Constraints and Workarounds to Support Clinical Consultations in Synchronous Text-based Platforms

Brenna Li
brli@cs.toronto.edu
University of Toronto
Toronto, Canada

Tetyana Skoropad
tetyana.skoropad02@gmail.com
Ivan Franko National University of Lviv
Lviv, Ukraine

Puneet Seth
sethp1@mcmaster.ca
McMaster University
Hamilton, Canada

Mohit Jain
mohja@microsoft.com
Microsoft Research
Bangalore, India

Khai N. Truong
khai@cs.toronto.edu
University of Toronto
Toronto, Canada

Alex Mariakakis
mariakakis@cs.toronto.edu
University of Toronto
Toronto, Canada

ABSTRACT

Medical consultations over synchronous text-based platforms are becoming increasingly popular for virtual care, yet little is known about how physicians translate their training to this healthcare medium. We report the constraints, workarounds, and opportunities highlighted by eight primary care physicians who used such a platform in simulated medical scenarios with standardized patients. We found that due to the perceived inefficiency of communicating over text, the physicians made subconscious use of double-barreled questions and action multiplexing to streamline the conversation. In addition, the physicians overcame the lack of missing verbal and visual cues by adding explicit messages to convey empathy and active listening. We also identify several affordances of text-based platforms, such as the ability for users to reference the conversation history and for patients to feel a sense of privacy during sensitive disclosure. From these findings, we propose design opportunities for how future synchronous text-based platforms can better support medical consultations.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**; • **Applied computing** → **Health informatics**.

KEYWORDS

virtual care, synchronous text, clinical consultation, active listening, non-verbal cues

ACM Reference Format:
Brenna Li, Tetyana Skoropad, Puneet Seth, Mohit Jain, Khai N. Truong, and Alex Mariakakis. 2023. Constraints and Workarounds to Support Clinical Consultations in Synchronous Text-based Platforms. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (CHI '23), April 23–28, 2023, Hamburg, Germany*. ACM, New York, NY, USA, 17 pages. https://doi.org/10.1145/3544548.3581014

CHI '23, April 23- April 28, 2023, Hamburg, Germany

ACM ISBN 978-1-4503-9421-5/23/04…$15.00
https://doi.org/10.1145/3544548.3581014

1 INTRODUCTION

Roughly 35% of medical encounters between patients and medical professionals are currently conducted over digital communication platforms [6, 9, 23, 47]. Although the COVID-19 pandemic is often credited for the sharp rise in the global adoption of virtual care services [8, 71, 88, 89], several studies have found them to yield sustained effectiveness and satisfaction beyond the pandemic for both patients and physicians [25, 28, 39, 65, 82]. Research in this space has mainly focused on the utility of phone and video calls, yet purely text-based platforms yield comparable benefits [44, 79]. In fact, messaging platforms are already being used extensively by physicians around the world [3, 37, 49, 61, 62], such as in Israel where 86.5% of primary care physicians use WhatsApp on a daily basis to communicate with patients and colleagues [3].

Text-based platforms can either be asynchronous (e.g., emails, medical web portals) or synchronous (e.g., instant chat messaging). In this context, synchronicity refers to the fact that both conversational participants — patients and physicians in our case — are expected to be present on the platform at the same time [35, 85]. Asynchronous messaging platforms can be used in a synchronous manner, but our work is specifically concerned with synchronous messaging platforms given their growing popularity in healthcare. A myriad of new platforms designed for synchronous patient-physician consultation offer improved security and privacy features over more widely used instant messaging platforms. Ask a Doctor[1], Teladoc[2], TELUS MyCare[3], Maple[4], and Text2MD[5] are examples of offerings in this space.

Although physicians are becoming increasingly accustomed to virtual care consultations, they are primarily trained to handle face-to-face patient interactions [13, 14]. Even the literature on best practices for physician-patient interactions focus on in-person encounters [18, 68, 84, 86]. While many of these skills translate to phone and video calls, which have the advantage of allowing

[1] htpps://www.ask-adoctor.com
[2] https://www.teladoc.ca
[3] https://www.telus.com/en/personal-health/my-care
[4] https://www.getmaple.ca
[5] https://www.text2md.com

the conversation participants to hear and see one another [8, 11], little has been reported about whether physicians are able to adapt their training while using synchronous text-based platforms. Learning about the challenges that physicians face while using these platforms can reveal new opportunities for improving upon their design in the context of clinical consultations.

In this work, we seek to characterize how physicians use synchronous text-based platforms for virtual patient consultations. We are interested in understanding how physicians adapt their skills to the text modality and the barriers that are inherent to this modality. Although patients are an equally important stakeholder, we focus on the experiences of physicians in this paper since they are the ones who typically lead these conversations [72]. We conducted a study with eight primary care physicians and employed two standardized patients (SPs) to participate in simulated medical scenarios. The scenarios were framed such that the physicians would be meeting new patients presenting with symptoms related to either a urinary track infection or anxiety. We then analyzed the messages that physicians sent, their interactions with the platform, and their feedback from post-study interviews to elicit our findings.

