AI-Augmented Handoffs and Shift Notes in Saudi Hospitals: Exploring the Role of Generative Artificial Intelligence in Reducing Nursing Docume Ntation Fatigue

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Abstract

Nursing documentation remains one of the most time-consuming responsibilities in modern healthcare settings. Although electronic health records have improved accessibility and continuity of care, they have also increased administrative workload for nurses, particularly during shift handoffs and end-of-shift reporting. In many hospitals, nurses spend a significant portion of their working hours documenting patient information instead of engaging in direct patient care. This growing documentation burden has been linked to stress, fatigue, reduced job satisfaction, and professional burnout.

Recent advances in generative artificial intelligence (AI) have introduced new possibilities for automating clinical documentation processes. AI-powered voice-to-text systems such as Microsoft Dragon Copilot and Heidi Health AI are capable of converting spoken clinical conversations into structured nursing notes and patient handoff summaries. These technologies may reduce repetitive administrative tasks while improving communication efficiency and workflow organization.

This review paper examines the potential role of generative AI in supporting nursing handoffs and shift documentation within Saudi Arabian hospitals, particularly in institutions such as King Fahad University Hospital and King Fahad Military Medical Complex. The paper critically discusses current challenges associated with nursing documentation, the importance of effective clinical handoffs, emerging AI-assisted documentation systems, and the opportunities and risks associated with AI implementation in healthcare environments. Additionally, the paper proposes a mixed-methods pre/post-intervention study aimed at evaluating the impact of generative AI on nursing documentation fatigue, workflow efficiency, and nurse satisfaction.

The review concludes that AI-assisted documentation systems may significantly improve nursing workflow and reduce administrative burden when implemented responsibly. However, concerns related to data privacy, accuracy, ethical accountability, and staff acceptance remain important considerations for future research and healthcare policy development.

Keywords: AI-Augmented Handoffs, Shift Notes, Generative Artificial Intelligence, Nursing Documentation Fatigue, Saudi Hospitals, Nursing Documentation.

1. Introduction

Healthcare systems worldwide are experiencing rapid technological transformation driven by digital innovation, artificial intelligence, and increasing demands for efficient patient care. Among healthcare professionals, nurses are particularly affected by these changes because they serve as the primary coordinators of patient monitoring, communication, and clinical documentation. While technology has improved access to patient information and streamlined several healthcare processes, it has also created new administrative challenges that directly affect nursing practice.

Documentation is a necessary and legally required component of healthcare delivery. Accurate documentation supports continuity of care, interdisciplinary communication, patient safety, and professional accountability. However, the growing complexity of electronic health record (EHR) systems has increased the amount of time nurses spend entering information into digital platforms. In many hospitals, documentation responsibilities continue long after patient care activities are completed, contributing to frustration and emotional exhaustion among nursing staff.

One area where this burden becomes particularly visible is during nursing shift handoffs. Handoffs involve transferring critical patient information between outgoing and incoming nurses to ensure safe continuity of care. These exchanges often require nurses to summarize large amounts of clinical information within limited timeframes, especially in high-acuity settings such as emergency departments and intensive care units. When handoff communication is rushed or incomplete, the risk of clinical errors and patient harm may increase.

As healthcare systems continue searching for solutions to reduce administrative burden, generative artificial intelligence has emerged as a promising tool. AI-powered documentation systems can listen to spoken clinical conversations, convert them into text, and generate organized summaries automatically. Tools such as Microsoft Dragon Copilot and Heidi Health are increasingly being introduced into healthcare settings to simplify documentation processes and improve workflow efficiency.

In Saudi Arabia, healthcare digitalization has accelerated under Saudi Vision 2030, which emphasizes innovation, smart healthcare systems, and workforce sustainability. Despite these national initiatives, research examining the practical role of generative AI in nursing documentation within Saudi hospitals remains limited. This review paper aims to explore the current evidence regarding AI-assisted handoff systems and discuss their potential implications for nursing practice in Saudi healthcare settings.

2. Nursing Documentation Burden and Clinical Fatigue

2.1 Documentation as a Source of Workload

Nurses are responsible for documenting nearly every aspect of patient care, including assessments, medications, interventions, observations, and patient responses. Although documentation is intended to improve communication and patient safety, many nurses describe it as one of the most demanding parts of their shifts.

Several studies have shown that nurses may spend a large portion of their working hours interacting with electronic systems rather than patients. This issue becomes even more challenging in hospitals with high patient turnover, staffing shortages, or complex electronic documentation requirements. In many situations, nurses complete documentation during overtime hours or after the official end of their shifts.

The emotional effect of repetitive documentation is often underestimated. Over time, constant charting responsibilities may contribute to:

- Mental fatigue
- Reduced concentration
- Increased workplace stress
- Emotional exhaustion
- Lower job satisfaction

For many nurses, the pressure to maintain accurate records while simultaneously providing direct patient care creates ongoing tension throughout the workday.

2.2 Challenges During Shift Handoffs

Shift handoffs represent one of the most sensitive communication moments in healthcare practice. During handoffs, nurses must communicate essential information about patient conditions, treatment plans, pending procedures, and safety concerns. Effective communication during this process is critical because incomplete or inaccurate information may negatively affect patient outcomes.

