

The Human Factors in the Adoption of Ambient Artificial Intelligence Scribe Technology: Towards
Informed and User-centered Implementation of AI in Healthcare

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

The landscape of healthcare documentation has undergone substantial transformations over the past few decades, evolving in parallel with technological advancements and shifts in healthcare delivery models. Central to these changes is the electronic medical record (EMR), a digital iteration of patients' paper charts, which has become standard in healthcare settings. While EMRs are instrumental in streamlining data management and accessibility, they have introduced new challenges, particularly in the form of administrative burden on healthcare providers.

This thesis explores the integration of ambient artificial Intelligence (AI) scribe technology, a solution leveraging advancements in automatic speech recognition (ASR) and natural language processing (NLP), into physicians' workflows. AI scribes semi-automate the documentation process by capturing and synthesizing physician-patient interactions in real-time, potentially alleviating the administrative workload on clinicians and improving the quality of care. The potential benefits of this technology are vast, and its adoption raises significant questions regarding privacy, consent, and trust, especially given its capability to record sensitive interactions in detail.

The study aims to (1) explore the integration of ambient scribe technology into physicians' workflows and assess its impact on physician-patient interactions, (2) identify and analyze the concerns related to privacy, consent, and trust among patients and physicians regarding the use of the technology, and (3) develop and evaluate a flexible informed consent protocol for patients and physicians. A mixed-method approach was employed, integrating quantitative data from surveys and qualitative insights from semi-structured interviews, providing a comprehensive understanding of the multifaceted impact of the technology.

The findings reveal that while AI scribes offer efficiency gains, particularly for complex and lengthy encounters, they are less beneficial for simpler visits. Further, the efficiency of documentation with AI scribes compared to without is found to be dependent on individuals, with some physicians reporting negligible improvements due to extensive post-editing and the need for customization, while others noted notable gains. Regarding the impact on interaction, patients and physicians reported enhanced interactions due to reduced distractions but noted instances of self-censorship by patients due to discomfort with the recording process. Patients also expressed worry about self-

ensorship by physicians due to medicolegal concerns and unintended consequences due to technology over-reliance.

Concerning the second objective, patients and physicians expressed significant privacy concerns due to a lack of understanding and transparency in data handling policies. Patients also expressed concerns regarding autonomy of private data, unauthorized access, and data breaches. The findings underscore the need for transparent data handling policies and robust security measures. Trust in physicians and pre-established patient-physician relationships also played a notable role in patient consent, with patients more likely to consent to AI scribe use with familiar physicians.

To address these concerns, the thesis proposed a Multi-Tier Granular Informed Consent (MTGIC) framework, integrating tiered and granular consent models to enhance transparency and participant control over personal data. The empirical evaluation of the MTGIC was well-received by both patients and physicians, though it necessitates ongoing refinement to enhance usability and ensure it aligns with user needs.

In conclusion, while ambient scribe technology presents a promising tool for enhancing healthcare delivery, its successful implementation is contingent upon careful consideration of its integration into clinical workflows, the management of privacy concerns, and the development of effective consent processes. This study contributes to the ongoing discussion on the best practices for integrating emerging technologies into healthcare systems, aiming to enhance operational efficiency and patient care quality.

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List of Abbreviations

AAL	Ambient Assisted Living
AI	Artificial Intelligence
AIS	Ambient Intelligent Systems
ASR	Automatic Speech Recognition
CSCW	Computer Supported Cooperative Work
EHR	Electronic Health Record
EMR	Electronic Medical Record
GDPR	General Data Protection Regulation
GenAI	Generative AI
HIPAA	Health Insurance Portability and Accountability Act
LLMs	Large Language Models
ML	Machine Learning
MTGIC	Multi-Tier Granular Informed Consent
NLP	Natural Language Processing
PbD	Privacy by Design
PHI	Personal Health Information
PIPEDA	Personal Information Protection and Electronic Documents Act
VSD	Value Sensitive Design

Chapter 1 Introduction

The landscape of healthcare documentation has undergone substantial transformations over the past few decades, evolving in parallel with technological advancements and shifts in healthcare delivery models. At the heart of these changes is the electronic medical record (EMR)¹, a digital iteration of patients' paper charts that has become standard in healthcare settings. While EMRs are instrumental in streamlining data management and accessibility, they have also introduced new challenges, particularly in terms of the administrative burdens placed on healthcare providers.

Clinical documentation is a critical component of healthcare, serving numerous essential functions, from facilitating patient care continuity to ensuring legal and financial compliance [2], [3]. However, the transition from paper-based to electronic records has not been seamless. Numerous studies show that there are unintended consequences with EMRs, such as significant increases in clinicians' workload, documentation errors and decreased interaction with patient [4], [5]. The increased workload is often attributed to physician burnout, a phenomenon characterized by emotional exhaustion, depersonalization, and a reduced sense of personal accomplishment [6], [7], [8].

Integrating EMRs into daily medical practice is also criticized for the lack of interaction between physician and patient and the quality of the relationship. Multiple studies indicate a shift in the relationship between physicians and patients from dyadic to triadic - where both the patient and physician deal with the computer and each other [9], [10]. This triadic relationship detracts from the time available for patient interactions, resulting in less face-to-face interaction, divided attention and increased cognitive workload. The impact is profound, often attributed to reduced quality of care and patient satisfaction.

In response to the challenges posed by the integration of EMRs into healthcare systems, various solutions were proposed and implemented. Notable of these are the adoption of medical scribes and dictation tools. Medical scribes are professionals from various fields who receive short clinical documentation training to assist physicians with EMR entry [11]. Studies on the impact of medical scribes have shown that they relieve clinicians of administrative tasks, enhance efficiency, improve documentation quality, and contribute to improvements in care delivery, benefiting both physicians and patients [12], [13], [14]. However, the long-term sustainability of employing medical scribes presents numerous concerns. In

¹ While Electronic Medical Record (EMR) and Electronic Health Record (EHR) are often used interchangeably in this research, it is important to recognize their distinct definitions. EMR refers to a digital system within a hospital or clinic that documents patient history, with access typically restricted to the originating institution [1]. On the other hand, an EHR encompasses a broader scope, enabling the sharing of a patient's comprehensive medical history across different healthcare institutions [1].

Canada, the scribe program is designed to offer pre-med graduates an opportunity to gain clinical experience before pursuing medical school or other specializations[15]. This cost-effective approach often leads to high turnover rates, necessitating frequent retraining of scribes and reducing the full benefit physicians can derive from their assistance. Additionally, there are concerns about privacy and the lack of medical training and accountability associated with medical scribes [12].

Dictation tools, as the name suggests, allow healthcare providers to record patient information verbally, which is then transcribed and integrated into EMRs. While these tools facilitate more comprehensive note-taking, they introduce additional steps that could potentially extend the time spent on documentation through activities such as logging in, transferring notes, and editing [16].

In this context, ambient scribe technology² emerges as a promising solution, leveraging advancements in automatic speech recognition (ASR) and natural language processing (NLP) to semi-automate the documentation process. By capturing and synthesizing physician-patient interactions in real-time, the technology promises to alleviate the administrative workload on clinicians and enhance the quality of care [1]. Yet, despite its potential, the adoption of ambient scribe technology raises significant questions regarding privacy, consent, and trust, especially considering its capability to record sensitive interactions in detail [17], [18].

The technology is currently in a phase of rapid evolution with major technology and healthcare vendors, including Google's DeepMind, Microsoft's Nuance, and startups such as DeepScribe, Tali-AI, Mutuo Health, and many more contributing to advancements in various components and competing for market share. The varied AI scribe providers also offer a range of functionalities and features, from simple transcription and summarization of patient-physician dialogues to more complex tasks like generating lab orders, requisitions, and integration with existing EMR systems. This dynamic pace of development and deployment underscores the technology's adaptability and potential for rapid iteration. This state of flux highlights a critical window for research and policymaking to influence the technology's trajectory, ensuring it aligns with healthcare standards and addresses user needs effectively.

This thesis aims to delve into these issues with the following objectives:

1. Explore the integration of ambient scribe technology into physicians' workflows and assess its impact on physician-patient interactions.

² The terms Artificial Intelligence (AI) scribe, ambient scribe, and digital scribe are variously used in the literature to describe technology that assists in medical documentation. For clarity and consistency in this thesis, "ambient scribe technology" and "AI scribe" will be used interchangeably. "AI scribe" is chosen for its conciseness, while "ambient scribe technology" accurately reflects the technological aspect being discussed.

2. Identify and analyze the concerns related to privacy, consent, and trust among patients and physicians regarding the use of ambient scribe technology.
3. Develop and evaluate a flexible informed consent protocol that can be utilized by patients and physicians to use ambient scribe technology.

To accomplish these objectives, a mixed-method study design was used to understand the multifaceted impact of ambient scribe technology comprehensively. The approach included surveys and semi-structured interviews with patients and physicians, offering quantitative and qualitative insights. The purpose of the surveys was to gather broad perspectives on the use of the technology, while the follow-up interviews were performed with a subset of participants to gain richer qualitative insights into their thought processes and values. The data analysis employed statistical analysis for quantitative data and inductive thematic analysis for qualitative data focused on identifying patterns and themes related to the technology's integration and its implications.

Overall, the study found that patients and physicians exhibited a blend of optimism and caution regarding using AI scribes. Most physicians were enthusiastic about the potential for increased efficiency and reduced workload that AI scribes could offer. However, some felt the technology was not yet advanced enough to provide tangible benefits. Additionally, physicians highlighted the need for AI scribes to possess critical capabilities and features to integrate seamlessly into their workflows. Regarding the impact on patient-physician interactions, both parties agreed that AI scribes could enhance communication by allowing physicians to focus more on patients and better read body language.

However, there were significant concerns about using AI scribes in sensitive encounters, such as mental health and sexual health visits or discussions with legal implications. Physicians worried patients might feel uncomfortable and withhold critical information or self-censor during these interactions. Patients echoed these concerns, preferring not to use AI scribes in such cases or having the option to switch them off as necessary. In addition, patients expressed concerns about the technology's short- and long-term impact on physicians. These included self-censorship to appear more professional or avoid medicolegal issues and loss of vigilance and complacency due to over-reliance.

The avoidance of using AI scribes or withholding critical information when using it was influenced by the perceived privacy and security of the technologies' data processing and storage policy and capability, which also impacted consent. The majority of both groups expressed that privacy policies and perceptions affected their willingness to adopt or continue to use AI scribe. In contrast, some physicians expressed privacy concerns in AI scribes were similar to EMRs. Others expressed that security safeguards mattered more, while some wanted the government to vet the service providers. In conjunction with privacy, trust, among other factors, impacted patient consent. Notably, patients expressed their trust in a physician

would impact their consent to an AI scribe, demonstrating the value of patient-physician relationships in healthcare.

This thesis developed a conceptual framework called a Multi-Tier Granular Informed Consent (MTGIC), integrating tiered and granular consent models to address privacy and trust concerns and aid in informed consent. The framework was developed based on value sensitive design (VSD) and privacy by design (PbD) principles and was informed by existing literature. It was evaluated in the surveys and interviews conducted. The empirical evaluation of the conceptual model revealed that patients and physicians found it enhances transparency, understandability, and, most importantly, user autonomy. Various recommendations are made for future iterations of the model for improved usability, particularly simplifying its wording and presentation.

The thesis concludes by discussing the most prominent findings and providing practical and timely recommendations for AI scribe service providers, physicians, and researchers. The challenges and limitations of the study are also provided.

1.1 Thesis Structure

The thesis is structured as follows:

Chapter 1 introduces the research topic and outlines the research objective and contribution. This chapter also provides the structure of the thesis.

Chapter 2 provides a comprehensive overview of ambient scribe technology, including the ethical questions regarding the technology and the current landscape. It also discusses the role of human factors in AI scribe adoption and effectiveness.

Chapter 3 presents the study's mixed-method design, which includes the study design, participant eligibility criteria, recruitment strategies, and data collection and analysis methods.

Chapter 4 presents the study's findings, including the study population data (also applicable to Chapter 5), quantitative results, and qualitative insights for objectives 1 and 2.

Chapter 5 addresses the research's third objective, developing a flexible informed consent protocol for AI scribes and its evaluation based on empirical data. The chapter begins with an overview of the framework's background and presents the methodology, which details the various design and analytical approaches employed to design the proposed Multi-Tier Granular Informed Consent (MTGIC) framework. It concludes with the empirical findings of the proposed consent process for AI scribes.

Chapter 6 synthesizes the research findings, addressing the initial research questions and discussing the implications of the results. It explores the challenges and limitations encountered during the study and considers the broader impact of the research findings on the field.

Chapter 2 Background

2.1 Ambient Scribe Technology

An ambient scribe (also known as an AI scribe or digital scribe) is a technology that semi-automates the documentation of medical notes. While different AI scribes have somewhat varied processes, they are similar in that they operate unobtrusively from a computer or mobile app and record physician-patient encounters to convert them to text using ASR and analyze them using NLP models before summarizing them into medical notes [20], [21], [22]. Some AI scribes also have features that enable the drafting of prescriptions, lab orders, requisitions and, as such, generate billing codes.

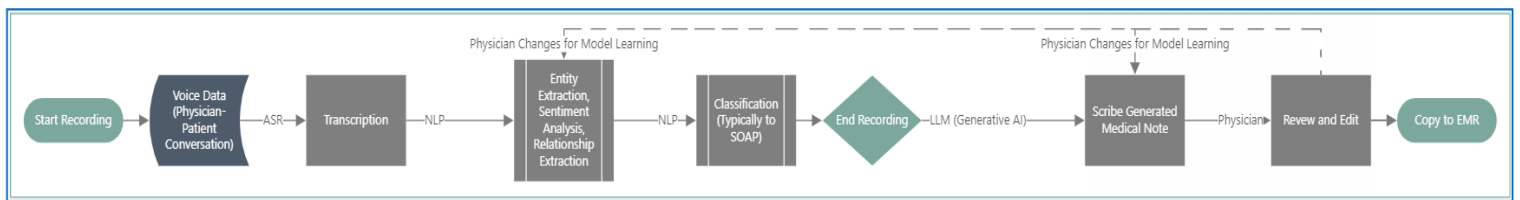


Figure 1: Typical process of ambient scribe technology

Figure 1 illustrates the typical ambient scribe technology workflow commencing with ASR, the system's auditory component, which captures and transcribes spoken language during the physician-patient interaction. This transcription process relies on algorithms that recognize and interpret human speech. Following transcription, the text undergoes NLP analysis, where algorithms conduct a syntactic and semantic evaluation to extract relevant clinical information, like diagnoses and prescription details, from the dialogue. NLP algorithms can also be used to identify entities and their interrelations, which is crucial for precise medical documentation.

After NLP analysis, generative AI models synthesize the structured data into preliminary medical notes leveraging large language models (LLMs), which are trained on extensive medical language corpora. LLMs craft narratives encapsulating the dialogues' extracted information, ensuring the documentation aligns with the medical industry's standards and formats. Most scribes use the SOAP (Subjective, Objective, Assessment, Plan) framework.

The effectiveness of an AI scribe hinges on the accuracy of its constituent models. These, in turn, depend on comprehensive training across the ASR, NLP, and LLM components [23]. A broad spectrum of medical dialogues is necessary for ASR to accurately recognize various terminologies, accents, and colloquialisms encountered in clinical environments [24]. Quality NLP training requires detailed medical dialogues and annotations, while LLMs need extensive medical summaries from various disciplines for effective training.

Although empirical evidence of AI scribe efficacy remains limited, the pursuit of state-of-the-art AI performance is rapidly evolving. Currently, the only data available on the efficiency of AI scribes is from service providers, which claim an average of approximately 40% reduction in documentation time [26], [27], [28]. The only third-party study I was able to find was [18], which used a fictional demonstration of the technology to get the perspective of physicians regarding its benefits and risks. The findings demonstrate that the perceived benefits are similar to medical scribes, as discussed in Chapter 1, and the risks are similar to other ambient intelligent technologies [29], [30], [31], [32], [33] with context-specific differences, given its voice-based nature, and capture of entire patient-physician conversation, which includes medical and non-medical personal conversation.

2.1.1 Ethical Issues

Limited studies examine the privacy and ethical concerns specific to AI scribes which emerge because of the voice recording of entire conversations between patients (including family members) and physicians, inclusive of health, personal and work information [18]. However, studies on Ambient Intelligent Systems (AIS) as a whole shed light on relevant user privacy requirements, such as user control over personal data and the right to determine how, when, and how much data is shared, as crucial factors in the adoption of ambient technologies [8], [9]. Further studies highlight the demand for transparency in data handling and clear consent processes [8], [9]. Studies also found that privacy requirements are closely tied to trust and consent for AISs and play a pivotal role in successfully adopting ambient technologies in healthcare. The details of the privacy and ethical concerns raised by these studies are discussed in section 2.2.1.

Given these considerations and the unique nature of the technology, there is an imperative need for a dedicated exploration of these issues within this specific context. This thesis investigates some of the ethical and privacy-related issues raised by previous studies in AIS and medical scribes.

2.1.2 Current Landscape

Currently, terms of service agreements between AI scribe providers and physicians govern data collection, retention, and usage, as evidenced by service providers' terms of service in [34], [35], [36], [37], [38], [39]. Accordingly, clinicians are tasked with obtaining consent from their patients to collect, use, and disclose personal information. While different service providers have different approaches to storing, processing and retaining data, most maintain data ownership and the right to reuse data according to their privacy policy [40], [41], [42], [43], [44]. There is also ambiguity around their policy and its implementation, particularly on what the reuse entails and their force majeure clause. Still, all claim compliance with at least one of the personal and health privacy regulations, such as the Personal

Information Protection and Electronic Documents Act (PIPEDA)³, the Health Insurance Portability and Accountability Act (HIPAA), and the General Data Protection Regulation (GDPR), which apply to Canada, the United States (US) and European Union (EU) respectively. However, the process undermines the need for informed consent (applicable under GDPR and PIPEDA), the requirement for transparency on data use and processing, and the right to access, amend, or remove data.

In addition, there is a limitation to the applicability of the aforementioned regulations when it comes to AI, especially machine learning-based tools [46], [47], [48]. For instance, HIPAA is only applicable to Personal Health Information (PHI) for health plans, health care providers and clearinghouses, and their business associates [47]. Further, it is not applicable for downstream uses, which is where algorithm training occurs. In addition, some states/jurisdictions allow one-party recording, which enables the physician or patient to use an AI scribe without the consent of the other. Even with PIPEDA and GDPR, informed consent is ineffective, given the complexity of the end-user license agreement. To address these gaps, the Belmont Report for Health Data [47] suggests an ethical consideration for data usage and emphasizes the need for plain language and manageable informed consent. Similarly, the newly issued principles for generative AI technology use by the Office of the Privacy Commissioner Canada emphasizes valid consent, which is part of PIPEDA and recommends establishing a separate review process to ensure the privacy and ethical soundness of data reuse [49].

In conclusion, while legal frameworks like PIPEDA advocate for valid consent, practical implementation faces significant challenges, particularly regarding AI scribe services in healthcare. Notable are the lengthy and complex terms of service and privacy policies, which are often laden with legal jargon, that pose an understanding and accessibility barrier for both physicians and patients. This complexity hinders the ability of physicians to grasp the full scope of these agreements and effectively communicate the pertinent details to patients, thereby compromising the process of obtaining informed or valid consent. The tendency to focus solely on the tool's primary purpose while overlooking the broader implications of data usage further exacerbates this gap.

2.2 The Role of Human Factors in Ambient Scribe Technology Adoption and Effectiveness

Integrating ambient scribe technology into healthcare settings requires various human factors considerations for successful adoption. Human factors engineering, as defined by the International

³ Ontario, New Brunswick, Newfoundland and Labrador have a health-related privacy law that is similar to the PIPEDA and is applicable in their jurisdiction [45]. The remaining provinces and territories also have health-related privacy law but the PIPEDA is still applicable in those jurisdictions as their laws have not been substantiated as equivalent to PIPEDA [45].

Ergonomics Association, involves the application of theoretical and empirical data to optimize human well-being and overall system performance through the design of interactive systems [50]. Human factor considerations are pivotal when integrating technologies such as AI scribes into complex environments like healthcare as they address the interaction between humans and technology, aiming to enhance the efficiency of healthcare delivery and the experience of providers and patients.

The deployment of ambient scribe technology fundamentally changes the nature of tasks performed by healthcare providers. This requires assessing how the change fits into the clinical workflow and the compatibility of new tasks to their workflow. Task compatibility, a concept central to human factors, assesses how well a technology integrates without disrupting existing workflows. This is crucial as poor integration could negate the potential benefits by making the technology a hindrance rather than an aid. Furthermore, AI scribes aim to reduce the cognitive workload associated with documentation, thereby allowing physicians to focus more on patients by reducing their workload during patient encounters. Therefore, it is crucial to understand how technology impacts cognitive workload. Objective 1 of this thesis investigates this empirically based on self-reports in user interviews with physicians (see section 4.3.1 for detail).

Safety is another concern for human factors and is paramount in healthcare settings, with errors having significant consequences. Human factors research emphasizes designing inherently safe systems with multiple defenses against error. For ambient scribe technology, this involves ensuring the reliability of the ASR and NLP components and the data management system to ensure data security and confidentiality. Reliability is defined as the consistent performance of a technology, particularly regarding its ability to function under diverse and potentially challenging clinical conditions. This study is more interested in data safety as it relates to privacy and trust and its alignment with privacy regulations such as PIPEDA, HIPAA, and GDPR. Objectives 2 and 3 of this thesis investigate privacy and trust and their role in user acceptance theoretically and empirically. The subsection below discusses the position this thesis takes when examining the role of privacy and trust in adoption of AI scribes.

Informed consent is another concept that is relevant to privacy and human factors. Informed consent is discussed in detail in section 5.2.2.1.

2.2.1 The Role of Privacy and Trust in the Adoption of Ambient Intelligent Systems

Privacy is a construct without a universally accepted definition [31]. Different disciplines adopt definitions that are relevant to their field and context. This thesis adopts the definition of privacy as a right, which was first used by Warren and Brandis [51]. Accordingly, privacy is defined as follows by Stefanos Gritzalis [52]:

“Indefeasible right of an individual to control the ways in which personal information is obtained, processed, distributed, shared, and used by any other entity”.

This definition also aligns with the value sensitive design (VSD) principle that defines privacy as the right to determine how information is collected and used [53], but Gritzalis’ definition is more comprehensive and hence adopted.

Trust, on the other hand, is defined as expectation or belief and involves a trustor and trustee [32]. In the context of ambient scribe technology, there are two primary dimensions of trust: 1) trust in ambient scribe service providers and 2) trust in ambient scribe technology. Additionally, trust in healthcare providers (physicians) may also play a role in patients’ perception of the technology and their experience, adding a third dimension to the trust equation.

Studies show that privacy and trust are interrelated and may be studied together or separately [32], [54]. Wilowska et al. [55] studied the role of privacy and trust in adopting AIS in assisted living technologies and found that both are moderate to strongly connected to acceptance. In the context of ambient scribes, scribe providers’ ability to safeguard the privacy of patient information and prevent unauthorized access and breaches may influence the trust users may have in the provider. Similarly, trust in AI scribe providers may reduce the privacy concerns patients and physicians have, leading to acceptance of the technology. Trust may also be influenced by the perceived accuracy and reliability of the technology. If patients and physicians find the technology reliable—accurately captures and interprets the encounter—they would be more likely to trust it. This trust is crucial for technology adoption, as it impacts the willingness of healthcare professionals to rely on it for medical documentation and the comfort of patients in knowing their interactions are correctly recorded and used.

In conclusion, addressing human factors such as task compatibility, cognitive workload, privacy, trust, and informed consent is critical for successfully integrating ambient scribe technology into healthcare practices. These factors influence the technology’s acceptance by healthcare providers and patients and ensure compliance with ethical standards and legal requirements.

Chapter 3 Methodology

This thesis employs a mixed-method approach to address the complexities of integrating ambient scribe technology into medical workflows and related privacy and trust concerns. This section outlines the specific methodologies applied to achieve the research objectives and details the data collection and analysis processes that underpin the study's findings.

The main objectives of the thesis are to:

1. Explore the integration of ambient scribe technology into physicians' workflows and assess its impact on physician-patient interactions.
2. Identify and analyze the concerns related to privacy, consent, and trust among patients and physicians regarding using ambient scribe technology.
3. Develop⁴ and evaluate a flexible informed consent protocol that can be utilized by patients and physicians when implementing ambient scribe technology.

To address these objectives, a mixed-method approach, integrating both quantitative and qualitative methods, is applied to harness the strengths of each. The approach ensures comprehensive data collection, with quantitative data providing a statistical foundation with measurable, numerical insights and qualitative data presenting depth and context through detailed, narrative responses. This allows for triangulation design which is one of the most common methods for validating research findings. According to Creswell and Clark, triangulation design seeks convergence, corroboration, and correspondence of results from different methods [55]. This study corroborates quantitative results from close-ended surveys with qualitative results from open-ended survey questions and semi-structural interviews.

3.1 Study Design & Participants

The study design included a remote survey using Qualtrics and a follow-up interview with a subset of the participants. The study participants included four distinct groups: 1. physicians who have used AI scribes (early adopters), 2. physicians who have never used AI scribes (non-adopters), 3. patients who have encountered AI scribe in their hospital/clinic visit at least once (scribe-experienced) and 4. patients that have never encountered AI scribe in practice (scribe-inexperienced).

⁴ The development of the consent protocol is based on literature review and design principles discussed in section 5.3. The evaluation is carried in the surveys and interviews. See Chapter 5 for details on objective 3.

Subsequent sections discuss the recruitment approach, study material, and analysis method. Appendix A contains the recruitment and study materials.

3.1.1 Recruitment

Following ethics approval, recruitment was conducted from February 1 to March 8, 2024. Different strategies were employed for recruiting patient and physician groups. The inclusion and exclusion criteria for the participant groups are presented as follows:

Physician Inclusion Criteria:

- Must be licensed medical doctors practicing in Canada.
- Must be actively practicing in one or more medical specialties.

Patient Inclusion Criteria:

- Must be adults aged 18 and above.
- Must have interacted with healthcare services within the past 12 months.

The exclusion criteria for both groups were the inability to read and write in English, as the study was conducted in English and access to a translator was not feasible.

3.1.1.1 Patients

Digital platforms were heavily utilized for patient recruitment. This included publication in the University of Waterloo Digital Newsletter targeting students, alumni, and staff members, engagement with healthcare and community-based Facebook groups in Canada and targeted advertisements. Flyers were also posted in various campus buildings with appropriate permissions, aiming to reach a broad array of students, faculty, and visitors. Additionally, a snowball sampling method was employed, leveraging personal and participant networks and physicians using AI scribe technology.

Interested and eligible participants were directed to contact the researcher or fill in a Microsoft Form to indicate interest or ask questions. I followed up with participants to address inquiries and provide an informational letter and the survey link. This process aimed to prevent duplicate responses and filter out bots. After completing the survey, participants could enter a separate form to enter a gift card draw and express interest in a follow-up interview. Figure 2 shows the patient recruitment and participation journey.

A total of 42 patients completed the survey, with a subset of 17 patients participating in a follow-up interview. One interview was excluded due to technical issues during the interview, reducing the number of interviews that inform the study to 16.

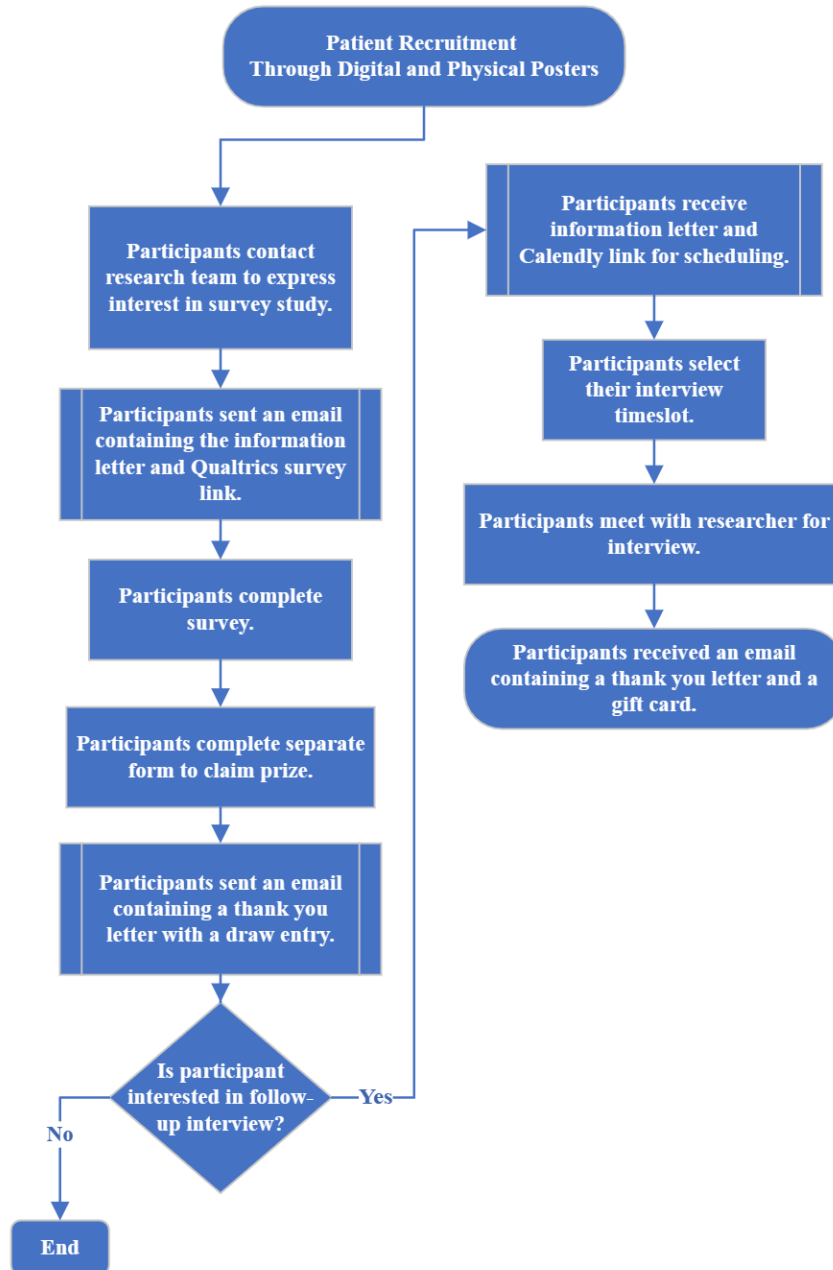


Figure 2: Patient Recruitment and Participation Journey

3.1.1.2 Physicians

Physician recruitment was conducted through professional networks of the research team and collaborators. Physicians were invited via email and encouraged to forward the invitation to their networks for a snowball sampling. This approach was crucial for accessing a typically challenging group to recruit. Although snowball sampling is criticized for limited generalizability due to shared experiences

or viewpoints between participants in the same network, the recruitment through different professional networks and the diversity within the population allowed for diverse perspectives in this case.

Physicians recruited through trusted networks received an informational letter and the survey link. After completing the survey, physicians could fill out a separate form to receive a gift card and indicate their interest in a follow-up interview. Figure 3 shows the physician recruitment and participation journey.

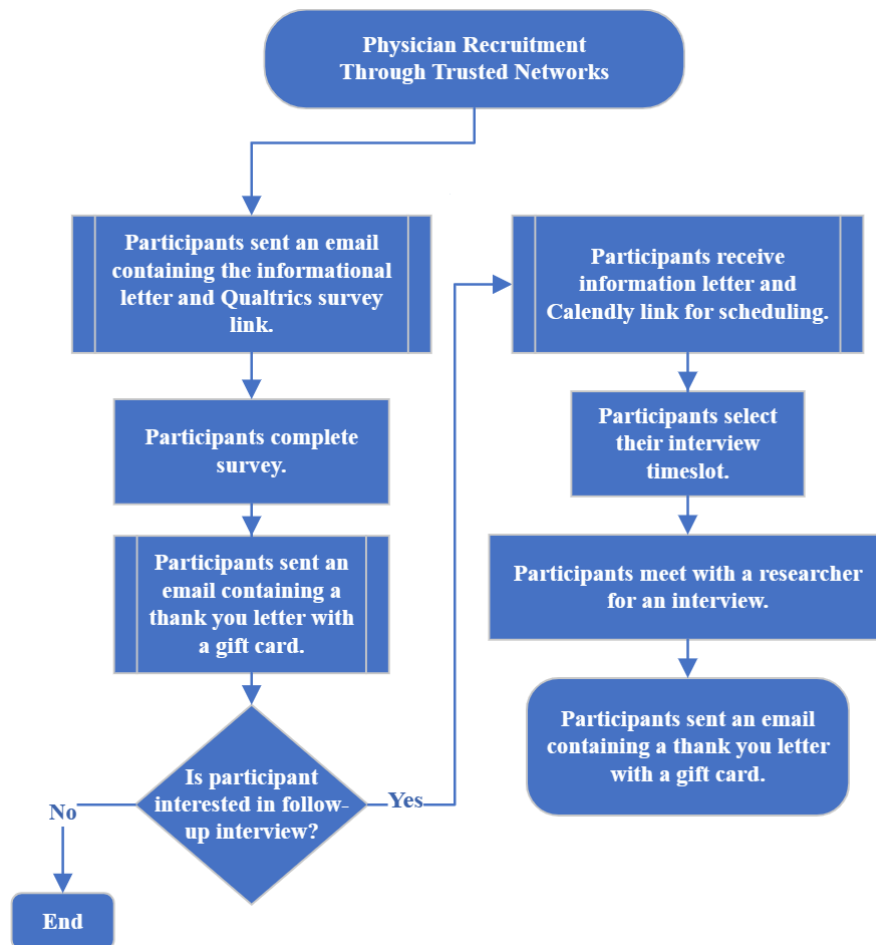


Figure 3: Physician Recruitment and Participation Journey

A total of 20 physicians completed the survey, with a subset of 9 physicians participating in a follow-up interview.

3.1.2 Data Collection Methodology

3.1.2.1 Survey

Surveys were employed for both groups to gather quantitative and qualitative insight from a diverse audience. Remote surveys are chosen because they are less demanding on users. They can be conducted on their own time and without the pressure of a researcher's oversight, allowing the attainment of a wider audience that may not be available for an interview due to time limitations or personal comfort.

The surveys for both groups were conducted anonymously in Qualtrics. The questions were designed to be as similar as possible for both groups to allow comparison in perspective but tailored to each group's level of understanding.

The survey design for the patient and physician population follows the format shown in Figure 4. In total there were two surveys: one for physicians and one for patients. Each survey contained separate questions for those that have used (or encountered) AI scribe and those who haven't when seeking information on experience/expectation and future uses. The separation was done after the introduction of the technology. The following subsections provide details on the surveys.

Note that all survey sections end with an open-ended question designed to get deeper insight into the values that influences participants responses. For the actual questions see Appendices A 7 and A 8.

3.1.2.1.1 Patient Survey Summary

1. **Introduction and consent:** The survey begins with an informational letter that outlines the study's objectives, followed by questions to confirm participants' understanding and agreement. This section ensures that all participants have a clear understanding of what the survey entails, when and how to withdraw, how the data is stored, processed and how long it's retained. Participants are also given consent options including opting-in for anonymous quote sharing.
2. **Demographics data (7 questions):** This section collects essential demographic information such as age, gender, education, cultural background, employment status, income, and geographic location. This data is crucial for ensuring the study gathers diverse perspectives across demographic groups.
3. **Ambient scribe technology description:** Before delving into questions about participants' perspective and experiences, they are introduced to ambient scribe technology with a textual description and video demonstration. The textual introduction covers the technology's functionality and processing. The demonstration shows the technology in action. The introduction

is aimed at ensuring all participants, regardless of prior exposure, understand what the technology is and how it functions.

Following the introduction participants are asked if they have any questions regarding the technology and whether they have encountered it in their medical visits before. The latter question enables which set of questions participants see in the next step.

4. Experience with (or expectations for) ambient scribe technology:

- **Scribe experienced patients:** This subgroup is queried about the frequency of their interaction with AI scribes, with options from '1 time only' to 'More than 5 times' and satisfaction on a scale of 1 to 10. A subsequent open-ended question prompts them to describe how the technology has affected their healthcare interactions, seeking personal stories or specific examples of its impact.
- **Scribe inexperienced patients:** Those who have not used the technology respond to a Likert scale question about their awareness of the technology and potential openness to future use. Subsequent open-ended questions prompt them to discuss their reasons for their level of interest and the specific information they would need if their healthcare provider adopted this technology.

5. Contextual usage scenarios (3 questions): Participants are asked to rate their comfort with using the technology in various medical contexts, such as routine check-ups, specialized consultations, and emergency interventions, using a Likert scale from 'Extremely Uncomfortable' to 'Extremely Comfortable'. Subsequent open-ended questions prompt them to elaborate on any scenarios where they might prefer not to use the technology and where they would find it particularly beneficial.

6. Privacy and trust concerns (3 questions): Participants are asked to rate their level of agreement with three statements about ambient scribe technology related to trust and privacy. The statements along with participants' response are provided in section 4.2.5. Subsequent open-ended questions prompt them to elaborate what influenced their response and the measure they think is necessary to address privacy concern if any.

7. Consent preferences and levels (14 questions)

- a. **Consent information preferences (6 questions):** Participants are inquired when and how they prefer to be informed about the use of the technology during medical consultations, choosing from multiple-choice options that specify different moments and methods for receiving this information. Participants are also asked who should make the decision about the use of AI scribe during medical consultations and how comfortable they feel to refuse consent. Subsequent open-ended questions seek information on what influenced their

response, what can be done to make them feel empowered to refuse consent in situations they don't comfortable, and other thoughts/concerns they have about the topic.

- b. **MTGIC and consent choices (8 questions):** Here participants are introduced to the MTGIC conceptual design and asked to select the consent option they feel comfortable using the MTGIC basic design. The goal of this segment is to gather nuanced views on how participants want their data handled and shared for AI scribe technology and potentially beyond.

After selecting their consent choices on the MTGIC model, participants complete a modified system usability scale (SUS) to evaluate the MTGIC model. Finally, this section inquires participants feedback on the model using open-ended questions.

8. **Final submission confirmation (4 questions):** Here participants are given the choice to submit the survey or withdraw with a set of steps confirming their choice and giving them the options to change their response before submission. This is especially important as the survey is anonymous, which means they can't withdraw after submission.

3.1.2.1.2 Physician Survey Summary

The physician survey parallels the patient one closely with minor differences to account for the difference in their role, knowledge on the technology and practice. The differences are discussed below.