We found that the key constraints experienced by physicians were the perceived inefficiency of the interaction and the lack of non-verbal cues that they could both perceive and express. Physicians often felt that typing out their thoughts and questions was slow, but they were quick to adapt their workflow. They subconsciously used double-barreled questions and action multiplexing to maximize their productivity and spent additional effort making their messages more concise to mitigate confusion. Physicians also tried to accommodate for the lack of verbal and visual cues by adding explicit messages to express empathy. Furthermore, they changed their behavior according to the typing indicator built into the interface as they attempted to convey active listening. We also discovered unique benefits to synchronous text-based platforms: the ability for physicians to incorporate standardized questionnaires, for patients to disclose sensitive topics with an added level of privacy, and for both stakeholders to review and reflect on the conversation history.

To summarize, our research reports primary care physicians' perspectives on synchronous text-based platforms. Through the qualitative analysis of the conversations and actions displayed during our scenario-driven study, we identify the opportunities, constraints, and workarounds that come with this modality. These findings lead to design implications and opportunities for future platforms designed specifically for medical consultation.

2 RELATED WORK

For the purposes of this work, we consider virtual care to encompass the contexts in which healthcare providers leverage computer-mediated communication platforms to address the needs of remote patients [9, 23, 78, 89]. In our overview of related work, we examine three categories of virtual care: phone and video calls, asynchronous text messaging, and synchronous text messaging.

2.1 Phone and Video Call Consultation

The majority of virtual care is delivered through phone or video calls [8, 89]. These modalities have served as useful substitutes for in-person consultations because of their ability to connect individuals without significantly detracting from the interpersonal characteristics of face-to-face conversations [40, 77]. Since patients and physicians do not need to be at the same location, phone and video calls have allowed physicians to conduct their work in non-clinical settings [8, 11]. They have also enabled physicians to provide follow-up care for chronically ill patients [83], particularly the elderly or those who struggle with mobility. Snoswell and Comans [78] found that appointments conducted over phone and video calls have greater patient attendance when compared to in-person visits. Meanwhile, Liu et al. [54] found that video consultations reduced appointment times for internal medicine patients by 35% without significantly impacting the patient experience.

Despite the prominence of phone and video calls as modalities for virtual care, experts have frequently noted that they are not substitutes for face-to-face clinical visits and that e-mediated consultation can erode trust between physicians and patients [2, 33]. Researchers have therefore proposed guidelines for the situations when these modalities are most appropriate [48, 52, 60]. Segal et al. [76] suggest that phone and video calls are best suited for encounters with clear clinical goals and straightforward diagnosis options. They also suggest that these modalities are useful when it is easy for patients to describe their symptoms without the physician being in the same room. These recommendations align with findings by Ekman et al. [26], who examined the scenarios that were most often used for virtual care. They found that upper respiratory infections and urinary tract infections were some of the most common virtual consultation cases, whereas situations related to mental health were less frequent.

There are a variety of explanations for why phone and video calls are not suitable for all virtual care scenarios. Several works have commented on the inability for clinicians to conduct physical examinations during remote consultations [5, 16]. Brant et al. [15] found that the reliance on appropriate internet provision and broadband reliability were chief concerns amongst physicians regarding these modalities as well. Phone calls are further constrained because they force physicians to rely entirely on the spoken words and intonation of the patient to make an assessment [8, 16]. As we explore text-based consultation platforms in our review of related work and our own research, many of these challenges persist and are amplified by the removal of audio and visual feedback.

2.2 Text-based Consultation

2.2.1 Asynchronous Text. Asynchronous text-based consultation refers to the use of emails, clinical portals, and online forums for connecting patients and physicians [10, 20, 35, 56]. Despite the varied interactions entailed by such technologies, the core feature that unifies them is the fact that conversational partners are not required to be simultaneously present on the platform, meaning that some encounters can take days before completing. Stamenova et al. [79] found that when given the option of using video calls, phone calls, or asynchronous text, both patients and physicians had a strong preference for the latter. Some of the major benefits that participants in their study noted were the ability to respond when it was most convenient, the extra time they had to reflect on questions and responses, and the resulting written record of the

interaction [79]. Johansson et al. [41] identified additional benefits to using asynchronous text, such as the situational convenience it affords and the ability for physicians to review patient files as needed.

Asynchronous interactions also come with their own detriments, the foremost being the lack of immediate feedback for both physicians and patients [44]. Another consequence to asynchronous texting observed by Johansson et al. [41] is that some physicians were found to be contacting different patients at the same time, a dangerous behavior that can potentially impact the quality of patient care. Finally, asynchronous consultations complicate the billing process for many physicians since consultations have ill-defined start and end times [30, 34].

2.2.2 Synchronous Text. Synchronous text-based consultations refer to the use of platforms like live messaging services and mobile chat applications that require patients and physicians to be present at the same time to engage in a sustained dialogue [31, 35]. According to literature related to linguistics and computer-mediated communication, these platforms offer users instant feedback and sustained dialogue that would be similar to what would be experienced during face-to-face conversations [46, 73]. Ku et al. [50] elaborate that synchronous interactions are often preferred over asynchronous counterparts because they can be more personal and direct. These benefits have made synchronous text-based platforms popular outside of clinical applications, particularly in education and the service industry [42, 55, 80].