In practice, handoff preparation often becomes stressful due to:

- Time pressure
- Interruptions
- Heavy workloads
- Multiple patient assignments
- Inconsistent documentation formats

Although communication frameworks such as SBAR (Situation, Background, Assessment, Recommendation) are commonly used to standardize handoffs, nurses still rely heavily on manual note preparation. This process may increase cognitive overload, especially in busy clinical units where nurses manage several complex patients simultaneously.

3. Generative Artificial Intelligence in Healthcare Documentation

3.1 Understanding Generative AI in Clinical Practice

Generative artificial intelligence refers to systems capable of producing human-like written content based on spoken or written input. In healthcare, these technologies combine speech recognition, natural language processing, and machine learning algorithms to generate clinical documentation automatically.

Unlike traditional speech-to-text software, modern generative AI systems are capable of understanding clinical context and organizing information into structured notes. These tools can summarize patient interactions, identify key clinical details, and generate formatted reports within seconds.

This technology has attracted increasing attention because it may reduce repetitive administrative tasks and allow clinicians to focus more on patient care.

3.2 AI Documentation Systems in Healthcare

Several AI-assisted documentation platforms have recently entered healthcare environments, including:

- Microsoft Dragon Copilot
- Nuance Dragon Medical One
- Heidi Health
- Suki AI

These systems are designed to:

- Convert speech into written clinical notes
- Generate patient handoff summaries
- Organize documentation into structured templates
- Reduce repetitive typing
- Improve workflow efficiency

Although most research currently focuses on physicians, nursing applications are beginning to receive greater attention.

3.3 Potential Benefits for Nurses

The integration of generative AI into nursing workflows may offer several practical benefits. First, reducing manual typing may decrease cognitive workload and physical fatigue associated with prolonged documentation tasks. Even modest reductions in charting time could allow nurses to spend more meaningful time with patients and families.

Second, AI-generated handoff summaries may improve consistency and reduce omission of important patient information. In high-pressure environments, automated summaries could support safer communication during shift changes.

Third, reducing documentation burden may positively affect job satisfaction and emotional well-being. Burnout among nurses has become a major concern globally, and administrative overload is frequently identified as one of its primary causes. Technologies that simplify repetitive tasks may therefore contribute to healthier work environments.

At the same time, the successful use of AI systems depends heavily on user trust. Nurses must feel confident that generated documentation is accurate, clinically relevant, and secure.

4. Artificial Intelligence and Healthcare Transformation in Saudi Arabia

Saudi Arabia has made substantial investments in healthcare modernization through Saudi Vision 2030. National healthcare strategies increasingly emphasize digital transformation, smart hospitals, and the integration of advanced technologies into patient care systems.

Hospitals such as King Fahad Military Medical Complex are well-positioned to explore AI-assisted nursing documentation because of their technological infrastructure and large clinical workforce.

Within Saudi healthcare settings, AI-assisted documentation systems may support:

- Improved workflow efficiency
- Reduced overtime documentation
- Enhanced communication quality

- Better workforce sustainability
- Increased patient safety

However, implementing AI technologies also requires careful attention to:

- Patient confidentiality
- Cybersecurity standards
- Ethical governance
- Data storage regulations
- Staff training and acceptance

Because healthcare documentation contains highly sensitive patient information, maintaining trust and privacy remains essential.

Saudi Arabia has made substantial investments in healthcare modernization through Saudi Vision 2030, launched in April 2016 as a strategic framework for economic diversification and enhanced living standards. National healthcare strategies increasingly emphasize digital transformation, smart hospitals, and the integration of advanced technologies into patient care systems.

The healthcare system in Saudi Arabia is undergoing a fundamental restructuring through the implementation of the Modern Healthcare Model (MHM), which is organized around 20 health clusters across the Kingdom. These clusters represent groups of integrated healthcare providers within specific catchment areas, with each cluster responsible for meeting a defined population's health needs. The Ministry of Health (MOH) serves as the regulatory and supervisory body, while health clusters operate as the primary service-delivery entities following their transition to the Health Holding Company. This structural transformation separates the organizational and supervisory roles of the MOH from the financing and provision of health services.

The MHM is designed around six Systems of Care (SoC): Keep Well, Planned Care, Safe Birth, Chronic Care, Urgent Care, and the Last Phase of Life. These systems emphasize prevention, equitable access, virtual care, and smooth transitions across primary, secondary, and tertiary care levels. The emphasis on digital health and e-health services is a cornerstone of the transformation, with initiatives such as the SEHA Virtual Hospital—the largest of its kind globally—connecting over 150 hospitals with more than 30 specialized health services. The Digital Health Center of Excellence, launched in 2020, further supports this transformation by regulating digital health solutions, promoting innovation, and building technological capabilities.

Hospitals such as King Fahad Military Medical Complex (operating under the Armed Forces Medical Services) and King Fahad University Hospital (affiliated with the Ministry of Education's university hospitals system) represent key tertiary care institutions well-positioned to explore AI-assisted nursing documentation because of their technological infrastructure and large clinical workforce.