1. **Introduction and consent:** This section is similar to patients with different wording as relevant.
2. **Demographics data (8 questions):** This section collects essential demographic information such as age range, medical specialty, practice duration, nature of medical practice, geographic location and familiarity with medical software.
3. **Ambient scribe technology description:** This section is similar to patients with different wording as relevant.
4. **Experience with (or expectations for) ambient scribe technology:** This section is slightly different from patients as the role of the two groups is different. As such, physicians are asked more detailed questions and questions on the patient's experience and expectations. This section enables to understand the current stage of the technology, experience, benefits, challenges/risk, and future direction.
 - **Early adopter physicians (6 Questions):** This subgroup is presented with the following questions:
 - AI scribe provider/s used
 - Frequency of use, with options from 'Daily' to 'Rarely'
 - Satisfaction on a scale of 1 to 10

- Open ended questions inquiring benefits and challenges experienced, how they communicate the technology to patients and questions/concern from patients if any.
- **Non-adopter physicians (5 Questions):** This subgroup is presented with the following questions:
 - Likert scale question about technology awareness and likelihood of adopting in the future
 - Open ended questions inquiring expectations on potential advantage, potential risk/challenge, how they will communicate the technology to their patient, what questions/concerns they expect from patients and what influences their future adoption.
- 5. **Contextual usage scenarios (4 questions):** This section is similar to patients with different wording as relevant.
- 6. **Privacy and trust concerns (3 questions):** Here physicians are asked if privacy concerns impact their willingness to adopt or continue to use the technology with a ‘yes’ or ‘no’ option. Subsequent open-ended questions prompt them to elaborate what influenced their response and the measures they think are necessary to address privacy concern if any.
- 7. **Consent preferences and levels (14 questions)**
 - a. **Consent information preferences (6 questions):** This section asks similar lines of questions for physicians as patients; however, they are tailored for their role. Below are the details. Physicians are inquired when and how they prefer patients be informed about the use of the technology during medical consultations. The difference is that physicians are choosing when information about and consent for the technology is provided to and sought from patients. This is because physicians along with their staff are responsible for administering consent, whereas they have the option to update their consent as they like. Similar to patients they are asked who should make the decision about the use of AI scribe during medical consultations and how comfortable they think patients feel to refuse consent. Subsequent open-ended questions seek information on what influenced their response, what can be done to make patients feel empowered to refuse consent in the situation they don’t comfortable, and other thoughts/concerns they have about the topic.
 - b. **MTGIC and consent choices (8 questions):** This section is similar to patients with different wording as relevant.
- 8. **Final submission confirmation (4 questions):** This section is similar to patients with different wording as relevant.

3.1.2.2 Semi-Structured Interviews

A follow-up interview was performed with a subset of participants to gain richer qualitative insights into their thought processes and values. The interviews were conducted through MS Teams and lasted 30 minutes on average. The interviews were one-to-one with an interviewer and a participant at a time. Participants were first asked for consent to the interview and recording with the option for manual note-taking. The consent form in Appendix A 11 provides the exact script read for the participants. The consent script was also provided in writing for self-reading. The informational letters in Appendices A 9 and A 10 provide the details on the purpose of the recording (i.e., for transcription), its handling, retention period and withdrawal process. The informational letter was sent along with the interview invitation and participants were given a chance to read it at the start of the interview or ask any question. The purpose of the recording, its handling, retention period and withdrawal was further discussed during the beginning of the interview to ensure participants were making an informed decision.

Pre-prepared questions (see Appendices A 12 and A 13) were used as a starting point for the interviews. The nature of the semi-structured interview allowed to modify the line of questions for each participant providing the benefit of structure, while enabling the participants' insight to lead with a seamless flow. This enabled to understand the values, experiences, and perspectives of the participants in depth. This nuanced approach was essential for the exploratory study.

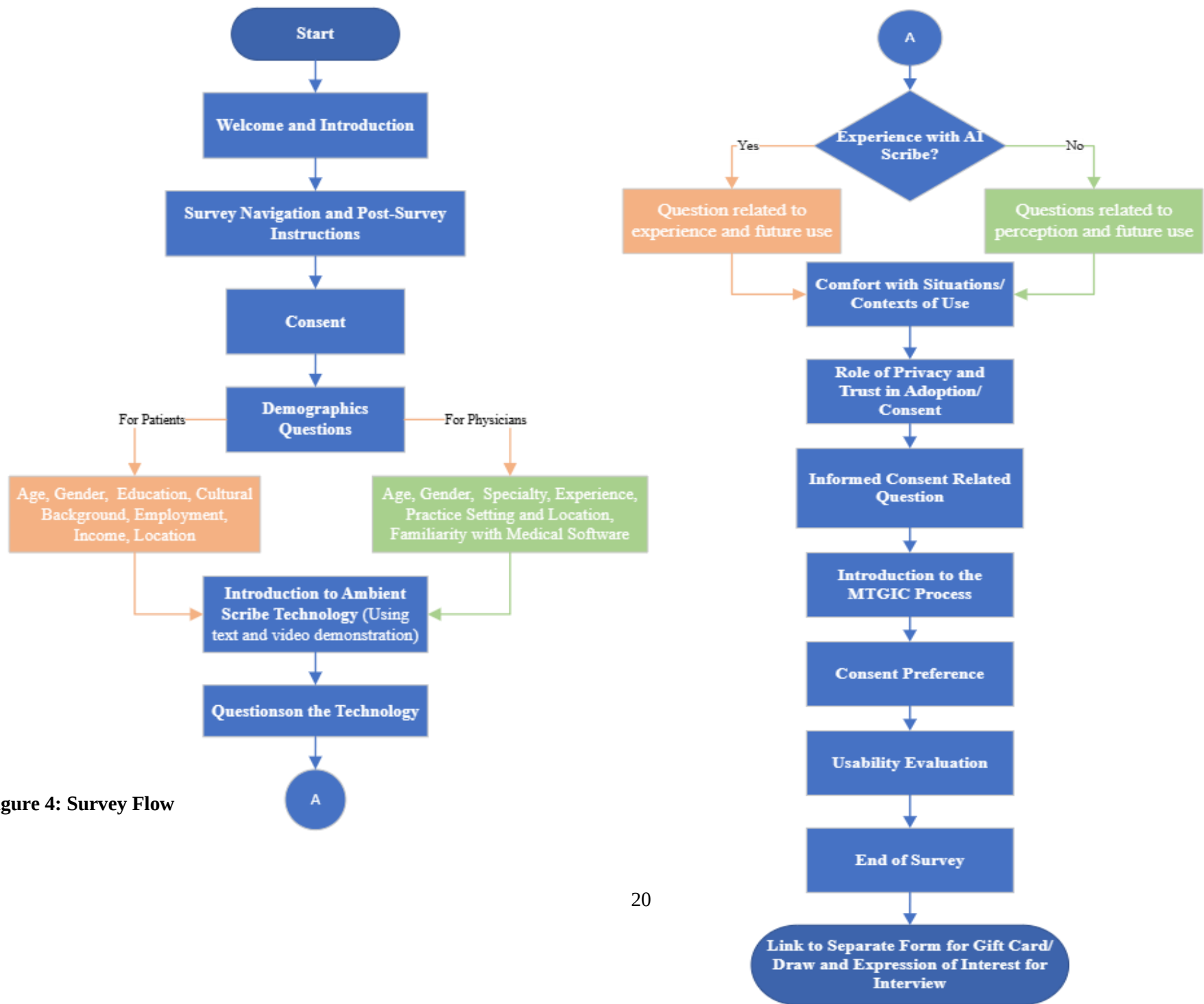


Figure 4: Survey Flow

3.2 Data Analysis Methodology

Data from surveys and semi-structured interviews were synthesized to provide a comprehensive picture of the current state of AI scribe technology in healthcare, highlighting physicians' and patients' experiences and perceptions. Quantitative survey data was analyzed using statistical measures of central tendency and mean difference as relevant in MS Excel. In contrast, the qualitative data from corresponding open-ended questions was analyzed thematically and correlated with the quantitative findings.

The interview data was transcribed and then analyzed thematically to further understand the underlying values of the user and corroborate with the survey findings. The transcription process involved the primary coder (the author, a graduate student) and a secondary coder (an undergraduate student), both trained in qualitative data analysis. The coders reviewed and modified the interview recordings and auto-generated transcripts from Microsoft Teams to ensure accuracy before analysis. Once transcribed, the data was anonymized randomly to prevent any sequence from providing clues to the participants' identities. Verbatim transcription was not used; instead, the transcription was edited to remove filler words, repetitions, and grammatical errors to aid in coding.

The qualitative data from the open-ended survey questions and the interview was analyzed using reflective inductive thematic analysis in a similar approach starting from the survey. Reflective inductive analysis [56], [57], [58] was chosen as it enabled themes to emerge from the data without the constraints of a pre-existing theoretical framework or preconceived assumptions. This was especially important given the study's exploratory nature. Furthermore, given the development of the conceptual MTGIC model relied on a literature review, it was essential to evaluate the assumptions based user data inductively.

The coders reviewed the data for familiarization and independently tagged a subset of the data with codes. They then shared the initial codes and reviewed them for alignment. This was followed by a discussion to generate initial themes through clustering of similar codes. The primary coder then completed the coding for the entire data set and organized it based on the initial themes.

The tools used for coding were NVIVO 14 and MS Word for the survey for the primary and secondary coders, respectively. The interview was coded entirely in MS Word using table for codes, themes and frequency, and headings and subheadings to organize the relevant quotes. The switch from NVIVO to MS Word was made for the interview as the latter was found to be efficient and effective for the task without an extensive demand for memory space, which was a considerable challenge when coding and analyzing the survey.

The initial themes were subsequently shared and discussed with the larger research team, consisting of an HF professor with extensive health technology experience and a physician, in addition to the two coders. The initial themes and codes were shared in the form of exported NVIVO files for the survey and MS word files for the interview. The discussion served to refine the initial themes ensuring they capture meaningful patterns in the data and are appropriately interpreted. The primary coder then further refined the themes based on the discussions, generating subthemes for clarity and focus as relevant to align them with the research question and develop the analytical story. The secondary coder then reviewed the updated clustering to ensure the themes and codes aligned with the consensus. The larger research team served as final reviewers ensuring consistency and meaningfulness and providing critical insights for unique codes and themes identified. The findings from the larger team served to revise the themes, subthemes and codes leading to the results discussed in Chapter 4 for objectives 1 and 2, and in section 5.6 for objective 3. Recommended future work as a result of unique themes that emerged or areas that require further exploration is discussed in section 6.1.

Chapter 4 Results and Discussions

The results and discussions are presented following the order of the research objectives, beginning with the integration of ambient scribe technology into physicians' workflows (section 4.3.1), followed by its impact on physician-patient interactions (sections 4.3.2 and 4.4.1), and concluding with the analysis of privacy, consent, and trust concerns (sections 4.3.3 and 4.4.2). These cover objectives 1 and 2 of the study. Wherever applicable, a comparison of patient and physician perspectives is provided. Objective 3 is discussed in Chapter 5.

The study population and demographic data applicable to the entire thesis is discussed in the subsequent section.

4.1 Study Population

4.1.1 Physicians

A total of 20 physicians completed the survey, and 9 of them participated in the follow-up interview. Among the survey participants, 7 (35%) have used or continue to use ambient scribe technology and will be referred to as early adopters. The remaining 13 (65%) were non-adopters. Among the interview participants, 5 (55.6%) were early adopters. The remaining 4 (44.4%) were non-adopters. The demographic data of the physician group that completed the survey and the subset that completed the interview are provided in Table 1 and Table 2 respectively. The demographic data demonstrates a good diversity with participants age (with a median of 30-39 and an average of 40-49), gender (55% M and 45% F) and practice setting (60% Urban and 40% Suburban, rural and remote). Some of the demographics, such as province and specialty, are heavily influenced by recruitment abilities, which may impact the generalizability of the finding; however, given the exploratory nature of the study, it is expected that the findings will largely be applicable with few nuances.

Table 1: Physician Survey - Participant Demographics

Characteristics		% (n)
Experience with AI Scribe		
	Early Adopters	35% (7)
	Non-Adopter	65% (13)
Age (years)		
	Under 30	Less than 5
	30 - 39	55% (11)
	40 - 49	25% (5)
	50 - 59	Less than 5
	60 and above	Less than 5
Gender		
	Male	55% (11)
	Female	45% (9)
Medical Specialty		
	Family Medicine	85% (17)
	Pediatrics	Less than 5
	Specialty Practice	Less than 5
Province		
	Manitoba	Less than 5
	Nunavut	Less than 5
	Ontario	85% (17)
	Quebec	Less than 5
Practice Setting		
	Urban	60% (12)
	Suburban	Less than 5
	Rural	25% (5)
	Remote	Less than 5

Figure 5 shows physician participants' self-reported familiarity with medical software tools in relation to their AI scribe use. As can be seen from the figure, while the result is slightly skewed towards a higher level of familiarity for early adopters, the mean difference is 0.66. This difference is not statistically

significant, as determined by Welch's t-test with a t-value of -0.83 and a p-value of 0.42. The mean familiarity for each group is 3.43 and 2.77 for early adopters and non-adopters, respectively, which rounds to 3 or very familiar for both.

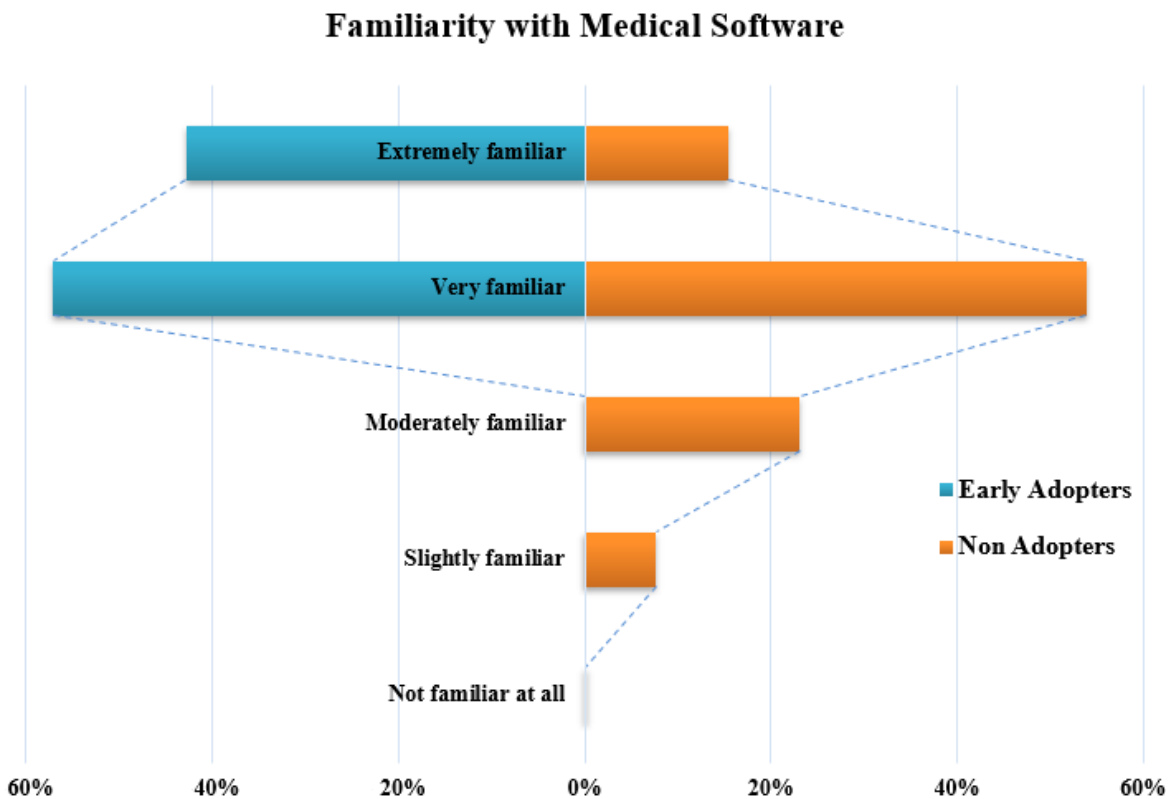


Figure 5: Physician self-rated Familiarity with Medical Software such as EMR/EHR

Table 2: Physician Interview - Participant Demographics

#	Identification	Medical Specialty	Province	Practice Type
1	D1_non-adopter	Family medicine	Ontario	Hospital, Clinic (Group)
2	D2_non-adopter	Family medicine	Ontario and Quebec	Clinic (Group)
3	D4_non-adopter	Family and emergency medicine	Nunavut, Ontario	Telemedicine, Clinic (Solo)
4	D9_non-adopter	Emergency medicine	Ontario	Hospital
5	D3_early adopter	Family medicine	Ontario	Hospital, Clinic (Group)
6	D5_early adopter	Family medicine	Ontario	Clinic (Group)
7	D6_early adopter	Pediatrics	Ontario	Community Hospital, Clinic (Group)
8	D7_early adopter	Family medicine	Ontario	Clinic (Group)
9	D8_early adopter	Family medicine	Ontario	Clinic (Group)

4.1.2 Patients

42 patients completed the survey, and 16 participated in the follow-up interview. Among the survey participants, 17 (40%) had interacted with an AI scribe at least once and hence will be referred to as scribe experienced. The remaining 25 (60%) were scribe inexperienced. Among the interview participants, 6 (37.5%) were scribe experienced. The remaining 10 (62.5%) were scribe inexperienced. The demographic data of the patient group that completed the survey and the subset that completed the interview are provided in Table 3 and Table 4 respectively. The demographic data demonstrates a good diversity in terms of participant gender (38% males, 55% female and 7% non-binary), cultural background (36% African, 17% South Asian, 14% Hispanic/Latinx, 14% European, 10% First Nations or Indigenous, among other groups), and household income (with a median of \$75,000 to \$99,999). Some of the demographics, such as age (with a median of 25-34 years old) and location (predominantly Ontario), are influenced by recruitment, which employed University of Waterloo campus posters and newspaper, and physician recruitment of patients that used AI scribe (see section 3.1.1.1 for detail). While the demographics may impact the generalizability of the finding, given the study's exploratory nature, the current demographics are expected to provide well-rounded data that should largely be applicable with few nuances.

Table 3: Patient Survey - Participant Demographics

Characteristics	% (n)
Experience with AI Scribe	
Scribe-experienced	40% (17)
Scribe-inexperienced	60% (25)
Age (years)	
18 - 24	24% (10)
25 - 34	45% (19)
35 - 44	14% (6)
45 - 54	Less than 5
55 - 64	Less than 5
65 - 74	Less than 5
Gender	
Male	38% (16)
Female	55% (13)
Non-Binary	7% (3)

Highest Level of Education	
High School	Less than 5
College Diploma	Less than 5
Bachelor's Degree	43% (18)
Post-graduate Diploma	Less than 5
Master's Degree	26% (11)
Doctorate (Ph.D.)	12% (5)
Cultural Background	
African	36% (15)
European	14% (6)
East Asian	Less than 5
Middle Eastern	Less than 5
South Asian	17% (7)
Southeast Asian	Less than 5
First Nations or Indigenous	Less than 5
Hispanic/Latinx	14% (6)

Others	Less than 5
Prefer not to answer	Less than 5
Employment Status	
Employed full time	36% (15)
Employed part time	14% (6)
Unemployed	Less than 5
Self-Employed	12% (5)
Retired	Less than 5
Student	29% (12)
Household Income	
Less than \$25,000	12% (5)
\$25,000 - \$49,999	14% (6)
\$50,000 - \$74,999	14% (6)
\$75,000 - \$99,999	36% (15)
\$100,000 - \$149,999	14% (6)
More than \$150,000	Less than 5
Prefer not to answer	Less than 5

Province	
Alberta	Less than 5
British Columbia	Less than 5
Manitoba	Less than 5
Ontario	69% (29)
Quebec	14% (6)

Table 4: Patient Interview - Participant Demographics

#	Identification	City	Province
1	P1_scribe-experienced	Toronto	Ontario
2	P2_scribe-experienced	Toronto	Ontario
3	P5_scribe-experienced	-	-
4	P6_scribe-experienced	Vancouver	British Columbia
5	P10_scribe-experienced	Kitchner	Ontario
6	P16_scribe-experienced	Montreal	Quebec
7	P3_scribe-inexperienced	Waterloo	Ontario
8	P4_scribe-inexperienced	Waterloo	Ontario
9	P7_scribe-inexperienced	Kitchener	Ontario
10	P8_scribe-inexperienced	Hamilton	Ontario
11	P9_scribe-inexperienced	Hamilton	Ontario
12	P11_scribe-inexperienced	Toronto	Ontario
13	P12_scribe-inexperienced	Kitchner	Ontario
14	P13_scribe-inexperienced	Drayton	Ontario
15	P14_scribe-inexperienced	Waterloo	Ontario
16	P15_scribe-inexperienced	Waterloo	Ontario

4.2 Quantitative Results

The subsections below summarize the results from the survey.

4.2.1 Experience and Perceptions of Early Adopters

Table 5 summarizes the experiences of early adopter physicians with AI scribe technologies. As seen from the table, the majority of early adopters used Tali AI (54%)⁵ followed by AutoScribe (43%)⁵, which are both Canadian companies. The choice of AI scribe providers is largely attributed to word-

of-mouth introduction. Another reason for the predominantly Canadian-based service provider usage might be the desire to utilize an in-country server. Although early adopters didn't directly cite their reason for adopting Canadian-based companies for server location, they expressed a need for the service provider server to be in Canada to comply with PIPEDA requirements.

Regarding usage frequency, 57% of early adopters reported using AI scribes daily. In contrast, one early adopter – representing 14% of early adopters reported using an AI scribe a few times before discontinuing its use. Additionally, 57% of early adopters expressed a positive experience with AI scribes, rating it 8 out of 10. The remaining rated their experiences 4, 5 and 6 out of 10. The average experience with AI scribes by early adopters was 6.7, corresponding to moderately positive. Section 4.3.1 discuss the interview findings on the integration of AI scribe into physicians' workflow, which corroborates the quantitative findings. See section for detailed insights.

Table 5: Experience of Early Adopters Physicians

Characteristics		% (n)
Scribe Provider Used⁵		
	AutoScribe	43% (3)
	Nabula	14% (1)
	Scribe Berry	14% (1)
	Tali AI	57% (4)
	Others	14% (1)
Frequency of Use		
	Daily	57% (4)
	Weekly	29% (2)
	Rarely	14% (1)
Experience with AI Scribe		(1 being very negative, and 10 being very positive)
	4	14.3% (1)
	5	14.3% (1)
	6	14.3% (1)
	8	57.1% (4)

⁵ Some physicians had used or use AI scribe from multiple providers as they are in exploratory phase. Hence the percentage not adding to 100%.

4.2.2 Expectations and Perceptions of Non-Adopters Physicians

Figure 6 shows the level of familiarity non-adopters had with AI scribe technology before the study. As shown in the figure, 23% were first introduced to the concept through the study, whereas 8% were very familiar with it. There wasn't a single non-adopter that expressed extreme familiarity with the concept before the interview. Despite this, an overwhelming 77% were at least slightly familiar with the concept, indicating the relevance and publicity of the tool. However, as discussed in section 3.1.1, the recruitment strategy of utilizing networks of physicians and snowballing might have impacted some of the findings.

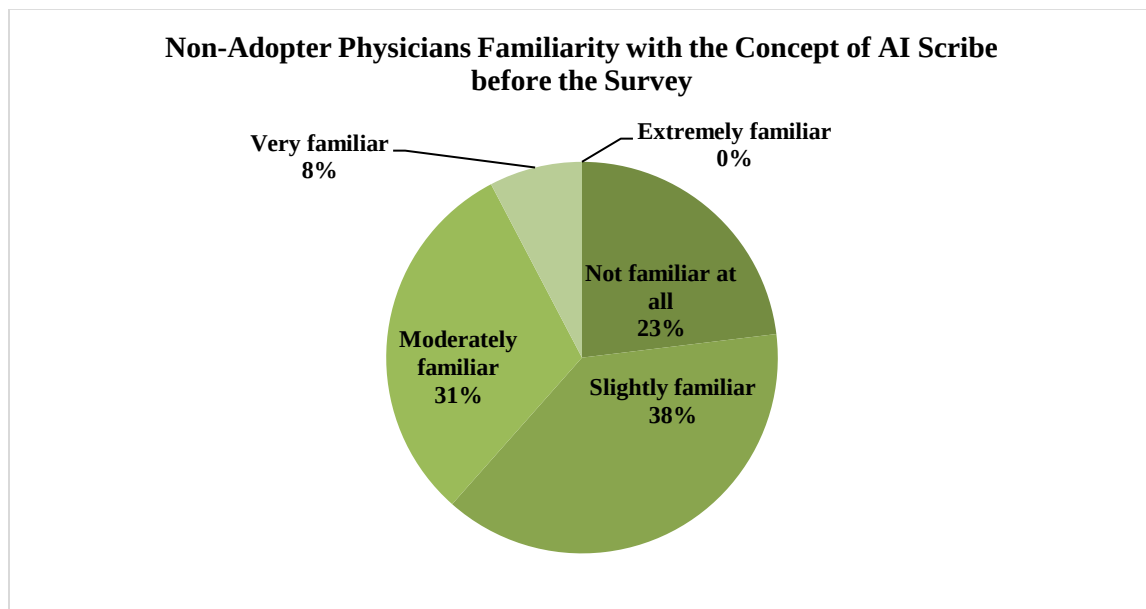


Figure 6: Non-Adopters Physicians Familiarity with the Concept of AI Scribe before the Survey

When asked about the likelihood of adopting an AI scribe in their practice within the next 12 months, non-adopters didn't have a consistent leaning. An equal number of non-adopters expressed that they were somewhat likely/unlikely to adopt it, whereas those who expressed an extreme likelihood of adopting it exceeded those who expressed an extreme unlikelihood of adopting it by a mere 5%. Figure 7 depicts this result.

Those who expressed a strong desire to adopt it were motivated by the promise of efficiency and improved interaction with patients, whereas those who expressed extreme unlikelihood expressed factors beyond their control, such as clinic administration decisions and approval/endorsement by the

province for use citing confidentiality implications. Those who were somewhat likely/unlikely to adopt it discussed benefits and risks, including reduced administration/paperwork burden, increased cost and concerns related to data privacy and confidentiality. Furthermore, 2 non-adopters - representing 15% of non-adopters and 10% of all physicians expressed skepticism regarding efficiency gain, citing they already have an efficient workflow and worried technological issues or the expectation of perfection slowing them down.

Section 4.3.1 discuss the interview findings on the integration of AI scribe into physicians' workflow, which corroborates the survey findings discussed here. The only finding from the survey that didn't come up in the interviews was the risk of the loss of intuition and gestalt. Below is the excerpt from a physician that expressed such concern.

I worry the efficiencies gained are lost with expectation of perfect documentation. The concern to me is trying to take away the art in medicine, the loss of intuition and gestalt in the fever pitch of AI technology and extreme accountability that would certainly be weaponized in medicolegal cases. [D20_non-adopter]

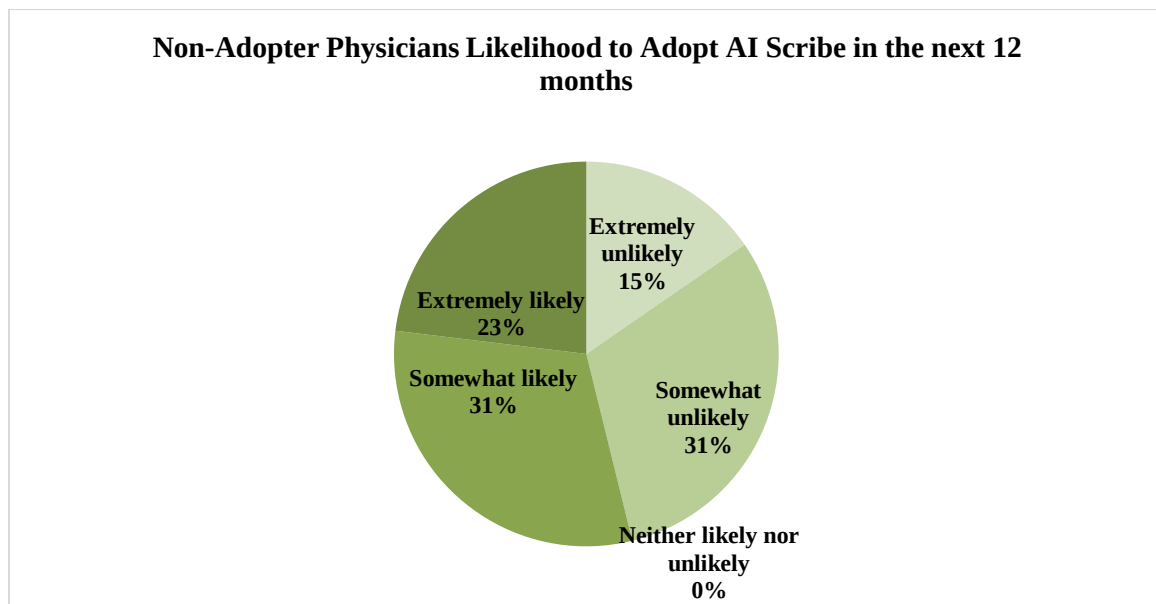


Figure 7: Non-Adopter Physicians Likelihood to Adopt AI Scribe in the next 12 months

4.2.3 Experience and Perceptions of AI Scribe-experienced Patients

Table 6 summarizes the experiences of AI scribe-experienced patients. As seen from the table, the majority of the scribe-experienced patients (82%) have encountered it more than once. The average experience by scribe-experienced patients was 7.5 out of 10, leaning toward very positive with a median and mode of 8.

Table 6: Experience Rating of Patients that have interacted with AI Scribe

Characteristics	% (n)
Frequency of Interaction	
1 time	18% (3)
1 to 5 time	53% (9)
More than 5 times	29% (5)
Experience with AI Scribe	(1 being very Negative, and 10 being very positive)
4	12% (2)
6	18% (3)
7	6% (1)
8	35% (6)
9	18% (3)
10	12% (2)
Average	7.5

Figure 8 shows scribe-experienced patients' specific opinions. Notably, 82% of scribe-experienced patients agreed that AI scribe use has positively enhanced their interaction with their physicians, whereas 18% were neutral about it. Similarly, 82% of scribe-experienced patients expressed willingness to use AI scribe in their future consultation. Indicating an overall positive experience. The remaining 18% didn't provide much insight into what influenced their decision in the survey. However, the interview results in section 4.4.1 shed light on patients' perspectives and insight, although it is impossible to map those opinions to individual survey responses.

When it came to full comfort with using AI scribes, scribe-experienced patients' opinions, with only 47% - almost half the number of those who said it improved their interaction with their physician and are happy to reuse it, expressing no concern. The remaining 53% were either neutral or expressed concern despite using it. The interview findings in section 4.4 shed light into the reasonings; see the section for detailed insights.

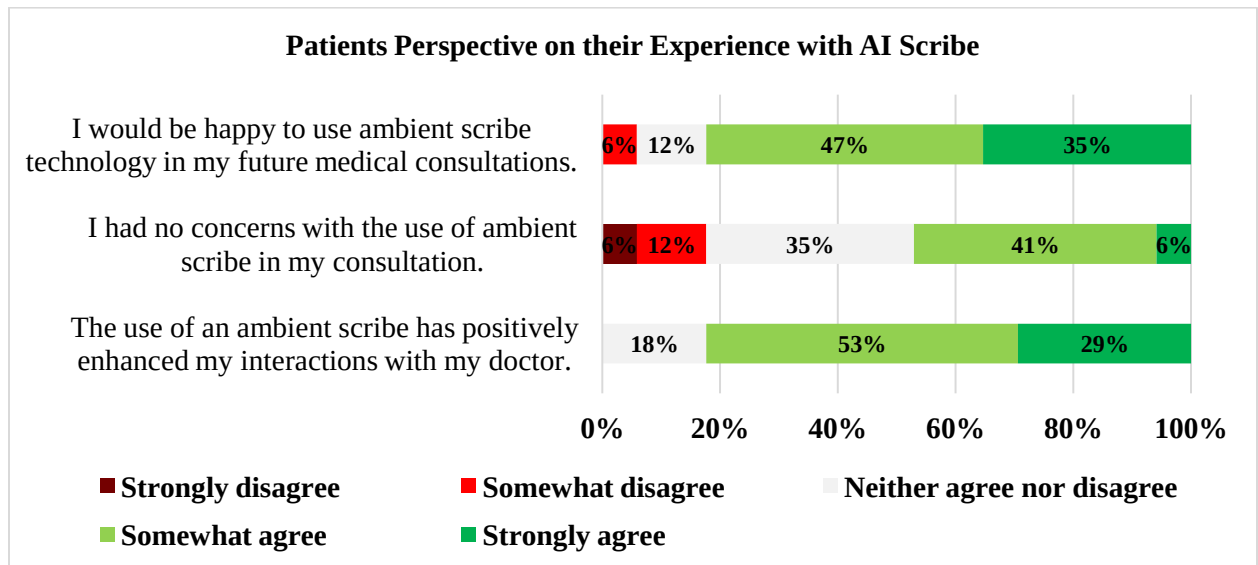


Figure 8: Perspectives of AI Experienced Patients

4.2.4 Expectations and Perceptions of AI Scribe-inexperienced Patients

Figure 9 shows the level of familiarity scribe-inexperienced patients had with the concept of AI scribe technology before the study. As shown in the figure, 52% were first introduced to the concept through the study, whereas 8% were very/extremely familiar with it. This contradicts the findings from physicians, where the majority were at least slightly familiar with the concept, which is expected as AI scribes directly impact the day-to-day function of physicians, whereas patients only experience it during healthcare visits. The patient numbers also confirm that adoption is at an early stage, and there has not been much discussion in the general public realm.

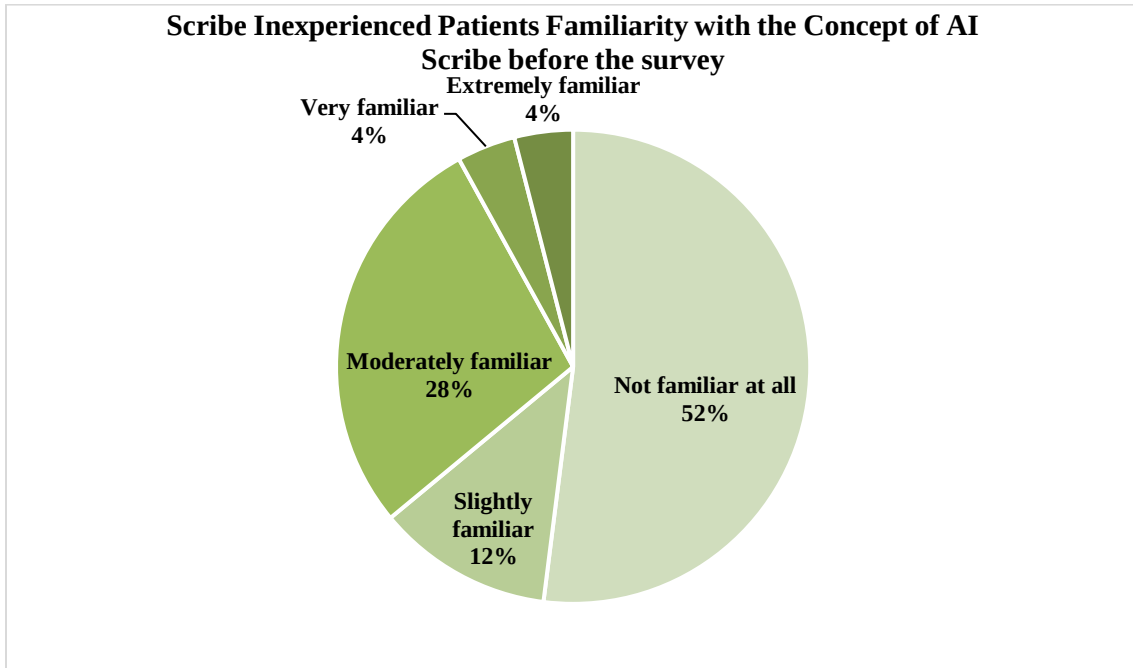


Figure 9: Scribe-inexperienced Patients' Familiarity with the Concept of AI Scribe before the survey

When asked about the likelihood of considering/consenting to the use of the technology during future consultation, scribe-inexperienced patients collectively leaned towards willingness, with 48% expressing positive likelihood and 28% expressing negative likelihood. A notable 24% of scribe-inexperienced individuals said they were neither likely nor unlikely. The interview findings in section 4.4 shed light into the reasonings; see the section for detailed insights.

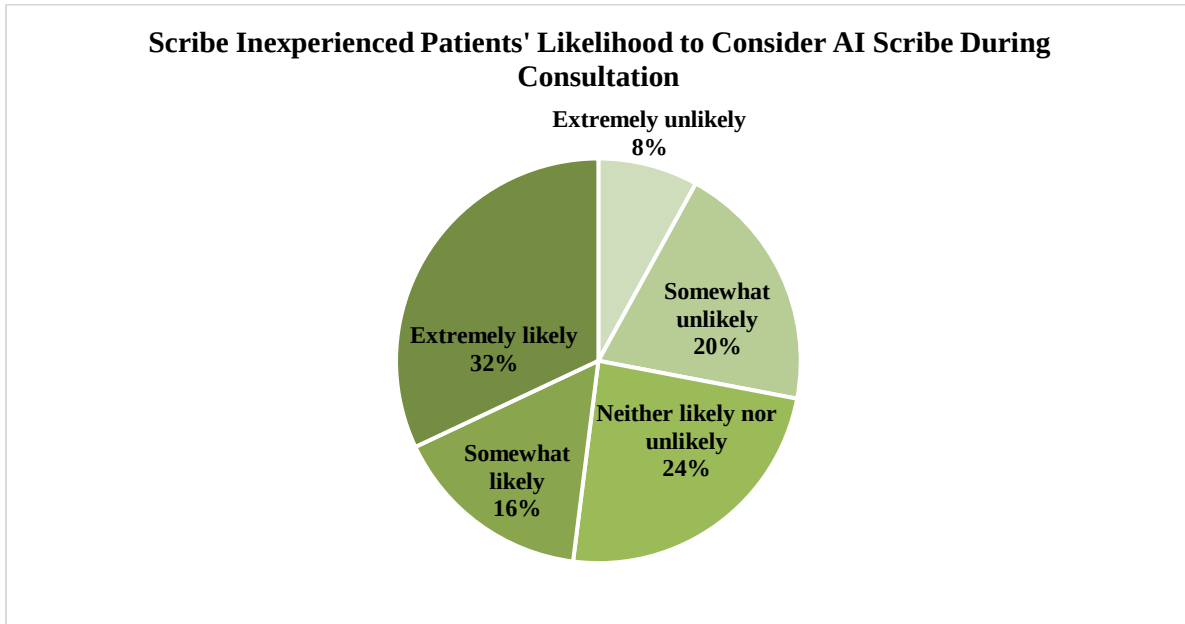


Figure 10: Scribe-inexperienced Patients' Likelihood to Consider AI Scribe During Consultation

4.2.5 Patients' and Physicians' Perspectives on Privacy and Trust in relation to Ambient Scribe Technology

Patients' self-reported privacy and trust regarding using ambient scribes is presented in Figure 11. As can be seen from the figure, nearly 47.6% expressed privacy concerns with the use of AI scribes. Furthermore, 54.8% indicated privacy concerns impact their willingness to consent. However, interestingly, 42.8% said they trust AI scribe providers will ensure the confidentiality of their private information, with 31% expressing neutrality on the level of trust they place in service providers. Looking at the raw data closely, 16.7% of the total respondents who had a neutral stance on trust in service providers' assurance of privacy still had concerns about the privacy of their information. In explaining what influenced their response, participants expressed concerns about unauthorized access, data breaches, lack of knowledge of data storage policies and access controls such as the security details and clearance of the service providers' employees, and the data's secondary use for profit. Below are some quotes from patients.