Although synchronous text-based platforms are becoming increasingly popular for virtual care, their utility in this space has been explored to a lesser degree. Most related works originate from the mental health domain, where such platforms have been used for counselling and patient assessment [17, 22, 24, 57]. For instance, Hoermann et al. [36] found synchronous text-based consultations to be comparable to face-to-face and phone-call interactions with respect to mitigating mental health concerns like anxiety, eating disorders, and addiction. Investigations outside of mental health contexts are less prevalent in the literature. One of the exceptions is the work by Grainger et al. [31], who studied the impact of a live discussion board designed to facilitate discussions about arthritis between healthcare providers and patients. The authors found that this format was effective at reaching a large audience and giving patients the chance to seek timely help in a reliable manner.

In light of the literature in this space, little is known about the opportunities and obstacles that physicians face as they leverage synchronous text-based platforms in a primary care setting, especially when the physicians are not previously familiar with the patient's medical history. Our work seeks to fill this gap through a qualitative analysis of physician's messages and actions as they engage in the consultation process.

3 METHODS

In this section, we describe the study that we conducted to simulate remote consultation scenarios and to elicit feedback from physicians. The study protocol was approved by the Research Ethics Board at University of Toronto under Protocol #41033.

3.1 Participants

Through connections with the Department of Family & Community Medicine at the University of Toronto & McMaster University, we used word-of-mouth and convenience sampling to recruit 8 family physicians. The inclusion criteria for this study was that participants were expected to have at least two years of practising experience and a valid license registered with the College of Physicians and Surgeons of Ontario. The demographic information of the physicians is reported in Table 1. The cohort included three males and five females under the age of 45. The participants came from multiple institutions and had varied clinical backgrounds, ranging from family heath organizations and private clinics to teaching hospitals. All of the physicians utilized electronic health records in their day-to-day work, and the majority had previous experience using an online platform to communicate with patients.

3.2 Medical Scenarios

We turned to the literature to inform the construction of the medical scenarios we would use in our study. Based on research findings by Ekman et al. [26], we selected urinary tract infections (UTI) and mental health concerns as the two topics for our scenarios since they varied in their prevalence within virtual care. We also selected these topics because they varied in diagnostic complexity and sensitivity; we anticipated that the UTI scenario would relate to physical symptoms that physicians could readily probe, while we expected the anxiety scenario to be more circuitous. To generate the scenarios, we first crafted fictitious patient profiles in collaboration with a practicing physician in family medicine who was a member of the research team. We then drew upon our collective experiences and training in human-centered design to generate the scenarios, while the physician ensured that the materials would be sufficiently detailed for a standard clinical encounter. The scenarios are summarized below:

- **Urinary tract infection (UTI) scenario:** Marilyn Kim, a woman in her late thirties, is experiencing discomfort when she urinates. She also feels an increased need to urinate despite not increasing her liquid consumption. She is a busy businesswoman who consumes lots of coffee to stay awake throughout the day. She was a heavy smoker in the past, but she quit after her mother passed away from a heart attack 15 years ago.
- **Anxiety scenario**: Taylor Thompson, a young woman in her early twenties, is having trouble sleeping. She has never been formally diagnosed with anxiety, but she has had related issues in the past and there is a history of clinical anxiety among the other women in her family. She has been actively searching for a full-time job for the past six months since her current part-time role ends soon. She has submitted dozens of applications for various openings, but she has yet to hear back from anyone.

3.3 Procedure

We hired two standardized patients (SPs) from the University's Department of Medicine to serve as conversational partners for the physicians in our study. SPs are often used in healthcare education and academic research to take on the characteristics of real patients

Table 1: The demographics of the physicians who participated in our study.

ID	Gender	Age Range	Clinical Background	Virtual Care Experience
P1	Male	35–44 years old	8 years in clinical practice, currently works at a family health organization	Previous experience with web-based dashboards and chat-based systems
P2	Male	25–34 years old	3 years in clinical practice currently works in a private clinic	N/A
P3	Male	35–44 years old	10 years in clinical practice, currently works at a family health organization	Previous experience with video calls
P4	Female	25–34 years old	5 years in clinical practice, currently works at a family health organization	Previous experience with video calls
P5	Female	35–44 years old	11 years in clinical practice, currently works at a family health organization	Previous experience with web-based dashboards, chat-based systems, and video calls
P6	Female	25–34 years old	3 years in clinical practice, currently works at a family health organization	N/A
P7	Female	25–34 years old	10 years in clinical practice, currently works at a family health organization	Previous experience with web-based dashboards, chat-based systems, and video calls
P8	Female	25–34 years old	2 years in clinical practice, currently a medical school instructor	Previous experience with video calls

so that physicians can practice or demonstrate their communication skills in a repeatable environment [4, 7, 51]. Both of the SPs in our study were female; one was in her late twenties and had four years of experience, while the other was in her early thirties and had eight years of experience. The SPs were simultaneously trained to carry out both scenarios so that one could act as the backup for the other in case of a scheduling issue or emergency. During the two-hour training session, the SPs were told to act as if they were new patients visiting a walk-in clinic for the first time. They were further instructed to behave in a "shy manner" — not being immediately forthcoming with some information, but eventually answering all questions whenever the physician pushed further. These instructions allowed the physicians to lead the conversation, which is typical of most patient-physician encounters [72]. The SPs were also told that they could make up their own answers whenever they were asked about a detail that was not specified in our scenarios.