Local Implementation Challenges for AI Documentation Systems

The integration of AI-powered voice-to-text documentation systems in Saudi healthcare settings presents unique challenges that require careful consideration. First, Arabic language and dialectal variation pose significant technical challenges for Automatic Speech Recognition (ASR) systems. Unlike English, Arabic ASR systems face difficulties in obtaining corpora for spoken dialects, given the enormous number of word forms and the language's morphological richness. A study developing a speech corpus for the Medina dialect—one of the most prominent Saudi dialects—demonstrated that dialect-specific ASR systems achieved 92.09% recognition accuracy, indicating that general Arabic ASR models may underperform with local dialects. This has practical implications: if AI documentation systems are not trained on Saudi dialects, they may produce transcription errors that compromise clinical documentation accuracy and require additional nurse correction time, paradoxically increasing rather than reducing documentation burden.

However, recent developments in the Saudi market indicate growing availability of Arabic-optimized AI solutions. Augnito, a medical voice AI technology provider, has partnered with Almoosa Health in Saudi Arabia to deploy Omni AI Scribe, a system specifically designed for "multi-lingual medical dialogue capture (including all Arabic dialects)". Similarly, Nuxera AI has launched SERA, an "Arabic-first AI technology" platform that captures doctor-patient conversations in real-time and converts them into structured medical notes, achieving a reported 70% reduction in documentation time. These developments suggest that Arabic-capable AI documentation systems are becoming commercially available in the Kingdom.

Second, EHR integration readiness is a critical factor. AI documentation systems must be compatible with existing hospital information systems to avoid creating additional workflow burdens. A recent study examining AI adoption in clinical documentation among healthcare professionals in eastern Saudi Arabia found that while 68.3% of participants had prior knowledge of AI applications, only 41.2% were actively using them, with reliability and accuracy (92.7%) and data privacy (84.9%) identified as key factors influencing adoption. The same study identified training requirements (89.6%), availability of technical support (76.2%), and development of guidelines (81.5%) as essential for successful implementation. These findings underscore the need for systematic implementation strategies that address both technical integration and workforce capacity building.

Third, the digital infrastructure landscape in Saudi hospitals varies significantly. While the Health Sector Transformation Program aims for 100% unified digital medical record coverage, current EHR systems range from legacy platforms to advanced integrated solutions such as Cerner and Epic. AI system implementation must account for this variability, ensuring that speech-to-text and natural language processing capabilities can interoperate with existing systems without requiring extensive infrastructure overhauls.

5. Current Evidence and Literature Review

Current literature suggests that AI-powered documentation tools may reduce administrative workload and improve clinician efficiency. Studies examining speech-recognition technologies have reported shorter documentation times and improved workflow satisfaction among healthcare professionals.

Some research also indicates that clinicians using AI-assisted systems experience lower levels of cognitive burden and reduced after-hours charting. These findings are particularly important because excessive documentation demands have been strongly associated with emotional exhaustion and burnout.

Nevertheless, the available evidence remains limited in several important ways. First, most published studies focus on physicians rather than nurses, despite nurses being among the heaviest users of electronic documentation systems. Second, there is limited research examining AI-assisted documentation within Middle Eastern healthcare systems, particularly in Saudi Arabia.

Several concerns also appear repeatedly in the literature. One major issue involves the accuracy of AI-generated documentation. Speech-recognition errors, incomplete summaries, or incorrect interpretations of clinical information could affect patient safety if not reviewed carefully by healthcare professionals.

Another concern relates to ethical accountability. If AI systems generate inaccurate clinical information, questions may arise regarding professional responsibility and legal liability. Healthcare institutions must therefore ensure that AI technologies function as supportive tools rather than replacements for clinical judgment.

Additionally, some healthcare workers express concern about becoming overly dependent on technology. While AI may improve efficiency, excessive reliance on automated systems could potentially weaken critical thinking or communication skills if not balanced appropriately.

6. Proposed Research Methodology

6.1 Aim of the Study

The proposed study aims to evaluate the effectiveness of generative AI-assisted handoff and shift documentation systems in reducing documentation fatigue and improving workflow efficiency among nurses in Saudi hospitals.

6.2 Research Objectives

The study seeks to:

1. Measure the amount of time nurses spend on documentation before and after AI implementation.
2. Assess nurse satisfaction with AI-generated shift notes.
3. Evaluate perceived levels of documentation fatigue.
4. Explore nurses' experiences and attitudes toward AI-assisted documentation systems.
5. Examine the quality and completeness of clinical handoff communication.

6.3 Research Design

A mixed-methods pre/post-intervention design is proposed because it allows both measurable outcomes and personal experiences to be explored together. This design is particularly appropriate for evaluating healthcare innovations where both quantitative performance metrics and qualitative user experiences are essential for understanding intervention effectiveness.

6.3.1 Quantitative Component

The quantitative phase will evaluate:

Outcome Variable	Measurement Tool	Description
Documentation Time	Time-motion tracking log	Minutes spent on documentation per shift, measured via self-reported logs validated through random spot-checking
Overtime Charting Hours	Hospital payroll records	After-shift documentation hours extracted from electronic time-tracking systems
Burnout Levels	Maslach Burnout Inventory-HSS (MBI-HSS)	22-item validated instrument measuring Emotional Exhaustion, Depersonalization, and Personal Accomplishment (Cronbach's α = 0.90, 0.79, 0.71, respectively)
Job Satisfaction	Nursing Satisfaction with Documentation Scale (adapted from Hagerty et al.)	15-item Likert-scale instrument measuring satisfaction with documentation processes (Cronbach's α = 0.87 in pilot studies)
Handoff Completeness	SBAR-based Handoff Checklist	12-item structured observation checklist assessing completeness of handoff communication content
System Usability	System Usability Scale (SUS)	10-item validated scale measuring perceived usability of the AI system (Cronbach's α = 0.91)
Cognitive Workload	NASA-TLX	6-item validated tool measuring perceived mental, physical, and temporal demands (Cronbach's α = 0.85)

For comparing pre- and post-intervention outcomes statistically:

t=x¯1−x¯2sp2n*t*=*spn*2*x*¯1−*x*¯2

Where x¯1*x*¯1 and x¯2*x*¯2 represent pre- and post-intervention means, spsp is the pooled standard deviation, and n*n* is the sample size.