*"My information getting into the hands of wrong persons is something that worries me."
[P13_scribe-inexperienced]*

“I’m concerned about how this info is stored and who all can access it.” [P26_AI Scribe-inexperienced]

“I think that tech companies are inherently driven by profit, not patient care. Are software engineers seeing my data? What security clearance do they have?” [P33_AI Scribe-experienced]

“Especially with LLMs gaining popularity, I would be concerned with privacy issues.” [P31_AI Scribe-inexperienced]

On the other hand, 4.6% of the total respondents who had a neutral stance on level of trust in service providers' assurance of privacy expressed no to little concern for the privacy of their information. One such participant cited their reason for the trust rating to be related to accuracy.

“I guess my problem is not with privacy but accuracy.” [P28_AI Scribe-inexperienced]

Among those who somewhat or strongly agree that the service provider will ensure their privacy, the most common reason is good faith or understanding of the consequences of misuse by service providers.

“I'd believe the service care provider and my health care provider should be able to guarantee my privacy before using the tool.” [P14_AI Scribe-experienced]

“Service providers definitely understand the consequences of not being confidential, hence, I would trust them to an extent.” [P34_AI Scribe-inexperienced]

In contrast, those who somewhat or strongly disagreed that they trust service providers will ensure their privacy cited the following: 1) data breaches, 2) the risk does not outweigh the benefit, and 3) general distrust in for-profit companies.

“Data leaks all the time including for banking and things that rely on confidentiality like that married persons dating site Ashley Madison?” [P29_AI Scribe-inexperienced]

“I am very concerned about my medical privacy and do not believe that the benefits of the technology outweigh the risks of privacy violations, etc. I have zero to low trust in any for-profit healthcare adjacent company.” [P36_AI Scribe-inexperienced]

“Even if I'm told about the confidentiality clause, it's hard to trust completely.” [P25_AI Scribe-inexperienced]

Overall, with the 42 patients that completed the survey, there was a varied level of trust in service providers' assurance of patients' privacy and confidentiality, with the result leaning towards some level of trust in ambient service providers. Still, the trust didn't fully translate to patients not having privacy concerns, which differs from recent privacy and trust studies on ambient intelligent systems [32]. I hypothesize this could be due to:

- 1) The voice capture of the tool, which records casual and sensitive information. This is also supported by the study on the future of consent in AI [18], and
- 2) Technology's recency and rapid development, many patients are looking for further information and clarity regarding the technology's scope, controls and regulations.

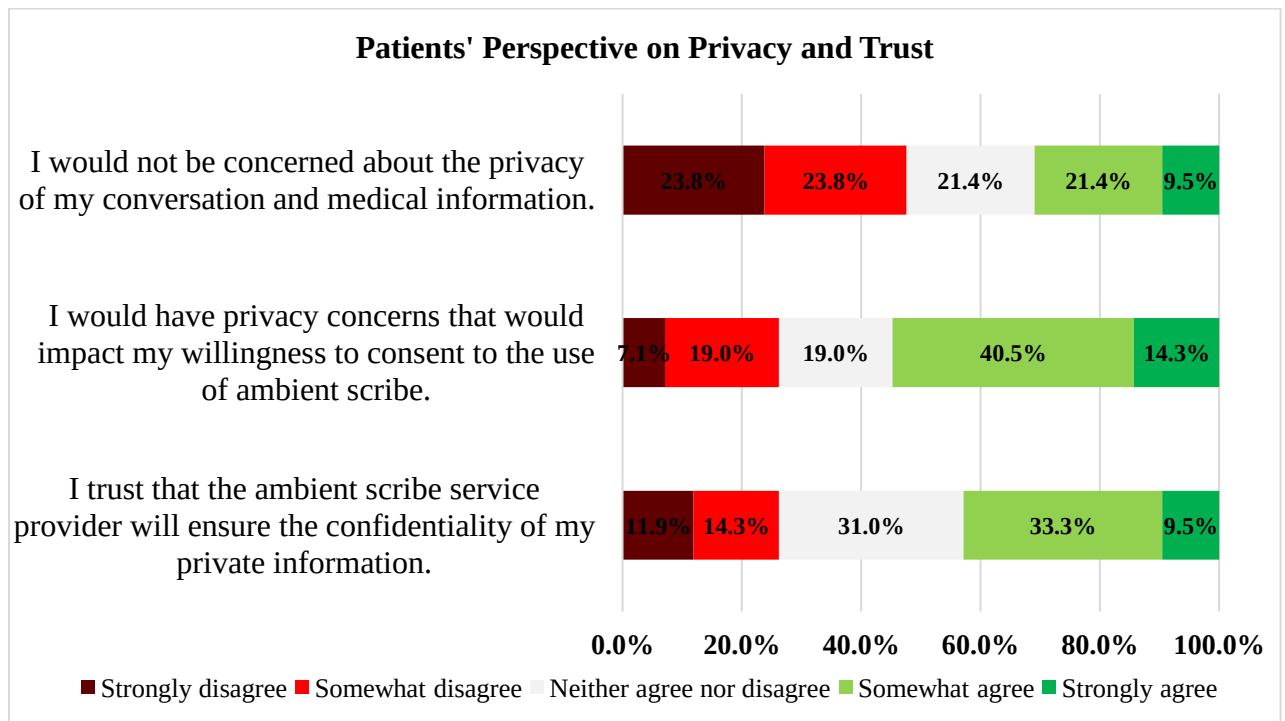


Figure 11: Patients' Perspective on Privacy and Trust

Privacy concerns also influenced physicians' willingness to adopt ambient scribes, with 65% (13 out of 20) saying that privacy concerns impact their willingness to adopt or continue to use ambient scribes. Figure 12 presents the breakdown of physician responses by early adopters and non-adopters, which shows a consensus between both groups.

Conversely, 35% of physicians reported that privacy concerns do not impact their decisions. A common reason cited by these physicians is the perceived similarity of the risks associated with AI scribes to those of EMRs. This group believed that any digital medical record system's existing cybersecurity risks are inherent. One such physician said: *"...the EMR itself is on a cloud service. So either way, there is susceptibility to cyber-attacks and the information being compromised as it is online."* [D16_Early Adopter]

Another physician highlighted the importance of geographical data storage, suggesting improvements: "... need servers in Canada to comply." [D15_Early Adopter]. This comment underscores the necessity for adherence to national data protection regulations. Furthermore, robust contractual safeguards to prevent data misuse were emphasized. One physician said: "Make it part of any agreement not to share info." [D1_Early Adopter].

Overall, the survey reveals a nuanced view among physicians regarding adopting ambient scribe technology, with a notable portion still apprehensive due to privacy concerns. Addressing these concerns with targeted measures could help increase acceptance and trust in this emerging technology.

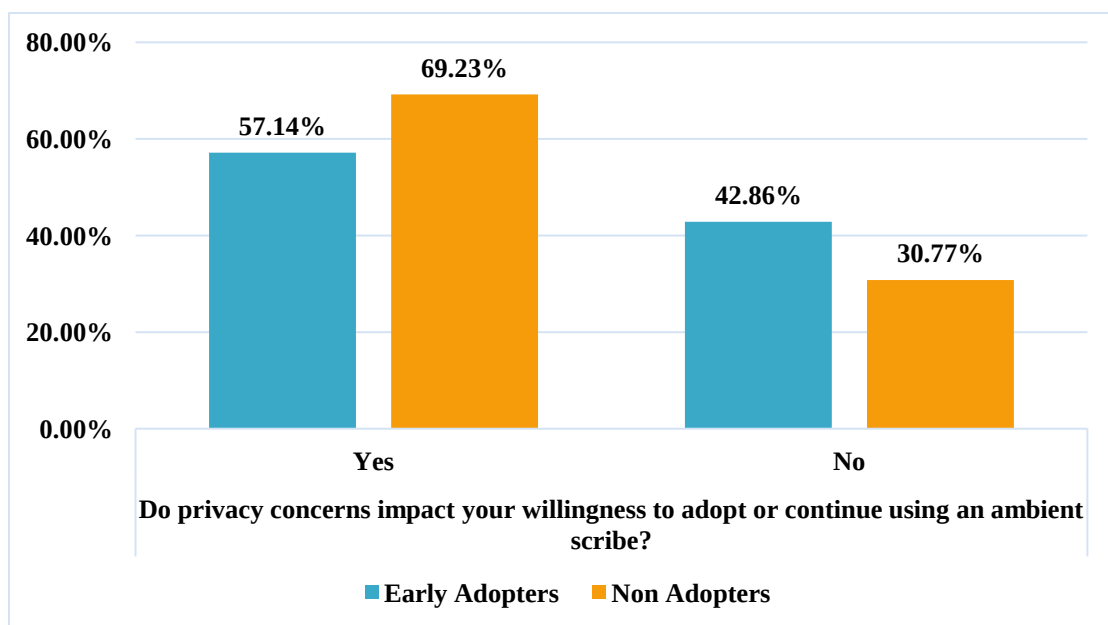


Figure 12: Impact of privacy concern on physician adoption of ambient scribe technology

4.3 Qualitative Results from Physician Interviews

4.3.1 Integration of AI Scribe into Physician Workflow

Interviews with physicians show that they employ varied strategies for documentation, ranging from mostly completing charting during patient encounters to not documenting during patient encounters at all. The strategies were based on habit, sensitivity to patient needs, particularly during emotional cases, or inability to document due to cognitive workload (e.g. complex encounters) or physical demand (e.g. physical examination) of the interaction. The time spent documenting also varied from

physician to physician; although there was no sufficient evidence for the reason based on the self-reported nature of the interview, it was evident that documentation time for all physicians was dependent on the nature of patient visit/concern with most common visits taking a few minutes to document and being mostly templated, while complex or multiple concern cases or mental health cases taking the longest to document.

The interview themes, subthemes, and codes related to the integration of AI scribes into physicians' workflow are summarized in Table 7. The subsections discuss the themes and provide relevant quotes.

Table 7: Themes and codes related to the integration of AI scribes into physician workflow

Main Theme	Subtheme	Codes
Efficiency	Negative experiences and critiques	• No net efficiency gain • Extensive editing time • Delay in note availability • Reluctance to workflow change • Incompatibility with physician style • Preference for existing system
	Positive Experiences/views	• Enhanced efficiency for complex and lengthy encounters • Reduced charting time • Decreased post-encounter charting
Workflow Changes		• Need for patient consent • Extended patient interaction • Increased documentation time during an encounter • Overall decrease in charting time
User Interface and Features		• Understanding of multi-party dynamic interactions • Delayed documentation capabilities
	Special considerations for hospital and emergency medicine	• Ability to manage multiple parallel patient encounters • Accessibility Across Varied Device

4.3.1.1 Efficiency

Seven out of nine (77.78%) physicians expressed positive thoughts/experiences with AI scribes. Two of the nine physicians, one from each group, expressed critical views/experience with AI scribes mainly related to their efficiency. The reluctance among the non-adopter physicians was comfort with the current system of documentation, skepticism about efficiency gain beyond current levels,

availability of the notes in real-time, and dislike to spelling out labs and prescriptions to be generated. There were also some reservations about the AI systems' ability to integrate with various software used, such as prescription modules and referral networks.

*Everybody does things differently. I have a lot of students and residents come through the clinic, and they type while they're talking to patients. I won't do that. **I prefer to talk to the patients, print out all the stuff they need like requisitions, and then type their note afterwards...**Actually, yesterday, I was in the clinic, and **I noted that every two patients I saw, I would type up their notes, and I was on track. I found that 2 patients and typing notes took about 20 to 25 minutes. So, it's about 2 to 3 minutes of typing per patient, and I see about 20 patients a day.***

*The prescription part is something I wouldn't want the AI to handle. **If I have to dictate to the AI what the prescription should say, I might as well type it. When I'm discussing with the patient, I'll decide on a medication, they agree, and then I create the dose. If the AI were to be involved, I'd have to spell out the dose and details, which would not save me time. Especially considering our prescription module is finicky and requires information in a specific order, otherwise, it doesn't recognize it.***

With labs, patients often request general lab work. I have my standard tests I order based on what medications they're on and their conditions. But it's not standard across the board; I tailor it to each individual. So, it wouldn't save me time on those tasks, just the actual typing of the note. [DI_non-adopter]

The early adopter who didn't have a positive experience shared a similar sentiment with the non-adopter regarding the AI scribe not surpassing their prior efficiency as it involved extensive post-editing and the scribe's inability to learn from the physician's preference.

It didn't improve my efficiency. I use templates in my EMR, which works well for me. The AI needed to surpass that efficiency. I found myself editing the notes extensively afterward, which negated any time savings. The note quality was awkward, often repetitively mentioning "the patient" in a way that didn't read like a good note. My practice focuses on consultation notes and follow-ups, which differ from the SOAP notes that many family physicians use. The AI's rigid structure didn't suit the dynamic of pediatric consultations, where multiple family members might speak, and the AI struggled to discern who said what.

*Especially, I guess one thing that I was surprised about when I started to look into it is that **it doesn't learn your preferences**. [D6_early adopter]*

Still, the early adopter was open to using an AI scribe if the concerns raised were addressed. The physician further expressed keenness in investing time to teach the model their preferences and build templates if it led to long-term efficiency.

*I would love something in the future that would learn your preferences because all of us chart differently and have different preferences for charting. Some people might not care that it says the patient said this, ... **I want my notes to seem like a human is typing it out.***

*And so, **if it could learn preferences, I would be happy to invest time into making customizable templates.** Even that or having a way to integrate our stamps and templates into the AI so that we can say this encounter is this type, like it's an ADHD follow-up, and these are the questions I always ask. [D6_early adopter]*

The remaining physicians mostly expressed a positive outlook/experience regarding AI scribes when it came to efficiency. Most found it extremely beneficial during complex and lengthy encounters, whereas they expressed that simple cases were better suited for manual documentation.

Below is an excerpt from a physician comparing the documentation time for simple (one issue, common) versus complex visits.

*I think I do a pretty good job of being able to interact with the patient, still have eye contact and still be charting. But **depending on the nature** of the problem, charting time varies. **If it's something like a respiratory tract infection, it might only take me 2 minutes to do the charting in the room [during patient encounter]** and a few minutes for the examination. Then, I tell the patient the treatment plan, and complete the charting may take only 2 to 3 minutes.*

*But if it involves **mental health issues, or multiple problems they discussed, or more complex problems** where I have to organize more tests or make a referral, that can take a significant amount of time. Let's say it's a 20-minute visit and there's a variety of different problems, I could spend about **75% of the appointment charting**, and that's not even the complete note. Then later I would*

*have to add to that note. ... If it's a **full day of work where I didn't get all the charting done**, I would probably **spend another one to two hours in the evening doing charting**. [D3_Early Adopter on charting without AI Scribe]*

Below are excerpts from physicians regarding when AI scribe is best suited.

I remember doing a more complex encounter and was pretty pleased with the kind of output and how it pulled apart some of the different issues or presenting concerns and was able to kind of weed through what was relevant and what wasn't from the discussion cause often with these longer encounters, it can be wide-ranging dialogue that doesn't always pertain directly to the clinical concern at hand. So, I found it to be quite interesting. So, it flipped.

So, I tend to rely on the scribe often in these longer, complex encounters when it is hard to capture everything or there are many things to keep in mind that I can't document as quickly, as opposed to maybe those really simple ones that are actually pretty straightforward and don't require a lot of support when we're doing our documentation. [D5_Early Adopter]

*To delineate the types of patients for the appropriate use of an ambient scribe, we interviewed the CEO of an ambient scribe service provider. It was found that **if the current documentation time is less than two minutes, then an ambient scribe is not ideal. The use of AI scribe is ideal in complex cases**. [D7_Early Adopter]*

4.3.1.2 Workflow Changes

Physicians reported three primary workflow changes that have emerged from AI scribe use. These include 1) the requirement for patient consent, 2) longer patient interaction, and 3) redistribution of documentation time.

The use of AI scribes by physicians introduces a third-party tool that has access to sensitive health information; as a result, patient consent is critical. Physicians recognize this and share introducing the tool at the onset and seeking patient consent.

*I usually say hi, and I'll say a few things here and there. Then, **I let them know I'm using this AI scribe product and I do very brief consent.** It's just a couple sentences and I think most people have been comfortable. I think I've had a couple that choose not to proceed with the scribe, and I think that's totally fine and so I don't push it any further. If they say, I'm not interested, then we move on.*
[D5_Early adopter]

Some early adopters also shared that the use of AI scribes typically results in longer patient interactions because of more in-depth communication and less distraction by documentation requirements. In addition, some physicians noted a redistribution in documentation time with longer charting than usual during the encounters and a notable reduction in charting time post-encounter.

*On a per patient basis, we noticed that there was a **slightly longer time spent per patient.** We analyzed the use of ambient scribes for 30 business days in my clinic. Typically, in half a day, I see about 12 to 15 patients, and I use the ambient scribe for 1 or 2 patients. We saw the minutes spent per patient **increase from 11 minutes to 14 minutes per patient,** when using an ambient scribe. This could be due to two reasons. Firstly, the scribe **doesn't transcribe the CT scans, or the lab requisitions** I require, so I'll need to go in and add those later. Whereas if I was typing the note out at the same time, I'd be **pulling in those requisitions and filling them out as I'm building the note.** Therefore, there's a **little bit of efficiency loss.** However, when using ambient scribes, **most of that information is documented during the patient visit** and not afterwards. As a result, we've **reduced 1100 minutes of after-hours work over a 15-business day period.***

*Overall, I'm **spending more time per patient** because I'm **more engaged and thorough** without getting distracted by the computer. However, the additional documentation time is **significantly decreased.** [D7_Early adopter]*

4.3.1.3 User Interface and Features

Physicians raised numerous features they would need for AI scribes to be compatible with their workflow. These were largely dependent on their practice type, setting, and demographics. Most notable were the understanding of multi-party dynamic interactions, delayed documentation capabilities, and special considerations for hospital and emergency medicine. The last one is discussed separately in section 4.3.1.3.1 due to the unique demands of the practice type.

Physicians working with demographics involving family members or translators highlighted the importance of AI scribes' understanding of the dynamic interactions and relationships within the room. They expressed a need for AI scribes to capture multiple voices with correct identification and account for social considerations, particularly in pediatric settings where family dynamics can significantly impact treatment plans.

*I think in our specific setting [paediatrics], **somehow understanding the relationship to the people in the room would be nice.** ... There are often multiple family members like parents or grandparents and a child and being able to capture that in the note is important. ... I'll just give you an example. **We'll see a child with parents who are separated, and, Mom will say, "Oh, at my house, this is what happens," and at Dad's house, "This is what happens."** And that's often really **important social considerations when we're coming up with a treatment plan for a child**, so being able to capture that would really be good. [D6_Early Adopter]*

A physician practicing telemedicine discussed the challenges faced with delayed documentation due to the necessity of entering notes after the nurse records the visit. They expressed a desire for interim storage, and a process of identification to update the records once registered in the EMR system.

When I'm doing telemedicine, I will often have an interaction over the phone and then do the documentation later and ... I can't enter a note until the nurse has recorded a visit. ... Some 12 hours later when the visits entered and then I can add a note. ...

So often I am doing documentation 12 hours later, if it recorded that at the time over the phone that would be great. [D4_Non adopter]

4.3.1.3.1 Special Considerations for Hospitals and Emergency Medicine

Given hospitals' unique practice settings and dynamics, AI scribes' fitness for the workflow depends on their adaptability. Physicians in emergency departments particularly expressed a need for an AI scribe capable of managing multiple encounters simultaneously as they move from patient to patient while their lab work or treatment is in progress. In this fast-paced environment, physicians chart while

conducting interviews and examinations, necessitating a technology interface that seamlessly accommodates multitasking and rapid transitions between patients.

*I usually manage 4 to 8 patients simultaneously [in the emergency department].
When I see a new patient, I enter their room, talk to them, and chart on the computer while interviewing them. After the initial talk, I perform a physical exam and return to my computer to input orders. While walking to see another patient, I continue charting and reviewing orders. Sometimes I fall behind on charting and need to pause seeing patients for about 15 minutes to catch up....*

*The workflow [in emergency department] is very dynamic. **The technology needs to be adept enough to handle the rapid and fragmented nature of ER visits.** The user interface should support **managing multiple encounters simultaneously, enabling seamless transitions between patients.** [D9_non-adopter]*

Moreover, physicians expressed that technology accessibility varied across different hospital settings, from the convenience of portable computers in urban environments to the challenges of limited broadband connectivity in rural areas. To address these discrepancies, AI scribes should be accessible across various devices, including laptops and smartphones, and capable of recording interactions for later transcription and summarization when broadband connectivity is available.

In urban settings, I use a laptop to chart while moving between rooms. In rural settings, the process is slower because I need to return to a desk to chart. Sometimes, due to emergencies, I move from one room to another without charting immediately. [D9_non-adopter]

4.3.2 Impact of AI Scribe on Physician-Patient Interactions

The interview's themes, subthemes, and codes that impact AI scribes on physician-patient interaction from physician perspective are summarized in Table 8. The subsections discuss the themes and provide relevant quotes.

Table 8: Themes and codes related to the impact of AI scribes on physician-patient interaction from physicians' perspective

Main Theme	Subtheme	Codes
Enhanced Interaction	Better Rapport and Patient Focus	• Increased face-to-face patient interactions • Improved eye contact and body language reading • Enhanced patient communication and engagement • Better understanding of patients
	Better Time and Workload Management	• More patient time, less documentation time • Reduced cognitive workload
Self-censorship/ Withholding of Information	Context/Situation dependent sensitivity	• Mental health • Embarrassing Situations • Legal Issues
	Information Sharing and Trust	• Open to disclose substance use, but desire to keep off record • Patient and physicians self-censoring (withholding information)

4.3.2.1 Enhanced Interaction

As 8 of the 9 (88.89%) physicians interviewed documented to an extent while seeing patients without AI scribe, the shift to not chart and interact with patients face to face and read their body language was regarded as highly favorable. Here is what some of the non-adopters had to say.

The utility of an AI there would be to focus more on the patient. We've been taught since medical school that we should face a patient and look at the patient while the patient is talking, but you can't do that if you're looking at a computer.
[D4_non-adopter]

It would enable me to spend less time in front of the computer, and more time face-to-face with my patients. [D9_non-adopter]

Early adopters shared the same sentiment but noted that they still would not be free from the computer as they needed to check previous visit notes, family history, lab results, medication doses, and the like. Still, they reported a lower cognitive workload when using AI scribe, which contributed positively to patient interaction. The ability to review the transcript as needed allowed them to manage stressful workdays better. Below are two excerpts from early adopters.

The scribe allows me some cognitive space to do some of that work and also engage probably more directly with the patient, whether that's eye contact or body language. But in many ways, I'm still attached to the screen and the computer ... I've to check their previous history, tests, medication doses as well as I speak to them. [D5_early adopter]

It's beneficial when I'm stressed out. ... It reduces my burden as a physician so that I can maintain an eye contact with my patient. It's very helpful, especially in capturing and storing detailed interactions with my patients... allows for better communication and understanding. [D8_early adopter]

4.3.2.2 Self-censorship and Withholding of Information

While physicians mostly expressed feeling comfortable with using AI scribes for most situations (see section 5.6.2), they shared that patients will likely not feel the same and may self-censor or withhold information that they find sensitive, embracing, or has legal ramifications. They expressed that these situations are sensitive even without an AI scribe and that introducing an AI scribe would heighten pre-existing discomfort.

Physicians shared the following about their experiences with patients regarding sensitive issues.

*There are **instances where patients are reluctant to disclose certain information.** For example, whenever there's a complain, patients don't want to tell a triage nurse what's going on, they would question everything going into the EMR and inquire about confidentiality. It's usually incidents involving foreign objects and private parts. **Even without AI, I have to remind patients that everything's confidential and that I'm a physician. I sometimes have to reassure them that I***

won't discuss their information with anyone else. It's just between the patient and me, and it's going directly into their chart. [D9_non-adopter]

Anything around the genitals that people come in for, they are generally squeamish about it.

I've had one guy... actually, multiple examples are coming up. So, if you're talking about gonorrhea, chlamydia, STIs, or things like that, people want to be reassured very firmly that this is not going any further than the note. So, if you start telling them that this is going to be sent to the cloud, ... and I don't know where it's going to go and who's going to have access to it, they're going to get a bit squeamish about that. [D4_non-adopter]

*I haven't done an extensive mental health visit yet, but I could see some patients who have a **mental health issue** being very sensitive about the information. They may have concerns that it's going somewhere else. For example, they might be worried that the **insurance company has access** to that information. [D3_early adopter]*

4.3.3 Privacy, Trust and Consent

Table 9 summarizes the themes, subthemes and codes emerging from physician interviews that relate to privacy, trust and consent in relation to AI scribe adoption. The subsections below discuss the themes and provide relevant quotes.

Table 9: Themes and codes related to privacy, trust and consent with AI scribe from physician interview

Main Theme	Subthemes	Codes
Data Handling and Storage Inquiries		• Data storage location and duration • Access permissions and controls • Data processing and transcription • Security measures • Secondary data use
Assurance of Ethical Data Use		• Industry standard security measures • Data Anonymization • Exclusively used for the primary purpose • Compliant to regulation • Ethical use
Privacy and Consent	Patient Demographics and Comfort with Technology	• Age • Tech savviness • Professional background • Comfort with tech use in sensitive areas
	Sensitive Visit Types	• Mental health visits • Sexual health visits • Legally sensitive issues • Situation with social stigma
Transparency and Trust	Transparency and Communication	• Communicating function and benefits • Transparency in data handling and storage • Assurance of ethical use
	Patient-physician relationship and trust	• Pre-established relationship • Trust

4.3.3.1 Data Handling and Storage Inquiries

Physicians expressed a need to know and understand service providers' data handling and storage policies to make informed decisions and address patient queries.

Some physicians shared that data handling and storage policies were among the factors they reviewed and compared to decide which service providers to use. Here is what one physician had to say.

*Before using the product, understanding the **privacy and security features are always important**. You want to know; **how long data is retained/stored, who has access to the data and how it's processed and transcribed**. [D5_early adopter]*

Physicians also discussed that information related to data handling and storage, such as where the data is going, whether it's stored, the storage duration, access permissions and controls, storage/access security and other uses, are among the information patients want to know. Below are two excerpts from early adopters on their experience with patient queries on data storage and handling by service providers.

*There are two main questions people have: **where the data is being stored and is there anything else using my data**. [D7_early adopter]*

*I've had **one person ask where the information is going**. ... I think the **main concern that a patient have is not knowing where the information is going, if it's being stored somewhere and who has access to it**. [D3_early adopter]*

4.3.3.2 Assurance of Ethical Data Use

Among the main requirements of physicians is assurance that the data encountered by the scribe is collected, processed, stored and utilized ethically with complete transparency. Beyond security risks, there are uncertainties and a lack of information surrounding secondary data use and processing. All the physicians interviewed expressed that if industry-standard security measures are employed to protect data, data is anonymized during processing, is used only for generating notes from the encounter, and is compliant with applicable regulations, they would have no issues using the tool. However, differences arise when data is used for secondary uses (see section 5.6.1 for details).

Below is a comprehensive excerpt from one physician interview that shows the nuanced considerations physicians evaluate.

*I suspect the major issue is if that data is used in some identifiable way, after the encounter. Health information is private and guarded closely. If you're **in a closed***

*room and the software is on the computer in the room with you, and the **software codes up the encounter into text and then drops all that data, then there is absolutely no concern.***

*The next level would be if you're sending that data over. So, say the software isn't on the computer itself but is remote, and the data has to be sent to that server to be interpreted. That's the next level of concern, and that **can be remedied with good technological solutions like HTTPS, SSL, and secure encryption, and anonymizing the data before transmission.** Some identifiable information may remain say a patient mentioned their spouses name, but it is minimized. The level after is if the data remains on that server. Well, **that's hackable. You don't want to keep it around too long.***

*The **next level of privacy concerns** would be if the **service provider is doing something with that data. Are they using the data to train other AIs?** In that case, patient might have some interest in that. Now, **their health information is helping a private company, and they should benefit from that—** or at least I think they should. It's like you know how mid-journey and similar AI tools not only train from the works of old masters but also modern artists. These people are still living. So, **they have some financial interest in this. So, does the patient actually stand to benefit? Should the patient be paid to provide his data to the service?***

The next level is, what if those data are being sold? So, I write an email about buying a kitchen stove, for example, and now I have started getting advertisements from different companies for the kitchen stoves. [The service provider] made a profit from that. And if this company is trying to make some money from this, do I say I have back pain, and then all of a sudden, I'm getting advertisements for physiotherapy products?

*There's a moral aspect to it, and I outlined a spectrum of concerns, **but I think depending on how it's used, I could have absolutely no concerns about this whatsoever.** [D4_Non adopter]*

4.3.3.3 Privacy and Consent

Consent is a pivotal theme linked to privacy. Analysis from both surveys and interviews indicates that the majority of physicians (refer to detailed quantitative results in section 5.6.2) believe that patients' consent to use AI scribes largely depends on the nature of their visit. Visits involving sensitive information typically heighten privacy concerns, prompting more cautious consent considerations.

Conversely, approximately 22% of physicians (2 out of 9 interviewed) reported that consent is less influenced by the visit type and more by patient demographics and individual comfort with technology. For instance, one pediatrician noted an acceptance of AI tools among younger, tech-savvy parents in their practice, suggesting minimal resistance to adopting AI scribes due to demographic factors.

I live in a place where many people work in IT and tech, and many people who have kids tend to be younger and more technology focused. So, I would not anticipate any challenges in introducing AI in our practice. [D6_early adopter]

Another physician highlighted variability in consent that did not correlate directly with the sensitivity of the medical issue. The physician explained that the response was mixed. Some patients have declined the use of AI for routine encounters while others readily accepted it for more sensitive discussions. This suggests that personal comfort with technology may play a significant role.

I don't know if I have deep insight into why they've opted not to use it. They weren't necessarily sensitive encounters like mental health. People have been fine with using the scribe technology for encounters that could be thought of as particularly sensitive.

So, it doesn't always seem to be based on that, and my sense is that personal comfort level or some level of trust with the technology. [D5_early adopter]

Those who said consent depended on the nature of the visit expressed various reasons patients might not consent to use AI scribes, among which the majority are the perceived sensitivity of the information shared. Information perceived as sensitive included visits related to mental health, sexual health, legal implications, embarrassing situations, and those that impacted others, such as family members.

Physicians further discussed that such situations are delicate even without the involvement of AI scribes. They expressed that even without a scribe, they often face reluctance from patients in such situations and need to reassure them that it's a safe and confidential environment.

From my experience with patients, if it's a legally sensitive situation, like, for example, I have patients who have been raped. I'm not sure if they'd want that recorded. Then there are sensitive issues like problems with private parts. I have female patients who are uncomfortable discussing these issues with me, let alone having them recorded. [D1_non adopter]

I had one guy once who was doing steroids. He was injecting steroids into his thigh, and he got an infection with the injection. He said don't put this in the note. And I said I must write something and then he got so squeamish about that he just left. He just he didn't want any documentation at all. This is a guy who wants healthcare but doesn't want documentation of that healthcare at all. [D4_non adopter]

*Patients might be hesitant **on abuse or embarrassing situations**. They might not want it transcribed. I'd inform them that the information would be documented in their medical chart regardless and assure them of its confidentiality.*

***Even without AI, I have to remind patients that everything's confidential and that I'm a physician.** I sometimes have to reassure them that I won't discuss their information with anyone else. It's just between the patient and me, and it's going directly into their chart. [D9_non adopter]*

4.3.3.4 Transparency and Trust

Physicians expressed that transparency and communication were key elements to obtaining patient consent. They expressed that communicating the function of AI scribes and data processing and storage process helped introduce the technology and eased patients' concerns, ultimately leading to positive reception and comfort. Physicians discussed the key points to introducing the technology are its benefits, and its data handling policy. In terms of benefits, physicians discussed the tools' role in aiding them with notetaking and reducing their workload, freeing them for focused interaction and speeding the process. With regards to data handling, physicians discussed what patients are looking for, such as where their data is stored and how it is used, particularly looking for assurance that it is securely and ethically managed.

There are two main questions people have: where is the data being stored and is there anything else using my data.

For data storage, I inform them that the data is being transmitted to an external server that's run by the company that I got the subscription from. ... In terms of what else their data is used for, I inform them it may be used for quality control, which involves using that information to improve the AI model over time, making my life a lot easier.

By putting it in that context and saying that it makes my life easier, patients seem more willing to agree, since they're sympathetic towards physician burnout.
[D7_early adopter]

I think it depends on how you present it to the patient, and how much trust they have in you. I informed them that this is a tool that's going to help me and save a lot of time. I explain that I won't have to type while I'm talking to them and have an eye contact and they really like that idea.

I think there's a lot of trust that I'm using the technology ethically and responsibly.
[D3_Early Adopter]

In addition to transparency in communication, physicians discussed the role of prior relationships in the acceptance of AI scribes. Physicians discussed that introducing the technology to their ongoing patients is easier since they have an established relationship and trust built over time.

I think what also helps is, I think many of these patients know me fairly well and so I think there's some general trust that I'm not introducing some nefarious technology into the relationship.

I generally know my patient very well, they're kind of ongoing patients, so I'm not doing walking in or new patient intakes at the moment. [D5_early adopter]

The role of pre-established trust between patient and physician in patients' acceptance of AI scribe was also echoed by patients, who expressed feeling comfortable with consenting to physicians they had seen routinely, whereas they felt uneasy with first-time visits. See detail section 5.6.2.

4.4 Qualitative Results from Patient Interviews

4.4.1 Impact of AI Scribe on Physician-Patient Interactions

Table 10 summarizes the themes, subthemes and codes emerging from patient interviews related to the impact of AI scribes on physician-patient interaction from patient perspective. The subsections below discuss the themes and provide relevant quotes.

Table 10: Themes and codes related to the impact of AI scribes on physician-patient interaction from patients' perspective

Main Theme	Subtheme	Codes
Efficiency		• Quicker Consultation • Reduced wait-time • Less repetition
Communication	Enhanced Interaction	• More Focused interaction • Improved eye contact
	Increased Cognitive Workload	• Feel the need to speak eloquently • Expect the need for specificity in my concern • Concern about accent recognition
	Self-censorship/ Withholding of Information	• Patient conscious and cautious of disclosed information • Discomfort in discussing issues related to a legal nature
Wary of Negative Impact on Physicians	Loss of vigilance and Complacency	• Physicians zoning out or being less attentive • Physicians over-reliance on scribes
	Self-censorship/ Withholding of Information	• Reduced openness and honesty by physicians • Medicolegal concerns

4.4.1.1 Efficiency

All patients who have encountered AI scribes and the majority of those who hadn't shared that they experienced or expected efficiency gain in the form of quicker consultation, reduced wait time, and

less repetition as a result of AI scribe use. Early adopters particularly mentioned that they noticed the consultation was faster as physicians didn't take notes while speaking to them. This also meant they were not asking them to repeat what they said earlier, as their cognitive attention was not divided. Here is what they had to say.

*During the interview, I found out that the consultation was **a lot faster than expected**. He asked me questions straight to the point and he didn't stop to jot down notes. It was **more interactive, like the communication was smooth**. He **did not take his eyes off me and listened to every word I said**. The interview was brief and fast-paced. It really **saved a lot of time, and we had a better interaction**.*
[P10_scribe-experienced]

*Yes, it was different because usually, **when talking to a doctor, they ask me to repeat it again**. With scribes, the **process was faster**, and my **doctor wasn't regularly taking notes**, he was just listening to me all the while technology was capturing what I said and then afterwards, he went through the technology and everything that I said the AI listed out the important parts in a separate tab.*

***There was more focus on me**, and it made things it made it made it made the process faster.* [P2_scribe-experienced]

4.4.1.2 Communication

Patients raised numerous subthemes related to communication that highlight positive and negative aspects. The most prominent positive aspect raised was the enhancement of patient-physician interaction due to reduced workload for physicians, which enabled more focus on patients and improved eye contact. Below is an excerpt from a patient with scribe experience.

I like having a face-to-face conversation, not that I'm just talking, and they are just on their book, or the computer fixated on it.

I feel like it strengthens physician relations because you're able to maintain eye contact with me while I'm explaining. So, I think I prefer using a scribe.
[P1_Scribe-experienced]

Patients who have not used AI scribes expressed similar sentiments, demonstrating the communication tax felt by patients with the current EMR documentation. Patients who have not experienced AI scribes also looked forward to physicians being able to speak to them without the distraction of notetaking.

It will be more personal and intimate because the physician can have a conversation with me. [P12_scribe-inexperienced]

On the less desirable side, both experienced and inexperienced patients expressed concerns due to the voice-recording nature of scribes. Patients expressed the pressure to speak eloquently, professionally, and in specifics, given they are being recorded, which can contribute to increased cognitive workload in choosing, constructing, and polishing their sentences before speaking. This can be especially taxing for those in pain and may result in the reduction of the patient-physician relationship to transactional, making the relationship impersonal. Below are some excerpts from patients that expand on this.

*I would think I would be a lot less colloquial, avoid **funny** expressions and stuff like that, like how I communicate in more like **professional meetings**.*

... if I was deadly sick, like I feel awful, I might change my words a bit to be more conducive to being recorded and more self-aware, so that might get the point across a bit less.

*I might try and enunciate a bit more as well, cause when you talk to Siri, you have to kind of be very clear and less colloquial for it to understand you.
[P11_scribe-inexperienced]*

Aside from the pressure to speak professionally, scribe-inexperienced patients with accents expressed concern about the AI scribes' ability to recognize their accents. Hence, they shared that they would choose their words and speak slowly in hopes that it would help.

Any interaction that I have had with voice-related tools, they have trouble grabbing my accent. I feel that a person is still able to understand me. But if I'm going to an automated drive through, or if I do any sort of voice access codes,

then I speak much more slowly and clearly than I would in regular conversation, to ensure that they're picking up the exact thing that I'm saying. In a doctor setting where we have a limited time frame to connect with the physician, if I am having to focus a lot on what I'm saying and how I'm saying, then that would make me a little uncomfortable because I would be thinking that this technology might not be able to grab my accent. [P15_scribe-inexperienced]

The same sentiment was shared by scribe-experienced patients, who shared they were concerned about accent recognition during their first encounter. Physicians assured them it would be fine and showed them the transcript, which helped ease their concern.

The first time I was skeptical about the tool getting my accent. So, once that was ruled out, I was there to complain about something, so I just went straight to the point and was done with it. [P1_scribe-inexperienced]

Another concern shared by patients with/without AI scribe experience was withholding information as a precaution to privacy risk or disclosure and overall discomfort or feeling of unease. Patients with experience with AI scribes mentioned that they left out information they didn't want to be recorded, potentially affecting the quality of information physicians get to provide care.

I think there might be specific information that and I want to leave out, like information concerning my personal life, or any information I would not want recorded. Everything else should be the same. [P10_scribe-experienced]

While most AI scribe-experienced patients shared that they fully self-censored information, one patient discussed withholding sensitive information during AI scribe use and sharing it with the physician once the recording stopped.

I was cautious about sharing sensitive information, like sexual practices or details about family interactions, while being recorded. My concerns were more about confidentiality than privacy and security. I would not want the doctor replaying what I said about my sexual life and how I interacted with my wife and family.