We used Slack[6] (shown in Fig. 1) as the interface for hosting conversations between SPs and physicians. Although there are an increasing number of platforms specifically designed for this purpose, Slack shares their core functionality without including any idiosyncratic features that may have influenced our findings. We also opted Slack over such platforms because it did not require physicians to be pre-enrolled in a physician network. All participants were given a unique profile with a pseudonym to maintain their privacy. During the simulated consultations, physicians shared their screen with the researchers over the videoconferencing platform Zoom[7] so that the researchers could observe their interactions with Slack. The same Zoom call was used for post-session interviews. The sessions were recorded with explicit consent from the physicians so that they could be further analyzed afterwards.

Prior to each session, we asked the physicians to complete a survey that contained ten questions to get an understanding of their demographics, background, and experience with virtual care. We then gave them a short introduction on the goals of the scenarios. The physicians were asked to imagine that they work at a walk-in clinic that often sees new patients, meaning that they were expected to treat the SPs as real patients being enrolled into their clinic without any prior information. They were also told to imagine that they would have the opportunity to follow-up on the conversations with in-person visits, reducing the need to reach a final diagnosis during the encounter. The physicians were allotted as much time that they felt would be needed for each conversation but were instructed to aim for an encounter that they deemed to be "clinically reasonable". Before proceeding to the simulated consultations, we gave them a brief tutorial on how to use the various software platforms for the purposes of the study; in particular, we had a brief conversation with them over Slack to illustrate the platform's functionalities and resolve any issues.

Each physician engaged in both the UTI and anxiety scenarios with a break in between, and the presentation order of the scenarios was counterbalanced to minimize bias. The same SP acted out both scenarios for a given physician for scheduling reasons. After going through both scenarios, the physicians engaged in a semi-structured interview to gather feedback on their overall experience and to follow-up on any interesting observations that were noted during the encounters. During the semi-structured interview, we asked physicians about their initial approach to the two scenarios and how they adjusted their approach over time. We also inquired about how their experience compared to what they typically encounter in alternative formats, namely face-to-face appointments, phone calls, and video calls. The entire study lasted 60–90 minutes per physician, with about two-thirds being dedicated to the consultation scenarios and the rest to the post-study interview. The physicians were paid $120 for their time, which was commensurate with their hourly

[6]https://slack.com/
[7]https://zoom.us/

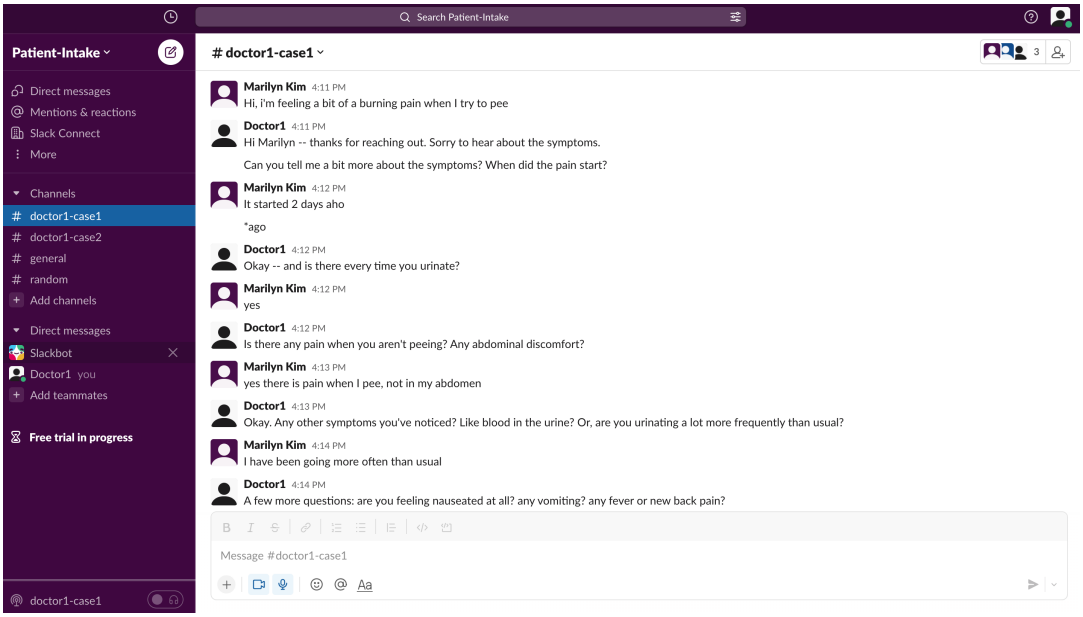


Figure 1: A screenshot of the Slack interface that physicians used during our study. The SPs were given a fictitious name, while the physicians were given unique identifiers to separate conversations for data analysis.

pay rate. After the physicians left, we conducted a short debriefing session with the SPs to contextualize the physicians' comments and to lend their own perspective on the session; however, these sessions were not conducted as formal interviews since the focus of our work is on the experiences of physicians during these interactions.