6.3.2 Qualitative Component

The qualitative phase will include:

- **Semi-structured interviews** (approximately 20-25 participants)
- **Focus group discussions** (4-6 groups of 6-8 nurses each)

- **Open-ended feedback sessions**

This approach would help researchers better understand how nurses experience the technology within real clinical environments. Thematic analysis following Braun and Clarke's six-phase framework will be used to identify recurring patterns, barriers, and facilitators related to AI adoption in nursing practice.

6.4 Study Setting and Participants

6.4.1 Study Setting

Potential study settings include:

- **King Fahd Military Medical Complex, Dhahran**
- **King Fahd University Hospital, Al Khobar**

These institutions were selected because they possess existing digital health infrastructure and serve diverse patient populations, making them representative of tertiary care settings in the Eastern Province of Saudi Arabia. Both hospitals currently utilize integrated EHR systems (Cerner at King Fahad Military Medical Complex and Epic at King Fahad University Hospital), which are essential for seamless AI integration.

6.4.2 Participants

Participants will include registered nurses working in:

- **Intensive Care Units (ICUs)**
- **Emergency Departments**
- **Medical-Surgical Units**

6.4.3 Sample Size and Sampling

Sampling Strategy:

A **stratified purposive sampling** strategy will be employed to ensure representation across different clinical units. Nurses will be stratified by:

- Clinical unit type (ICU, Emergency, Medical-Surgical)
- Years of experience (≤ 5 years, 6-10 years, > 10 years)
- Shift schedule (day vs. night shift)

Quantitative Sample Size:

Sample size will be calculated using power analysis with the following parameters:

- Power = 0.80
- α = 0.05 (two-tailed)
- Moderate effect size (Cohen's d = 0.5)
- Paired t-test design

Using G*Power software, this calculation yields an estimated sample size of approximately **64 nurses** for paired pre-post comparisons. To account for potential attrition (estimated at 15-20%), the target sample will be 80-90 nurses who complete both pre- and post-intervention assessments.

Qualitative Sample Size:

Data saturation will guide qualitative sample size, with an estimated target of:

- **20-25 interview participants** (selected from those who completed quantitative measures)
- **4-6 focus groups** (6-8 participants per group, total 24-48 participants)

Inclusion Criteria:

- Registered nurses with at least 12 months of clinical experience in the current unit
- Currently employed in the study units
- Willing to provide written informed consent
- Able to communicate in English or Arabic

Exclusion Criteria:

- Nurses on extended leave (maternity, sick, or annual leave > 4 weeks)
- Nurses with less than 6 months' experience in the current unit
- Temporary or agency nursing staff

- Nurses who decline to participate

6.5 Intervention Details: The AI Documentation System

6.5.1 AI System Description

The study will implement **Microsoft Dragon Copilot**, an AI-powered clinical documentation tool that integrates speech recognition with natural language processing capabilities. The system features:

- **Speech-to-Text Engine:** Converts spoken clinical narratives into text with >95% accuracy claims for medical vocabulary
- **Natural Language Understanding:** Interprets clinical context and identifies key information elements
- **Structured Note Generation:** Formats information according to SBAR and nursing documentation templates
- **EHR Integration:** Directly populates notes into the hospital EHR system

6.5.2 Technical Integration with Hospital Systems

The AI system will be deployed as an **integrated module within the existing EHR infrastructure** (Cerner at KFMMC and Epic at KFUH), rather than as a standalone application. This integration approach ensures:

Integration Feature	Description
Single Sign-On (SSO)	Nurses access the AI system using existing EHR credentials
Bi-directional Data Flow	AI-generated notes directly populate EHR fields; patient data is accessible to AI for context.
Template Synchronization	AI uses hospital-approved nursing note templates.
Audit Trail	All AI-generated and edited notes are logged for quality assurance.
HL7/FHIR Compliance	Standardized healthcare data exchange protocols

This integrated approach was chosen to eliminate the need for nurses to copy and paste information between separate systems, which would itself be an additional burden and a potential source of error. The integration will be managed by the hospital's IT department in collaboration with the AI vendor's implementation team.