*There were **details I wasn't comfortable disclosing with the recording device on, those of a sexual nature.** I discussed those details with him after the recording stopped. [P16_scribe-experienced]*

4.4.1.3 Wary of Negative Impact on Physicians

Patients also expressed concerns about how scribe usage may affect physicians and its potential impact on them. Among the concerns was physician complacency or loss of vigilance due to over-reliance on AI scribes to document. While this concern was raised by 2 out of 10 (20%) of scribe-inexperienced patients interviewed, it was not reported by scribe-experienced patients in this study. However, literature on AI scribe challenges and technology reliance over the long-term point to complacency and loss of skill as an issue [59]. A study that explored the hypothetical implementation of AI scribes found that physicians were wary about the ability to structure their thought processes and impact their critical thinking due to automation [60].

I'll always be concerned that the physician is not 100% present because the interaction is being recorded. [P12_scribe-inexperienced]

Patients also expressed concern about physician openness and honesty with AI scribe present due to medicolegal issues. Patients expressed that physicians might be too concerned about the legal implications of their diagnosis and recommendation to cover their basis.

*I do worry that when we have aids like that, the **participation of the human is lessened.***

*I worry that my **doctor would listen less** because they know that it's being recorded. Or even that they will **respond to me differently** because they know they're being recorded. As a result, it might be **less honest and direct** between me and a physician because there's going to be more legal troubles if every conversation you have with your doctor is recorded. So maybe they **wouldn't give me their best advice**, they would give me advice that they feel is most appropriate, in case a third party heard it. [P14_scribe-inexperienced]*

4.4.2 Privacy, Trust and Consent

Table 11 summarizes the themes, subthemes, and codes emerging from the patient interview related to privacy, trust, and consent in relation to AI scribe adoption. The subsections below discuss the themes and provide relevant quotes. The codes related to privacy, consent, and trust from the patient interview significantly overlap the ones from physicians, demonstrating the shared understanding and challenges in the area.

Table 11: Themes and codes related to privacy, trust and consent with AI scribe from patient interview

Main Theme	Codes
Data privacy and security	• Data storage location and duration • Access permissions and controls • Data processing and transcription • Security measures • Secondary data use • Data Anonymization
Privacy and Consent	• Perceptions of data privacy and security • Reason for visit
Consent and Utility	• Accuracy and reliability of tool • Ease of access to notes
Trust and Consent	• Patient-physician relationship and trust • Pre-established relationship

4.4.2.1 Data Privacy and Security

A recurring theme across both AI scribe-experienced and inexperienced patients was apprehension regarding data management by AI scribe providers. Patients expressed uncertainty about the lifecycle of their recorded information, which included concerns about whether their data would be permanently stored or securely deleted after a certain period, and the specifics of the storage solutions used, such as cloud storage or local servers, and their associated security protocols.

Furthermore, patients were particularly interested in understanding who would have access to their data and under what circumstances it might be used for purposes beyond their immediate medical care. This is crucial in an era where data breaches and misuse of personal information are prominent issues in the public consciousness. The fear that their sensitive medical information could be accessed

by unauthorized parties or used without their consent for research or other purposes added a layer of complexity to their concerns.

*I was curious about the use of the technology, so I asked my doctor a few questions... **my main concern about my data and its privacy. I was really concerned about how it would end up, what it would be used for, and how it would be handled.** [P2_scribe-experienced]*

Moreover, some patients indicated that they opted to self-censor because they had pressing questions about data handling. This cautious approach to personal disclosure highlights a significant trust barrier that needs addressing. The reluctance to fully engage during consultations where AI scribes are used due to fears of data misuse can impact the effectiveness and quality of patient care, given that physicians don't have the full picture of the issue.

I wondered what happens to these recordings afterward. Will it be deleted? Where is it stored? How safe is it? ... While these were basically questions that kept popping into my head, I didn't ask because I was careful of what I disclosed. [P5_scribe-experienced]

Conversely, other interviewees reported reassurances from their healthcare providers mitigated their concerns. These assurances often touched on the security measures in place to protect data and the anonymization processes used when data is applied to secondary purposes. Such reassurances were critical for alleviating patient fears and fostering a more trusting and open interaction with healthcare providers.

... I asked what if someone else comes in contact with their information with my recording in the transcript. Everyone is going to know about me, my medical history. He said that it's going to be stored securely and if the data was to be used for some other purposes, it would not contain my name, my demographics and any identifying information like that. [P10_scribe-experienced]

4.4.2.2 Privacy and Consent

Similarly to the findings for physician interviews, consent is found to be closely tied to privacy perceptions. The willingness of patients to consent to the use of AI scribes is significantly influenced by their perceptions of data privacy and security. Patients noted that their consent decisions largely depend on the perceived robustness of data handling practices. A crucial factor for these decisions was found to be the context of the medical visit, which significantly affects patients' privacy. For routine medical inquiries, such as a consultation for a common cold, patients expressed a relatively lower sensitivity to privacy concerns. Conversely, for sensitive matters—such as mental health assessments, sexual health issues, or conditions with potential legal ramifications—patients expressed a need for stringent privacy and security measures. Section 5.6.2 discusses the impact of the visit on consent.

*The main factors would be **how the data is stored, what it's used for, and how secure it is**. Those are my three primary concerns. My decision would be based on getting more information on these aspects.*

*The situation would also play a significant role. It's a combination of those three factors and the context of the visit. For example, **if it's a low-risk situation, like a routine check-up with a family doctor, I might be more lenient about the data's security or its potential uses**. However, **if it's a sensitive situation where privacy is paramount, I would want the data to be highly secure and the usage to be tightly controlled before I give my consent**. [P3_scribe-inexperienced]*

4.4.2.3 Consent and Utility

Besides privacy, patients shared that accuracy and utility of the AI scribe and ability/ease of access to documentation by AI scribe influence/ed their consent.

AI scribe-experienced patients in particular shared inquiring physicians about the technology's accuracy and potential for error before consent. They wanted to ensure the technology was reliable and beneficial. Below is a sample excerpt.

I asked about its capabilities, how long my data would be stored and its privacy, the device's accuracy, and the possibility of technical errors. I also inquired about how the device had assisted him in the past and its necessity. He reassured me that

I could decline its use if I felt uncomfortable, but I chose to allow him to continue using it as it seemed harmless and did not make me uncomfortable. The interview was regarding an abdominal pain I was experiencing. [P16_scribe-experienced]

Some patients specifically inquired about the benefit to them and not just physicians, and expressed a desire to see clear advantages from the AI scribe that justify its use in their care beyond time saving during notetaking.

I think it's already beneficial for the physician. I would feel more comfortable when there are more examples of how it's beneficial for the patient. I already know it's beneficial for the physician, but the physician is there for my benefit, so how is it benefitting me? [P15_scribe-inexperienced]

Moreover, patients expressed the desire to have access to the notes generated by the AI scribe for their record and reference; finding it one tangible benefit if easy access is guaranteed.

***For me, it also depends on access.** Having had to advocate for myself and people in my care, I can see there being an advantage to having this theoretically neutral scribe tool when your very tired. I've had an infant hospitalized before and I could not remember any details from the appointment because I was sleep deprived. I need someone to take notes for me. I see the value of having a scribe in such situations if accessing the record is not a complicated process. However, the utility is lost if accessing this information is cumbersome. Additionally, not all care providers might be comfortable with patients having records of consultations, as it could hold them accountable for their spoken words or decisions, which not every provider may want. [P7_scribe-inexperienced]*

4.4.2.4 Trust and Consent

Trust was another major factor for consent in the use of AI scribes. Patients that have encountered AI scribe and consented to its use shared that they trusted their physician would not introduce something harmful or unsafe.

The trust I had in my physician was transferred to the technology. I had no doubts about using the technology because I trusted my physician. I was confident he

wouldn't introduce something that could negatively impact me or compromise his work. [P6_scribe-experienced]

Similarly, scribe-inexperienced patients echoed that physician endorsement of the technology plays a significant role in their willingness to consent to it.

*Another factor is **the level of trust I have in the software, particularly if my doctor endorses it strongly. If they find it immensely helpful, I'd be more inclined to give it a try.** [P11_scribe-inexperienced]*

In addition, patients expressed that they would be uncomfortable to use AI scribe with a physician they are meeting for the first time, showcasing the importance of pre-established relationship and trust for AI scribe consent.

If it's my first visit with the physician, I'd be comfortable if it's a human-to-human interaction because I think that's very important.

For the following sessions, I don't mind having a scribe because the history is already there. Therefore, even if there's a miscommunication, the physician can verify with the records that everything makes sense.

Also, I think prescribing a medication should be easy with a scribe, once the technology has developed. [P12_scribe inexperienced]

Chapter 5 Development of Conceptual Design for Informed Consent for AI Scribes

5.1 Introduction

The inherent intertwinement of development and utilization of Machine Learning (ML) based tools means a bidirectional service dynamic, unlike traditional unidirectional interactions where the tool's role concludes post-service. ML-based technologies engage in an ongoing data exchange, learning and evolving from each user interaction. This continuous interaction raises significant privacy, confidentiality, and security concerns, especially when personal health data is involved. While users value the immediate utility of these technologies, they may harbour reservations about their data being used for secondary purposes. This concern underscores the need for a nuanced approach to informed consent that addresses these multifaceted issues.

This chapter builds up from the privacy and ethical challenges and the current legal and operational landscape discussed in Chapter 2 and presents the development of a conceptual design for informed consent, which herein is called a Multi-Tiered Granular Informed Consent (MTGIC), to describe the information structure of the design. The conceptual design of the framework is based on the principles of VSD. It is informed by a thorough review of literature from AIS and user perception studies to ensure it is both ethically robust and aligned with user expectations. The findings from literature form the basis for the assumptions and subsequent requirements for the design and are then validated through user study which is presented in section 5.6.

5.2 Background

5.2.1 Consent and Informed Consent

Consent is permission granted by an individual for actions to be taken, information to be used, or activity to be performed, where the guarantor has ownership or vested interest in the activity or information. Typically, consent is obtained after a comprehensive communication process that outlines the intentions and implications. Consent has been practiced in the medical field for centuries, first influenced by the Hippocratic oath [61] and has evolved significantly over the years.

In earlier medical practices, the decision-making process was predominantly physician-driven, with less emphasis on explicit consent. In 1914, US Justice Cardozo laid down the basic principle, “Every human being of adult years and sound mind has a right to determine what should be done with his

own body” [62]. This was followed by the formulation of the Nuremberg Code in 1957, mandating voluntary participation and informed consent in research [63]. This shift was further solidified by the Declaration of Helsinki, which enhanced ethical guidelines and established the principles worldwide [64].

Informed consent is a specific type of consent that refers to participants voluntarily agreeing to partake in activities, fully aware of all potential risks and benefits [61]. This practice is standard in research and medicine and is increasingly recognized in consumer applications, particularly with data protection regulations making it an explicit requirement. However, the implementation of informed consent in ML-based medical tools remains uneven and lacks standardized guidelines (see section 2.1.2 for detail).

Effective application of informed consent requires that individuals are thoroughly informed about what data will be collected, how it will be used, and the potential risks and benefits to aid in making a well-informed decision.

5.2.1.1 Consent Models

Several consent models are commonly used in medicine and research, each with distinct advantages. According to Svenja Wiertz and Joachim Boldt [65], the selection of a consent model hinges on balancing individual autonomy with the public good. The decision typically involves information needs, available time, audience comprehension, and associated benefits and risks. Below are some of the primary consent models.

Specific Consent requires informed consent for each particular study (or type of data use) and provides detailed information about the uses’ aims, risks, and benefits [65]. Specific Consent is preferred for preserving self-determination, as it allows individuals to control the use of their data. However, for advancing research, extensive consent models like Broad or General Consent are seen as more practical and reduce the obstacles posed by Specific Consent. Broad Consent requires participants to consent to multiple future studies under general guidelines and objectives without specific details at the time of consent. It is much simpler than Specific Consent but more comprehensive than General Consent. General Consent merely requires consent for data collection or treatment agreement without details of the benefits and risks. This is often used when the activity is well-known and poses minimal risk. In the medical field, general consent is common for routine blood tests, dental cleaning, etc.

Tiered Consent is the middle ground between Specific Consent and Broad Consent, allowing participants to customize the breadth of their consent [65]. Tiered Consent is also known as Multi-Layered Consent and refers to a model where individuals can provide varying levels of consent based on different tiers or categories. Each tier corresponds to a specific purpose or type of data processing. Granular consent takes the concept further by allowing users to provide consent at a more detailed level. For instance, granular consent allows users to select consent to specific data processing activities [66].

The MTGIC framework integrates tiered and granular consent models to ensure clarity and understandability with a structured mapping of choices. This approach is intended to enhance transparency and participant control over personal data, aligning with individual preferences and regulatory requirements.

5.2.2 Value Sensitive Design (VSD) Principle

VSD is among several methodologies that aim to integrate human values into system design. Other similar methods include computer ethics, social informatics, computer-supported cooperative work (CSCW), and participatory design, each contributing unique perspectives and methodologies [67], [68]. The collective goal of these methodologies is to align technology with human values through ethical analysis, socio-technical evaluations, collaborative technology design, or democratic participation in design processes, respectively.

I have selected the VSD approach to develop a model for informed consent for ambient scribe technology, as informed consent in AIS is inherently personal and significantly shaped by individual perceptions and values. Hence, VSD allows users to dive deep into the values influencing their perceptions and choices. Moreover, VSD allows the investigation of technological factors that determine the feasibility of consent processes and data protection within these systems. VSD also provides a system of integrating empirical findings into technological and conceptual investigations. Overall, VSD employs a systematic, iterative process that incorporates human values into technological development and has been proven effective in the development of the informed consent model (see section 5.2.2.1). Therefore, I believe VSD is particularly well-suited to this objective.

As Friedman articulated, VSD is a theoretically grounded approach that incorporates human values into technology development and design in a principled and comprehensive way [52]. It features a

tripartite framework with conceptual, empirical, and technical dimensions. Each dimension plays a pivotal role in ensuring that the technology designed aligns with the values of its stakeholders.

Conceptual Investigation

The conceptual investigation focuses on identifying stakeholders and understanding their values, setting the theoretical foundation for the design, characterizing and framing these values, deciding how they will be operationalized, and defining criteria for evaluating the design's success in embodying these values.

Empirical Investigation

The empirical investigation examines how stakeholders perceive and prioritize values in the context of technology use, addressing how these perceptions influence design decisions. It delves into understanding the trade-offs between competing values and usability and contrasts stated values (what people say) against observed values (what people do), offering insights into the real impact of technology on stakeholders.

Technical Investigations

The technical investigation focuses on the technology's functionality, features, capacity, vulnerabilities, and strengths. It may be retrospective or proactive, where the former focuses on understanding the implications of the existing technology and the latter extends to new possibilities.

In conclusion, VSD stands out as a comprehensive, multidimensional approach that acknowledges the importance of values in technology design and provides a structured methodology to ensure these values are integral to the design process. Its emphasis on a broad conception of values, stakeholder engagement, and the integration of values into technical design sets a robust framework for developing technology that is not only functional but also ethically grounded and human centered. This makes it ideal for the design of informed consent in AI scribes where stakeholders have varied values.

5.2.2.1 Informed Consent Online

Friedman B. et al. provide a conceptual model and design principle for informed consent based on VSD principles [69]. The model consists of five components: disclosure, comprehension,

voluntariness, competence, and agreement. It offers a robust framework for ensuring ethical and user-centered consent processes in online environments.

Disclosure emphasizes providing clear, accurate, and thorough information regarding online actions or decisions potential benefits and risks. For data collection scenarios, this involves explicitly detailing what information will be gathered, the entities that will have access to it, the duration of data retention, the purposes for which the data will be used, and the measures in place to protect the individual's identity.

Beyond mere disclosure, **comprehension** ensures that the individuals truly understand the information presented. This is crucial in the online context, where complexities and nuances might be overlooked or misunderstood. Ensuring comprehension involves presenting information in a clear, accessible manner and verifying that the individual has accurately grasped the implications of their choices.

Voluntariness safeguards the individual's freedom of choice, ensuring their decision is neither manipulated nor coerced. Maintaining voluntariness is key in the digital domain, where user decisions can be subtly influenced by design choices or information framing. It's crucial to avoid situations where users feel compelled to consent due to a lack of viable alternatives or under conditions where essential services or information are contingent upon consent.

Competence pertains to the individual's ability to make informed decisions, encompassing mental, emotional, and physical capacities. This component recognizes the diversity in user capabilities and emphasizes the need for consent mechanisms that are inclusive and adaptable to different levels of user competence.

Agreement ensures that individuals have a clear and unequivocal opportunity to agree to or decline participation. This means providing a mechanism that is not only accessible but also devoid of ambiguity, allowing users to make informed choices readily.

5.3 Methodology

The design of the conceptual consent model for MTGIC follows VSD's tripartite methodology [70], following a conceptual, technical and empirical investigation throughout the design phases, as shown in Figure 13. The conceptual investigation focused on the stakeholders, primarily patients and physicians, and secondarily service providers, their values based on the literature on similar technologies, and conceptual frameworks such as privacy by design principle and informed consent model influenced the conceptual design. The empirical investigation focused on evaluating the

assumptions for the conceptual design from the primary stakeholders based on surveys and interviews. The technical investigation focused on system analysis based on literature review and regulatory policies.

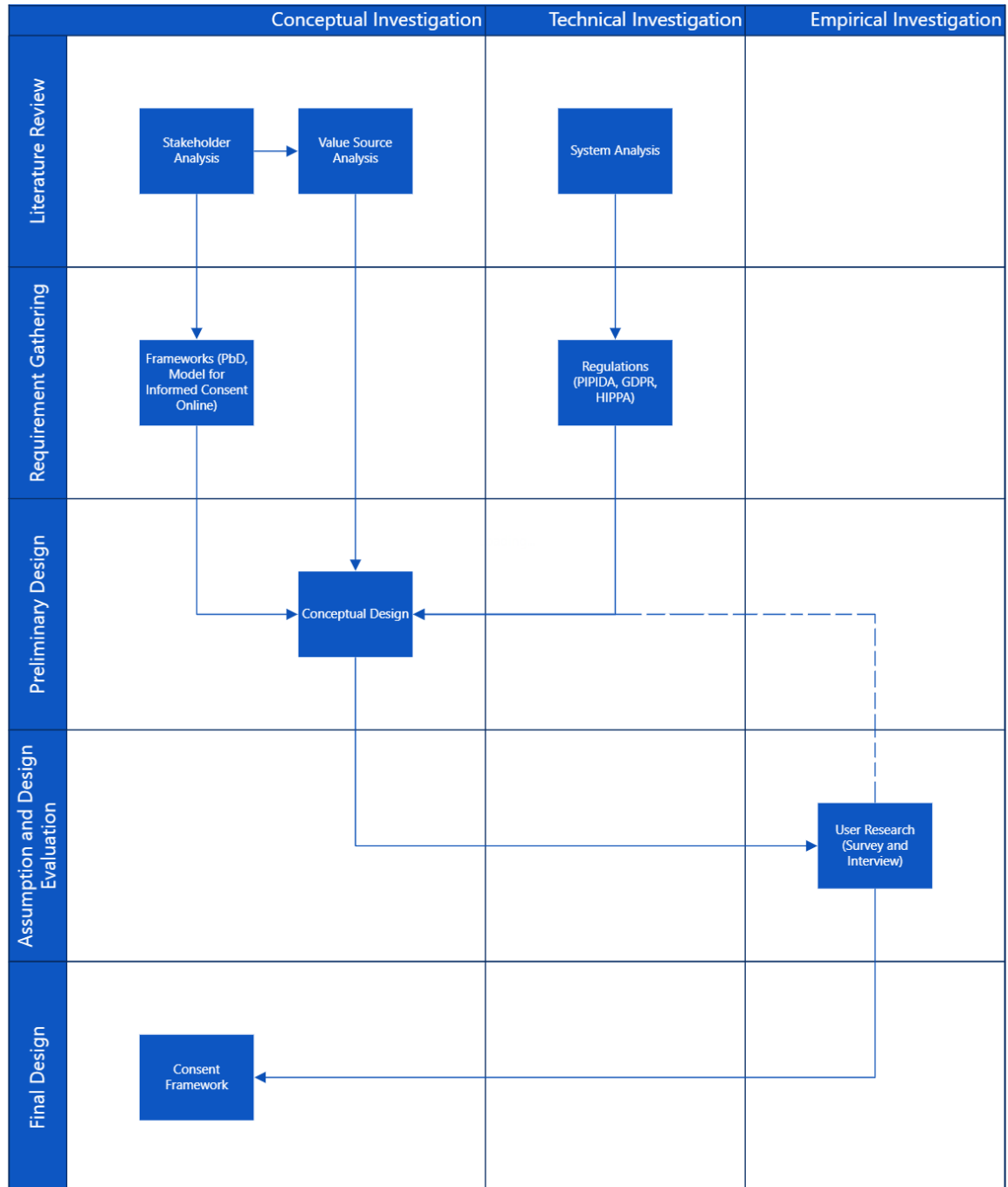


Figure 13: VSD's Tripartite Methodology for MTGIC Design

The dashed line making a closed loop between the user research and conceptual design stages represents a potential iteration between the two to refine the design. For this thesis, only one primary user research is completed whose outcome is presented in section 5.6. Section 6.1.3.1 provides the recommended changes from the finding that make up the final design.

5.4 Design Requirements

5.4.1 Regulatory Requirements

Most AI scribe providers are currently based in Canada, the US, and Europe, and hence, their privacy policies aim to emulate the data protection regulations applicable in these regions (see detail in section 2.1.2). The following subsections summarize the requirements of the PIPEDA, HIPAA and GDPR as relevant to AI scribes.

5.4.1.1 PIPEDA Requirements

1. **Informed Consent:** Obtain meaningful consent for collecting, using, and disclosing personal information.
2. **Limiting Collection:** Collect only the information necessary for the stated purpose.
3. **Limiting Use, Disclosure, and Retention:** Use or disclose personal information only for the purpose it was collected unless consent is given or required by law.
4. **Accuracy:** Keep personal information accurate, complete, and up to date.
5. **Safeguards:** Implement security measures to protect personal information.
6. **Openness:** Be transparent about policies and practices regarding managing personal information.
7. **Individual Access:** Provide individuals access to their personal information and correct any inaccuracies.
8. **Accountability:** Designate an individual or individuals accountable for the organization's compliance with PIPEDA.

5.4.1.2 HIPAA Requirements

1. **Privacy Rule Compliance:** Ensure proper use and disclosure of Protected Health Information (PHI).
2. **Security Rule Compliance:** Implement administrative, physical, and technical safeguards for electronic PHI.

3. **Business Associate Agreements:** Execute agreements with third-party service providers handling PHI.
4. **Training:** Provide training to employees on handling PHI.
5. **Patient Access to Records:** Allow patients to inspect and obtain a copy of their PHI.
6. **Breach Notification:** Notify individuals and, in some cases, the media of a breach of unsecured PHI.

5.4.1.3 GDPR Requirements

1. **Explicit Consent:** Obtain clear, informed consent for processing personal data.
2. **Right to Access:** Allow individuals to access their personal data.
3. **Right to Rectification:** Enable individuals to correct inaccurate personal data.
4. **Right to Erasure:** Provide the right for individuals to have personal data deleted.
5. **Right to Data Portability:** Allow individuals to transfer their data to another organization.
6. **Data Protection Impact Assessments:** Conduct assessments for processing activities that pose a risk to data subjects.
7. **Data Breach Notification:** Within 72 hours, notify the appropriate regulatory body and affected individuals of a data breach.
8. **Data Protection Officer (DPO):** Appoint a DPO for organizations processing large amounts of personal data.

5.4.2 Privacy by Design

Privacy by Design (PbD) is a framework developed by Ann Cavoukian that advocates for privacy to be embedded into the design and architecture of IT systems and business practices [71]. It is founded on the premise that privacy should be an integral part of system design rather than an add-on feature. Privacy by design has seven foundational principles to ensure products are designed with privacy in mind [72]. These include:

1. **Proactive approach** – anticipating privacy risks and designing for their prevention,
2. **Privacy as the default** – implementing maximum privacy levels by default, which includes ensuring communication purposes for data collection, use, retaining, and disclosure is before or at data collection, collecting the minimum amount of data for the purpose, receiving consent, minimizing the amount of identifiable data collected, and destroying all data following its use,

3. **Holistic** (within the broader context), **integrative** (considering all stakeholders) and **creative** (not bounded by existing choices) embedding of privacy into design,
4. **Full functionality** without trade-offs in functionality, benefit, security and privacy,
5. **End-to-end security** – from data collection to data destruction at the end of a process; this involves service providers assuming responsibility for data security throughout its lifecycle and adhering to gold standards,
6. **Visible and transparent data policy** – privacy-related policies and procedures shall be clearly documented and made available for users, and practices shall follow policies and procedures subject to independent verification, and
7. **Respect for user privacy**— privacy policies should be designed considering users’ interests and needs. They should seek user consent, employee checks for accurate information collection, provide users with access, and comply with applicable regulations.

Applying PbD principles to AI scribe involves designing the technology to protect user data from the outset. This includes implementing robust encryption methods, clear data retention policies, and secure data sharing protocols on the technological front, as well as transparency in how patient data is collected, used, and shared to ensure the validity of the consent.

5.4.3 Privacy and Ethical Concerns Related to Ambient Intelligent Systems

As discussed in section 2.1.1, while limited studies specifically address AI scribes' privacy and ethical concerns, broader research on AIS provides insights into user privacy requirements critical for adopting such technologies. The following subsections summarize the privacy and ethical issues associated with AIS derived from system analyses and user studies. These insights form the foundation for the requirements of the conceptual MTGIC design. The validity of these requirements is later confirmed through user research.

5.4.3.1 Based on System Analyses

Numerous studies have explored the privacy and ethical challenges of AIS. Of primary relevance are Caire et al. [32], who studied the privacy challenges with a focus on Ambient Assisted Living (AAL), and Martinez-Martin et al. [31], who studied the ethical issues of AIS in healthcare broadly. Most of the challenges studied are relevant to AI scribes due to the similarities of the technologies and their persuasive nature.

One major concern is the collection of private and sensitive data gathered during patient-physician encounters. It is important to note that patients not only discuss their medical concerns but also their personal life, work, family and future plans with physicians. Hence making the conversation extremely personal. The most common way of dealing with the security of private information in AIS is deidentification at the source [30]. Deidentification is defined by the National Institution of Standards and Technology as a tool used to remove personal information from data that is collected, used, archived, and shared with other organizations [73].

Deidentification reduces the risk of disclosure but does not eliminate it. Previously anonymized data can still be reidentified through data mining or data matching, resulting in identity and sensitive information disclosure [74], [75]. Disclosure can also happen as a result of unauthorized access. Studies have shown that policy violations have resulted where employees access information of family members, friends or celebrities out of curiosity, personal motivation or financial gains [76].

From an ethical standpoint, it is essential to clearly communicate the risk to privacy in AIS systems and be transparent with the processes, recognizing individuals have different risk tolerance and circumstances that make them more vulnerable than others. Hence, it should be up to the individuals to decide the level of consent they desire and opt in. Beyond privacy and consent, AIS presents ethical challenges concerning data management, liability, bias and fairness [30].

The accuracy of machine learning algorithms in AIS depends heavily on the representativeness of the data on which they are trained. Often, such bias affects women and people of color [30]. Current AI scribes are trained on limited datasets, and hence, there is a need to obtain more datasets for training. While this benefits the overall model development, the privacy and consent issues discussed above are exacerbated. In addition, the collected data – transcript, needs to be annotated by trained professionals and verified to ensure errors and biases are not incorporated in the model. This raises questions such as the credentials of the annotators, engineers, and software developers that access the data, complicating the data management. Liability of error and disclosure in AIS is also of contention. According to AI scribe service providers, physicians are responsible for ensuring the notes are accurate. It is unclear who is responsible for data disclosure.

5.4.3.2 Based on User Studies

User studies provide a different perspective with overlapping themes from a system perspective, focusing on the human aspects of privacy and ethics in AIS [18], [32], [77], [78]. These studies

highlight user perceptions and concerns, significantly influencing their technology acceptance. A significant concern among users is the potential for misuse of personal data [32]. Regarding ethical considerations, issues such as consent, data sharing, and transparency are frequently raised. Users further expressed a need for clear information on how their data will be used and insisted on having control over this process [18].

5.4.4 Summary of Design Requirements

Table 12 summarizes the design requirements specific for the conceptual design of the consent from the discussions in sections 5.4.1 to 5.4.3. It should be noted that some design requirements have a broader applicability extending the design of the consent and applying to the implementation or the design of the tool. While these are discussed in sections 5.4.1 to 5.4.3, they are not summarized in the table. These include requirements that apply to the design of the tool such as security features, compliance with regulatory requirements beyond consent and the like.

Table 12: Summary of Design Requirements

Requirement Summary	Source	Applicability	Requirement Details
Disclosure of information	Informed Consent, User Studies, PbD	Design	Information about the tools' purpose, functionality, data collection, use, process and retention shall be disclosed. See sections 5.2.2.1, 5.4.2 and 5.4.3 for detail.
Comprehension of information	Informed Consent, Regulations	Design	Consent shall be inquired in a clear, concise and comprehensive manner and format. See sections 5.2.2.1 and 5.4.3 for detail.
Voluntariness of agreement	Informed Consent, User Studies, Regulations, PbD	Design and Implementation	The consent model shall allow for a clear option to opt-in or opt-out to use the tool without consequences or trade-offs in benefit, functionality, security and privacy. The consent shall be sought in an environment free of coercion. See sections 5.2.2.1, 5.4.1, 5.4.2 and 5.4.3 for detail.
Competence to agree	Informed Consent, Regulations	Implementation	Consent shall be sought from capable adults or legal custodians. See sections See sections 5.2.2.1, 5.4.1 and 5.4.2 for detail.
Explicit agreement	Informed Consent, PbD, Regulations	Design and Implementation	Consent shall be explicitly obtained not implied. See sections 5.2.2.1, 5.4.1 and 5.4.3 for detail.
Minimizing data collection to necessity	System Analysis, Regulations, User Studies, PbD	Design and Implementation	Consent shall be sought for each type of data collected for each purpose. Data shall only be used for the purpose of the consent. See sections 5.2.2.1, 5.4.2 and 5.4.3 for detail.
Use data only for specified purposes			
Data retention limits	Regulations	Design	Consent shall be sought for the retention period per type of data collected, exception may occur if a data is required to be stored for a certain period for legal compliance. Such exceptions shall be clearly communicated. See section 5.2.2.15.4.1 for detail.
Transparency in privacy policies	Regulations, PbD	Implementation	Consent shall be sought from users on data collection, use, process and retention. In the case of exceptions these should be transparently communicated in the consent form. See sections 5.4.1 and 5.4.2 for detail.
Access to one's data	User Studies, Regulations	Implementation	Users shall have easy access to any stored personal data. See sections 5.4.2 and 5.4.3 for detail.
Control of data (Erasure, Withdrawal)	User Studies, Regulations	Implementation	Users shall have a simple data withdrawal process. See sections 5.4.2 and 5.4.3 for detail.

5.5 Proposed Multi-Tier Granular Informed Consent Design

The proposed consent model consists of three tiers that seek users' consent for 1) use of the tool, 2) data storage, and 3) secondary data use. Subsequently, users are sought to make granular choices regarding the types and duration of data and use cases they are comfortable with if they consent to the tier. This format is designed to make the consent process comprehensible and clear. The following section presents the tiers, what they represent and how they compare to current practices.

- 1) **Consent for Fundamental Use of Technology:** This initial tier is foundational, covering AI scribes' primary function of recording consultations for documentation.

In the current practice, this consent includes the next two levels, forcing users to agree to everything to use the tool. Friedman [69] argues this is a less obvious type of coercion as physicians are forced to agree to everything to use the service, and subsequently pass the no choice agreement to patients when requesting their consent. By introducing a tiered consent with option to agree to primary function only, MTGIC mitigates coercion and upholds valid consent in its fullest.

- 2) **Consent for Data Storage:** The second level addresses permissions for storing distinct data types, such as audio recordings, transcription, and summary notes. Here, users can choose which data types they agree the service provider stores and for how long.

In the current practice, although different service providers have slightly different policies and transparency, all act as the data controller, having full autonomy over what is stored and how it is processed and used. The MTGIC model places the choice to what is stored and for how long in the hands of the users, giving them full autonomy over their data.

- 3) **Consent for Secondary Use of Data:** The final tier relates to secondary data uses, such as algorithm training or research, offering users autonomy to decide how their data can be used.

Appendix B shows the detailed consent description as presented to patients and physicians, which is worded slightly differently to ensure it is optimally comprehensible to the level of understanding of each user and their role. As such explanation of each consent tier is tailored to the group and the granular details are named for comprehension. For example, the physician version uses the term "quality assurance" for one of the granular options under secondary data use, whereas the patient version uses "quality checks".

5.6 Empirical Investigation of MTGIC

The empirical investigation was completed through surveys and semi-structural interviews to validate the design assumptions and evaluate the usability of the consent model from patients' and physicians' perspectives. The details of the empirical study methodology are discussed in Chapter 3. The study demographics are discussed in section 4.1. This chapter presents the empirical findings, beginning with quantitative data followed by qualitative insights from the surveys that explain the participants' choices. The results of semi-structured interviews, which offer a deeper understanding of the values and perceptions influencing the participants, are also discussed.

5.6.1 Consent Preferences of Patients and Physicians – Quantitative Results from Surveys

Table 13 and Table 14 show the preferences of patients and physicians, respectively. A majority of both groups—95% of patients and 95% of physicians—felt comfortable with basic use, tier 1 of MTGIC. However, consent for data storage was comparatively lower, with only 64% of patients and 55% of physicians in favour, with concerns stemming from perceived risks associated with data storage. Both groups agreed that deleting data after transferring it to the EMR significantly reduced these risks. Some participants also felt that the tool's role was complete once data was transferred to the EMR.

Those who favoured data storage highlighted its utility. Physicians noted that retained data allows for more comprehensive review and reflection when finalizing patient notes. Thirty-five percent of all physicians surveyed, or over 50% of physicians who supported data storage, preferred storing the data for six months or less. The next most common storage durations preferred by physicians were up to one year, with fewer opting for up to three years, five years, or longer. Physicians who preferred long-term storage cited access to historical patient data for ongoing care and medicolegal protection as their primary motivations.

Patients, unlike physicians, did not show a clear preference for data storage duration. However, they shared similar reasons for supporting data storage, including enabling physicians to access their details later for better diagnostic accuracy, personal access to transcripts and summaries for a deeper understanding of their health condition, and sharing information with loved ones, other healthcare providers, or insurance companies for smoother processing of claims. Some patients also recognized the utility of stored data in medicolegal cases.

Finally, a relatively smaller proportion of patients and physicians—48% of patients and 25% of physicians—supported secondary data use. When considering data use for purposes such as model training, quality assurance, and health-related research by non-profit and for-profit organizations, the majority felt that contributing to such uses was not their responsibility due to the sensitive nature of health information and associated privacy and security risks. Conversely, those open to secondary data use were motivated by potential improvements in healthcare and benefits to other patients, particularly in cases involving serious diagnoses like cancer or public health issues. Physicians supportive of secondary use also cited potential enhancements in healthcare and AI scribe technology as motivations.

Table 13: Patient Consent Preference

Basic Use	41.0	98%
None	1.0	2%
Data Storage	27.0	64%
6 months or less	3.0	7%
Over 6 months, up to 1 year	6.0	14%
Over 1 year, up to 3 years	5.0	12%
Over 3 years, up to 5 years	7.0	17%
Over 5 years	6.0	14%
Secondary Data Use and Sharing	20.0	48%

Table 14: Physician Consent Preference

Basic Use	19.0	95%
None	1.0	5%
Data Storage	11.0	55%
6 months or less	6.0	30%
Over 6 months, up to 1 year	2.0	10%
Over 1 year, up to 3 years	1.0	5%
Over 3 years, up to 5 years	1.0	5%
Over 5 years	1.0	5%
Secondary Data Use and Sharing	5.0	25%

Figure 14 and Figure 15 present the granular data storage consent preferences for patients and physicians, respectively, revealing a clear preference for storing transcriptions and summaries over

voice recordings by both groups. Fifty-two percent of patients and 40% of physicians expressed comfort with medical summaries, while 52% of patients and 35% of physicians favoured written transcripts. This preference was attributed to the perception of textual formats as less intrusive and easier to manage regarding privacy.

Conversely, voice recordings were less favored, with 19% of patients and 30% of physicians reporting discomfort or extreme discomfort. This aversion was largely due to concerns over the security of voice data, including the risks associated with hacking and discomfort stemming from potential access to voice recordings by members of the medical team and AI scribe providers. Moreover, patients and physicians perceived a lack of necessity for retaining voice data post-transcription and summarization, rendering it redundant for the primary goal of summarizing medical encounters. In contrast, participants who favoured the storage of voice recording discussed its benefits primarily for ASR model training, particularly for accent recognition.