3.4 Analysis

The main sources of data that we collected were (1) the conversation logs stored on Slack, (2) the video recordings of the physicians' screens captured over Zoom, and (3) the transcripts from the semi-structured interviews with physicians. The logs were qualitatively analyzed using methods of grounded theory [81]. Two researchers went through one round of open coding and two rounds of axial coding to understand the types of messages that were sent and the overall structure of the conversation [1, 87]. Three categories of physician-initiated messages were identified through this process: questions, explanations, and expressions of empathy. The researchers assigned the codes independently to all the messages sent by physicians, achieving an inter-rater reliability score of 0.98. The screen capture data was reviewed whenever a conversation log required further context or the research observer had noted interesting behaviors during the study itself. The interview transcripts were also analyzed by the same two researchers through methods of grounded theory coding to support the observations from the other data sources.

3.5 Positionality

One of the authors is a practicing family physician with industry experience in building technology for healthcare. The rest of the authors are human-computer interaction researchers who often work at the intersection of computer science and healthcare. With the exception of one author based in India, the rest of the authors and physicians who participated in our research are based in a single major metropolitan area in North America. While virtual care is becoming increasingly common worldwide [6, 9, 23, 47], text-based consultation is even more accessible to populations with limited resources due to its lower technology requirements compared to phone and video calls. Different countries and cultures often have their own norms for patient-physician interactions [74], digital interactions [70], and communication in general [59], so the generalizability of our findings with respect to these dimensions should be explored further. Similar considerations could also be raised regarding the age and training of the physicians who participated on our study.

3.6 Limitations

Although clinical consultations involve multiple stakeholders, our work focuses on the experiences of physician because they are the ones who drive the consultation process [72]. As such, we leveraged SPs so that we could compare and contrast physicians' interactions across unique performances of the same scenario without worrying about the disclosure of sensitive health information. Had we engaged with real patients, the variability in their personality and behavior would have had significant impact on our findings. We also had concerns that there would be selection bias in terms of the patients that would willingly consent to participating in research where every part of their consultation would be analyzed. Since the SPs were trained to carry out scenarios in a semi-scripted manner, we recognize that they are not representative of real patients and therefore limit our commentary on their experiences.

Regarding our choice for using Slack, we acknowledge that there may be platforms or software plug-ins with functionality designed

Table 2: The average and standard deviation of various metrics for the length of the conversations that occurred during our study: duration, conversation turn count, and word count. The metrics are split according to the two scenario topics and the role of the conversation partners.

Scenario	Duration (minutes)	Conversation Turns			Words Typed		
		Physicians	SPs	Both	Physicians	SPs	Both
UTI	12.5 ± 3.3	23.0 ± 8.6	20.5 ± 5.5	43.5 ± 13.8	298.8 ± 135.5	100.4 ± 49.5	399.1 ± 180.9
Anxiety	20.5 ± 4.75	29.0 ± 7.2	33.3 ± 5.6	62.25 ± 11.1	460.0 ± 101.3	225.9 ± 76.4	685.4 ± 135.3

to address some of the challenges identified in our work, but in such cases, our findings still highlight the importance of those features. Slack also has its own set of features that are not commonly included in other platforms, such as message threading and bookmarking. However, physicians did not use these capabilities during our study. Regarding the scenarios we generated, we selected two scenarios that we anticipated would elicit varied interactions from physicians and SPs, and we also crafted personas that would lead to a reasonable amount of conversation without being unrealistic. Nevertheless, these scenarios do not represent the full spectrum of medical concerns or patient personalities that physicians may encounter over a synchronous text-based platform, so future work may be needed to expand our findings.

4 RESULTS

In this section, we first provide an overview of the conversation structure and flow. We then examine temporal and feedback-related constraints that physicians perceived while using the synchronous text-based platform. We conclude by describing the unique opportunities afforded by the platform.

4.1 Consultation Structure and Flow

4.1.1 Conversation Statistics. Table 2 summarizes the duration and length of the conversations that took place during our study. The average duration of each conversation was 16.5 ± 6.9 minutes across both scenarios, with conversations in the anxiety scenario taking longer than those in the UTI scenario. The physicians were responsible for 51.7% of the conversational turns in the UTI scenario and 52.7% of the conversational turns in the anxiety scenario. Furthermore, the physicians typed significantly more words than the SPs. The difference in the number of words typed by the physicians and SPs was statistically significant according to a pairwise t-test ($p \ll .01$) in both the scenarios, but the same could not be said for the difference in conversational turns. Still, these metrics suggest that physicians were generally responsible for steering the conversations.