6.5.3 Workflow Integration and Usage Protocol

Nurses will use the AI system during two primary documentation moments:

Handoff Preparation (End of Shift):

1. Nurse activates AI system via secure workstation microphone
2. Verbally dictates patient summaries following the SBAR structure
3. AI generates draft handoff notes in real-time
4. Nurse reviews and edits AI-generated notes
5. Final notes electronically signed and saved to EHR

Patient Assessment Documentation:

1. Nurse performs bedside assessment
2. Verbally documents findings in the AI system
3. AI organizes information into a structured template
4. Nurse confirms and submits documentation

Device Specifications:

- Secure, noise-canceling headphones with integrated microphones will be provided to participants
- Mobile workstations (COWs - Computers on Wheels) equipped with AI system access will be available at the point of care
- Tablets with AI access for bedside documentation in ICUs

6.6 Study Timeline

The proposed study will be conducted over 12 months, divided into the following phases:

Phase	Duration	Activities	Rationale
Phase 1: Pre-intervention (Baseline)	Months 1-3	- Obtain ethical approvals - Recruit participants - Administer pre-intervention questionnaires - Collect baseline documentation time data (4 weeks) - Conduct baseline qualitative interviews	Establishes a benchmark for outcome comparison
Phase 2: System Preparation	Month 4	- AI system installation and configuration - EHR integration testing - Security and compliance validation - Technical troubleshooting	Ensures system readiness before staff exposure
Phase 3: Training and Orientation	Month 5	- 2-week staff training sessions (4 hours per nurse) - Hands-on practice with simulated cases - Competency assessment - Help desk and support system established	Ensures nurses are comfortable with technology
Phase 4: Adaptation/Washout Period	Months 6-8 **(3 months)**	- Nurses use an AI system for routine documentation - No formal data collection during this period - Technical support available 24/7 - Early user feedback collected informally	Critical period for nurses to acclimate to AI; eliminates learning curve effects; builds user confidence.
Phase 5: Post-intervention Evaluation	Months 9-11	- Administer post-intervention questionnaires - Collect post-intervention documentation time data (4 weeks) - Conduct follow-up qualitative interviews - Collect system usage logs	Measures intervention effects after adaptation

Phase 6: Data Analysis	Month 12	- Data cleaning - Statistical analysis - Thematic analysis of qualitative data - Integration of findings	Synthesizes results for reporting

6.6.1 Rationale for 3-Month Washout Period

The **3-month washout/adaptation period** (Months 6-8) is critical for several reasons:

1. **Minimizing Learning Effects:** Allows sufficient time for nurses to transition from initial enthusiasm or resistance to routine, natural use of the technology
2. **System Optimization:** Provides an opportunity to address technical issues and user feedback before formal outcome measurement
3. **Workflow Integration:** Supports integration of AI into established workflow patterns
4. **Consistency in Documentation:** Ensures AI-generated documentation represents stable, normalized usage rather than early-stage variability

This 3-month adaptation period is consistent with recommendations from implementation science literature for health information technology evaluations.

6.7 Data Collection Instruments

6.7.1 Quantitative Instruments

Instrument	Description	Items	Validity/Reliability	Administration
Demographic Questionnaire	Captures age, gender, education, years of experience, unit type, shift schedule	8 items	Content validity is established by expert review	Paper/electronic (10 min)
Documentation Time Log	Self-reported minutes spent on documentation per shift; includes random spot-checking by research assistants	Daily log for 4 weeks	Validated through observation correlation ($r > 0.85$ in pilot)	Electronic log (2 min/day)
Overtime Hours Tracking	Captures after-shift documentation hours	Extracted from the hospital payroll system	Objective measure	System-generated
Maslach Burnout Inventory-HSS (MBI-HSS)	Measures Emotional Exhaustion (9 items), Depersonalization (5 items), Personal Accomplishment (8 items)	22 items	$\alpha = 0.90$ (EE), 0.79 (DP), 0.71 (PA)	Paper/electronic (15 min)
Nursing Documentation Satisfaction Scale	Adapted from Hagerty et al.; measures satisfaction with documentation processes	15 items	$\alpha = 0.87$ (pilot validation)	Paper/electronic (10 min)

SBAR Handoff Completeness Checklist	Observational tool assessing completeness of handoff communication across 12 SBAR elements	12 items	Content validity established; inter-rater reliability > 0.80	Research assistant observation (5 min/handoff)
System Usability Scale (SUS)	Measures the perceived usability of an AI system	10 items	α = 0.91 (validated)	Electronic (5 min)
NASA-TLX	Measures cognitive workload across 6 dimensions	6 items	α = 0.85 (validated)	Electronic (5 min)

6.7.2 Qualitative Instruments

Instrument	Purpose	Content Focus	Duration
Semi-Structured Interview Guide	Explore individual experiences and perceptions.	Perceptions of AI technology; documentation fatigue; workflow changes; trust in AI accuracy; training adequacy; barriers and facilitators	45-60 minutes
Focus Group Discussion Guide	Facilitate group-level insights and consensus.	Peer experiences; collective attitudes; recommendations for implementation; organizational culture; teamwork and communication	60-90 minutes
Open-Ended Feedback Form	Capture spontaneous observations and suggestions	Unanticipated issues; creative uses; improvement suggestions; concerns	10 minutes

6.8 Data Collection Procedures

6.8.1 Pre-Intervention Phase (Months 1-3)

1. Obtain institutional ethical approval from the hospital IRB and the Ministry of Health
2. Recruit participants through unit-level presentations and information sessions
3. Obtain written informed consent in English and Arabic
4. Administer pre-intervention questionnaires (demographics, MBI-HSS, Nursing Documentation Satisfaction Scale)
5. Collect baseline documentation time data over 4 weeks (nurses complete daily logs)
6. Conduct initial qualitative interviews and focus groups (n=20-25 interviews; 4-6 focus groups)
7. Assess baseline handoff completeness through 30 observed handoffs per unit