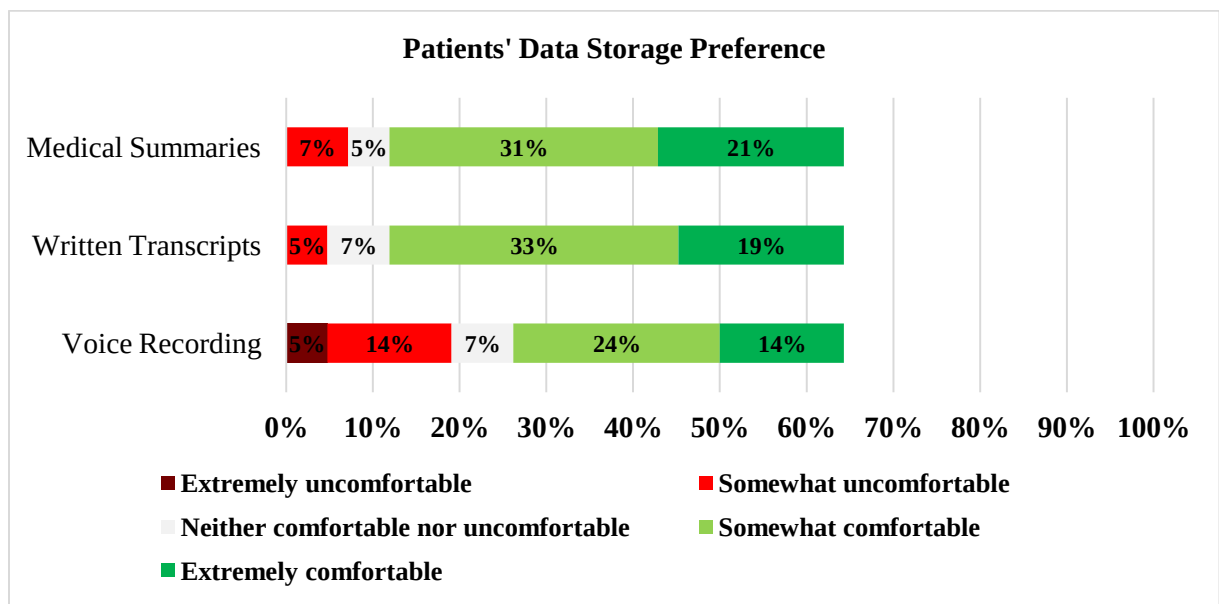


Figure 14: Patients' Data Storage Preference

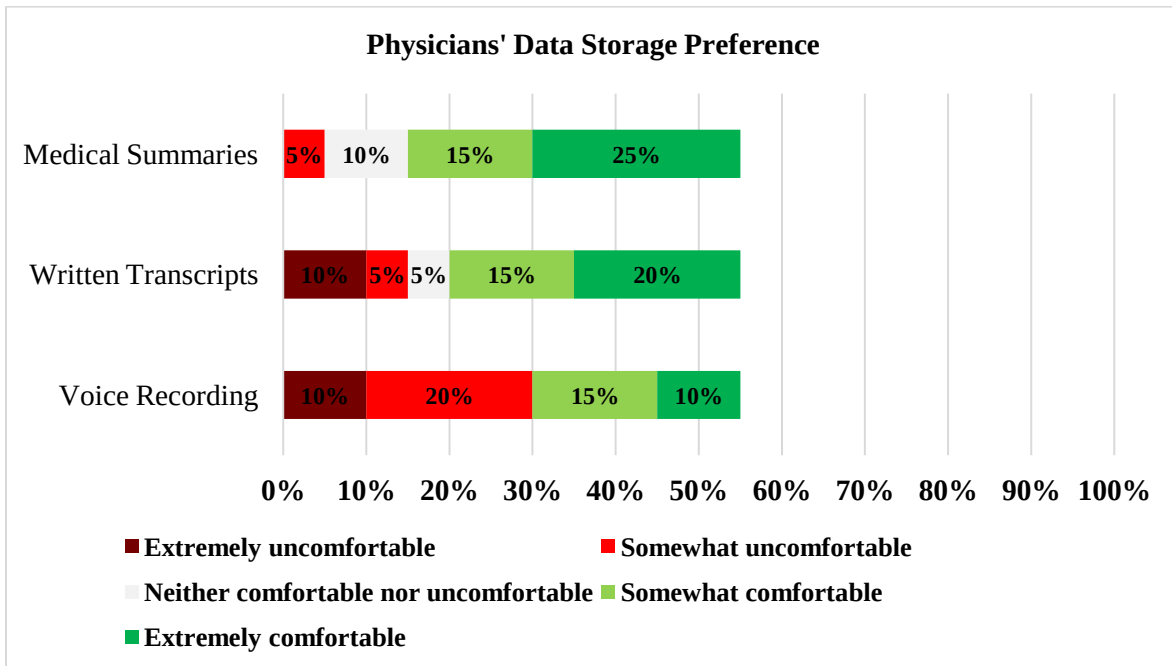


Figure 15: Physicians’ Data Storage Preference

Figure 16 and Figure 17 show the granular preferences of patients and physicians, respectively, regarding secondary data use. The results show that patients generally have a balanced view in their comfort with secondary data use with few nuances where the lowest consent was for collaboration with for-profit entities – with 24% of all participants or 50% of participants who were okay with secondary data use consenting to it, whereas the highest consent was for quality assurance – with 36% of all participants or 75% of participants who were okay with secondary data use consenting to it. The consent for academic and non-profit research was provided by 26% of all patient participants with algorithm training and model enhancement, which was slightly higher at 36% of all participants. The data shows that patients, in general, are more reluctant to have their data used for research than for other purposes, such as model training or quality assurance. This finding somehow contradicts the interview results, where participants expressed more enthusiasm for academic and non-profit research. The contradiction may be due to numerous factors, including limited information during the online surveys, unconscious preconceived notions on research, or social influence during the interviews, given the existence of a human interviewer. The latter is an established phenomenon known as social desirability bias, which can be common in qualitative research and, in this case, introduces a limitation to the findings (see section 6.2 for detail).

Physicians, on the other hand, displayed a greater degree of comfort across all categories compared to patients except for collaboration with for-profit entities. Only 10% of all physicians, or 40% of those who were okay with secondary data use, were okay with data use by collaboration with for-profit entities. In contrast, all physicians who were okay with secondary use were okay with other data uses, recognizing the benefit of technology in their field.

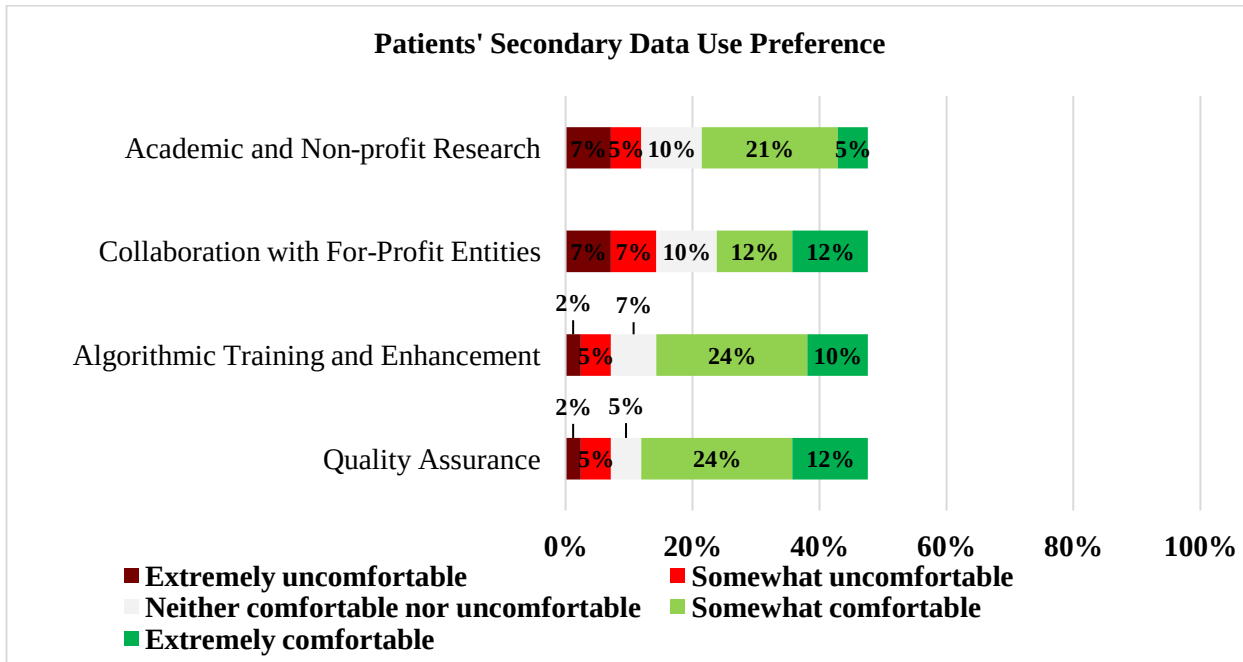


Figure 16: Patients' Secondary Data Use Preference

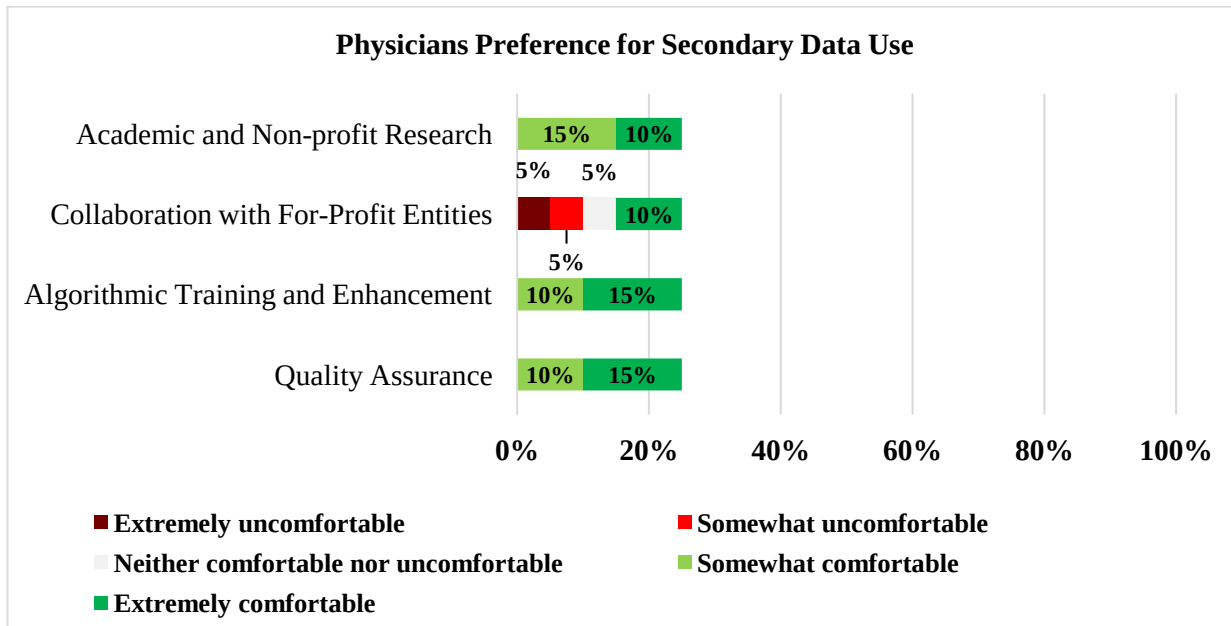


Figure 17: Physicians’ Secondary Data Use Preference

5.6.2 Situation/Context Dependent Preference and Comfort in using AI Scribe

Figure 18 and Figure 19 show patients' and physicians' comfort with using AI scribes in various situations. The result shows that while consent is dependent on the situation/context, as discussed in sections 4.3.3 and 4.4.2, there is also dependency on personal comfort and the perceived benefit of the technology. In no situation did either group feel unanimously comfortable.

The comfort level between patients and physicians coincided on sensitive issues such as mental health, telemedicine and discussions of a legal nature, with a comparable percentage of patients and physicians being equally comfortable/uncomfortable with the situations. However, patient and physician comfort diverged for appointments with minors, where 21% of patients and 10% of physicians expressed extreme discomfort. Similarly, 19% of patients were uncomfortable with emergency care, whereas 5% of physicians were. While the percentages are not expected to translate to the population, they enable the comparison and contrast of the two stakeholders’ openness with the qualitative results that provide the reasoning. In the case of emergency care, physicians found that the fast-paced nature of emergency care can extremely benefit from a reduced workload, whereas patients felt they were too stressed and in pain to be wary of recording and had reduced ability to make informed consent.

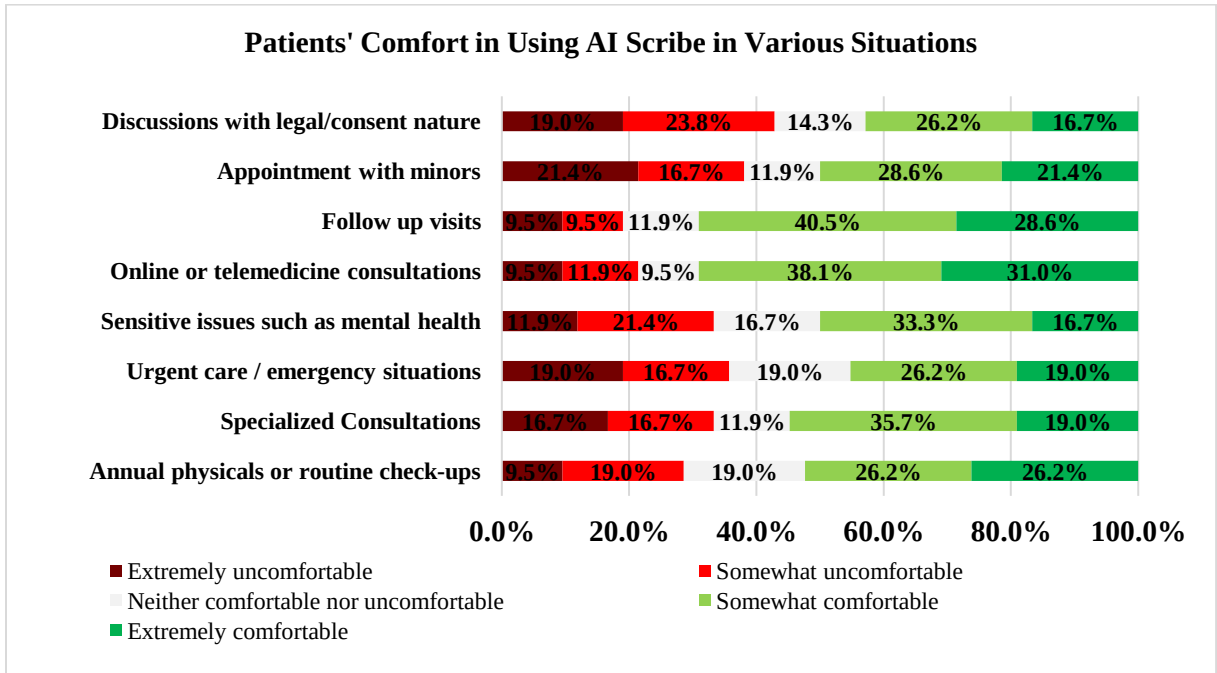


Figure 18: Patients' Comfort in Using AI Scribe in Various Situations

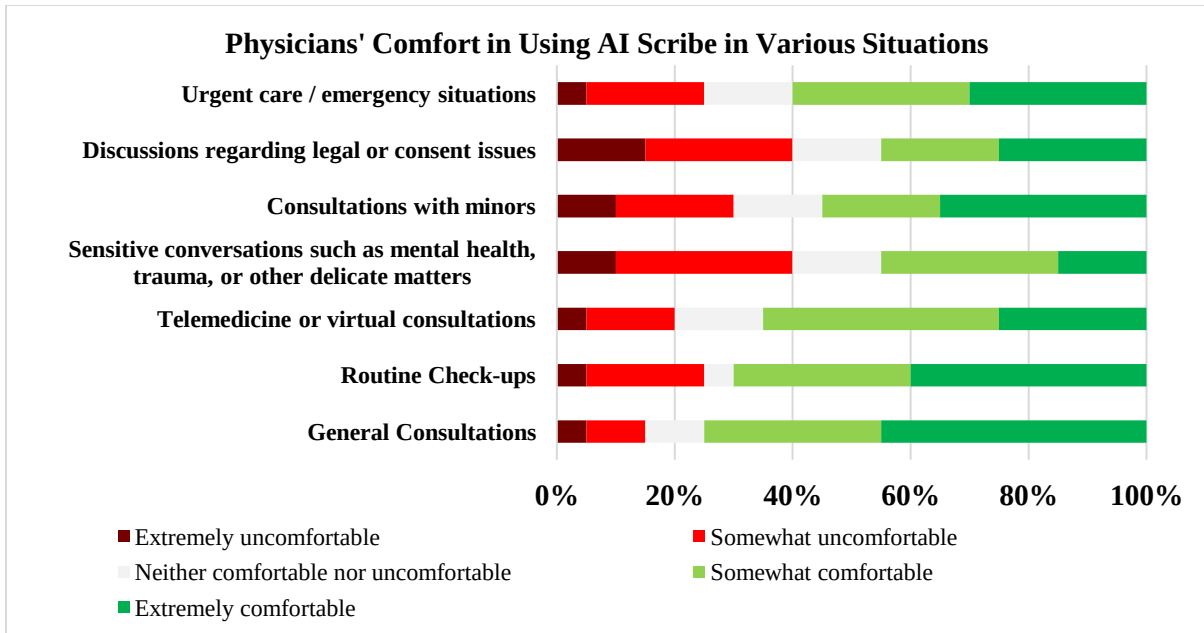


Figure 19: Physicians' Comfort in Using AI Scribe in Various Situations

Overall, physicians' opinion was primarily influenced by expected comfort for patients and the benefit of AI scribe for the situation (for example, documentation time), and secondarily medicolegal challenges (see section 4.3). On the other hand, patients' opinion was influenced by the sensitivity of

the visit, privacy and confidentiality risk perceptions, ability to make informed consent, trust/familiarity with the physician, legal impact and perceived benefits.

5.6.3 Usability Evaluation of Conceptual MTGIC Model

Figure 20 and Figure 21 present the ratings of patients and physicians, respectively, on the usability of the MTGIC conceptual model in terms of the understandability of the process and options, complexity/ease of use, desire to use, and impact of use on trust and confidence.

Regarding the understandability of the process, 67% of patients and 75% of physicians agreed that it was somewhat or extremely easy to understand. Only 14% of patients and 5% of physicians found it somewhat difficult to understand, and the remaining rated the ease of understandability as neutral. This contrasted with the perceived complexity of the model, where 24% of patients and 35% of physicians found it somewhat or extremely complex despite finding it easy to understand. This demonstrates the desire for a simpler consent model that is quicker to complete. This is a common critique of detailed consent models [79]. Another reason for the perceived complexity is that patients and physicians are expecting to complete this just prior to their consultation and expressed the pressure and time crunch (see sections 5.6.5 and 5.6.4 for detail).

Regarding confidence in understanding the presented consent options, 67% of patients and a higher 85% of physicians felt confident. This shows a notable level of assurance in both groups, although the higher rating among physicians likely reflects their medical training and experience with consent forms.

Regarding the desire to implement a multi-level consent process in practice, responses were more mixed. About 57% of patients and 50% of physicians expressed a desire to adopt MTGIC, indicating a moderate interest in using a granular approach to consent, which might have been influenced by the perceived benefits, such as enhancing individual control over personal information and medical decisions. On the other hand, those who expressed reluctance and neutrality, particularly among physicians, expressed concerns about the practicality of detailed consent and its potential to increase the administrative burden or the need for additional training.

Finally, regarding the impact of the multi-level consent process on trust and confidence, 60% of patients and 65% of physicians agreed that it would enhance their trust and confidence in the consent process. This was influenced by the perception that a more detailed and tiered consent process would contribute to higher transparency and integrity in medical procedures and data handling.

Overall, these results highlight a complex balance between the desire for detailed and transparent consent processes that enhance trust and the need for practical, easy-to-implement solutions that do not overly complicate the consent procedure or impose on the time constraints of patients and physicians. Refining the MTGIC to simplify its application while retaining its detailed structure may help improve its overall usability and acceptance.

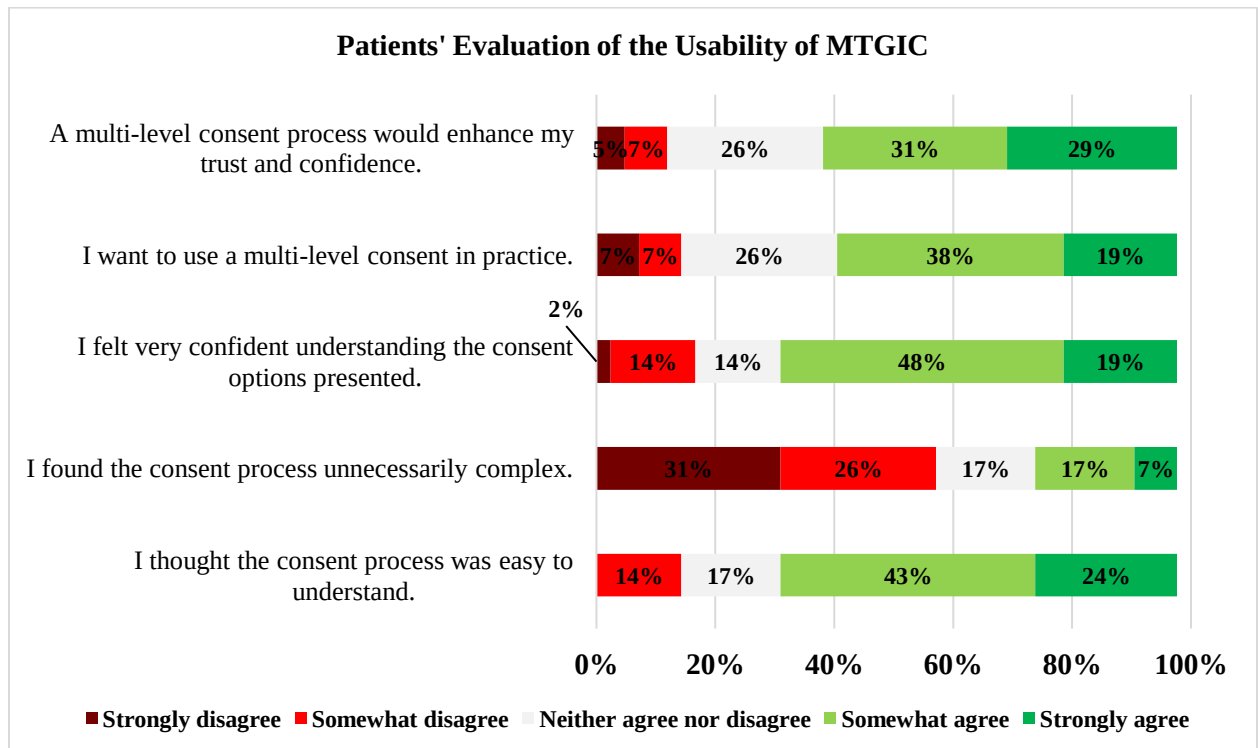


Figure 20: Patients Rating of Usability of MTGIC

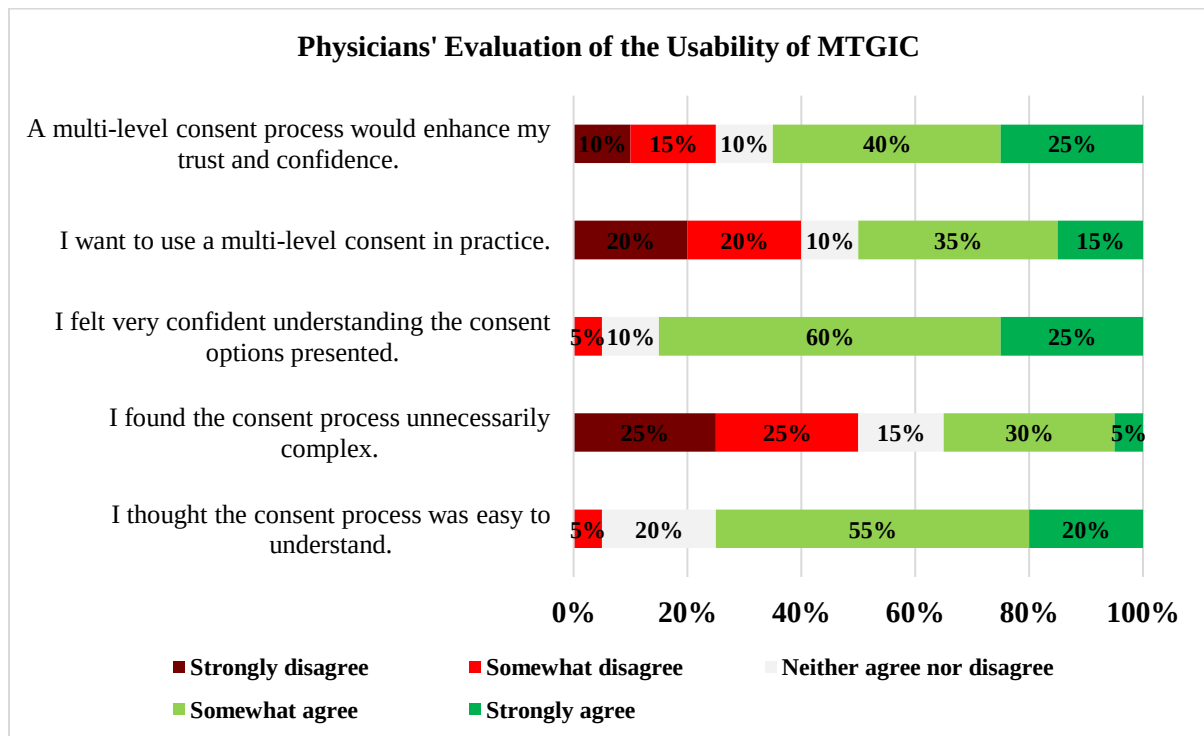


Figure 21: Physicians' Rating of Usability of MTGIC

5.6.4 Values that Influenced Patients' Preference for Consent

Table 15: Themes and codes that Influenced Patients' Preference for Consent

Theme	Codes
Comparison of MTGIC Vs. Current Consent Process	- Awareness and Understanding in Data Handling Process - Autonomy and Control in Data Management - Simplified Consent for Stressful Situations
Timing of Consent Decisions	- Preferences for When and Where to Consent - Ability to Decline Technology Use - Discretion and Privacy in the Consent Process - Early Information on Technological Interventions
Reactions to MTGIC	- Optimal Detail in Consent Information - Desire for Expanded Detail on Data Sharing - Concerns Over Information Overload - Perceived Lack of Genuine Consent Options

5.6.4.1 Comparison of MTGIC Vs. Current Consent Process

Patients expressed a preference for the MTGIC over the current consent for AI scribes due to enhanced transparency and a comprehensive discussion of the data management process. They found that the MTGIC ensured a complete understanding of what one is consenting to and expressed the desire to use it as it fostered informed decision-making.

I find the granular option more helpful because it requires understanding all aspects of what I'm consenting to. Until this becomes the norm and a significant majority give complete consent, I think the granular approach is preferable. [P11_scribe-inexperienced]

I favor the detailed process. It's comprehensive and provides clarity, allowing individuals to make informed decisions. [P3_scribe-inexperienced]

Similarly, patients emphasized the desire for a detailed consent process where the specifics of data usage, particularly regarding de-identification, are explicitly stated. Patients expressed that this not only aids them in understanding what they are consenting to but also provides a sense of security.

I prefer a detailed consent process that clearly states how my information will be used, especially if it's de-identified. This way, I know what I'm agreeing to and feel more secure in my decision. [P16_scribe-experienced]

Patients also preferred MTGIC because they wanted autonomy in data management, and they found it allowed them to control their data privacy levels. Patients who supported MTGIC emphasized the importance of choosing consent preferences that align with their personal comfort and security needs.

I prefer having different options. I want to go with the one that has different levels so that I can choose whichever one I want. [P1_scribe-experienced]

However, in high-stress or emergency situations, patients expressed a preference for simplified consent processes that do not overwhelm them in times of stress or enormous pain.

I would prefer to know about the more granular options for myself, as it allows for a more informed decision. However, in high-stress or emergency situations, I wouldn't want to make detailed consent decisions. It's too demanding during emotionally charged moments. For routine visits to a general practitioner, I'm comfortable reviewing and deciding on these options in advance, setting my preferences for how I wish to interact with the technology. But in more stressful circumstances, I'd prefer not to deal with complex consent decisions, as the stress could impact my ability to make a fully informed choice. [P7_scribe-inexperienced]

5.6.4.2 Timing of Consent Decision

Patients expressed varying preferences for timing and location of consent to AI scribe use. A significant portion preferred receiving information about the AI scribe well before their appointments. This early provision of information was seen as a crucial element to allow adequate time to understand the technology's implications and to conduct further research if necessary. Such an approach also addressed the need for patients to feel they can decline the use of the technology without any repercussions. However, there was no consensus as some preferred making the decision just before the appointment as they felt it puts the use into context.

I would like to make the decision where the technology is going to be used. When booking my appointment, maybe, but definitely in the doctor's office before my interview. [P2_scribe-experienced]

Conversely, those who expressed wanting the information and consent earlier also discussed the desire to decline the technology without an impact on their appointment. They discussed knowing the potential use of the AI scribe when booking an appointment and being able to decline it at booking would assure them it's okay to do so.

I'd like the option to decline the use of the tool if I prefer. It's important that these tools don't become so common that declining their use isn't an option. Ideally, I'd

want to be informed about the tool's adoption by my regular medical practice well before I need to book an appointment. I wouldn't want to be put in a position where I have to make a consent decision in a stressful moment, like when seeking care. The medical practice we usually visit communicates technological changes well in advance, which I appreciate. Being surprised by such a tool at the appointment would not be ideal. [P7_scribe-inexperienced]

On a similar note, some patients expressed pressure to consent if consent is required in front of a service provider, such as a receptionist, a nurse, or a physician. They expressed the desire for consent to be administered discreetly beforehand. This preference stems from past experiences where healthcare staff's immediate review of personal medical information led to discomfort. One such patient expressed that their recent medical history has heightened their sensitivity to privacy, emphasizing the need for a consent process that respects personal space and allows time for thoughtful consideration.

I would feel comfortable if I can do it discreetly in the waiting area without no one checking it immediately. I can take my time to read it and then I put it somewhere, and then they can have look at it, but not in front of me. I hate it when doctors check your survey immediately. I don't want to see it. A couple of years ago, I was perfectly healthy, but in the past two years, I've had a couple of surgeries, so when I see them looking at surgeries, I don't like it. They could see somewhere else but do not take the form right there and review my concern. [P9_scribe-inexperienced]

Another reason patients wanted to be informed early was to ensure that they had sufficient time to understand the technology and its implications, thereby facilitating a more informed and less stressful consent process. Some patients shared that being introduced to new technology only at the time of the appointment can be stressful and inhibit their ability to make an informed consent.

*As a patient, if I were informed about this technology, I would have several concerns because I wouldn't be aware of it. In the future I know I can see myself using it. However, if I didn't do this research study and if I am **only told about it during the encounter**, it might be **stressful for me to consent**. I would **prefer to know about the technology earlier than my appointment** to know what I'm getting into. [P14_scribe-inexperienced]*

5.6.4.3 Reaction to MTGIC

Patients' feedback on MTGIC ranged from satisfaction with the current level of detail to calls for more comprehensive information and concerns about the potential for information overload. This variability highlights the challenges in designing consent processes that cater to diverse patient needs and levels of understanding.

Some patients found the current MTGIC process well-balanced, noting that the level of detail provided was neither overwhelming nor insufficient, thus facilitating informed decision-making.

I favor the detailed process. It's comprehensive and provides clarity, allowing individuals to make informed decisions. The format and level of detail are just right—not too overwhelming yet sufficiently thorough to cover various scenarios.
[P3_scribe-inexperienced]

Conversely, some patients felt that the MTGIC could benefit from additional details, particularly concerning data processing methods, such as how data is deidentified and transferred and the specifics of data sharing, including organizations' names and how it'll be managed.

Perhaps more details on the extent of data sharing, like whether it could be shared with major health organizations or agencies, and how that would be managed.
[P16_scribe-experienced]

On the same topic, one patient suggested detailing the risks involved in the use of the technology similar to research consent forms. At the same time, the patient expressed that even when detailed, consent might not be comprehensible to all, leading to uninformed consent. This shows the delicate balance between the level of information and comprehension. There is also a need to raise awareness about consent processes and assure users that they can still receive service without the technology.

***I worry that with our current consent culture, people wouldn't fully understand the information and might still consent.** It would have to be delivered in a way that ensures patients know they'll receive the same level of care whether or not they consent. Currently, people tend to click through consent without fully understanding, so I'm concerned it wouldn't be taken as seriously as it could be.*

*... I think that the consent forms need to be read like how we write ethics clearance in university, where the **advantages and possible risks are stated**. Right now, it reads mostly as the advantages when everything goes perfectly, and this is used perfectly ethically. Whereas a data leak is a significant risk but not really highlighted.*

*Some **terms could be expanded upon**, like **what does “deidentified” mean?** If only my name is taken off, that **information isn't deidentified enough for me** because it could **help develop stereotypes about certain groups** of people. I would need expansion on certain words, and I would want **inclusion of the risk**. But then it gets so long, I understand why it can't really be that long. [P13_scribe-inexperienced]*

Consent is not optional

Several patients indicated that they felt or would feel compelled to agree to anything, particularly if consent is solicited immediately before an appointment. This perceived coercion can inhibit genuine consent, as one patient described feeling obligated to agree to continue with their scheduled appointment:

*Honestly I think getting to know all this information, such as what the scribing is used for and what it's going to be doing, would help. But my main concern would still be the same; **I would agree to anything before the appointment because I cannot miss it.***

In an ideal where getting an appointment isn't difficult, I think I would be comfortable with the model where I receive all the doctor's notes, with the guarantee that everything is deleted from the service providers. That would also alleviate my earlier concerns that I mentioned about not knowing what the scribe is noting down, not knowing what is being recorded, and if it contains inaccuracies because of my accent. Therefore, gaining access to those doctor's notes, reading through them, and knowing that none of this data will be stored would be ideal for me. [P15_scribe-inexperienced]

If I'm informed during the encounter, I'll be very concerned and not confident at all. But if I am told ahead of time, then I would be more confident in saying no or yes. I think the timing will be important.

If I'm told right there, then I might say yes because I don't know anything about it and I'm too nervous and scared at that time, since there are already so many

*things on my mind during the appointment.
If I'm informed about it earlier, I'll be more confident to say no. [P14_scribe-
inexperienced]*

5.6.5 Values that Influenced Physicians' Preference for Consent

Table 16: Themes and Codes that Influenced Physicians' Preference for Consent

Main Theme	Subtheme	Codes
Comparison of MTGIC Vs Consent Current Model		• Autonomy Emphasis • Flexibility Appreciation
Operational Challenges in Implementing MTGIC	Barriers on Patient Side	• Time Management Issues • Administrative Overload • Legal Complexities in Consent
	Timing of Consent Decision	• Streamlining Consent • Digital Consent Implementation • Accessibility and Technological Limitations • Developing Alternative Consent Methods

5.6.5.1 Comparison of MTGIC Vs Consent Current Model

Physicians expressed either optimism for MTGIC or indifference. Those who preferred the MTGIC model over the current consent model cited autonomy as a significant factor. These physicians valued the control that the MTGIC model provides, allowing for specific decisions about what information is stored and shared. This preference stemmed from a desire to manage the details rather than prescribing to a preset policy by service providers.

*I think I would **prefer to have control over it**. With the first [current consent] model, I wouldn't have to worry about the details, but [with the MTGIC model] having control means I can decide what's stored and what's shared. [D9_non-adopter]*

Conversely, physicians who expressed indifference indicated that the choice of consent model does not significantly impact their professional practice or personal values. While they acknowledged that having different options for data use confers a sense of ownership, they expressed that this is not a decisive factor for them. This opinion stems from the trust placed on service providers to ensure

ethical data use and comply with privacy policies (see section 4.2.5 for detail). Hence, physicians felt they need not be concerned about consent options.

On the other hand, physicians' opinion is influenced by the perceived effort to administer detailed consent (see section 5.6.5.2 for detail).

*For me, it **doesn't matter as much. Having different options for how my data is used gives me more ownership over it**, but it wouldn't be a big factor for me either way. I don't think I have a strong preference regarding the consent process.*
[D6_Early Adopter]

5.6.5.2 Operational Challenges in Implementing MTGIC

5.6.5.2.1 Barriers on Patient Side

Most physicians cautioned about the challenges of integrating detailed consent models, such as the MTGIC, into their workflow, particularly on the patient's side. Physicians felt wary about introducing inefficiencies into the limited time available for consultation, highlighting the dilemma of balancing thorough consent processes and the necessity to maximize patient interaction time.

*From a **privacy perspective, that's the best way to go. However, it makes it more cumbersome**. If I have to go through extra consent steps, I only have 15 minutes with the patient, and spending a couple of minutes on consent means that a significant portion of my appointment time is taken. Though I agree with the multi-stage consent, I don't think I would have time to do it.* [D1_non adopter]

Further, physicians discussed the challenges of managing consent for each appointment if it is done within the appointment time slot. While physicians appreciated the value of MTGIC, they expressed the lack of guidance on when, how, and where to administer consent for AI scribes.

*This model would be a barrier to me and my patient if I had to **explain this consent model every time**. You could only ask for consent the first time, but a patient may say yes to everything and then one day come in with a very sensitive issue and they **may forget what they had consented to**. Even if it's anonymized*

*data, they may not want some of that information stored. So ,we need to **determine how to ask for consent, and how often to ask.***

*After conducting the survey, I realized we should be getting **written consent** so that it is documented that the patient consented to this. However, that would act as a barrier **if I had to do that at every visit** since time is spent explaining consent, even though the tool's goal is to save time. [D3_early adopter]*

Physicians' opinion was also strongly impacted by the broader trend of increasing administrative tasks in medical roles, where they lamented the introduction of EMRs and subsequent changes to their workflow to include administrative work that was otherwise performed by support staff. As a result, some physicians expressed a strong desire for the consent process not to be the task of the medical health team. They recommended it to be as upfront as possible to avoid bogging down medical professionals with additional administrative duties, and for physicians to be only involved as needed.

*What I would say is whatever you do, don't make that part of the doctor's job. Because it's so there's been this creep of administrative tasks into physician and nursing roles and that that is part of what's made us so inefficient, like we had we, we have an EMR at [ABC] hospital that I was working at. It was just absolute...I mean you can put this in your transcription if you like. It was absolute *** **** and it it's decreased our efficiency by 20%. So now we're doing things that were administrative tasks before, like entering orders, became our job right. Before we usually just wrote them with a pen then it would be done by admins. So that was someone else's job that we took on.*

I don't want as a doctor or to have my nurses having to go through every time I'm going to begin of transcription, like I'm sure as you know, because you're obtaining consents for these this it takes a lot of time and it's really boring and involved and it's inefficient.

If consent is necessary, it should be as upfront as possible in the process. When patients walk into the hospital, they should get a piece of paper that introduces the technology and ask for consent, and as physicians. We could do a quick verification of the consent. [D4_non-adopter]

Physicians discussed a unique challenge for minors as obtaining consent could be complex when it involves custody arrangements. Physicians recommended a clear understanding and accommodation of legal nuances in consent processes to ensure that the rights and preferences of all parties are respected.

I think it would have to be whoever parent has the ability; it depends on what the custody agreement is. A lot of parents will have shared custody and both will make medical decisions. Sometimes it gets more complicated than that depending on the legal issue. So I think whoever makes the medical decisions would be the caregiver to also provide consent for this. [D6_Early Adopter]

5.6.5.2.2 Timing of Consent Decision

Similar to patients, physicians discussed the importance of the timing for administering consent. However, unlike patients that were motivated by the ideal time for them to read, research, comprehend, and make informed decisions, physicians were more concerned about the efficiency of the process. As discussed in sections 5.6.3 and 5.6.5.2, a major drawback for the MTGIC from physicians' perspective was expected time spent in administering consent. As a result, physicians discussed that consent for AI scribe use should be sought out via email or text alongside appointment reminder.

With the patient, I think the most efficient way is to have the consent form sent to all patients that have an email in the EMR, because spending so much time on every consult is too much.

Most people have email so that will probably be the most effective way. If they haven't signed the consent form, then I would talk to them during the consultation and ask if they are comfortable with it. [D2_non-adopter]

Furthermore, one early adopter discussed that their practice already administers consent via email for those with their contact information on file. The physician further shared that patients have three options: yes, no, and maybe. Patients who choose maybe would discuss their reservations and questions before the start of the consultation. Below is the relevant excerpt from the interview.

Currently, we send **appointment reminders** to the patients, and have them fill out a standardized form before they come in about their reason for visit. I **included the AI consent form** to make it easier so I'm not explaining it to the patient repeatedly.

At this point, the **patient has three options**: Yes, no, or maybe.

A 'yes' indicates the patients are familiar with it and they have no issues with it.

A 'no' clearly indicates they aren't interested. In this case, it's **not worth my time to convince them**.

If a patient indicates '**maybe**' then I will have a discussion with them. What I'll do is I'll say "Hey, by the way, you wrote maybe on the AI consent form. **How can I help to answer any questions?**"

Not everyone fills out the form, but of those people who fill out the questionnaire, about 20% say maybe, and it's **usually a one-time response** because they get their answers the next time they come in. For me, **once I answered their questions, all so far have become a yes**, none of them have become a no. [D7_early adopter]

Although electronic consent through email or text is preferred, there are several accessibility challenges to consider. These challenges include technological limitations, such as some practices lacking online scheduling capabilities, and demographic factors. For instance, certain practices serve populations that are not proficient with technology, do not anticipate receiving communications through these channels, or face language barriers.