4.1.2 Overall Consultation Structure. As mentioned earlier, three categories of messages were uncovered as we analyzed the conversations: questions, explanations, and expressions of empathy. Example messages from each category are provided in Table 3, and Fig. 2 illustrates how messages from these categories were interspersed chronologically during each consultation session. We found that most conversations began with physicians expressing empathy through friendly small talk to introduce themselves and understand the concerns the SP was presenting. This was often followed by a series of questions to better understand the SP's symptoms and medical background. The questioning generally started broadly with open-ended questions and eventually switched to closed-ended questions.

Once the physicians had a clearer picture of the SP's underlying issues during the information gathering phase, they sent a series of messages to explain the potential diagnoses and treatment plans. Finally, the conversations usually concluded with more casual small talk and expressions of empathy.

4.1.3 Information Gathering Process. P1 provided a detailed summary of how they typically gather information during their face-to-face patient consultations:

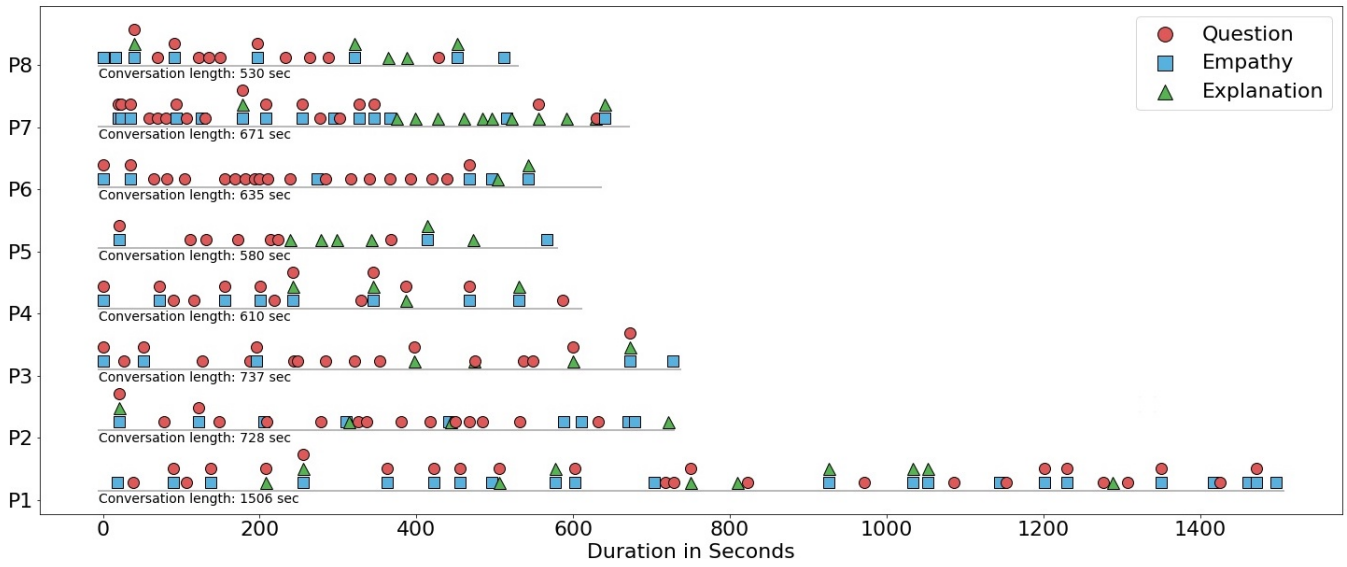
(1) They first use the OPQRST (onset, provokes or palliates, quality, radiates, severity, time) mnemonic that is often taught in medical schools to query the patient about their presenting illness and symptoms [63].
(2) After forming a general understanding of the patient's chief complaints, they switch to questions that are more relevant to the diagnosis and treatment plan. In their own words,
> *Then there's kind of a set of questions that are related to what I'm thinking about for the diagnosis, or maybe treatment or management that are maybe a little bit different. . . . and may or may not inform the diagnosis and formulating the management plan.* [P1, interview]
(3) To conclude the consultation, they often ask questions that may not be directly related to the patient's chief complaints but may still yield important information. These are often related to the patient's medical background, such as their social, medication, and family medical history.

The rest of the physicians in our study also approached the consultations with a predetermined plan in mind.