6.8.2 System Preparation and Training Phase (Months 4-5)

1. AI system integration with existing EHR
2. Security testing and validation
3. Conduct 4-hour mandatory training sessions for all participants
4. Provide competency assessment and additional practice as needed
5. Establish a help desk and support system
6. Complete system readiness checklist

6.8.3 Adaptation/Washout Period (Months 6-8)

1. Nurses use an AI system for all routine documentation
2. Technical support available 24/7
3. Monthly check-ins with unit nurse managers

4. Informal feedback collected for system optimization
5. No formal research data was collected during this period

6.8.4 Post-Intervention Phase (Months 9-11)

1. Administer post-intervention questionnaires (MBI-HSS, Nursing Documentation Satisfaction Scale, SUS, NASA-TLX)
2. Collect post-intervention documentation time data over 4 weeks (nurses complete daily logs)
3. Collect overtime documentation data from payroll
4. Conduct follow-up qualitative interviews and focus groups (20-25 interviews; 4-6 focus groups)
5. Assess post-intervention handoff completeness through 30 observed handoffs per unit
6. Collect system usage analytics (frequency, duration, features used)

6.8.5 Data Management

- All data will be anonymized using unique participant identifiers
- Quantitative data will be stored in encrypted databases with access restricted to the research team
- Qualitative data will be transcribed verbatim, with identifying information removed
- Data will be retained for 5 years post-study in compliance with institutional data management policies
- Voice recordings used for AI processing will be deleted immediately after transcription

6.9 Statistical Analysis Plan

6.9.1 Quantitative Analysis

Analysis Type	Method	Purpose	Software
Descriptive Statistics	Means, SD, frequencies, percentages	Summarize participant demographics and baseline characteristics	SPSS 27.0
Normality Testing	Shapiro-Wilk test, Q-Q plots	Determine parametric vs. non-parametric tests	SPSS 27.0
Bivariate Analysis	Paired t-tests (parametric) or Wilcoxon signed-rank tests (non-parametric)	Compare pre- and post-intervention outcomes	SPSS 27.0
Multivariate Analysis	Generalized estimating equations (GEE)	Adjust for potential confounding variables (age, experience, unit type)	R or SAS
Subgroup Analysis	ANOVA or Kruskal-Wallis tests	Examine differences by unit type, experience level, and shift schedule	SPSS 27.0
Effect Size	Cohen's d	Measure the magnitude of the intervention effect	SPSS 27.0

Statistical significance will be set at $\alpha = 0.05$. All tests will be two-tailed. Bonferroni correction will be applied for multiple comparisons where appropriate.

6.9.2 Qualitative Analysis

Thematic analysis following **Braun and Clarke's six-phase framework** will be employed:

1. **Familiarization with the data:** Repeated reading of transcripts; initial noting of patterns
2. **Generating initial codes:** Systematic coding of interesting features across the entire dataset
3. **Searching for themes:** Collating codes into potential themes; gathering all relevant data for each theme
4. **Reviewing themes:** Checking themes against coded extracts and entire dataset; generating thematic map

5. **Defining and naming themes:** Ongoing analysis to refine specifics of each theme; clear definitions and names
6. **Producing the report:** Final analysis; selection of compelling extract examples; final analysis of research question

Rigor Measures:

- **Inter-coder reliability:** Two researchers will independently code 20% of transcripts; Kappa coefficient > 0.80 will be considered acceptable
- **Member checking:** Findings will be shared with participants for validation
- **Triangulation:** Comparison of findings across interviews, focus groups, and quantitative data
- **Reflexivity:** Researchers will maintain reflective journals to acknowledge potential biases
- **Thick description:** Rich, contextual descriptions to support transferability

6.9.3 Mixed-Methods Integration

Data integration will occur at the interpretation stage using a **weaving approach**, where quantitative findings and qualitative themes are presented together in a coherent narrative to provide complementary insights.

6.10 Validity and Reliability

6.10.1 Internal Validity

Threat	Mitigation Strategy
History	Include control units if feasible; document external events.
Maturation	Include a washout period to minimize learning effects.
Instrumentation	Use the same validated instruments pre- and post.
Statistical Regression	Use appropriate statistical methods; examine for floor/ceiling effects.
Attrition	Target over-recruitment (20%); compare baseline characteristics of dropouts
Contamination	Monitor for AI system use sharing; reinforce study protocols.

6.10.2 External Validity

Aspect	Strategy
Setting	Select two diverse hospitals with different EHR systems.
Participants	Include multiple unit types and experience levels.
Intervention	Detailed description of the AI system and implementation protocol to support replication
Population	Clear inclusion/exclusion criteria specified

6.10.3 Reliability

- **Inter-rater reliability:** Handoff completeness observations will be conducted by two trained research assistants with >0.80 agreement
- **Test-retest reliability:** Subset of participants (n=20) will complete questionnaires twice (2-week interval) for reliability assessment
- **Internal consistency:** Cronbach's α will be calculated for all multi-item instruments

6.11 Potential Limitations and Mitigation Strategies

Limitation	Impact	Mitigation Strategy
Learning effects during early AI use	May underestimate the true intervention effect	Include a 3-month washout period before post-intervention data collection
Selection bias in participant recruitment	May limit generalizability	Use stratified purposive sampling with broad inclusion criteria; document recruitment rates.
Hawthorne effect	Behavior change due to observation	Minimize researcher presence during routine shifts; emphasize anonymity; use objective measures where possible.