One physician shared that their practice's booking system and challenges that could emerge if consent during booking is added as follows:

The ideal situation would be before they came in, like when they booked the appointment or in the waiting room. For online booking, they could get a notification that their doctor is using an ambient scribe and ask for their consent right then. However, our office doesn't have online booking, and we cater to an older population that struggles with technology. We have an office assistant who triages calls for appointments. If she had to add an extra 2-3 minutes per phone call for consent, that would significantly increase her workload, especially since we have about 3000 patients in the group, and she handles around 100 phone

calls a day. We don't want to extend her working hours unnecessarily. [D1_non-adopter]

Another physician shared the challenges of interacting via portal/emails with patients with language barriers, given the inability to have translation available.

Our workflow is such that for any new patients, they get an email with some forms and consents they have to agree to anyways, like consent for email communication, for example. So, this could be incorporated as part of that, and then just confirmed when they arrive that they read and agreed to it prior to the appointment.

We use a system [Ocean] to send all new patients forms to fill out beforehand, so this is why templates are more efficient at the moment. About 60 to 70% of the time, families do fill it out. The challenges are more with newcomers to Canada or those who don't speak English as their first language, unless there are translation options available. [D6_early adopter]

Overall, physicians agreed that online consent with the option to discuss questions at the start of the consultation is ideal. Still, given the associated challenges, it can't be universally used. Paper-based or digital consent during check-in or at the start of consultation should be available as an option.

Chapter 6 Concluding Discussion

This thesis explored the integration of ambient scribe technology into healthcare, specifically during physician consultation with patients, with the goal of semi-automating the note-taking process. The objectives of the studies were to:

1. Explore the integration of ambient scribe technology into physicians' workflows and assess its impact on physician-patient interactions.
2. Identify and analyze the concerns related to privacy, consent, and trust among patients and physicians regarding using ambient scribe technology.
3. Develop and evaluate a flexible informed consent protocol that can be utilized by patients and physicians when implementing ambient scribe technology.

For this, a mixed-method approach that utilized surveys and semi-structural interviews was employed with both patients and physicians, those with experience with AI scribes, and those without. The study occurred in Canada, and participants were recruited throughout the country.

The subsequent sections discuss the study's most significant findings and their practical impact and implications. The study's limitations and future work are also discussed.

6.1 Answering the Research Questions

6.1.1 Research Question One

The study's first objective was to explore how AI scribe fits into physicians' workflow and assess its impact on physician-patient interaction. As the first part of this question only applied to physicians, only physicians were inquired. Non-adopters were asked about their current workflow, how they expected the AI scribe would fit the workflow and their expectations. Early adopters were asked about their workflow with and without AI scribe and its benefits and challenges. The findings are discussed in sections 4.3.1. The major findings are discussed in the below subsection.

The second part of the first objective explores both patients' and physicians' perspectives on the impact of AI scribes on patient-physician interaction. Those with AI scribe experience were asked how it impacted their experience, whereas those without were asked how they expected/perceived it to impact them. Participants were also prompted to provide both positive and negative impacts. The

findings are discussed in sections 4.3.2 and 4.4.1. The major findings are discussed in the below subsection.

6.1.1.1 Integration of ambient scribe Technology into Physicians' Workflows

6.1.1.1.1 Efficiency

Both positive and negative experiences/perceptions were raised from early adopters and non-adopters regarding integrating AI scribe into physician workflow, indicating the complex nature and personal preferences to workflow/task flow. On the negative side, negligible efficiency improvement (or reduction) due to extensive post-editing, the need to spell out lab requisitions and prescriptions, and the inability to adapt to each physician's style were discussed. These concerns were presented by physicians who described having a reasonably comfortable documentation routine without an AI scribe and considered their process efficient and well executed. For this group of physicians, an AI scribe must surpass their current efficiency level and provide a seamless experience to be worth it. This includes 1) integration with other modules of the EMR experience, including prescription and requisition software, and 2) customization for individual physicians, learning from their personal style of note-taking and test orders.

On the positive side, which was the majority opinion, physicians expressed efficiency gain, particularly for complex and lengthy encounters that are otherwise the most difficult to document. Contrarily, for simple encounters, AI scribes were not seen as helpful as the amount of time it takes to document those visits was equivalent, if not less, to the time it takes to get the software running and review the generated note. Hence, physicians must determine beforehand if the scribe is needed for the encounter. Practically, this requires knowing the reason for a patient's visit before consultation by inquiring and documenting during appointment booking or in the waiting room.

Given the qualitative nature of the study's assessment of the impact on workflow, coupled with the fact that some of the findings are expected and not experienced reporting, it was not possible to quantify the documentation efficiency of using an AI scribe. However, the findings enable us to understand the need for efficient AI scribes and how to use them best in practice.

6.1.1.1.1.1 Recommendation for AI Scribe Providers

- Enhance Integration with EMR systems, including prescription and requisition software. This will reduce the need for physicians to switch between systems and enhance overall workflow efficiency,
- Develop AI scribes that can adapt to individual physicians' unique note-taking styles and preferences, learning from each physician's specific documentation habits, and
- Establish a simple and robust in-line feedback system for collecting and incorporating physician feedback. This feedback loop should be efficient and easy for physicians to use, ensuring continuous improvement of the AI scribe technology based on user experiences and needs. It would also be ideal for service providers to provide incentives for constructive feedback, recognizing the value physicians provide while paying for the service. This is particularly crucial at this stage of the technology, which is highly reliant on physicians.

6.1.1.1.1.2 Recommendation for Physicians

Physicians should evaluate the necessity of using AI scribes for each patient encounter. AI scribes might not be as efficient for simple or mostly templated visit types. Their primary value is in complex cases where documentation demands are high.

While it might be a personal call, I encourage physicians to provide detailed feedback regarding AI scribes' performance regularly. This feedback is vital for AI scribe providers to enhance the system's accuracy and usability and ensure the technology evolves to better assist physicians in the long term.

6.1.1.1.1.3 Recommendation for Future Work

I highly recommend conducting quantitative studies to measure the efficiency gains from AI scribes across different medical specialties and encounter types. Potentially, this research could use time-motion analysis to compare periods with and without AI scribe usage, quantifying time spent per type of encounter and the impact on documentation quality and physician satisfaction. Such research would provide concrete data to guide the refinement of AI scribes, making them more effective and suited to diverse clinical settings.

6.1.1.1.2 Workflow Changes

While physicians explicitly reported three primary changes to their workflow, the overall findings suggest that there are four changes. These are:

1. Patient Consent
2. Patient Interaction Time
3. Redistribution of documentation time and effort
4. Assessing the need for AI scribe use based on visit type⁶

It is important to note that not all the changes will apply to all physicians depending on their current workflow and their practice type and capability. For instance, practices that introduce AI scribes outside the consultation room and seek consent (i.e., during booking, in the waiting room or online) will not have a substantial change to their workflow as a result, except for confirming consent verbally or via their system at the onset. Similarly, physicians who document patients' reason of visit beforehand could assess the utility of using AI scribe without notable impact on their workflow. However, for physicians who currently don't have such systems in place, there will be notable impacts on their workflow either through the introduction of a system of obtaining such information beforehand or seeking such information at the start of the consultation. This could impact efficiency gains as a result of AI scribe use if done at the beginning of the consultation, and whether the efficiency gain offsets these new additions to the workflow will be dependent.

In addition, while some physicians reported increased patient interaction time as a result of the ability to focus more on patients and create better connections without the distraction of active documentation, physicians who don't chart while seeing patients without an AI scribe are expected not to see much difference in this regard. However, the redistribution of documentation time is expected to affect all physicians as there will be a significant shift in completing a substantial portion of charting during encounters, with the AI scribe performing most of the job and the physician reviewing details and adding missing information. This should result in minimal documentation post-

⁶ While physicians did not directly report this as a workflow change, the assessment of whether the AI scribe is relevant for the visit, as discussed in section 6.1.1.1.1, means this is an additional step and a change to their workflow.

encounter. However, it is important to note that the impact will differ for all physicians based on their work routine and preferences, with some changes to adapt to the new tool.

It is also important to note that the exact workflow changes will depend on the type of AI scribe and the evolution of the technology. As the performance and functionality of NLP and GenAI capabilities evolve daily, it will be important to study the impact periodically until the technology reaches maturity.

6.1.1.1.2.1 Recommendation for AI Scribe Providers

Providers should offer comprehensive training and support to ensure physicians can effectively integrate the technology with minimal disruption. This support should include detailed guidelines on workflow changes, system customization, and best practices for optimizing documentation processes. For instance, AI scribe providers should take ownership of the consent process, providing the form and the platform to document and maintain it. This approach helps ensure that the implementation of AI scribes enhances clinical workflows rather than complicate them.

6.1.1.1.2.2 Recommendation for Physicians

Physicians should carefully assess how and whether AI scribe technology fits into their workflow. While AI scribes in the current state may be suitable for some physician, the study shows that their fit is not universal. Factors such as personal efficiency and style, patient demographics, and the types of medical issues commonly encountered determine compatibility. However, as the performance and capability of AI scribes are evolving rapidly, physicians are encouraged to evaluate suitability periodically. Periodical evaluation helps ensure that technology adoption is beneficial and not just a response to external pressures.

6.1.1.1.2.3 Recommendation for Future Work

The current study explored the impact of AI scribe integration on workflow based on self-reports. Field studies can further enhance the understanding of the findings here and provide a deeper insight. I recommend future studies extend beyond understanding and focus on developing strategies to help practices adapt AI scribes seamlessly. Ideally, future studies involve collaboration between academia, AI scribe providers, EMR providers and hospitals for efficient user-centred iterative design.

6.1.1.1.3 User Interface and Features

The diversity of practice environments and patient populations physicians encounter necessitates specialized interfaces and features. These are discussed in section 4.3.1.3 along with their context.

6.1.1.1.3.1 Recommendation for AI Scribe Providers

- Implement precise speaker recognition (also known as speaker diarization) capabilities to accurately identify all participants, including family members, medical staff, and interpreters.
- Enhance voice recognition technologies to include robust background noise filtering features.
- Ensure secure interim storage and establish reliable identification processes for telemedicine appointments to compensate for delayed updates to EMR.
- Equip hospital-based AI scribes with user-friendly interfaces and systems capable of managing multiple patient interactions concurrently, accommodating physicians' needs to shift between patients awaiting test results or requiring urgent care.
- Ensure the AI scribe system is versatile and accessible via phone, laptop, or desktop platforms.
- Develop systems that remain functional during internet disruptions with alternative processes.

6.1.1.1.3.2 Recommendation for Future Work

This study explored the experiences and expectations of outpatient physicians across various specialties. While the goal was not to limit AI scribe use for family physicians, who are the current primary users and the upfront stakeholders the current tool is designed for, specialists and emergency physicians have expressed a keen interest in using the tool. Incorporating their perspectives early in the development process is imperative, as insights from these groups can enrich the user experience significantly and overlap with those of family physicians.

Most participants (85%) in this study have been family doctors. It has been challenging to recruit other demographics, so the insight gleaned from other physicians is been limited. Still, unique perspectives have been gained from the limited number of pediatricians and emergency physicians who participated. Recognizing the distinct needs of emergency departments and hospitals, I have delineated findings specific to these settings in section 4.3.1.3.1.

I advocate for a comprehensive follow-up study to explore each practice environment's specific needs and nuances. Such research would provide deeper insights and foster a more tailored approach to AI scribe technology development.

6.1.1.2 Impact of AI Scribe on Patient-Physician Interaction

The perceived impact of AI scribes on patient-physician interactions primarily pertained to communication dynamics. Physicians noted that AI scribes facilitated enhanced interactions by reducing distractions, allowing for more focused patient engagements. However, they also reported the potential for instances of self-censorship by patients, where they may withhold sensitive information due to discomfort with the recording process.

Conversely, patients reported a broader range of impacts. They concurred with physicians on the benefits of enhanced interaction and self-censorship but highlighted additional pressures, such as the need to articulate their concerns more eloquently and professionally due to the verbatim recording. This requirement can cause increased cognitive load, particularly during pain and stress. In addition, patients raised concerns about the AI's ability to recognize diverse accents, prompting some patients to modify their speech to avoid potential misunderstandings.

To alleviate these concerns, physicians should reassure patients at the outset of consultations that the AI is adept at recognizing various accents and that any discrepancies in the transcription can be corrected upon review. Implementing a consent mechanism, such as the MTGIC, could further empower patients by allowing them to specify the type and level of information they are comfortable with being retained, potentially easing concerns about the need to speak eloquently and professionally.

Besides communication, patients noted significant improvements in consultation efficiency. They reported quicker consultations due to not having to repeat information and the potential for reducing wait times. This contrasts with some physicians' experiences of increased interaction time per patient, which may depend on a per-physician basis or could be a result of an engaged interaction where perceived interaction time is shorter than actual.

On the contrary, patients expressed concerns about the potential negative impacts of AI scribes on physician behaviour, including decreased vigilance, increased complacency, and instances of self-censorship driven by medicolegal concerns. These issues underscore the complex implications of

integrating AI technologies in clinical settings, suggesting a need for ongoing assessment and adaptation to optimize both patient and physician experiences.

6.1.1.2.1 Recommendation for AI Scribe Providers

- Provide clear, accessible information about how the AI works, including its limitations and how it handles transcription errors.
- Implement a consent model such as MTGIC that allows users autonomy over what data is retained.

The above two changes combined will help reduce patient apprehension about the recording process.

6.1.1.2.2 Recommendations for Physicians

- Assure patients about the AI scribe's capabilities, specifically its accuracy in voice recognition and physicians' review of important details to correct any errors in the clinical note.
- Be cautious of over-reliance on AI scribes. This can be achieved by regularly assessing how AI's use impacts clinical decision-making and patient interactions.

6.1.1.2.3 Recommendations for Future Work

This study was based on self-reports, which are subjective. An objective empirical study that measures how AI scribes affect consultation times, patient satisfaction, and overall clinical outcomes is crucial. The research should also consider variations across different medical specialties and settings. Further, I recommend an investigation on the long-term effects of AI scribe usage on the patient-physician relationship, with a focus on trust, communication patterns, and patient willingness to share sensitive information should be conducted.

6.1.2 Research Question Two

The study's second objective was to identify and analyze the concerns related to privacy, consent, and trust among both patients and physicians. Quantitative and qualitative data was collected in these regards from all participants through the survey and interview and is presented in sections 4.2.5, 4.3.3 and 4.4.2. The major finding is discussed in the below subsection.

6.1.2.1 Privacy and Consent in AI Scribe Adoption

A significant segment of patients and physicians expressed considerable apprehension regarding privacy when considering the adoption of AI scribes. This trepidation substantially influenced their willingness to consent to the technology. From the patient's perspective, predominant concerns stemmed from fears of unauthorized access and data breaches, compounded by a lack of clarity regarding data management policies. Physicians paralleled these concerns with those associated with EMRs, though some acknowledged the necessity of stringent privacy policies and robust security measures.

Both stakeholders emphasized the critical need for transparency in data handling, storage, and secondary use policies. An analysis of service provider policies, as discussed in section 2.1.2, underscored the complexity and opacity of these policies, which only a minority of early adopters and experienced users could confidently understand. The pervasive uncertainty about data management policies poses significant risks for the widespread adoption of AI scribe technology and could degrade the quality of patient care due to self-censorship or the withholding of sensitive information by patients.

6.1.2.2 Trust and Consent in AI Scribe Adoption

Trust in physicians and the strength of pre-established patient-physician relationships emerged as critical factors influencing patients' consent to use AI scribes. Patients were more likely to consent to using AI scribes with physicians they had prior interactions. This finding suggests that deploying AI scribes during initial patient encounters may pose challenges until such technologies become more normalized within clinical settings.

6.1.2.3 Other Factors for Consent

Beyond privacy and trust, patients indicated a need to understand the personal benefits of the technology before granting consent. Notably, factors such as ease of access to medical notes were highlighted as incentives that could sway patients toward consenting to using AI scribes.

6.1.2.4 Recommendation for AI Scribe Providers

- Communicate the benefits and potential risks associated with the use of ambient scribes to both healthcare providers and patients to facilitate informed decision-making.

- Implement a simple and transparent data management and usage policy that can be understood without expertise.
- Implement and regularly update advanced security protocols to assure users of the safety and integrity of their data.
- Use and administer comprehensive, easy-to-understand consent models, such as the MTGIC, to streamline the consent process and reduce the administrative burden on physicians.

6.1.2.5 Recommendations for Physicians

Given the role of pre-established relationships and trust for consent, I encourage physicians to leverage this when introducing AI scribes to patients. Maintaining this trust is also important; hence, the technology's role, benefits, and risks should be openly and honestly discussed during consultations. This includes being well-informed about the AI scribe's functionality, data handling policy and the safeguards in place to protect patient information, and comprehensively addressing any patient concerns about privacy and the security of their data and

6.1.2.6 Recommendations for Future Work

The current study provides a snapshot of the attitudes of patients and physicians. Future research should investigate patient and physician attitudes toward AI scribes over time to identify trends in trust and acceptance as the technology becomes more widespread and normalized in clinical settings. This ongoing research is vital in assessing how perceptions of privacy and trust evolve with the continued use of ambient scribes and would inform further refinements to consent models and security measures.

6.1.3 Research Question Three

The third objective of this study was to develop and evaluate a flexible informed consent protocol that patients and physicians can use for ambient scribe technology. This led to the creation of a tiered consent form with detailed options, referred to as the MTGIC, which is based on extensive literature reviews and conceptual frameworks outlined in sections 5.2, 5.3 and 5.4. The developed framework was empirically evaluated, and the results are discussed in section 5.6.

The findings indicate that patients and physicians have nuanced preferences that necessitate a consent model tailored to their comfort levels, thereby validating the MTGIC approach. Traditional umbrella

consent models or binary (take-it-or-leave-it) options alienate most users or force them into decisions that do not reflect their true preferences.

Analysis of why participants made specific choices at the tiered and granular levels revealed that physicians' decisions were primarily driven by their expected comfort level for patients and the potential benefits of using an AI scribe, such as reduced documentation time. Concerns about medicolegal implications also played a secondary role in their decisions (refer to section 5.6.1 and 5.6.4 for more details).

On the other hand, patients were influenced by factors such as the sensitivity of their visit, risks to privacy and confidentiality, their capacity to provide informed consent, trust in and familiarity with their physician, legal implications, and the perceived personal benefits of the technology.

In evaluating the usability of the MTGIC model, the majority from both groups found the process to be understandable yet complex, with physicians reporting slightly higher rates of understanding and complexity. This suggests a need to streamline the consent process, possibly by simplifying the language. Additionally, I hypothesize that presenting the MTGIC in a purely textual format may have affected its usability. A redesigned format incorporating graphics, radio buttons, and hover-over details for clarification is recommended for future iterations to enhance user interaction.

As for the understandability of the options provided, most participants from both groups rated this aspect positively, with physicians again reporting slightly higher rates. This could be attributed to physicians' deeper understanding of the technology involved. However, there remains an opportunity to improve the clarity for both groups by simplifying the wording and providing feedback on user choices through visual cues and textual confirmations, such as stating, "You have chosen not to store any data. All your data will be promptly removed from the system once the function is complete."

Regarding the willingness to use MTGIC, at least 50% of participants from both groups expressed a positive inclination, with a higher percentage of patients feeling this way. Patients were mainly motivated by the MTGIC's autonomy over their data and ability to choose the medium of their health care. Conversely, those hesitant about the model were concerned about comprehending its implications, and a minority felt that physicians should make these decisions. Physicians also valued the autonomy the model provided but were wary of the increased workload that a detailed consent process could impose on their practice. Both groups agreed that consent for the AI scribe should

ideally be obtained before the appointment, possibly at the time of booking or appointment confirmation, allowing patients ample time to understand and make informed decisions.

Regarding the impact of MTGIC on trust and confidence in the AI scribe system, the majority of both groups responded positively, with a notably higher percentage of physicians agreeing. This positive response is believed to be influenced by the perception that a detailed and tiered consent process would enhance transparency and integrity in medical procedures and data management.

Overall, the MTGIC's conceptual design is viewed as a positive advancement, well-received by both user groups. The following subsection will outline recommendations for the next iteration of the consent form. It is crucial to recognize that while a consent form promoting transparency and informed decision-making marks a significant step forward, it is only part of the necessary changes. Ongoing education and awareness efforts regarding health technologies, data protection, and individual's rights to their data are essential to realizing the benefits of such innovations fully.

6.1.3.1 Recommendation for Future Iterations of MTGIC

- Incorporate graphical elements like icons and infographics to simplify and visualize complex concepts.
- Utilize straightforward language accessible at a middle school reading level to ensure comprehensibility for all users.
- Integrate interactive features such as radio buttons and sliders to facilitate user engagement and decision-making.
- Implement hover-over details for additional information and provide immediate visual and textual feedback to confirm user selections.
- Apply a tiered information presentation approach, allowing users to access more detailed information only if they choose.
- Optimize the layout to guide users seamlessly through the sections, enhancing the form's intuitiveness.
- Require consent to be acquired prior to appointments, potentially at the time of booking or through pre-visit communications.
- Provide options for patients to consult with healthcare providers about the consent form before signing, ensuring thorough understanding and comfort with the agreement.

6.1.4 Recommendation for Policy Makers

Policymakers across various sectors play a pivotal role in the adoption of technologies. The implementation of EMRs, for instance, was accelerated by policies that either incentivized or mandated their use for clinical documentation. Such policies have been adopted nationally, as seen with the HITECH Act in the U.S. [80] and locally within many Canadian hospitals. Despite these efforts, the technology has struggled with usability issues, leading to widespread development and trial of workarounds, as discussed in Chapter 1.

Given these challenges, I recommend the adoption of a more robust and carefully considered policy framework for AI scribes and other healthcare applications and beyond. This framework should actively involve key stakeholders and advocate for their needs in terms of functionality and user experience with service providers.

Policymakers are uniquely positioned to ensure that AI scribe technology aligns with users' interests, benefits, and protections. I recommend they incentivize or mandate the implementation of the recommendations outlined in sections 6.1.1.1.1.1, 6.1.1.1.2.1, 6.1.1.1.3.1, 6.1.1.2.1 and 6.1.2.4 for service providers. I advise policymakers to undertake future work suggested for researchers in sections 6.1.1.1.1.3, 6.1.1.1.2.3, 6.1.1.1.3.2 and 6.1.2.6 and support/promote collaboration among researchers and developers. Such efforts enable policymakers to implement informed and data-driven policies.

Additionally, I suggest policymakers establish a stringent vetting process to ensure that all data handling and policy compliance measures prioritize user data protection. This will safeguard against potential misuse and enhance trust in deploying AI scribe technologies in healthcare settings.

6.2 Challenges and Limitations of the Study

6.2.1 Study Population

6.2.1.1 Limitation of Recruitment

This study primarily relied on social media and university settings for patient recruitment, which may have skewed the sample toward younger individuals and those deeply connected to digital or academic environments. Additionally, recruiting patients through physicians who are early adopters

of AI technology could introduce biases, potentially influencing patients' views based on their physicians' experiences with the technology.

Physician recruitment uses snowball sampling due to the challenges of finding participants without a referral. This approach might limit the diversity of professional insights, as snowball sampling, despite its intent to widen participant outreach, often remains within relatively homogenous networks.

While effective in engaging certain population segments, these recruitment strategies may not capture the full spectrum of views from less accessible demographics, such as individuals less active on social media or outside the targeted academic and professional circles. As a result, the study's findings could be influenced by the inherent biases of the chosen recruitment methods, impacting the generalizability of the results to all patient and physician groups potentially affected by ambient scribe technology in healthcare settings.

6.2.1.2 Impact of Demographics and Regional Policies

The study explored the perspective of early adopters and non-adopters of AI scribes. It is important to note that early adopters of technology typically possess distinct characteristics that may skew a study's findings. These individuals are often more technologically savvy, more open to change, and more willing to experiment with new solutions to enhance their practice efficiency [81]. As a result, they are usually more receptive and positive to new technologies compared to later adopters, who could be more resistant to change or less comfortable with new technology. This discrepancy can affect ambient scribes' perceived effectiveness and utility, as early adopters may overlook certain shortcomings or adapt more quickly to the technology's demands.

Another aspect that impacts the study is the unique nature of Canada's healthcare system, which differs markedly from systems in other parts of the world, such as the United States. Canada's predominantly public-payer system has a different funding structures, regulatory environments, and healthcare priorities. This might result in differing attitudes toward deploying AI technologies, which can carry significant legal implications regarding data privacy and malpractice.

The differences in healthcare system structures and cultural attitudes towards technology and data privacy across regions suggest that the adoption patterns observed in Canada may not be directly applicable or replicable in other contexts. This regional variance underscores the necessity for

ambient scribe studies to consider regional healthcare policies, system structures, and cultural attitudes towards technology to understand the drivers and barriers to technology adoption fully.

Furthermore, there is a push to adopt ambient scribe technology in Canada, especially in Ontario [82], [83]. This stems from an overwhelming need for efficiency by the country's overburdened healthcare system and physicians. Further research should explore how these initiatives impact the uptake and effectiveness of ambient scribes.

6.2.2 Study Methodology

The study relies on self-reported data and retrospective accounts, which requires cautious interpretation. Observational studies are needed to confirm these impressions and objectively measure the ambient scribe's integration into healthcare practices. Different observational studies are recommended for each objective, as discussed in the subsections under section 6.1.

In addition, it is acknowledged that the results may be influenced by researcher biases and the selected methodologies. Braun and Clarke emphasize that researchers' assumptions and choices inevitably shape the knowledge produced [57]. With this acknowledgment steps are taken to identify and control the impact of researchers preconceived assumption and the impact of the chosen methodologies.

First, the subjective nature of thematic analysis is expected to introduce unconscious researcher bias. To mitigate this, a secondary coder, who was not involved in the study's development or data collection (e.g., interviews), was employed. Second, the development of the MTGIC based on a literature review prior to the survey and interviews is acknowledged as a potential source of preconceived bias in the coding and thematic analysis. To address this, an inductive reflective analysis approach was chosen, which requires researchers to engage with the data before coding. Finally, the study design incorporates the understanding that the evaluated conceptual consent design is based on assumptions that need to be validated or discarded based on the study's findings. This design approach helps mitigate preconceived assumptions. Additionally, triangulation in analysis was used to ensure that findings from different data sources corroborate each other. Section 5.6.1 discusses a case where survey and interview findings diverged. Furthermore, secondary data sources were employed to compare and validate the findings.

6.2.3 Development of Informed Consent Protocol

The development of the conceptual MTGIC model for AI scribes has brought forth several unresolved questions and challenges that warrant critical examination that have not been addressed given practical implementation limitations. These are discussed below and should be considered for future model iterations.

Withdrawal Process and Dynamic Consent

A significant consideration is the process by which users withdraw consent. The ideal scenario involves a dynamic consent model, allowing users to modify their consent choices anytime. However, this raises concerns about individual users' technical ability and the potential burden of managing additional accounts.

Future work should explore patient preferences regarding dynamic consent and physician and service providers perspectives on the administrative aspects of managing such a system.

Consent Fatigue

A potential critique of detailed consent processes is the risk of 'consent fatigue,' where users become overwhelmed by the volume and complexity of consent choices. However, the empirical study did not indicate consent fatigue significantly. Future studies precisely assess this.

Perspective of Service Providers and Developers

The implementation of a nuanced consent process necessitates the involvement and cooperation of service providers and developers. To fully operationalize the concept, these stakeholders must integrate the consent framework into their service offerings.

A key consideration is managing consent over time. Placing the responsibility of consent management on clinicians contradicts ambient scribe's primary objective—to reduce the administrative burden on healthcare providers. Therefore, service providers should ideally manage the consent process, treating clinicians as clients rather than administrators of the system.

Future research should include service providers as key stakeholders, exploring how consent can be effectively managed and maintained over time without imposing additional workload on healthcare providers.

In conclusion, while the multi-tiered granular consent process for AI scribes aligns with ethical and privacy standards, its practical implementation in a healthcare environment presents various challenges. Future studies should address these challenges and refine the model based on the findings of the empirical evaluation to ensure it is user-friendly, effective, and sustainable in a real-world setting.

References

- [1] D. Garets and M. Davis, “Electronic Medical Records vs. Electronic Health Records: yes, there is a difference,” *HIMSS Analytics*, 2006.
- [2] Chaudhry, Basit *et al.*, “Systematic review: impact of health information technology on quality, efficiency, and costs of medical care.,” *Annals of internal medicine*, vol. 144, no. 2006, pp. 742–752.
- [3] Hillestad, Richard *et al.*, “Can electronic medical record systems transform health care? Potential health benefits, savings, and costs.,” *Health Affairs*, vol. 24, no. 5, pp. 1103–1117, 2005.
- [4] E. Coiera, J. Ash, and M. Berg, “The Unintended Consequences of Health Information Technology Revisited,” *Yearb Med Inform*, vol. 25, no. 01, pp. 163–169, Aug. 2016, doi: 10.15265/IY-2016-014.
- [5] M. L. Cox *et al.*, “Documenting or Operating: Where Is Time Spent in General Surgery Residency?,” *Journal of Surgical Education*, vol. 75, no. 6, pp. e97–e106, Nov. 2018, doi: 10.1016/j.jsurg.2018.10.010.
- [6] T. Tajirian *et al.*, “The Influence of Electronic Health Record Use on Physician Burnout: Cross-Sectional Survey,” *J Med Internet Res*, vol. 22, no. 7, p. e19274, Jul. 2020, doi: 10.2196/19274.
- [7] A. J. Moy *et al.*, “Measurement of clinical documentation burden among physicians and nurses using electronic health records: a scoping review,” *Journal of the American Medical Informatics Association*, vol. 28, no. 5, pp. 998–1008, Apr. 2021, doi: 10.1093/jamia/ocaa325.
- [8] Maslach, Christina., Jackson, Susan E., and Leiter, Michael P., *Maslach burnout inventory manual*, 3rd ed. Palo Alto, CA: Consulting Psychologists Press, 1996.
- [9] D. Scott and I. N. Purves, “Triadic relationship between doctor, computer and patient,” *Interacting with Computers*, vol. 8, no. 4, pp. 347–363, Dec. 1996, doi: 10.1016/S0953-5438(97)83778-2.
- [10] C. Pearce, M. Arnold, C. Phillips, S. Trumble, and K. Dwan, “The patient and the computer in the primary care consultation,” *Journal of the American Medical Informatics Association*, vol. 18, no. 2, pp. 138–142, Mar. 2011, doi: 10.1136/jamia.2010.006486.
- [11] C. Bossen, Y. Chen, and K. H. Pine, “The emergence of new data work occupations in healthcare: The case of medical scribes,” *International Journal of Medical Informatics*, vol. 123, pp. 76–83, Mar. 2019, doi: 10.1016/j.ijmedinf.2019.01.001.
- [12] L. Shah, “A Scoping Review and Thematic Analysis of the Effects of Medical Scribes on Patients and Physicians,” Univesity of Victoria, Victoria, British Columbia, 2020. [Online]. Available: <https://dspace.library.uvic.ca/server/api/core/bitstreams/18664bc1-94ad-4282-a9c6-65936ad2f067/content>

- [13] C. G. Shultz and H. L. Holmstrom, “The Use of Medical Scribes in Health Care Settings: A Systematic Review and Future Directions,” *The Journal of the American Board of Family Medicine*, vol. 28, no. 3, pp. 371–381, May 2015, doi: 10.3122/jabfm.2015.03.140224.
- [14] B. D. Tran, K. Rosenbaum, and K. Zheng, “An interview study with medical scribes on how their work may alleviate clinician burnout through delegated health IT tasks,” *Journal of the American Medical Informatics Association*, vol. 28, no. 5, pp. 907–914, Apr. 2021, doi: 10.1093/jamia/ocaa345.
- [15] “Scribes - Medical Scribes of Canada.” Accessed: Dec. 05, 2023. [Online]. Available: <https://www.medicalscribesofcanada.ca/scribes/>
- [16] J. Viitanen, “Redesigning digital dictation for physicians: A user-centred approach,” *Health Informatics J*, vol. 15, no. 3, pp. 179–190, Sep. 2009, doi: 10.1177/1460458209337429.
- [17] S. Ghatnekar, A. Faletsky, and V. E. Nambudiri, “Digital scribe utility and barriers to implementation in clinical practice: a scoping review,” *Health Technol.*, vol. 11, no. 4, pp. 803–809, Jul. 2021, doi: 10.1007/s12553-021-00568-0.
- [18] L. Wilcox, R. Brewer, and F. Diaz, “AI Consent Futures: A Case Study on Voice Data Collection with Clinicians,” *Proc. ACM Hum.-Comput. Interact.*, vol. 7, no. CSCW2, pp. 1–30, Sep. 2023, doi: 10.1145/3610107.
- [19] M. M. Van Buchem, H. Boosman, M. P. Bauer, I. M. J. Kant, S. A. Cammel, and E. W. Steyerberg, “The digital scribe in clinical practice: a scoping review and research agenda,” *npj Digit. Med.*, vol. 4, no. 1, p. 57, Mar. 2021, doi: 10.1038/s41746-021-00432-5.
- [20] F. K. Khattak, S. Jeblee, N. Crampton, M. Mamdani, and F. Rudzicz, “AutoScribe: Extracting Clinically Pertinent Information from Patient-Clinician Dialogues”.
- [21] B. Li, N. Crampton, T. Yeates, Y. Xia, X. Tian, and K. Truong, “Automating Clinical Documentation with Digital Scribes: Understanding the Impact on Physicians,” in *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, Yokohama Japan: ACM, May 2021, pp. 1–12. doi: 10.1145/3411764.3445172.
- [22] M. Willis and M. H. Jarrahi, “Automating Documentation: A Critical Perspective into the Role of Artificial Intelligence in Clinical Documentation,” in *Information in Contemporary Society*, vol. 11420, N. G. Taylor, C. Christian-Lamb, M. H. Martin, and B. Nardi, Eds., in *Lecture Notes in Computer Science*, vol. 11420. , Cham: Springer International Publishing, 2019, pp. 200–209. doi: 10.1007/978-3-030-15742-5_19.
- [23] B. Ondov, K. Attal, and D. Demner-Fushman, “A survey of automated methods for biomedical text simplification,” *Journal of the American Medical Informatics Association*, vol. 29, no. 11, 2022.
- [24] B. D. Tran *et al.*, “‘Mm-hm,’ ‘Uh-uh’: are non-lexical conversational sounds deal breakers for the ambient clinical documentation technology?,” *Journal of the American Medical Informatics Association*, vol. 30, no. 4, pp. 703–711, Mar. 2023, doi: 10.1093/jamia/ocad001.
- [25] “Nabla Copilot · Enjoy care again.” Accessed: Jan. 25, 2024. [Online]. Available: https://www.nabla.com/?gclid=EAIaIQobChMI1bPQv5P5gwMV1zbUAR2FoAXvEAMYASAAEgJS3PD_BwE&adgroupid=158224400835&campaignid=20923440949&creative=650471358706

- [26] “Features - Tali AI.” Accessed: Jan. 25, 2024. [Online]. Available: <https://tali.ai/features>
- [27] “DeepScribe AI Medical Scribe.” Accessed: Jan. 25, 2024. [Online]. Available: <https://www.deepscribe.ai/>
- [28] “Your Documentation on Autopilot | Ambience Healthcare.” Accessed: Jan. 25, 2024. [Online]. Available: <https://www.ambiencehealthcare.com/>
- [29] S. L. Douglas *et al.*, “Ethical, legal and administrative implications of the use of video and audio recording in an emergency department in Ontario, Canada,” *BMJ Innov*, vol. 7, no. 1, pp. 224–230, Jan. 2021, doi: 10.1136/bmjinnov-2020-000430.
- [30] N. Martinez-Martin *et al.*, “Ethical issues in using ambient intelligence in health-care settings,” *The Lancet Digital Health*, vol. 3, no. 2, pp. e115–e123, Feb. 2021, doi: 10.1016/S2589-7500(20)30275-2.
- [31] P. Caire, A. Moawad, V. Efthymiou, A. Bikakis, and Y. Le Traon, “Privacy challenges in Ambient Intelligence systems: Lessons learned, gaps and perspectives from the AAL domain and applications,” *AIS*, vol. 8, no. 6, pp. 619–644, Nov. 2016, doi: 10.3233/AIS-160405.
- [32] W. Wilkowska, S. Otten, C. Maidhof, and M. Ziefle, “Trust Conditions and Privacy Perceptions in the Acceptance of Ambient Technologies for Health-Related Purposes,” *International Journal of Human–Computer Interaction*, pp. 1–16, Oct. 2023, doi: 10.1080/10447318.2023.2272075.
- [33] L. M. Owens, J. J. Wilda, P. Y. Hahn, T. Koehler, and J. J. Fletcher, “The association between use of ambient voice technology documentation during primary care patient encounters, documentation burden, and provider burnout,” *Family Practice*, p. cmad092, Sep. 2023, doi: 10.1093/fampra/cmad092.
- [34] “TermsOfUse — AutoScribe.” Accessed: Dec. 05, 2023. [Online]. Available: <https://mutuohealth.com/termsfuse>
- [35] “Terms of Use - Tali AII.” Accessed: Dec. 05, 2023. [Online]. Available: <https://tali.ai/terms-of-use>
- [36] “Terms of Use - DeepScribe.” Accessed: Dec. 05, 2023. [Online]. Available: <https://www.deepscribe.ai/terms>
- [37] “Terms of Service with BAA.” Accessed: Apr. 06, 2024. [Online]. Available: <https://www.nabla.com/docs/terms-baa>
- [38] “Terms of Service.” Accessed: Apr. 06, 2024. [Online]. Available: <https://www.nabla.com/docs/terms>
- [39] “Data protection agreement.” Accessed: Apr. 06, 2024. [Online]. Available: <https://www.nabla.com/docs/copilot-dpa>
- [40] “Privacy Policy — AutoScribe.” Accessed: Dec. 05, 2023. [Online]. Available: <https://mutuohealth.com/privacypolicy>
- [41] “Privacy Policy - Tali AI.” Accessed: Apr. 06, 2024. [Online]. Available: <https://tali.ai/privacy-policy>

- [42] “Privacy Policy - DeepScribe.” Accessed: Dec. 05, 2023. [Online]. Available: <https://www.deepscribe.ai/privacy>
- [43] “Nabla Copilot Privacy Policy (only for processing of customer data for contract management not patient health data) - For US Based Clients.” Accessed: Apr. 06, 2024. [Online]. Available: <https://www.nabla.com/docs/privacy-policy>
- [44] “Nabla Copilot Privacy Policy (only for processing of customer data for contract management not patient health data) - For clients outside US, primarily EU.” Accessed: Apr. 06, 2024. [Online]. Available: <https://www.nabla.com/docs/privacy-policy-row>
- [45] Office of the Privacy Commissioner of Canada, “Summary of privacy laws in Canada - Office of the Privacy Commissioner of Canada.” Accessed: Apr. 06, 2024. [Online]. Available: https://www.priv.gc.ca/en/privacy-topics/privacy-laws-in-canada/02_05_d_15/
- [46] G. Cohen and M. Mello, “HIPAA and protecting health information in the 21st century,” *JAMA Viewpoint*, 2018.
- [47] E. Parasidis, E. Pike, and D. McGraw, “A Belmont Report for Health Data,” *N Engl J Med*, vol. 380, no. 16, pp. 1493–1495, Apr. 2019, doi: 10.1056/NEJMp1816373.
- [48] Government of Canada, “Artificial Intelligence and Data Act.” Accessed: Nov. 09, 2024. [Online]. Available: <https://ised-isde.canada.ca/site/innovation-better-canada/en/artificial-intelligence-and-data-act>
- [49] Office of the Privacy Commissioner of Canada, “Principles for responsible, trustworthy and privacy-protective generative AI technologies - Office of the Privacy Commissioner of Canada.” Accessed: Apr. 06, 2024. [Online]. Available: https://www.priv.gc.ca/en/privacy-topics/technology/artificial-intelligence/gd_principles_ai/
- [50] “What Is Ergonomics (HFE)? | International Ergonomics Association.” Accessed: May 08, 2024. [Online]. Available: <https://iea.cc/about/what-is-ergonomics/>
- [51] S. D. Warren and L. D. Brandeis, “The Right to Privacy,” *Harvard Law Review*, vol. 4, pp. 193–220, 1908.
- [52] S. Gritzalis, “Enhancing Web privacy and anonymity in the digital era,” *Information Management & Computer Security*, vol. 12, no. 3, pp. 255–287, Jul. 2004, doi: 10.1108/09685220410542615.
- [53] B. Friedman and D. Hendry, *Value sensitive design: shaping technology with moral imagination*. Cambridge, Massachusetts: The MIT Press, 2019.
- [54] E.-M. Schomakers and M. Ziefle, “Privacy vs. Security: Trade-Offs in the Acceptance of Smart Technologies for Aging-in-Place,” *International Journal of Human–Computer Interaction*, vol. 39, no. 5, pp. 1043–1058, Mar. 2023, doi: 10.1080/10447318.2022.2078463.
- [55] J. W. Creswell and V. L. Plano Clark, *Designing and conducting mixed methods research*. Thousand Oaks, Calif: SAGE Publications, 2007.
- [56] V. Braun and V. Clarke, “Can I use TA? Should I use TA? Should I not use TA? Comparing reflexive thematic analysis and other pattern-based qualitative analytic approaches,” *Couns and Psychother Res*, vol. 21, no. 1, pp. 37–47, Mar. 2021, doi: 10.1002/capr.12360.