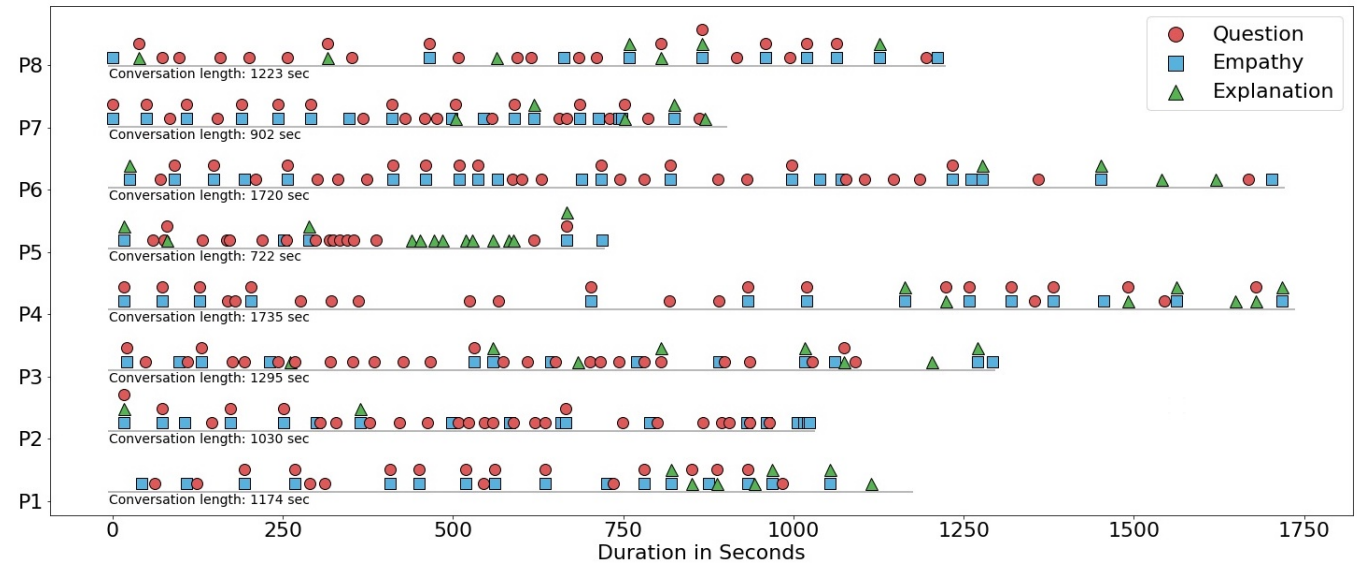
That being said, we saw that the physicians often catered the structure of their consultations to the patient's chief complaint. In the UTI scenario of our study, almost all the physicians followed the linear structure describe by P1 since they were quickly able to identify the line of questioning that was required:

> *So for something like a UTI, it's very straightforward. . . . [I would ask things] like "What type of symptoms do you have?", "What is your sexual history?", and "Are we looking at possible STIs on top of UTI?", and "Did they get a urine sample?"* [P6, interview]

In the anxiety scenario, on the other hand, most physicians felt that they required more follow-up questions to get the information they needed to progress the conversation forward. The conversation structure was much less linear, with physicians alternating between questions about the SP's presenting illness and medical background.



(a) UTI scenario



(b) Anxiety scenario

Figure 2: Timelines showing the kinds of messages that were exchanged between physicians and SPs during our study. Each shape along the timelines indicates when a message was sent. Vertically aligned shapes are used to indicate messages that included multiple codes, with the ordering of codes going from bottom to top.

Some felt that this was necessary since the SP's medical background could have been a factor influencing their mental health situation:

> *So if they're coming in for mental health, I think it's actually quite important for me to know their family medical history. … That gives me kind of a landscape of whether I am looking at someone who likely has a familial mental health concern, which often, you know, means that this may be a more difficult case to deal with.* [P6, interview]

4.1.4 Finer Patterns Within the Consultation. Close examination of Fig. 2 reveals finer patterns in the conversations. Many questions were often preceded or followed by expressions of empathy to either acknowledge the SP's input or to transition into a different

Table 3: The categories of messages, along with a description and examples, that were uncovered during the open coding analysis of the consultations conducted during our study.

Category	Description	Examples
Question	Questions that were asked about the SP's current symptoms, medical background, or social background; requests to clarify or confirm SP responses	Can you tell me more about the symptoms?
		Any ongoing health conditions, or major illnesses/surgeries in the past?
		Can you explain this a bit more?
Explanation	Explanations of medical terms, diagnosis, and treatment plans; statements foreshadowing future questions	It'll be important to keep some of these things in mind and we can discuss more later.
		It sounds like you might have a urinary tract infection, which is something we can address to make you feel better.
		The treatment is antibiotics - I will prescribe macrobid 100mg twice a day for 5-7 days.
Empathy	Statements of empathy that convey acknowledgement, compassion, or friendliness	Hi [patient name], I am doctor [doctor's name]. What can I help you with today?
		Sorry to hear about the symptoms.
		Not to worry, glad we got everything cleared up!

set of question topics. The following excerpts from consultation text highlight this pattern:

> You said that your anxiety is worse. So you have had anxiety in the past? But it was manageable? [P3 in response to SP2, conversation transcript]

> Aside from the burning pain, do you have any other symptoms? [P4 in response to SP1, conversation transcript]

The physicians also used expressions of empathy paired with explanations as a means of describing their thought process before the next question. For example,