Limited generalizability	Findings may not apply to all Saudi hospitals.	Select diverse units and settings; provide thick description; consider multicenter design.
AI system technical issues or downtime	May affect user experience and outcomes	Document all technical problems; include troubleshooting protocol; collect usage logs.
Short follow-up duration	It may not capture the sustainability of effects	3-month post-intervention measurement provides initial sustainability evidence
Self-report bias in documentation time logs	May overestimate time savings	Include random spot-checking by research assistants; compare with system logs.
Reactivity to AI system novelty	May inflate satisfaction scores	A washout period reduces the novelty effect; include open-ended questions to probe genuine perceptions.
Difficulty separating the AI effect from other organizational changes	May confound results	Document all organizational changes during the study period; include a comparison of other units if feasible.

6.12 Feasibility Assessment

Dimension	Assessment	Rationale
Technical Feasibility	High	Both study hospitals have existing EHR infrastructure and IT support
Organizational Feasibility	Moderate	Requires administrative support and buy-in from nursing leadership
Financial Feasibility	Moderate	AI system licensing and integration costs; potential vendor partnership
Staff Feasibility	Moderate	Requires staff time for training and study participation; manageable with shift scheduling
Ethical Feasibility	High	Data privacy safeguards in place; ethical approval process clear
Time Feasibility	Moderate	12-month timeline allows a comprehensive evaluation

7. Ethical Considerations

The integration of AI into healthcare documentation introduces several ethical and professional considerations. Protecting patient confidentiality remains a top priority because AI systems process highly sensitive clinical information.

Healthcare institutions implementing AI-assisted documentation systems must ensure:

- Secure data encryption
- Restricted access to patient records
- Compliance with Saudi healthcare regulations
- Continuous human review of AI-generated notes

In addition, nurses should receive proper training before using these systems in clinical practice. AI technologies should support nursing judgment rather than replace professional decision-making.

Institutional ethical approval would also be necessary before conducting any intervention study involving healthcare staff or patient information.

8. Future Implications for Nursing Practice

Generative AI may eventually become a routine component of nursing documentation systems. If implemented carefully, these technologies could help healthcare organizations reduce workload pressures while improving efficiency and communication quality.

Future developments may include:

- Arabic-language AI documentation systems
- Real-time multilingual handoff generation
- Integration with national EHR platforms
- Predictive workload analysis
- AI-assisted nursing care planning

However, future implementation strategies should remain patient-centered and ethically grounded. Technology alone cannot solve healthcare workforce challenges unless organizational culture, staffing conditions, and clinical support systems are also addressed.

9. Conclusion

Nursing documentation remains a critical yet burdensome responsibility within modern healthcare environments. Although electronic health records have undeniably improved accessibility, continuity, and standardization of patient information, they have simultaneously intensified administrative demands on nurses, particularly during patient handoffs and end-of-shift reporting. This paradox—technology solving one problem while creating another—has contributed significantly to documentation fatigue, cognitive overload, and professional burnout among nursing staff worldwide.

This review has examined the potential of generative artificial intelligence, particularly AI-powered voice-to-text and natural language processing systems such as Microsoft Dragon Copilot and Heidi Health AI, to alleviate this documentation burden. The evidence suggests that these technologies offer several promising benefits: reducing manual typing and cognitive workload, improving handoff communication consistency through structured automated summaries, and potentially enhancing nurse satisfaction by redirecting time toward direct patient care. In the context of Saudi Arabia's healthcare transformation under Vision 2030, AI-assisted documentation aligns strategically with national priorities for digital health innovation, smart hospitals, and workforce sustainability.

However, successful implementation requires careful navigation of several critical challenges. Technical issues such as speech recognition accuracy, particularly for Arabic dialects and diverse clinical terminology, must be addressed to ensure reliable documentation. Integration with existing EHR systems requires substantial IT infrastructure investment and careful workflow redesign. Furthermore, ethical considerations—including data privacy, cybersecurity, professional accountability for AI-generated content, and transparent governance frameworks—must be prioritized to maintain patient trust and clinical safety.

The proposed mixed-methods study offers a structured approach to evaluating AI documentation systems within Saudi hospital settings, with specific attention to local contextual factors including health cluster structures, EHR readiness, and workforce perceptions. By combining quantitative outcome measures (documentation time, burnout indicators, satisfaction scores) with qualitative exploration of nurse experiences, this research design can generate robust evidence to guide evidence-based policy and implementation decisions.

Ultimately, generative AI should be viewed as a supportive clinical tool designed to augment—not replace—nursing judgment, clinical reasoning, and compassionate care. The human elements of nursing practice remain irreplaceable. Technology alone cannot resolve workforce challenges or systemic inefficiencies unless accompanied by supportive organizational cultures, adequate staffing, comprehensive training, and continuous evaluation. As Saudi Arabia continues its ambitious healthcare modernization journey, thoughtful, context-sensitive integration of AI into nursing workflows holds significant potential to enhance both clinician well-being and patient outcomes.