- [57] V. Braun and V. Clarke, “Doing Reflexive Thematic Analysis,” in *Supporting Research in Counselling and Psychotherapy: Qualitative, Quantitative, and Mixed Methods Research*, Cham: Springer International Publishing AG, 2023.
- [58] V. Braun and V. Clarke, “Using thematic analysis in psychology,” *Qualitative Research in Psychology*, vol. 3, no. 2, pp. 77–101, Jan. 2006, doi: 10.1191/1478088706qp063oa.
- [59] J. C. Quiroz, L. Laranjo, A. B. Kocaballi, S. Berkovsky, D. Rezazadegan, and E. Coiera, “Challenges of developing a digital scribe to reduce clinical documentation burden,” *npj Digit. Med.*, vol. 2, no. 1, p. 114, Nov. 2019, doi: 10.1038/s41746-019-0190-1.
- [60] N. G. Taylor, C. Christian-Lamb, M. H. Martin, and B. Nardi, Eds., *Information in Contemporary Society: 14th International Conference, iConference 2019, Washington, DC, USA, March 31–April 3, 2019, Proceedings*, vol. 11420. in Lecture Notes in Computer Science, vol. 11420. Cham: Springer International Publishing, 2019. doi: 10.1007/978-3-030-15742-5.
- [61] M. Jefford and R. Moore, “Improvement of informed consent and the quality of consent documents,” *The Lancet Oncology*, vol. 9, no. 5, pp. 485–493, May 2008, doi: 10.1016/S1470-2045(08)70128-1.
- [62] D. P. Duryea, “Commentary on Schloendorff v. Society of New York Hospital,” in *Feminist Judgments: Health Law Rewritten*, 1st ed., S. Mohapatra and L. Wiley, Eds., Cambridge University Press, 2022, pp. 17–40. doi: 10.1017/9781108860901.002.
- [63] J. D. Moreno, U. Schmidt, and S. Joffe, “The Nuremberg Code 70 Years Later,” *JAMA*, vol. 318, no. 9, p. 795, Sep. 2017, doi: 10.1001/jama.2017.10265.
- [64] “WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects – WMA – The World Medical Association.” Accessed: May 05, 2024. [Online]. Available: <https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/>
- [65] S. Wiertz and J. Boldt, “Evaluating models of consent in changing health research environments,” *Med Health Care and Philos*, vol. 25, no. 2, pp. 269–280, Jun. 2022, doi: 10.1007/s11019-022-10074-3.
- [66] The Office of National coordinator for Health Information Technology, “Enabling Granular Choice for Health Care Delivery and Research Consent,” in *Privacy and Security Framework for Patient Centered Outcomes Research (PCOR)*, 2020.
- [67] Batya Friedman and Peter H. Kahn, “Human values, ethics, and design,” in *The human-computer interaction handbook: fundamentals, evolving technologies and emerging applications*, pp. 1177–1201. Accessed: Apr. 07, 2024. [Online]. Available: https://faculty.washington.edu/pkahn/articles/Human_Values_Ethics_Design.pdf
- [68] B. Friedman, P. H. K. Jr, and A. Borning, “Value Sensitive Design and Information Systems.”
- [69] B. Friedman, E. Felten, and L. I. Millett, “Informed Consent Online: A Conceptual Model and Design Principles”.

- [70] D. G. Hendry, B. Friedman, and S. Ballard, "Value sensitive design as a formative framework," *Ethics Inf Technol*, vol. 23, no. 1, pp. 39–44, Mar. 2021, doi: 10.1007/s10676-021-09579-x.
- [71] A. Cavoukian, "Privacy by Design [Leading Edge]," *IEEE Technol. Soc. Mag.*, vol. 31, no. 4, pp. 18–19, 2012, doi: 10.1109/MTS.2012.2225459.
- [72] A. Cavoukian, "Privacy by Design The 7 Foundational Principles".
- [73] S. L. Garfinkel, "De-identification of personal information," National Institute of Standards and Technology, NIST IR 8053, Oct. 2015. doi: 10.6028/NIST.IR.8053.
- [74] J. S. Yoo, A. Thaler, L. Sweeney, and J. Zang, "Risks to Patient Privacy: A Re-identification of Patients in Maine and Vermont Statewide Hospital Data | Technology Science," *Technology Science*, Oct. 2018, Accessed: May 09, 2024. [Online]. Available: <https://techscience.org/a/2018100901/>
- [75] L. Na, C. Yang, C.-C. Lo, F. Zhao, Y. Fukuoka, and A. Aswani, "Feasibility of Reidentifying Individuals in Large National Physical Activity Data Sets From Which Protected Health Information Has Been Removed With Use of Machine Learning," *JAMA Netw Open*, vol. 1, no. 8, p. e186040, Dec. 2018, doi: 10.1001/jamanetworkopen.2018.6040.
- [76] J. Blocki, N. Christin, A. Datta, and A. Sinha, "Regret Minimizing Audits: A Learning-Theoretic Basis for Privacy Protection," in *2011 IEEE 24th Computer Security Foundations Symposium*, Cernay-la-Ville, France: IEEE, Jun. 2011, pp. 312–327. doi: 10.1109/CSF.2011.28.
- [77] J. Offermann-van Heek and M. Ziefle, "Nothing Else Matters! Trade-Offs Between Perceived Benefits and Barriers of AAL Technology Usage," *Front Public Health*, vol. 7, p. 134, 2019, doi: 10.3389/fpubh.2019.00134.
- [78] J. I. Campbell, N. Eyal, A. Musiimenta, and J. E. Haberer, "Ethical Questions in Medical Electronic Adherence Monitoring," *J GEN INTERN MED*, vol. 31, no. 3, pp. 338–342, Mar. 2016, doi: 10.1007/s11606-015-3502-4.
- [79] H. Lee and U. Lee, "Toward Dynamic Consent for Privacy-Aware Pervasive Health and Well-being: A Scoping Review and Research Directions," *IEEE Pervasive Comput.*, vol. 21, no. 4, pp. 25–32, Oct. 2022, doi: 10.1109/MPRV.2022.3210747.
- [80] H. Burde, "THE HITECH ACT: An Overview | Journal of Ethics | American Medical Association," *AMA Journal of Ethics*. Accessed: Jul. 04, 2024. [Online]. Available: <https://journalofethics.ama-assn.org/article/hitech-act-overview/2011-03>
- [81] P. Tobbin and J. Adjei, "Understanding the Characteristics of Early and Late Adopters of Technology: The Case of Mobile Money," *International Journal of E-Services and Mobile Applications*, vol. 4, no. 2, pp. 37–54, Apr. 2012, doi: 10.4018/jesma.2012040103.
- [82] Ontario Government, "Ontario Helping Family Doctors Put Patients before Paperwork," Ontario Newsroom. [Online]. Available: <https://news.ontario.ca/en/release/1004479/ontario-helping-family-doctors-put-patients-before-paperwork>
- [83] Ontario Medical Association, "OMA welcomes artificial intelligence pilot and other initiatives aimed at reducing administrative burden for doctors." Accessed: Jun. 05, 2024. [Online]. Available: <https://www.oma.org/newsroom/news/2024/april/oma-welcomes->

artificial-intelligence-pilot-and-other-initiatives-aimed-at-reducing-administrative-burden-
for-doctors/

Appendix A

Study Materials

A 1. Ethics Approval

UNIVERSITY OF WATERLOO

Notification of Ethics Clearance to Conduct Research with Human Participants

Principal Investigator: Catherine Burns

Student investigator: Iman Basha

Research assistant: Nadia Nguyen

File #: 46012

Title: Exploring Patient and Provider Perspectives on Ambient Scribe Technology in Healthcare

The Human Research Ethics Board is pleased to inform you this study has been reviewed and given ethics clearance.

Initial Approval Date: 01/22/24 (m/d/y)

University of Waterloo Research Ethics Boards are composed in accordance with, and carry out their functions and operate in a manner consistent with, the institution's guidelines for research with human participants, the Tri-Council Policy Statement for the Ethical Conduct for Research Involving Humans (TCPS2 2022), the Ontario Personal Health Information Protection Act (PHIPA), and all laws and regulations of the province of Ontario (as applicable). Additionally, CREB operates in a manner consistent with the International Conference for Harmonization of Technical Requirements for Pharmaceuticals for Human Use (ICH) Guidance E6(R2): Good Clinical Practice, the International Organization for Standardization of Good Clinical Practices (GCP) as set out by ISO 14155 - Clinical investigation of medical devices for human subjects, Part C, Division 5 of the Food and Drug Regulations, Part 4 of the Natural Health Products Regulations, Part 3 of the Medical Devices Regulations. Both Boards are registered with the U.S. Department of Health and Human Services under the Federal Wide Assurance, FWA00021410, and IRB registration number IRB00002419 (HREB) and IRB00007409 (CREB).

Expiry Date: 01/23/25 (m/d/y)

Multi-year research must be renewed at least once every 12 months unless a more frequent review has otherwise been specified. Studies will only be renewed if the renewal report is received and approved before the expiry date. Failure to submit renewal reports will result in the investigators being notified ethics clearance has been suspended and Research Finance being notified the ethics clearance is no longer valid.

Level of review: Delegated Review

Signed on behalf of the Human Research Ethics Board



Heather Dekker, Ethics Advisor, hdekker@uwaterloo.ca, 519-888-4567, ext. 41506

A 2. Patient Recruitment Materials

Recruitment Poster

**Department of Systems Design Engineering
University of Waterloo**

PARTICIPANTS NEEDED FOR HEALTHCARE TECHNOLOGY

Help Shape the Future of Healthcare!

We invite volunteers to participate in a study exploring perspectives on ambient scribe technology in healthcare settings. Your views are essential in shaping the future of patient care and technology.

What Will Participation Involve?

- **Online Survey:** Share your thoughts through a brief survey, taking approximately 20 - 30 minutes.
- **Optional Interview:** Engage in a deeper discussion during a 30-minute virtual interview.

What's in it for You?

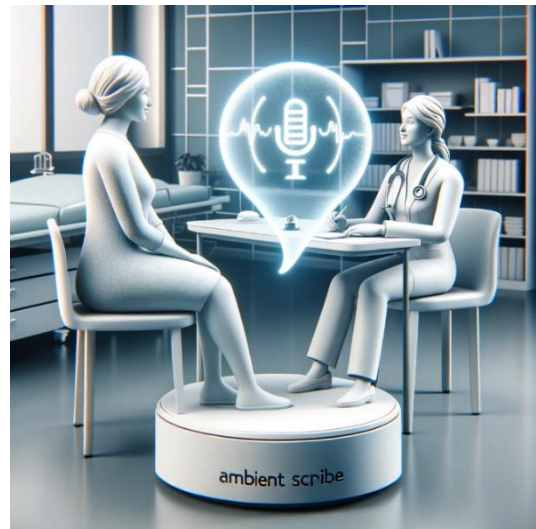
- **Survey:** Participants will be entered into a draw for one of five \$50 gift cards.
- **Interview:** Receive a \$25 gift card as a token of our appreciation.

Inclusion Criteria:

- Participants must be 18 years or older.
- You should have had some interaction with the healthcare system in the last 12 months. This includes being a patient, or a caregiver.
- You must be comfortable communicating in English, as the survey and interview will be conducted in this language.

Interested?

For more information about this study, please contact Iman Basha at xxxxx@uwaterloo.ca, [or click here to express your interest via a Microsoft form](#). [You may also scan the QR code to the right to access the form.](#)



**This study has been reviewed and received ethics clearance
through a University of Waterloo Research Ethics Board.**

A 3. Physician Recruitment Materials

Email Recruitment

Seeking Physicians' Insight on ambient scribe Technology – Thank You Gift Included

My name is Iman Basha and I am a master's student working under the supervision of Dr. Catherine Burns in the Advanced Interface Design Lab in the Systems Design Engineering Department at the University of Waterloo. As part of my master's degree, I am conducting a research study focused on understanding the perspectives and implications of ambient scribe technology in healthcare. Given your role as a healthcare professional and your experiences with patient care, I believe that you are well-positioned to provide valuable insight into this topic, and I would like to invite you to participate in this study.

To be eligible for this study, you must be **licensed physicians currently practicing in Canada**.

If you decide to volunteer for this study, you will participate in an online survey that will take about 20 - 30 minutes to complete. The survey will explore your views on the use of ambient scribe technology in healthcare settings, including its impact on patient care and privacy concerns.

In appreciation of your time, **you will receive a \$50 gift card of your choice as a token of appreciation** upon completing the survey. This gesture is our way of thanking you for your invaluable contribution.

To participate in the survey, please [click here](#).

Additionally, we are conducting optional follow-up interviews to gain deeper insights. These interviews will also take approximately 30 minutes. If you are interested in participating in the interview, [please click here to schedule it at a convenient time](#). **Participants in the follow-up interview will receive a remuneration of up to \$100.**

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board.

Please read the attached Information Letter for more details describing the study. If you would like to participate, or you require additional information to assist you in reaching a decision, please contact me at xxxxx@uwaterloo.ca. You may also contact my supervisor at xxxxxxx@uwaterloo.ca.

Your perspective is invaluable, and we also recognize the power of collective insight. Therefore, we kindly ask you to share this invitation with your colleagues and professional network, both within and outside of your specialty. By doing so, you may contribute to a broader and more diverse understanding of this technology's impact on healthcare.

Thank you for your time!

Sincerely,

Iman Basha,

MASc Candidate, Department of Systems Design Engineering

Faculty of Engineering, University of Waterloo

[Advanced Interface Design Lab](#)

200 University Avenue West, Waterloo, ON, N2L 3G1

Recruitment Poster

Department of Systems Design Engineering

University of Waterloo

PHYSICIANS NEEDED FOR HEALTHCARE TECHNOLOGY STUDY

We are inviting physicians to participate in a study on ambient scribe technology in healthcare. Your professional insights are crucial in understanding and shaping the integration of this innovative technology in enhancing patient care.

What Will Participation Involve:

- **Online Survey:** Share your thoughts through a brief survey, taking approximately 20 - 30 minutes.
- **Optional Interview:** Engage in a deeper discussion during a 30-minute virtual interview.

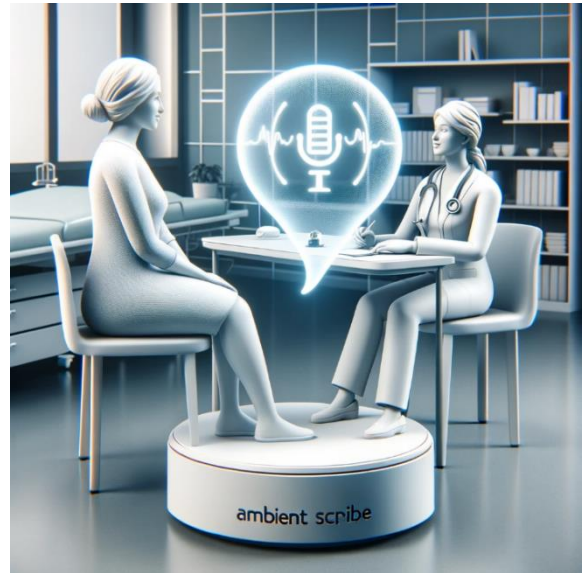
Acknowledging Your Time:

- **Survey Participation:** As a token of our appreciation, you will receive a \$50 gift card upon completing the survey.
- **Interview Contribution:** As a gesture of our gratitude for your valuable time and insights, you will receive up to \$100 for participating in the interview.

Join Us in This Endeavour:

For more information about this study, please contact Iman Basha at xxxxx@waterloo.ca, [or click here to express your interest via a Microsoft Form](#). You may also scan the QR code to the right to access the form.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board.



A 4. Patient Informational Letter for Survey

Study Title: Exploring Patient and Provider Perspectives on ambient scribe Technology in Healthcare

Faculty Supervisor: Catherine Burns, PhD, System Design Engineering, University of Waterloo, Email: xxxx@uwaterloo.ca

Student Investigator: Iman Basha, MASc, System Design Engineering, University of Waterloo. Email: xxxxx@uwaterloo.ca

This letter provides detailed information about your potential participation in our research study on ambient scribe technology in healthcare. Please read it carefully and retain a copy for your records. If you have any questions or require clarification on any part of this letter, feel free to contact us.

What is the study about?

You are invited to participate in a thesis research study exploring public perceptions of ambient scribe technology in healthcare, a significant step towards modernizing patient care. This technology, designed to automatically document patient-doctor interactions, has the potential to transform healthcare efficiency and accuracy. Your participation will contribute to a greater understanding of how this technology is received by the public and its potential impact on the healthcare experience.

What does participation involve?

Participation involves completing an online anonymous questionnaire, estimated to take between 20 - 30 minutes. The survey will ask for some basic information such as age, gender, and occupation, and will then explore your views on ambient scribe technology. Your responses will greatly enrich our research. If you agree, anonymous quotations from your open-ended responses may be used in future academic publications.

Opportunity for Further Involvement:

Should you wish to delve deeper into this topic, we invite you to express interest in participating in a follow-up interview. This is an opportunity to share more detailed insights and enhance our understanding of public views on ambient scribe technology. If interested, please indicate so in a separate form provided at the end of the survey. Additional details for the interview process will be sent to your email upon expressing your interest.

Who may participate in the study?

To participate in the study, you need to be at least 18 years of age, and possess a basic level of English proficiency to read and understand the questions and provide responses. In addition, you should have used a health service in Canada in the past 12 months.

Is participation in the study voluntary?

Your participation in this study is voluntary. You may decline to answer any question(s) you prefer not to answer by skipping to the next question and may stop participating at any time by going to the end of the survey and choosing to not submit your responses.

Will I receive anything for participating in the study?

If you participate in this study, you will be entered into a draw for one of five \$50 gift cards. The odds of winning are at least 1 in 20 or 5%, and you can choose from vendors such as Amazon, Best Buy, Canadian Tire, and Hudson Bay.

To keep your responses anonymous, you will be asked to provide your email address in a separate form for the purpose of receiving the gift card. Email addresses will be stored separately and then destroyed once gift cards have been issued unless you express interest to participate in the follow-up interview. The amount received is taxable. It is your responsibility to report this amount for income tax purposes.

If you choose to withdraw from the study early, please navigate to the end of the survey and opt not to submit your responses. You will then be directed to a separate form to enter the draw. However, if you accidentally close the browser mid-way and do not complete the survey, you won't be eligible for the draw. If you wish to be considered for the draw, you will need to restart and complete the survey.

What are the possible benefits of the study?

While there may not be direct personal benefits, your participation will play a crucial role in shaping the public discussion and future development of ambient scribe technology in healthcare.

What are the risks associated with the study?

There are no known or anticipated risks associated with participation in this study. If a question or the topic makes you uncomfortable, you can choose not to provide a response.

How is data collected, stored, and protected?

The questionnaire for this survey is anonymous and will not ask for your name or other identifying information. As described above, email addresses will be separately collected for sending gift cards.

Removing your responses later is not possible because the researchers will have no way of identifying which responses are yours.

This survey is hosted by Qualtrics, which has multiple safeguards in place, although no Internet transmission is ever fully secure. Collected data will be securely stored on password-protected computers for at least 7 years.

Has the study received ethics clearance?

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board (REB 46012). If you have questions for the Board, contact the Office of Research Ethics, toll-free at 1-833-643-2379 (Canada and USA), 1-519-888-4440, or reb@uwaterloo.ca.

Who should I contact if I have questions regarding my participation in the study?

If you have any questions about this study or need more information before you decide whether to participate, please contact one of the researchers named above.

A 5. Physician Informational Letter for Survey

Study Title: Exploring Patient and Provider Perspectives on ambient scribe Technology in Healthcare

Faculty Supervisor: Catherine Burns, PhD, System Design Engineering, University of Waterloo, Email: xxxxx@uwaterloo.ca

Student Investigator: Iman Basha, MASc, System Design Engineering, University of Waterloo. Email: xxxxx@uwaterloo.ca

This letter provides detailed information about your potential participation in our research study on ambient scribe technology in healthcare. Please read it carefully and retain a copy for your records. If you have any questions or require clarification on any part of this letter, feel free to contact us.

What is the study about?

You are invited to participate in a thesis research study about physicians' perspectives on ambient scribe technology in healthcare. Ambient scribe technology is an emerging digital tool designed to automatically record and transcribe patient-doctor interactions, aiming to streamline the documentation process in healthcare settings. This study seeks to understand how healthcare professionals perceive and experience this technology, its potential role in enhancing patient care, and thoughts on its integration into healthcare practices. We are particularly interested in exploring both the potential benefits and the challenges or concerns that physicians may have regarding the use of ambient scribe technology in their clinical practice.

What does participation involve?

Participation involves completing an online anonymous questionnaire, estimated to take between 20 - 30 minutes. Initially, demographic information such as age, gender, and medical specialty will be requested. Following this, the survey will delve into your views on ambient scribe technology, including any potential impacts on clinical practice. If you agree, anonymous quotations from your open-ended responses may be used in future academic publications.

Opportunity for Further Involvement:

Should you wish to delve deeper into this topic, we invite you to express interest in participating in a follow-up interview. This is an opportunity to share more detailed insights and enhance our understanding of the adoption of use and impact of integration of ambient scribe technology. If interested, please indicate so in a separate questionnaire provided at the end of the survey. Additional details for the interview process will be sent to your email upon expressing your interest.

Who may participate in the study?

The study is open to licensed physicians, currently practicing in Canada.

Is participation in the study voluntary?

Your participation in this study is voluntary. You may decline to answer any question(s) you prefer not to answer by skipping to the next question and may stop participating at any time by going to the end of the survey and choosing to not submit your responses.

Will I receive anything for participating in the study?

In appreciation of your time, you will receive a \$50 gift card of your choice as a token of appreciation upon completing the survey. This gesture is our way of thanking you for your valuable contribution to this significant research. The amount received is taxable. It is your responsibility to report this amount for income tax purposes.

To keep your responses anonymous, you will be asked to input your email address for purposes of receiving the electronic gift card in a separate form. Email addresses will be stored separately, then destroyed once electronic gift cards have been issued unless you express interest to participate in the follow-up interview.

If you choose to withdraw from the study early, please navigate to the end of the survey and opt not to submit your responses. You will then be directed to a separate form to receive a gift card. However, if you accidentally close the browser mid-way and do not complete the survey, you won't be eligible for a gift card. If you wish to receive a gift card, you will need to restart and complete the survey.

What are the possible benefits of the study?

While there may not be direct personal benefits, your insights will provide valuable data on the potential advantages and challenges of implementing ambient scribe technology in clinical settings. Your participation may contribute to a deeper understanding of how this technology could impact healthcare delivery, ultimately aiding in its development to better suit healthcare professionals' needs.

What are the risks associated with the study?

There are no known or anticipated risks associated with participation in this study. If a question or the topic makes you uncomfortable, you can choose not to provide a response.

How is data collected, stored, and protected?

The questionnaire for this survey is anonymous and will not ask for your name or other identifying information. As described above, email addresses will be separately collected for sending gift cards. Removing your responses later is not possible because the researchers will have no way of identifying which responses are yours.

This survey is hosted by Qualtrics, which has multiple safeguards in place, although no Internet transmission is ever fully secure. Collected data will be securely stored on password-protected computers for at least 7 years.

With your permission, the data you provide in this study may be shared on an online repository or database. This data may be used for secondary research by students or researchers in or outside Canada. Please understand that agreeing to this data sharing is entirely optional and will be done without any names or other identifying information. Choosing not to give consent for this part of the study will in no way impact your participation or experience in the main study.

Has the study received ethics clearance?

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board (REB 46012). If you have questions for the Board, contact the Office of Research Ethics, toll-free at 1-833-643-2379 (Canada and USA), 1-519-888-4440, or reb@uwaterloo.ca.

Who should I contact if I have questions regarding my participation in the study?

If you have any questions about this study or need more information before you decide whether to participate, please contact one of the researchers named above.

A 6. Consent form for Survey

Study Title: Exploring Patient and Provider Perspectives on Ambient Scribe Technology in Healthcare

This consent form is for your participation in an online survey conducted as part of a research study exploring the perspectives on ambient scribe technology in healthcare. Your participation is important to us and will contribute valuable insights into this field.

By completing this form, you are giving your consent to participate in this survey and confirming the below statements. Please read each statement carefully before agreeing.

- I have read the information presented in the information letter about a study conducted by **Dr. Catherine Burns**, System Design Engineering, University of Waterloo, and **Iman Basha**, MSc, System Design Engineering, University of Waterloo.
- I have had the opportunity to ask questions related to the study and have received satisfactory answers to my questions and any additional details.
- I understand that my participation in this survey is completely voluntary. I agree of my own free will to participate in this study.
- I am aware that I can withdraw my consent at any time prior to submitting the survey, by navigating to the end of the survey and opting not to submit my responses.

By providing your consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board (**REB 46012**). If you have questions for the Board, contact the Office of Research Ethics, toll-free at 1-833-643-2379 (Canada and USA), 1-519-888-4440, or reb@uwaterloo.ca.

For all other questions contact **Iman Basha** at xxxxx@uwaterloo.ca.

☐ YES ☐ NO I agree, of my own free will, to participate in this study.

☐ YES ☐ NO I agree to the use anonymous quotations in any paper or publication that comes from this research.

A 7. Survey – Patients

Start of Block: Welcome Message

Q4 Study Title: **Exploring Patient and Provider Perspectives on Ambient Scribe Technology in Healthcare**

Welcome, and thank you for taking part in this important survey. Your feedback is instrumental in helping us understand the impact of ambient scribe technology on healthcare and patient experiences.

This survey is for adults in Canada who have interacted with the healthcare system at least once in the past 12 months. It is designed to gather your perspectives and opinions on various aspects of ambient scribe technology, including its potential effects on doctor-patient interactions, privacy, and consent. Your honest and thoughtful responses are essential for our research efforts.

We greatly appreciate your time and valuable insights.

End of Block: Welcome Message

Start of Block: Survey Instructions

Survey Instructions

Take your time to answer the questions. If you prefer not to answer a specific question, feel free to skip it.

Withdrawal: You may withdraw at any time by going to the end of the survey and choosing not to submit your responses.

Post-Survey Process: After completing the survey or skipping to the end (in case of withdrawal), you will be directed to a separate form. Here, you can provide your contact details to enter a draw to win one of five \$50 gift cards as a token of our appreciation. The separation allows for the survey responses to stay anonymous, thereby adding a layer of confidentiality. The form will also inquire if you are interested in participating in a follow-up interview for deeper insights. Please express your

interest if you would like to participate.

Participating in the follow-up interview doesn't impact your chances of winning the draw.

Please make sure to follow the instructions at the end of the survey before exiting.

End of Block: Survey Instructions

Start of Block: Informational Letter

Informational Letter

The informational letter was sent to your email when you expressed your participation in the study. It details the study, including eligibility, data collection and storage, and withdrawal. If you are yet to read it, [please click here to read it](#) and reach out if you have any questions or concerns.

Consent This section seeks your consent to participate in this anonymous survey. By completing this section, you are giving your consent to participate in this survey and confirming to the below statements. Please read each statement carefully before agreeing.

I have read the informational letter about the study conducted by Dr. Catherine Burns, System Design Engineering, University of Waterloo, and Iman Basha, MASc, System Design Engineering, University of Waterloo. I have had the opportunity to ask questions related to the study and have received satisfactory answers to my questions and any additional details.

I understand that my participation in this survey is completely voluntary. I agree with my own free will to participate in this study.

I am aware that I can withdraw my consent at any time prior to submitting the survey by navigating to the end of the survey and opting not to submit my responses.

For all other questions, contact Iman Basha at xxxxxx[@uwaterloo.ca](mailto:xxxxxx@uwaterloo.ca).

This study has been reviewed and received ethics clearance through the University of Waterloo Research Ethics Board (REB 46012). If you have questions for the Board, contact the Office of

Research Ethics; toll-free at 1-833-643-2379 (Canada and USA), 1-519-888-4440. For all other questions, contact Iman Basha at xxxxx@uwaterloo.ca.

Basic Consent **Basic Consent**

I agree, of my own free will, to participate in this study.

☐ Yes

☐ No

Additional Consents

	Yes	No
I agree to the use of anonymous quotations in any paper or publication that comes from this research.	☐	☐

End of Block: Informational Letter

Start of Block: Demographics Data

Age What is your age group?

- ☐ 18 - 24
 - ☐ 25 - 34
 - ☐ 35 - 44
 - ☐ 45 - 54
 - ☐ 55 - 64
 - ☐ 65 - 74
 - ☐ 75 or older
-

Gender What is your gender?

- ☐ Male
 - ☐ Female
 - ☐ Non-binary / third gender
 - ☐ Prefer to specify _____
 - ☐ Prefer not to answer
-

Education What is the highest level of education you have completed or are currently pursuing?

- ☐ No Formal Education
- ☐ Primary Education
- ☐ High School
- ☐ Trade Certificate or Diploma
- ☐ College Diploma
- ☐ Bachelor's Degree
- ☐ Post-graduate Diploma or Certificate
- ☐ Master's Degree
- ☐ Doctorate (Ph.D.) or Equivalent
- ☐ Other _____
- ☐ Prefer not to say

Culture What is your cultural background? Choose all that apply.

☐

African

☐

European

☐

East Asian

☐

Middle Eastern

☐

South Asian

☐

Southeast Asian

☐

First Nations or Indigenous

☐

Hispanic/Latinx

☐

Others _____

☐

Prefer not to answer

Employment Status What is your current employment status?

- ☐ Employed full time
 - ☐ Employed part time
 - ☐ Unemployed
 - ☐ Self-Employed
 - ☐ Retired
 - ☐ Student
 - ☐ Other _____
 - ☐ Prefer not to answer
-

Income What is your approximate annual household income?

- ☐ Less than \$25,000
 - ☐ \$25,000 - \$49,999
 - ☐ \$50,000 - \$74,999
 - ☐ \$75,000 - \$99,999
 - ☐ \$100,000 - \$149,999
 - ☐ More than \$150,000
 - ☐ Prefer not to answer
-

Location In which City and Province are you currently residing?

☐ City _____

☐ Province _____

End of Block: Demographics Data

Start of Block: Experience with Ambient Scribe

Ambient Scribe Introduction to Ambient Scribe

An ambient scribe is a digital tool that helps doctors take notes during patient appointments. Traditionally, doctors would write or type notes while talking to patients. The ambient scribe eases this process, allowing doctors to focus more on the conversation. Here's how the ambient scribe typically works:

- **Record the Conversation:** It starts by recording the entire conversation between the doctor and the patient.
- **Convert Voice to Text:** The recorded voice is then converted into text format.
- **Identify Medically Relevant Information:** The text is then analyzed to find important medical information, such as the reason for the visit, relevant medical history, tests or assessments conducted, diagnoses, prescriptions, referrals, treatments or therapies provided, responses or outcomes of treatments, and follow-up plans.
- **Summarize into Standard Note Format:** Finally, it summarizes this information in a format similar to traditional doctor's notes. Doctors review these summaries to check their accuracy and edit them as necessary before adding them to the patient's health record. Some ambient scribes offer additional features, such as helping to draft prescriptions and lab test forms, which the doctors then review, edit, and sign.

For a practical illustration, consider watching the demonstration video below. Note that the demonstration is based on a specific ambient scribe service provider, Tali AI. Other service providers will have differences in function and interface. In addition, the demonstration is based

on virtual consultation but the tool works the same for in-person consultation as well.

Question on AS Do you have any questions about ambient scribe technology?

Used AS or No During your medical appointments, have you ever come across or used ambient scribe technology, the tool discussed above?

☐ Yes

☐ No

End of Block: Experience with Ambient Scribe

Start of Block: For those who have never used an ambient scribe

Display This Question:

If During your medical appointments, have you ever come across or used ambient scribe technology, th...
= No

UnExp - Familiarity Before hearing about this survey, were you aware of the concept of ambient scribe technology?

☐ Not familiar at all

☐ Slightly familiar

☐ Moderately familiar

☐ Very familiar

☐ Extremely familiar

Display This Question:

If During your medical appointments, have you ever come across or used ambient scribe technology, th...
= No

UnExp - Likely to Us How likely are you to consider using an ambient scribe during your medical consultations?

- ☐ Extremely unlikely
- ☐ Somewhat unlikely
- ☐ Neither likely nor unlikely
- ☐ Somewhat likely
- ☐ Extremely likely

Display This Question:

If During your medical appointments, have you ever come across or used ambient scribe technology, th...
= No

Q24 Please explain why you are likely or unlikely to consider using ambient scribe technology in your doctor visit.

Display This Question:

If During your medical appointments, have you ever come across or used ambient scribe technology, th...
= No

Q12- Never Used If your clinic or doctor started using ambient scribe technology, what information would you want to know about it?

End of Block: For those who have never used an ambient scribe

Start of Block: For those who have encountered an Ambient Scribe

Display This Question:

If During your medical appointments, have you ever come across or used ambient scribe technology, th...
= Yes

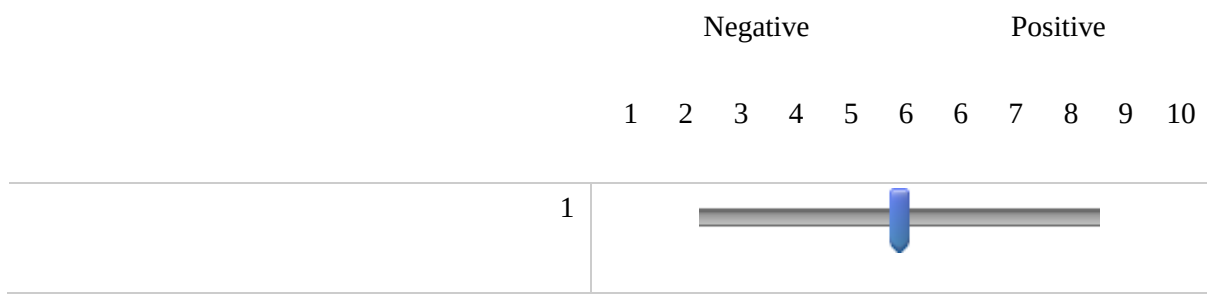
Frequency of Use How many times have you encountered ambient scribe technology during your medical consultations?

- ☐ 1 time only
- ☐ 1 to 5 times
- ☐ More than 5 times

Display This Question:

If During your medical appointments, have you ever come across or used ambient scribe technology, th...
= Yes

Exp - Rate AS On a scale from 1 to 10, how would you rate your overall experience with using ambient scribe technology? (1 being very Negative, and 10 being very positive)



Display This Question:

If During your medical appointments, have you ever come across or used ambient scribe technology, th...
= Yes

Exp w AS Please indicate how much you agree with the following statements.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
The use of an ambient scribe has positively enhanced my interactions with my doctor.	☐	☐	☐	☐	☐
I had no concerns with the use of ambient scribe in my consultation.	☐	☐	☐	☐	☐
I would be happy to use ambient scribe technology in my future medical consultations.	☐	☐	☐	☐	☐

Display This Question:

If During your medical appointments, have you ever come across or used ambient scribe technology, th...
= Yes

Optional Elaboration Please consider discussing what influenced your choices for the above statements. _____

End of Block: For those who have encountered an Ambient Scribe

Start of Block: Situations of Use

Situations Choice Please rate your comfort level with using ambient scribe technology in your medical consultations in the following scenarios

	Extremely un- comfortable	Somewhat un- comfortable	Neither comforta- ble nor uncomfort- able	Somewhat comfortable	Extremely comfortable
Annual physicals or routine check-ups	☐	☐	☐	☐	☐
Specialized consultations (e.g., for heart disease, diabetes)	☐	☐	☐	☐	☐
Emergency department visits	☐	☐	☐	☐	☐
Mental health therapy sessions (including sensitive topics)	☐	☐	☐	☐	☐
Online or telemedicine consultations	☐	☐	☐	☐	☐
Follow-up visits after initial consultation	☐	☐	☐	☐	☐
Appointments involving children	☐	☐	☐	☐	☐
Discussions about legal matters or medical consent	☐	☐	☐	☐	☐

Extra Situations Are there any situations or circumstances where you would prefer not to use ambient scribe? Please describe any such situations or reasons.

Are there any situations or circumstances where you would find ambient scribe technology particularly beneficial? Please discuss.

End of Block: Situations of Use

Start of Block: Privacy and Trust

Privacy and Trust Please indicate your level of agreement to the following statement if you were to use an ambient scribe in your medical consultation.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I would not be concerned about the privacy of my conversation and medical information.	☐	☐	☐	☐	☐
I would have privacy concerns that would impact my willingness to consent to the use of ambient scribe.	☐	☐	☐	☐	☐
I trust that the ambient scribe service provider will ensure the confidentiality of my private information.	☐	☐	☐	☐	☐

Please consider discussing what influenced your choices for the above statements.

If you have used or were to use an ambient scribe technology, what measures do you think are necessary to address privacy concerns?

End of Block: Privacy and Trust

Start of Block: Consent Preferences

Where Consent How would you prefer to be informed about the potential use of an ambient scribe for your medical consultation? (Select all that apply)

- ☐ When booking appointment
- ☐ Verbally in the waiting room
- ☐ Verbally at the start of the consultation
- ☐ Via informative posters or brochures in waiting rooms
- ☐ Through email along with appointment confirmation/reminder
- ☐ Others _____

Decision Who do you think should make the decision about using ambient scribe during a medical consultation?

