highest ratings were observed in hand hygiene and glove use, hub disinfection, recognition of signs requiring immediate cannula removal, documentation requirements, and minimizing repeated cannulation. Knowledge regarding antiseptic use, insertion site selection, dressing techniques, drying time of antiseptics, and clinically indicated removal was likewise rated high to very high. These findings indicate strong cognitive competence in evidence-based IV cannula care. Knowledge of hand hygiene, aseptic technique, hub disinfection, documentation, and complication recognition reflects awareness of internationally recommended infection prevention standards. Current literature consistently identifies these competencies as essential for reducing catheter-related infections and improving patient safety outcomes (World Health Organization, 2021; Centers for Disease Control and Prevention, 2022; Marsh et al. (2021); Gorski et al. (2021); Chopra et al. (2021); Webster et al. (2021)). The results suggest that the respondents possess the foundational knowledge necessary for safe IV cannula management.

3.2.2 Attitudes Toward IV Cannula-Related Infection Prevention

The nurses demonstrated a very positive attitude toward IV cannula-related infection prevention, with high ratings in personal responsibility for infection prevention, regular IV site assessment, patient safety, willingness to remind colleagues, openness in reporting concerns, and valuing continuous professional training. Respondents also strongly believed that evidence-based IV care is achievable even during busy clinical shifts. The findings indicate a strong commitment to infection prevention and patient safety. Positive attitudes promote accountability, vigilance, teamwork, and adherence to evidence-based standards. Literature emphasizes that healthcare workers who feel empowered to communicate concerns, engage patients in safety efforts, and participate in continuous education are more likely to sustain safe clinical practices (World Health Organization, 2021; Centers for Disease Control and Prevention, 2022; Gorski et al., 2021; Chopra et al., 2021; Alhumaid et al., 2021). Institutional support further strengthens nurses' confidence and reinforces compliance with recommended practices.

3.2.3 Practices in Preventing IV Cannula-Related Infections

The nurses reported a very high level of practice compliance in preventing IV cannula-related infections. Consistently performed practices included avoiding contamination of prepared insertion sites, disinfecting IV hubs before access, proper securement of cannulas, timely removal of unnecessary or compromised cannulas, escalation of difficult intravenous access, dressing maintenance, and completion of required documentation. Hand hygiene before IV handling, allowing antiseptics to dry completely before insertion, and routine IV site inspection and documentation were frequently performed but received comparatively lower ratings. These findings suggest that nurses generally implement evidence-based infection prevention measures in daily practice. Adherence to aseptic technique, hub disinfection, securement, documentation, dressing management, and timely cannula removal are recognized as critical interventions in reducing IV-related complications (Webster et al. (2021); Chopra et al. (2021); Gorski et al. (2021); Centers for Disease Control and Prevention (2022); Marsh et al. (2021)). However, the relatively lower ratings in hand hygiene consistency, antiseptic drying time, and routine site monitoring indicate opportunities for further improvement. Strengthening compliance in these areas may enhance overall infection prevention outcomes and patient safety (World Health Organization, 2021; Centers for Disease Control and Prevention (2022)).

3.3 Relationship Between Demographic Factors and Nurses' Knowledge, Attitudes, and Practices

The analysis revealed significant positive relationships between age and knowledge, as well as between length of clinical experience and both knowledge and attitude. IV-related training demonstrated a significant relationship with knowledge but was not significantly associated with attitude or practice. Gender showed no significant relationship with knowledge, attitudes, or practices. No demographic factor demonstrated a significant relationship with practice levels. The findings suggest that professional maturity and accumulated clinical exposure contribute to stronger knowledge and more favorable attitudes toward infection prevention. Older nurses and those with longer clinical experience may develop greater understanding of vascular access complications and preventive strategies through repeated exposure to clinical situations (Alhumaid et al. (2021); Marsh et al. (2021)). The absence of significant relationships between demographic variables and practice indicates that actual infection prevention behaviors may depend more heavily on institutional policies, supervision, monitoring systems, safety culture, organizational support, and workplace factors than on personal characteristics alone (World Health Organization, 2021; Centers for Disease Control and Prevention, 2022; Alshammari et al., 2021; Carayon, 2008). These results reinforce contemporary evidence that effective infection prevention requires both individual competence and supportive healthcare environments.

3.4 Proposed Surgical Unit Intravenous Infection Prevention Enhancement Program

The findings highlighted areas requiring reinforcement despite the generally high levels of knowledge, attitudes, and practices. Lower scores were observed in knowledge related to antiseptic concentration and clinically indicated removal, as well as in hand hygiene consistency, antiseptic drying time compliance, and regular IV site inspection and documentation. These findings justified the development of a structured enhancement program focused on strengthening infection prevention performance. The proposed Surgical Unit Intravenous Infection Prevention Enhancement Program emphasizes evidence-based refresher training, regular audits, standardized documentation systems, mentorship through IV champions, visual clinical reminders, and the implementation of structured insertion and maintenance bundles to improve compliance with best practices and reduce IV-related complications (Cho et al., 2025). The program seeks to improve compliance with hand hygiene, antiseptic use, documentation, and clinically indicated cannula removal while reducing IV-related complications. This approach aligns with recommendations from the World Health Organization (2021), Centers for Disease Control and Prevention (2022), and Gorski et al. (2021), which advocate competency-based education, continuous monitoring, and organizational reinforcement as essential strategies for sustaining high-quality infection prevention practices in healthcare settings.

4. Conclusion & Recommendations

The study found that nurses in surgical units demonstrated very high levels of knowledge, strongly positive attitudes, and very high levels of practice in preventing IV cannula-related infections. Age and length of clinical experience were significantly associated with knowledge, while length of clinical experience was also significantly related to attitude. Sex showed no significant relationship with knowledge, attitudes, or practices, and no demographic factor significantly influenced practice. The findings indicate that nurses possess strong competencies in infection prevention; however, lower-scoring areas related to antiseptic concentration, clinically indicated removal, hand hygiene consistency, antiseptic drying time, and documentation require continued improvement. Overall, effective IV cannula-related infection prevention depends on both individual competence and sustained organizational support.

Healthcare institutions should strengthen infection prevention efforts through continuous competency-based education, regular refresher training, structured supervision, periodic audits, and reinforcement of evidence-based IV cannula care standards. Emphasis should be placed on improving knowledge of antiseptic selection and clinically indicated removal, enhancing compliance with hand hygiene and antiseptic drying procedures, strengthening IV site assessment and documentation practices, and reviewing existing IV-related training programs to ensure their effectiveness. Hospital administrators, nursing leaders, and infection prevention teams should continue supporting monitoring systems, mentorship initiatives, and quality improvement activities to sustain high standards of patient safety and infection prevention performance.

The study was limited to nurses assigned to surgical units within selected hospitals and relied primarily on self-reported responses to assess knowledge, attitudes, and practices. The findings reflect the characteristics and experiences of the respondents during the period of data collection and may not fully represent nurses from other clinical settings, healthcare institutions, or geographic locations. In addition, the study focused on selected demographic factors and did not directly measure actual infection rates or other organizational variables that may influence infection prevention practices.

Compliance with ethical standards

This study was conducted in accordance with established ethical principles and applicable ethical standards governing research involving human participants. Ethical approval was obtained from an accredited institutional ethics review committee prior to data collection, and administrative permission was secured from the participating institutions. Participation was voluntary, and all respondents were informed of the study's purpose, procedures, benefits, and potential risks before providing written informed consent. Confidentiality, anonymity, participant welfare, and data privacy were maintained throughout the research process, and all data were handled in accordance with accepted ethical guidelines.

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