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11. Funding and Support

This proposed study is supported by the following institutional and funding bodies:

Funding Source	Type of Support	Role in Study
King Fahad Military Medical Complex, Dhahran	Institutional support, access to clinical settings, IT infrastructure	Provision of study setting, access to nursing staff, technical integration support
King Fahad University Hospital, Al Khobar	Institutional support, access to clinical settings	Provision of study setting, access to nursing staff
[University Name] - Deanship of Scientific Research	Research grant (proposed)	Funding for research personnel, data collection, software licensing
[Research Chair in Nursing Informatics/Health Informatics]	Academic support	Methodological guidance, data analysis resources

Disclosure: No direct industry funding has been received for this study from AI technology vendors (Microsoft, Nuance, Heidi Health, or others). All AI system licensing and implementation costs are proposed to be covered through institutional research grants and hospital IT infrastructure budgets. The study design, data collection, analysis, and reporting will be conducted independently of any commercial entity to ensure objectivity and minimize potential conflicts of interest.

Acknowledgments: The authors would like to acknowledge the nursing leadership and IT departments of King Fahad Military Medical Complex and King Fahad University Hospital for their preliminary discussions and support in conceptualizing this study. Further acknowledgments will be included following study completion.

12. Proposed Study Timeline

The proposed study is designed to be completed within an 18-month timeframe, allowing sufficient time for comprehensive preparation, adaptation, data collection, and analysis. The timeline is organized into six distinct phases:

Phase	Duration	Period	Key Activities	Deliverables
Phase 1: Preparation and Ethical Approvals	2 months	Months 1-2	• Finalize study protocol • Obtain IRB approval from both hospital sites • MOH research committee approval • Secure funding confirmation • Establish research team	• Approved protocol • Ethical approvals • Funding confirmation
Phase 2: Baseline Data Collection (Pre-Intervention)	3 months	Months 3-5	• Participant recruitment and consent • Pre-intervention surveys (MBI, satisfaction, demographics) • Baseline documentation time tracking (4 weeks) • Initial qualitative interviews and focus groups • SBAR handoff observations	• Baseline data set • Interview transcripts • Completed questionnaires
Phase 3: System Preparation and Integration	2 months	Months 6-7	• AI system licensing and procurement • EHR integration (Cerner/Epic) • Security and compliance testing • Technical troubleshooting	• Functional AI system • Integration validation • Security clearance
Phase 4: Training and Implementation	3 months	Months 8-10	• Staff training sessions (all participants) • Competency assessment • Go-live support • 2-month washout/adaptation period • Informal feedback collection	• Trained staff • Competency records • Implementation report

Phase 5: Post-Intervention Data Collection	4 months	Months 11-14	• Post-intervention surveys (MBI, satisfaction, SUS, NASA-TLX) • Post-intervention documentation time tracking (4 weeks) • Follow-up interviews and focus groups • System usage analytics • SBAR handoff observations	• Post-intervention data set • Interview transcripts • System usage logs
Phase 6: Data Analysis and Dissemination	4 months	Months 15-18	• Quantitative data analysis (descriptive, bivariate, multivariate) • Qualitative thematic analysis • Mixed-methods integration • Manuscript preparation • Conference presentations • Final report submission	• Data analysis report • Draft manuscripts • Conference abstracts • Final study report

Total Duration: 18 months

Key Milestones:

- Month 5: Completion of baseline data collection
- Month 7: AI system fully integrated and tested
- Month 10: End of washout/adaptation period
- Month 14: Completion of post-intervention data collection
- Month 18: Final report submission and manuscript preparation

13. Appendixes

The following appendices will be included in the full research protocol and final study report. These materials are available from the corresponding author upon reasonable request.

Appendix	Content	Purpose
Appendix A	Informed Consent Form (English and Arabic versions)	Obtains written consent from nurse participants
Appendix B	Participant Information Sheet (English and Arabic)	Provides detailed study information to potential participants
Appendix C	Demographic Questionnaire	Collects participant background information (age, gender, education, experience, unit, shift schedule)
Appendix D	Documentation Time Tracking Log	Self-reported daily log for measuring documentation time per shift
Appendix E	Maslach Burnout Inventory - Human Services Survey (MBI-HSS)	Validated instrument measuring emotional exhaustion, depersonalization, and personal accomplishment

Appendix F	Nursing Documentation Satisfaction Scale	Adapted instrument measuring satisfaction with documentation processes
Appendix G	System Usability Scale (SUS)	Measures perceived usability of the AI documentation system
Appendix H	NASA-TLX Workload Assessment	Measures perceived cognitive workload across six dimensions
Appendix I	SBAR Handoff Completeness Observation Checklist	Structured observation tool for assessing handoff communication quality
Appendix J	Semi-Structured Interview Guide (English and Arabic)	Guides individual qualitative interviews exploring nurse experiences
Appendix K	Focus Group Discussion Guide (English and Arabic)	Guides focus group discussions on AI adoption and implementation
Appendix L	AI System Usage Log Template	Captures system utilization metrics (frequency, duration, features used)
Appendix M	Open-Ended Feedback Form	Captures spontaneous observations and suggestions from participants

Note: All instruments will undergo content validity assessment by expert reviewers and pilot testing with a small group of nurses (n=10-15) prior to full study implementation. Instrument translations into Arabic will follow forward-backward translation procedures with bilingual nursing experts to ensure semantic equivalence and cultural appropriateness for the Saudi nursing context.