- ☐ Only the patient
 - ☐ Only the physician
 - ☐ Both the patient and physician
 - ☐ Others _____
-

Saying No How comfortable would you feel saying 'no' to using ambient scribe if you didn't want it during your doctor's visit?

- ☐ Extremely uncomfortable
 - ☐ Somewhat uncomfortable
 - ☐ Neither comfortable nor uncomfortable
 - ☐ Somewhat comfortable
 - ☐ Extremely comfortable
-

Impact of No Do you feel that choosing not to use ambient scribe during your doctor's appointment would impact your experience or relationship with your doctor? Please explain.

- ☐ Yes _____
 - ☐ No _____
-

Display This Question:

If Do you feel that choosing not to use ambient scribe during your doctor's appointment would impact... =
Yes

What can be done to make you comfortable to refuse consent to using ambient scribe?

Please share any additional thoughts or concerns you have regarding the consent process for using ambient scribe technology during your medical consultations.

End of Block: Consent Preferences

Start of Block: Consent Levels

Multi-Tier Granular Informed Consent Process for Ambient Scribe

For the purpose of the following questions, levels of consent in ambient scribe should be understood as below. Note that these levels are defined for the purpose of the study and may be different from what is used in practice.

1. **Consent for the Basic Use:** This is about agreeing to let the Ambient Scribe record and summarize what is said during your doctor's visits. This consent is similar to giving permission for the tool to be used for its primary function.
2. **Consent for Data Storage:** This is an agreement for the data (voice recording and corresponding texts) to be stored by the service provider, in addition to the primary use. Consent for data storage also involves a choice of the type of data that is stored. The data type includes *voice recordings*, *transcription (voice recording turned into text)*, and *the summary of the medical relevant information (i.e. doctor's note generated by the tool)*.
Some of the data may need to be stored for legal purposes for a specified period. In this case, the consent falls under level 1.
3. **Consent for Secondary Data Use and Sharing:** This level is about whether and how the service provider or other parties can utilize the voice recording, transcription and/or summary for secondary purposes. Often, these data are processed to remove identifiable information

such as names, birthdates, and locations from which the data originates. This process makes the data de-identified or anonymous. Possible uses of secondary data include:

- **Quality Checks:** Using the data to ensure the Ambient Scribe is working well and meeting the expected standards.
- **Improving the System:** Using the data to teach and improve the Ambient Scribe, helping it better understand and summarize medical conversations.
- **Sharing with Other For-Profit Companies:** Allowing your anonymized data to be shared with other for-profit companies or organizations for various purposes, such as developing new tools or identifying trends in healthcare issues or others.
- **Sharing with Academia or Non-profit Companies:** Allowing your anonymized data to be shared with not-for-profit companies or universities for research.

Tier Considering the levels of consent for Ambient Scribe technology, which of the following are you comfortable with? Please select all options that apply and specify your preferences where indicated:

- ☐ Basic Use
- ☐ Data Storage
- ☐ Secondary Data Use and Sharing
- ☐ None. Please explain your reasoning.
-

Display This Question:

If Considering the levels of consent for Ambient Scribe technology, which of the following are you c... = Data Storage

Data Type Please indicate how comfortable you are with the storage of the following types of data.

	Extremely uncomfortable	Somewhat uncomfortable	Neither comfortable nor uncomfortable	Somewhat comfortable	Extremely comfortable
Voice Recording	☐	☐	☐	☐	☐
Written Transcripts	☐	☐	☐	☐	☐
Medical Summaries	☐	☐	☐	☐	☐

Display This Question:

If Considering the levels of consent for Ambient Scribe technology, which of the following are you c... = Data Storage

Duration Please indicate the maximum duration you're comfortable with for storing your data.

- ☐ 6 months or less
- ☐ Over 6 months, up to 1 year
- ☐ Over 1 year, up to 3 years
- ☐ Over 3 years, up to 5 years
- ☐ Over 5 years

Display This Question:

If Considering the levels of consent for Ambient Scribe technology, which of the following are you c... =
Secondary Data Use and Sharing

Secondary Data Use Please indicate how comfortable you are with secondary use and sharing of your anonymized data.

	Extremely uncom- fortable	Somewhat uncomforta- ble	Neither com- fortable nor uncomforta- ble	Somewhat comfortable	Extremely comfortable
Quality Checks	☐	☐	☐	☐	☐
System Improve- ment (Model Train- ing)	☐	☐	☐	☐	☐
Sharing with For- Profit for New Tool Development	☐	☐	☐	☐	☐
Sharing with Non- Profit for New Tool Development	☐	☐	☐	☐	☐

SUS The following questions are designed to gather your thoughts on the ease of understanding and interacting with the multi-level consent introduced above for ambient scribe. Please read each

statement carefully and indicate your level of agreement based on your experience with the consent process.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I thought the consent process was easy to understand.	☐	☐	☐	☐	☐
I found the consent process unnecessarily complex.	☐	☐	☐	☐	☐
I felt very confident understanding the consent options presented.	☐	☐	☐	☐	☐
I want to use a multi-level consent in practice.	☐	☐	☐	☐	☐
A multi-level consent process would enhance my trust and confidence.	☐	☐	☐	☐	☐

Please provide any comments/suggestions/concerns you have with regards to the consent process.

End of Block: Consent Levels

Start of Block: Submission Confirmation

Submit Thank you for getting to this point. Please confirm whether you are okay to submit your responses:

- ☐ Yes, I am okay to submit my responses.
 - ☐ No, I do not want to submit my responses.
-

Display This Question:

If Thank you for getting to this point. Please confirm whether you are okay to submit your responses: = No, I do not want to submit my responses.

Confirm Choice You've chosen to not submit your responses. This means you are withdrawing from the study. Your responses will be discarded. Are you sure you want to proceed with this choice?

- ☐ Yes, confirm my choice.
 - ☐ No, change my choice.
-

Display This Question:

If You've chosen to not submit your responses. This means you are withdrawing from the study. Your r... = Yes, confirm my choice.

Thank you for confirming your withdrawal. Your responses will be discarded. Please continue to the end of the survey to access a separate form to enter into a draw for a gift card.

Display This Question:

If You've chosen to not submit your responses. This means you are withdrawing from the study. Your r... = No, change my choice.

You've chosen to submit your responses. Please continue to the end of the survey to access a separate form to enter into a draw for a gift card.

End of Block: Submission Confirmation

A 8. Survey – Physicians

Start of Block: Welcome Message

Remunerated Study: Exploring Patient and Provider Perspectives on Ambient Scribe Technology in Healthcare

Welcome to our survey. We are grateful for your participation and value your insights as a physician practicing in Canada.

This survey is designed to gather your perspectives on the use of ambient scribe technology in clinical settings. Your experience and feedback are crucial in understanding the challenges and implications of this technology, particularly in terms of privacy, consent, and its impact on doctor-patient interactions.

We kindly ask for your honest and detailed responses to a series of questions about your experiences, views, and preferences related to ambient scribe technology. Your contribution is highly valuable and will significantly aid our research.

Thank you for your time and expertise.

End of Block: Welcome Message

Start of Block: Survey Instructions

Survey Instructions

Take your time to answer the questions. If you prefer not to answer a specific question, feel free to skip it.

Withdrawal: You may withdraw at any time by going to the end of the survey and choosing not to submit your responses.

Post-Survey Process: After completing the survey or skipping to the end (in case of withdrawal), you will be directed to a separate form. Here, you can provide your contact details to receive a \$50 gift card as a token of appreciation. The separation allows for the survey responses to stay anonymous, thereby adding a layer of confidentiality. The form will also inquire if you are interested

in participating in a follow-up interview for deeper insights. Please express your interest if you would like to participate.

Please ensure to follow the instructions at the end of the survey before exiting.

End of Block: Survey Instructions

Start of Block: Informational Letter

Informational Letter

The informational letter was sent to your email when you expressed your participation in the study. It details the study, including eligibility, data collection and storage, and withdrawal. If you are yet to read it, [please click here to access it](#) and reach out if you have any questions or concerns.

Consent This section seeks your consent to participate in this anonymous survey. By completing this section, you are giving your consent to participate in this survey and confirming to the below statements. Please read each statement carefully before agreeing.

I have read the informational letter about the study conducted by Dr. Catherine Burns, System Design Engineering, University of Waterloo, and Iman Basha, MAsC, System Design Engineering, University of Waterloo.

I have had the opportunity to ask questions related to the study and have received satisfactory answers to my questions and any additional details.

I understand that my participation in this survey is completely voluntary. I agree with my own free will to participate in this study.

I am aware that I can withdraw my consent at any time prior to submitting the survey by navigating to the end of the survey and opting not to submit my responses.

For all other questions, contact Iman Basha at ..

This study has been reviewed and received ethics clearance through the University of Waterloo Research Ethics Board (REB 46012). If you have questions for the Board, contact the Office of Research Ethics; toll-free at 1-833-643-2379 (Canada and USA), 1-519-888-4440.

Basic Consent **Basic Consent**

I agree, of my own free will, to participate in this study.

☐ Yes

☐ No

Additional Consent **Additional Consent**

I agree to the use of anonymous quotations in any paper or publication that comes from this research.

☐ Yes

☐ No

End of Block: Informational Letter

Start of Block: Demographics Data

What is your age range?

☐ Under 30

☐ 30 -39

☐ 40 - 49

☐ 50 - 59

☐ 60 and above

What is your gender?

☐ Male

☐ Female

☐ Non-binary / third gender

☐ Prefer to specify _____

☐ Prefer not to answer

Which medical specialty do you practice in?

- ☐ Family Medicine/General Practice
 - ☐ Internal Medicine
 - ☐ Pediatrics
 - ☐ Psychiatry
 - ☐ Neurology
 - ☐ Cardiology
 - ☐ Oncology
 - ☐ Rheumatology
 - ☐ Endocrinology
 - ☐ Geriatric Medicine
 - ☐ Other
-

How many years, including residency, have you practiced medicine?

- ☐ Less than 2 years
 - ☐ 2 - 5 years
 - ☐ 5 - 10 years
 - ☐ 10 - 20 years
 - ☐ More than 20 years
-

Province In which province/territory do you currently practice?

- ☐ Alberta
 - ☐ British Columbia
 - ☐ Manitoba
 - ☐ New Brunswick
 - ☐ Newfoundland and Labrador
 - ☐ Northwest Territories
 - ☐ Nova Scotia
 - ☐ Nunavut
 - ☐ Ontario
 - ☐ Prince Edward Island
 - ☐ Quebec
 - ☐ Saskatchewan
 - ☐ Yukon
-

In which type of area do you currently practice?

- ☐ Urban
 - ☐ Suburban
 - ☐ Rural
 - ☐ Remote
 - ☐ Other _____
-

What is the nature of your medical practice?

- ☐ Family Practice / General Practice (Solo)
 - ☐ Family Practice / General Practice (Group)
 - ☐ Walk-in Clinic / Urgent Care
 - ☐ Academic Primary Care Clinic
 - ☐ Community Specialty Practice
 - ☐ Hospital-Based Practice
 - ☐ Other _____
-

How would you rate your familiarity with medical software tools (such as electronic medical records and other digital health software)?

- ☐ Not familiar at all
- ☐ Slightly familiar
- ☐ Moderately familiar
- ☐ Very familiar
- ☐ Extremely familiar

End of Block: Demographics Data

Start of Block: Experience with Ambient Scribe

Ambient Scribe Introduction to Ambient Scribe

An ambient scribe is a digital tool that employs voice recognition, natural language processing (NLP), and machine learning to transcribe medical dialogues during patient consultations. The tool operates unobtrusively from a computer or mobile app, capturing and converting spoken interactions into

clinical documentation. Its goal is to minimize the need for manual note-taking.

Once the conversation is recorded, the ambient scribe converts the audio into a text transcript. It then analyses the transcript to identify the medically relevant information and organize it in a SOAP (Subjective, Objective, Assessment, Plan) format. You can then review these automatically generated SOAP notes for accuracy and completeness and make edits as necessary before incorporating them into the patient's electronic health record.

Some ambient scribes also semi-automate the drafting of prescriptions and lab orders, which you can review, revise, and sign.

For a practical illustration, watch the demonstration video below. Note that the demonstration is based on Tali AI, the layout and steps of other service providers might be different.

Question on AS Do you have any questions about ambient scribe technology?

Used AS or No Have you ever used ambient scribe in your medical practice?

- ☐ Yes
- ☐ No
- ☐ Unsure

End of Block: Experience with Ambient Scribe

Start of Block: For those who have never used an ambient scribe

Display This Question:

If Have you ever used ambient scribe in your medical practice? = No

Or Have you ever used ambient scribe in your medical practice? = Unsure

Never Used Before hearing about this survey, how familiar were you with the concept of ambient scribe?

- ☐ Not familiar at all
- ☐ Slightly familiar
- ☐ Moderately familiar
- ☐ Very familiar
- ☐ Extremely familiar

Display This Question:

If Have you ever used ambient scribe in your medical practice? = No

Or Have you ever used ambient scribe in your medical practice? = Unsure

Never Used What potential advantages do you foresee in implementing an ambient scribe in your medical practice?_____

Display This Question:

If Have you ever used ambient scribe in your medical practice? = No

Or Have you ever used ambient scribe in your medical practice? = Unsure

What potential challenges or risks do you foresee in implementing an ambient scribe in your medical practice?_____

Display This Question:

If Have you ever used ambient scribe in your medical practice? = No

Or Have you ever used ambient scribe in your medical practice? = Unsure

If you were to use an ambient scribe in your practice, how would you communicate its use to patients? What (if any) questions or concerns would you anticipate from patients?

Display This Question:

If Have you ever used ambient scribe in your medical practice? = No

Or Have you ever used ambient scribe in your medical practice? = Unsure

Never Used How likely are you to consider using an ambient scribe in your practice within the next year?

- ☐ Extremely unlikely
- ☐ Somewhat unlikely
- ☐ Neither likely nor unlikely
- ☐ Somewhat likely
- ☐ Extremely likely

Display This Question:

If Have you ever used ambient scribe in your medical practice? = No

Or Have you ever used ambient scribe in your medical practice? = Unsure

Please explain why you are likely or unlikely to consider using ambient scribe technology in your practice within the next year.

End of Block: For those who have never used an ambient scribe

Start of Block: For those who have encountered an Ambient Scribe

Display This Question:

If Have you ever used ambient scribe in your medical practice? = Yes

Type of AS Which ambient scribe service have you used? Select all that apply.

- ☐ Abridge
- ☐ Augmedix
- ☐ DeepScribe
- ☐ iScribes
- ☐ Mutuo Health (AutoScribe)
- ☐ Nabla
- ☐ Nuance
- ☐ Saykara
- ☐ Scribe Berry
- ☐ Tali AI
- ☐ Others _____

Display This Question:

If Have you ever used ambient scribe in your medical practice? = Yes

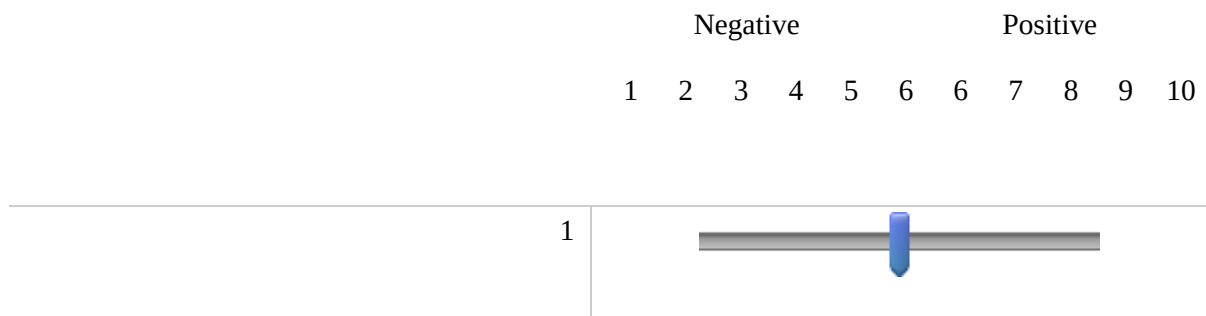
Frequency of Use How frequently do you use ambient scribe technology in your clinical practice?

- ☐ Daily
- ☐ Weekly
- ☐ Monthly
- ☐ Rarely

Display This Question:

If Have you ever used ambient scribe in your medical practice? = Yes

Rate AS On a scale from 1 to 10, how would you rate your overall experience with ambient scribes?
(1 being very Negative, and 10 being very positive)



Display This Question:

If Have you ever used ambient scribe in your medical practice? = Yes

Challenges What have been the major benefits and challenges of using an ambient scribe in your practice?

Display This Question:

If Have you ever used ambient scribe in your medical practice? = Yes

Communicating Use Please discuss how you communicated the use of ambient scribe to your patients. What (if any) questions/concerns did they have?

End of Block: For those who have encountered an Ambient Scribe

Start of Block: Situations of Use

Situations of Use

Situations Choice For each of the following clinical scenarios or visit purposes, please indicate your comfort level with using an ambient scribe.

	Extremely un- comfortable	Somewhat un- comfortable	Neither comforta- ble nor uncom- fortable	Somewhat comfortable	Extremely comfortable
General Consultations	☐	☐	☐	☐	☐
Routine check-ups	☐	☐	☐	☐	☐
Telemedicine or virtual con- sultations	☐	☐	☐	☐	☐
Sensitive conversations such as mental health, trauma, or other delicate matters	☐	☐	☐	☐	☐
Consultations with minors	☐	☐	☐	☐	☐
Discussions regarding legal or consent issues	☐	☐	☐	☐	☐
Urgent care / emergency situ- ations	☐	☐	☐	☐	☐

Beneficial Situation Are there any situations or circumstances where you would find ambient scribe technology particularly beneficial? Please discuss.

Reluctant Are there any situations or circumstances where you would be reluctant to use ambient scribe, or choose to turn it off temporarily? Please describe.

End of Block: Situations of Use

Start of Block: Privacy and Trust

Privacy Concerns? Do privacy concerns impact your willingness to adopt or continue using an ambient scribe? Please explain.

- ☐ Yes _____
- ☐ No _____

Display This Question:

If Do privacy concerns impact your willingness to adopt or continue using an ambient scribe? Please... = Yes

What privacy concerns do you have with the use of ambient scribe?

If you have used or were to use an ambient scribe, what measures do you think are necessary to address privacy concerns?

End of Block: Privacy and Trust

Start of Block: Consent Preferences

Introducing and Using Ambient Scribe

How would you prefer patients be informed about the potential use of an ambient scribe for your medical consultation? (Select all that apply)

When booking appointment

- ☐ Verbally in the waiting room
 - ☐ Verbally at the start of the consultation
 - ☐ Via informative posters or brochures in waiting rooms
 - ☐ Through email along with appointment confirmation/reminder
 - ☐ Others _____
-

Who do you think should make the decision about using ambient scribe during a medical consultation?

- ☐ Only the patient
 - ☐ Only the physician
 - ☐ Both the patient and physician
 - ☐ Others _____
-

Saying No Considering the benefits of ambient scribe technology to physicians, do you think patients might feel obligated to consent? Please share your thoughts.

Impact of No In the case where a patient might be uncomfortable with using an ambient scribe, do you think this could alter the way you connect or communicate with them? Please describe how their discomfort might influence your consultations or rapport with them.

Please share any additional thoughts or concerns you have regarding the consent process for using ambient scribe technology during your medical consultations.

End of Block: Consent Preferences

Start of Block: Consent Levels

Multi-level Consent Process for Ambient Scribe

Consent Levels For the purpose of the following questions, levels of consent in ambient scribe should be understood as below. Note that these levels are defined for the purpose of the study and may be different from what is used in practice.

- **Consent for Basic Use:** This level involves your agreement to use the ambient scribe to record medical consultations and generate clinical notes. It's foundational for integrating ambient scribe technology into your practice.
Note that some data may need to be stored for specific legal reasons as part of this consent.
- **Consent for Data Storage:** This consent pertains to your approval for storing the data recorded and generated as part of the primary purpose. These include **voice recordings, transcription** (voice recording turned into text) and **medical summaries** (clinical notes generated by the tool and any edits made by you).
- **Consent for Secondary Data Use and Sharing:** This level concerns your consent for the use of de-identified data (data where identifying information such as name, birthdate, location, and organization's name are removed) for purposes beyond direct patient care. Possible uses of secondary data include:
 - **Quality Assurance:** To ensure the ambient scribe system is functioning accurately and reliably in various clinical settings.

- **Algorithmic Training and Enhancement:** To improve the ambient scribe's capabilities in understanding and documenting medical interactions.
- **Collaboration with For-Profit Entities:** To share de-identified data with commercial organizations for developing healthcare technologies or analyzing healthcare trends.
- **Academic and Non-profit Research:** To share de-identified data with academic or non-profit organizations for medical research purposes.

Tier Considering the levels of consent for Ambient Scribe technology, which of the following are you comfortable with? Please select all options that apply.

- ☐ Basic Use
- ☐ Data Storage
- ☐ Secondary Data Use and Sharing
- ☐ None. Please explain your reasoning.

Display This Question:

If Considering the levels of consent for Ambient Scribe technology, which of the following are you c... = Data Storage

Data Type Please indicate how comfortable you are with the storage of the following types of data.

	Extremely uncomfortable	Somewhat uncomfortable	Neither comfortable nor uncomfortable	Somewhat comfortable	Extremely comfortable
Voice Recording	☐	☐	☐	☐	☐
Written Transcripts	☐	☐	☐	☐	☐
Medical Summaries	☐	☐	☐	☐	☐

Display This Question:

If considering the levels of consent for Ambient Scribe technology, which of the following are you c... =
Data Storage

Duration: Please indicate the maximum duration you're comfortable for your data to be stored.

- ☐ 6 months or less
- ☐ Over 6 months, up to 1 year
- ☐ Over 1 year, up to 3 years
- ☐ Over 3 years, up to 5 years
- ☐ Over 5 years

Display This Question:

If considering the levels of consent for Ambient Scribe technology, which of the following are you c... =
Secondary Data Use and Sharing

Please indicate how comfortable you are with secondary use and sharing of your anonymized data.

	Extremely uncomfort- able	Somewhat un- comfortable	Neither com- fortable nor un- comfortable	Somewhat comfortable	Extremely comfortable
Quality Assurance	☐	☐	☐	☐	☐
Algorithmic Training and En- hancement	☐	☐	☐	☐	☐
Collaboration with For-Profit En- tities	☐	☐	☐	☐	☐
Academic and Non-profit Re- search	☐	☐	☐	☐	☐

The following questions are designed to gather your thoughts on the ease of understanding and interacting with the multi-level consent introduced above for ambient scribe. Please read each statement carefully and indicate your level of agreement based on your experience with the consent process.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I thought the consent process was easy to understand.	☐	☐	☐	☐	☐
I found the consent process unnecessarily complex.	☐	☐	☐	☐	☐
I felt very confident understanding the consent options presented.	☐	☐	☐	☐	☐
I want to use a multi-level consent in practice.	☐	☐	☐	☐	☐
A multi-level consent process would enhance my trust and confidence.	☐	☐	☐	☐	☐

Please provide any comments/suggestions/concerns you have with regards to the multi-level consent process discussed above.

End of Block: Consent Levels

Start of Block: Submission Confirmation

Submit Thank you for getting to this point. Please confirm whether you are okay to submit your responses:

- ☐ Yes, I am okay to submit my responses.
- ☐ No, I do not want to submit my responses.

Display This Question:

If Thank you for getting to this point. Please confirm whether you are okay to submit your responses: = No, I do not want to submit my responses.

Confirm Choice You've chosen to not submit your responses. This means you are withdrawing from the study. Your responses will be discarded. Are you sure you want to proceed with this choice?

- ☐ Yes, confirm my choice.
- ☐ No, change my choice.

Display This Question:

If You've chosen to not submit your responses. This means you are withdrawing from the study. Your r... = Yes, confirm my choice.

Thank you for confirming your withdrawal. Your responses will be discarded. Please continue to the end of the survey to access a separate form to receive a gift card.

Display This Question:

If You've chosen to not submit your responses. This means you are withdrawing from the study. Your r... = No, change my choice.

You've chosen to submit your responses. Please continue to the end of the survey to access a separate form to receive a gift card.

End of Block: Submission Confirmation

A 9. Patient Informational Letter for Interview

Study Title: Exploring Patient and Provider Perspectives on ambient scribe Technology in Healthcare

Faculty Supervisor: Catherine Burns, PhD, System Design Engineering, University of Waterloo, Email: xxxxx@uwaterloo.ca

Student Investigator: Iman Basha, MASc, System Design Engineering, University of Waterloo. Email: xxxxx@uwaterloo.ca

This letter provides detailed information about your potential participation in our research study on ambient scribe technology in healthcare. Please read it carefully and retain a copy for your records. If you have any questions or require clarification on any part of this letter, feel free to contact us.

Study Overview

You are invited to participate in a thesis research study exploring public perceptions of ambient scribe technology in healthcare, a significant step towards modernizing patient care. This technology, designed to automatically document patient-doctor interactions, has the potential to transform healthcare efficiency and accuracy. Your participation will contribute to a greater understanding of how this technology is received by the public and its potential impact on the healthcare experience.

Participation Details

Your participation involves a 30-minute interview conducted virtually via Microsoft Teams.

Participation is completely voluntary, and you have the right to decline any questions or withdraw from the study at any point without any negative consequences.

In appreciation of your time, you will receive a \$25 gift card as a token of appreciation. This gesture is our way of thanking you for your valuable contribution to this significant research. You will have the option to choose from a selection of vendors, including grocery chains, pharmacies, bookstores, and coffee shops. The amount received is taxable. It is your responsibility to report this amount for income tax purposes.

Recording and Transcription

The interview will be recorded to ensure precise transcription. However, if you prefer not to be recorded, please inform us, and we will accommodate by taking detailed notes instead. Should you

wish, you can request a copy of the transcript for review and confirmation. If you do not request a transcript review within 5 business days of the interview, the recording will be permanently deleted. If a review is requested, the recording will be retained until you verify the transcript's accuracy, after which it will be permanently deleted. Please note that once the interview data is anonymized and the recording is destroyed, withdrawing your data from the study will not be possible. If you decide to withdraw from the study within these 5 business days, please contact me at xxxxxx@uwaterloo.ca, and your interview data will be removed accordingly.

Confidentiality and Data Storage

This interview is conducted through Microsoft Teams, which has multiple safeguards in place to prevent loss, misuse, and unauthorized access, disclosure, alteration, or destruction. However, no internet transmission is ever fully secure or error free.

Your identity will be kept confidential; your name will not appear in any thesis or reports resulting from this study. With your permission, anonymous quotations may be used.

The collected data will be securely stored for a minimum of 7 years, accessible only to the research team. There are no known or anticipated risks associated with your participation in this study.

Contribution and Anticipated Benefits

Your participation is highly valued and may contribute to the broader understanding and application of ambient scribe technology in healthcare.

Ethics Clearance

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board (REB 46012). If you have questions for the Board, contact the Office of Research Ethics, toll-free at 1-833-643-2379 (Canada and USA), 1-519-888-4440, or reb@uwaterloo.ca.

If you have any questions about this study or need more information before you decide whether to participate, please contact me.

I very much look forward to speaking with you and thank you in advance for your assistance in this project.

A 10. Physician Informational Letter for Interview

Study Title: Exploring Patient and Provider Perspectives on ambient scribe Technology in Healthcare

Faculty Supervisor: Catherine Burns, PhD, System Design Engineering, University of Waterloo, Email: xxxxx@uwaterloo.ca

Student Investigator: Iman Bashasha, MASc, System Design Engineering, University of Waterloo. Email: xxxxx@uwaterloo.ca

This letter provides detailed information about your potential participation in our research study on ambient scribe technology in healthcare. Please read it carefully and retain a copy for your records. If you have any questions or require clarification on any part of this letter, feel free to contact us.

Study Overview

You are invited to participate in a thesis research study about physicians' perspectives on ambient scribe technology in healthcare. Ambient scribe technology is an emerging digital tool designed to automatically record and transcribe patient-doctor interactions, aiming to streamline the documentation process in healthcare settings. This study seeks to understand how healthcare professionals perceive and experience this technology, its potential role in enhancing patient care, and thoughts on its integration into healthcare practices. We are particularly interested in exploring both the potential benefits and the challenges or concerns that physicians may have regarding the use of ambient scribe technology in their clinical practice.

Eligibility

The study is open to licensed physicians, currently practicing in Canada.

Participation Details

Participation involves a 30-minute interview, conducted virtually via Microsoft Teams. Your participation is entirely voluntary, and you have the right to decline any questions or withdraw from the study at any point without any negative consequences.

As a token of our appreciation for your valuable contribution, upon completion of the interview, you will receive \$100. If you choose to withdraw during the interview, you will receive a prorated amount based on the duration of your participation where the fully amount equates to 30 minutes or completion. Please note that the amount received is taxable, and it is your responsibility to report this for income tax purposes.

Recording and Transcription

The interview will be recorded to ensure precise transcription. However, if you prefer not to be recorded, please inform us, and we will accommodate by taking detailed notes instead. Should you wish, you can request a copy of the transcript for review and confirmation. If you do not request a transcript review within 5 business days of the interview, the recording will be permanently deleted. If a review is requested, the recording will be retained until you verify the transcript's accuracy, after which it will be permanently deleted. Please note that once the interview data is anonymized and the recording is destroyed, withdrawing your data from the study will not be possible. If you decide to withdraw from the study within these 5 business days, please contact me at xxxxx@uwaterloo.ca, and your interview data will be removed accordingly.

Confidentiality and Data Storage

This interview is conducted through Microsoft Teams, which has multiple safeguards in place to prevent loss, misuse, and unauthorized access, disclosure, alteration, or destruction. However, no internet transmission is ever fully secure or error free.

Your identity will be kept confidential; your name will not appear in any thesis or reports resulting from this study. With your permission, anonymous quotations may be used.

The collected data will be securely stored for a minimum of 7 years, accessible only to the research team. There are no known or anticipated risks associated with your participation in this study.

Contribution and Anticipated Benefits

Your participation is highly valued, and the findings from this study may benefit healthcare organizations, the broader research community, and contribute to the understanding and application of ambient scribe technology in healthcare.

Ethics Clearance

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board (REB 46012). If you have questions for the Board, contact the Office of Research Ethics, toll-free at 1-833-643-2379 (Canada and USA), 1-519-888-4440, or reb@uwaterloo.ca.

If you have any questions about this study or need more information before you decide whether to participate, please feel free to contact me.

I very much look forward to speaking with you and thank you in advance for your assistance in this project.

A 11. Verbal Consent form for Interview

Study Title: Exploring Patient and Provider Perspectives on Ambient Scribe Technology in Healthcare

Have you had a chance to read the information letter? Do you have any questions?

As a reminder, participation is voluntary, and you may end the interview session by advising me of your decision at any time. If you have questions for the Research Ethics Board, contact information for the Office of Research Ethics is listed on the information letter that you received prior to this session. For all other questions about the study, you may contact me at jfbasha@uwaterloo.ca.

By providing your consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities

Do you consent to participating in the interview?

☐ YES ☐ NO

Do you give permission for your interview to be audio recorded?

☐ YES ☐ NO

Do you give permission for your interview to be video recorded?

☐ YES ☐ NO

Do you agree to the use of anonymous quotations in any paper or publication resulting from this research?

☐ YES ☐ NO

Participant's name: _____

Researcher's signature: _____

Date: _____

A 12. Interview Questions – Patients

Demographic Questions

1. What is your medical specialty?
2. Is your practice type and setting?
3. Is your practice located in an urban or rural setting?
4. Do you use or have you used ambient scribe technology in your practice?

For those who have used AI scribe previously

1. How frequently do you use an ambient scribe in your practice?
2. Which service provider do you use?
3. How did you come to know ambient scribe?
4. What led to your decision to adopt ambient scribe in your practice?

Probing questions

- What things did you consider?

Questions to Understand Use in Context

5. Can you walk me through your consultation session where you use an ambient scribe?

Probing questions

- How do you communicate it to the patients?
- How is your consultation different from when you don't use ambient scribe?
- How long does charting take you with and without ambient scribe?
- How does your interaction differ from when you don't use ambient scribe?
- How does your communication style differ from when you don't use ambient scribe?

Questions to Understand Physicians Experience with using Ambient Scribe

6. Can you share a particularly memorable experience where ambient scribe technology had a significant impact on your consultation, positively or negatively?
7. Could you provide insights into patient feedback or reactions to the idea of having an ambient scribe during medical consultations?

For those who have not used AI scribe previously

Questions to Understand Use in Context

1. Can you walk me through your typical consultation process?

Probing questions

- How do you chart?

- How long does it take you to chart?

Questions to Understand Non-adopters Physicians Perspective

2. What are your perceptions and expectations regarding the potential use of ambient scribe technology in healthcare?
3. In your opinion, what potential advantages and disadvantages does ambient scribe technology offer to healthcare providers and patients?
4. How do you think the use of ambient scribe technology might impact the doctor-patient relationship?

Questions for All Physicians

Questions About Privacy

1. Does privacy concern impact your decision to adopt (or continue) using AI scribe?
2. What specific measures or assurances would you expect to be in place to protect patient information?
3. Are there situations or visit types you would not want to use AI scribe?

Questions about Consent

4. Which consent tiers and options would you consent to from the MTGIC?
5. How does the MTGIC compare with the current consent model (umbrella consent, take it or leave it)?
6. How do you see MTGIC being applied in your practice?
Probing Question: What benefits and challenges do you foresee MTGIC introducing?
7. Would you like to use MTGIC in practice?

Questions for Additional Insight

8. Are there any additional insights, experiences, or recommendations you would like to share regarding ambient scribe technology and its potential impact on clinical practice?

Is there anything else you believe is important for researchers and healthcare professionals to consider in this context?

A 13. Interview Questions – Physicians

Demographic Questions

1. What city and province do you currently reside?
2. If you are comfortable sharing, what is your employment status?

For participants who have not encountered AI Scribe

1. Based on the introduction to ambient scribe technology (AI scribe) provided in the survey, how would you describe your understanding of this technology?
2. What are your initial thoughts or feelings about the use of ambient scribe technology in healthcare settings?
3. Considering your current understanding, what expectations do you have for ambient scribe technology in terms of its functionality and its role during medical consultations?
4. What potential benefits do you anticipate AI scribe brings to patient care and the healthcare experience?
5. Do you have any concerns or perceived drawbacks regarding the use of ambient scribe technology in healthcare?
6. What factors would influence your decision to consent to or decline the use of ambient scribe technology in your medical consultations?
7. How do you think the presence of ambient scribe technology might influence your communication with healthcare providers during consultations?
8. Do you expect it to alter the doctor-patient relationship in any way? If so, how?

For participants who have encountered AI Scribe

1. Can you describe your first experience with ambient scribe technology during a medical consultation?

Probing questions

- How did the physician introduce the technology?
 - What were your initial thoughts and feelings?
 - Did you have any questions or concerns?
 - Did you feel comfortable to consent for its use?
2. How did the presence of AI scribe affect the quality of your medical consultations?

Probing questions

- Do you believe it has enhanced your care?
- Did the presence of AI scribe influence your communication with your physician?
- How did the use of AI scribe impact the doctor-patient relationship?
 - Did it make the consultation more personable, efficient, or perhaps more distant?
- Have you experienced benefits from the use of AI scribe in your consultation?
- Have you encountered any drawbacks or concerns due to the use of AI scribe?

Questions for All Patients

Questions About Privacy

1. In terms of consenting to the use of AI scribe during your medical consultations, what information or assurances would you need from healthcare providers?

Probing question: Does privacy concern impact your decision to consent to the use of AI scribe?

2. Would you feel comfortable to refuse to the use of AI scribe if you didn't want to?
3. What specific measures or assurances would you expect to be in place to protect patient information?
4. Are there situations or visit types you would not want to use AI scribe?

Questions about Consent

5. Which consent tiers and options would you consent to from the MTGIC?
6. How does the MTGIC compare with the current consent model (umbrella consent, take it or leave it)?
7. What benefits and challenges do you foresee MTGIC introducing?
8. Would you like to use MTGIC in practice?

Questions for Additional Insight

9. Is there anything else you think is crucial for healthcare providers and researchers to consider regarding the integration of AI scribe in healthcare settings?
10. Do you have any final thoughts or anything else you would like to add regarding your views on AI scribe and its potential impact on healthcare?

Appendix B

Conceptual Design of Multi-Tiered Granular Informed Consent

B 1. MTGIC Introduction Patient Version

1. **Consent for the Basic Use:** This is about agreeing to the ambient scribe record and summarize what is said during your doctor's visits. This consent is similar to giving permission for the tool to be used for its primary function.
2. **Consent for Data Storage:** This is an agreement for the data (voice recording and corresponding texts) to be stored by the service provider, in addition to the primary use. Consent for data storage also involves a choice of the type of data that is stored. The data type includes:
 - a) **Voice recordings,**
 - b) **Transcription (voice recording turned into text),**
 - c) **Summary of the medical relevant information (i.e. doctor's note generated by the tool).**

Some of the data may need to be stored for legal purposes for a specified period. In this case, the consent falls under level 1.
3. **Consent for Secondary Data Use and Sharing:** This level is about whether and how the service provider or other parties can utilize the voice recording, transcription and/or summary for secondary purposes. Often, these data are processed to remove identifiable information such as names, birthdates, and locations from which the data originates. This process makes the data de-identified or anonymous. Possible uses of secondary data include:
 - **Quality Checks:** Using the data to ensure the ambient scribe is working well and meeting the expected standards.
 - **Improving the System:** Using data to teach and improve the ambient scribe, helping it better understand and summarize medical conversations.
 - **Sharing with Other For-Profit Companies:** Allowing your anonymized data to be shared with other for-profit companies or organizations for various purposes, such as developing new tools or identifying trends in healthcare issues or others.
 - **Sharing with Academia or Non-profit Companies:** Allowing your anonymized data to be shared with not-for-profit companies or universities for research.

B 1. MTGIC Introduction Physician Version

1. **Consent for Basic Use:** This level involves your agreement to use the ambient scribe to record medical consultations and generate clinical notes. It's foundational for integrating ambient scribe technology into your practice.

Note that some data may need to be stored for specific legal reasons as part of this consent.

2. **Consent for Data Storage:** This consent pertains to your approval for storing the data recorded and generated as part of the primary purpose. These include **voice recordings, transcription** (voice recording turned into text) and **medical summaries** (clinical notes generated by the tool and any edits made by you).
3. **Consent for Secondary Data Use and Sharing:** This level concerns your consent for the use of de-identified data (data where identifying information such as name, birthdate, location, and organization's name are removed) for purposes beyond direct patient care. Possible uses of secondary data include:
 - **Quality Assurance:** To ensure the ambient scribe system is functioning accurately and reliably in various clinical settings.
 - **Algorithmic Training and Enhancement:** To improve the ambient scribe's capabilities in understanding and documenting medical interactions.
 - **Collaboration with For-Profit Entities:** To share de-identified data with commercial organizations for developing healthcare technologies or analyzing healthcare trends.
 - **Academic and Non-profit Research:** To share de-identified data with academic or non-profit organizations for medical research purposes.