> Okay I see. Sometimes when people are feeling overwhelmed and anxious, they sometimes don't want to be here any more or think of hurting themselves. Is that something you have thought about? [P7 in response to SP2, conversation transcript]

The information gathering phase of the consultations had its own set of patterns across physicians. P7 reported that starting with open-ended questions gives patients the time to formulate their thoughts as they become more acclimated to the conversation. P6 stated that open-ended questions are helpful for eliciting more information from patients with subjective or nebulous concerns (e.g., mental health or back pain), whereas more straightforward situations like the UTI scenario are much more efficient when they start with closed-ended questions. The physicians also indicated that the decision of whether to start with open- or closed-ended questions depended upon the patient's personality:

> *If they are not giving me a lot of detail with the open-ended questions, that was when I started to go more into closed-ended questions.* [P7, interview]

4.2 Temporal Constraints

4.2.1 Perceived Challenges. Many physicians commented on how consultations over the text-based platform felt longer relative to their face-to-face experiences. Contrary to these sentiments, the actual time it took for physicians to complete our simulated encounters was not remarkably different from the average time that they reported taking for their in-person appointments. We found that the average consultation duration during our study was 16.5 minutes, whereas the physicians reported their average consultation in clinic to typically be around 15 minutes. However, we stop short of drawing strong conclusions from this observation since the scenarios were simulated and the experience was novel for many of our participants.

The physicians attributed the perceived protraction of the consultation to the time spent typing out their messages. Typing was viewed to be a slower form of communication compared to speaking:

> *Collecting the information through text is just agonizingly slow, to be honest.* [P4, interview]

> *It definitely takes a lot more time to type versus when I talk.* [P6, interview]

Despite having a synchronous consultation in which both individuals were on their computers at the same time, the pace of the consultation did not feel comparable to verbal conversations:

> *You're both logged on at the same time, but I guess there's a delay in like the typing on both ends. And yeah, I find it a lot slower than real life.* [P7, interview]

The physicians also attributed the protraction of the encounter to the perceived effort required to appear professional. The physicians often considered text-based platforms to be better suited for casual conversations where shorthand text and acronyms are more acceptable, but they felt compelled to use more formal language. P7 commented on their efforts in trying to balance professionalism and efficiency:

> *I'm trying to do it that way, because I still want it to look professional, so I don't want to use text speech or like cut down words. I'd want to still like type things out fully and make it look formal, but that takes a bit more time.* [P7, interview]

The physicians also explained how they had to adjust their sentence structure and word choice to be different from how they would talk with their colleagues over text messaging. P6 noted,

> *We just kind of use [text messaging platforms] to discuss amongst colleagues and like ask each other questions, but it is rarely synchronous and the expectations are different.* [P6, interview]

When we analyzed the conversation scripts, we found very few instances of shortened or abbreviated words that were common in casual conversation; for example, the shorthand 'ok' was often expanded to its fuller form 'okay'.

4.2.2 Workaround: Use of Succinct and Precise Language. Beyond using more formal language to sound professional, we also found that the physicians expended significant effort making their messages more efficient for SPs to read, interpret, and respond. All of the physicians had instances when they removed, reworded, and reorganized messages that were about to be sent. When asked about this behavior, many spoke to the expectation that written messages should be more precise and succinct. P5 claimed that they specifically reworded many of their messages to be yes-no questions so that it would be easier for SP to respond to them. Although the physicians did not consider this adjustment to be difficult, it was a new experience that imposed a higher degree of mental effort. A quote from P8 highlights this well:

> *Sometimes, because you're typing and it's much slower to type than to speak, I feel like I have to think of ways to make my questions more precise. As an example, when I talked about CBT, I realized as I was typing, I didn't actually explain what it was. So then I had to say, "Brackets, Cognitive Behavioural Therapy". Because every word you're typing, you think about, "Does the patient understand that word?", and that's a bit more mental effort. Whereas when you're talking, you can clarify things easier and you can see their facial reactions if they don't understand something.* [P8, interview]

Another potential benefit that physicians anticipated from the use of succinct language was the fact that patients may be dissuaded from going on tangents, which are fairly common in clinical practice. As explained by P4,

> *The other thing is, like patients really like to waste your time a lot by their own agenda, which is harder for them to do in text because it takes longer.* [P4, interview]

The combination of streamlined questioning by physicians and barriers to long digressions by SPs made the overall consultation more efficient in terms of the amount of text that was exchanged.

4.2.3 Workaround: Action Multiplexing. Another time-saving workaround we observed from physicians was the act of multiplexing. We found that when physicians were waiting for SPs to respond to their questions, they would often begin preparing their next question in Slack's text entry panel to save time. P7 stated,

> *I'm mindful that it takes time to type, so if I've already written it down, then it's easier to send it and move things along.* [P7, interview]

Multiplexing during in-person clinic encounters was already a familiar practice for the physicians in our study. As P4 explains,

> *A lot of us in the clinic room, we multitask. Like typically as someone's talking to me, I am typing up the note; not only am I documenting, but I'm organizing my thoughts while they're talking.* [P4, interview]

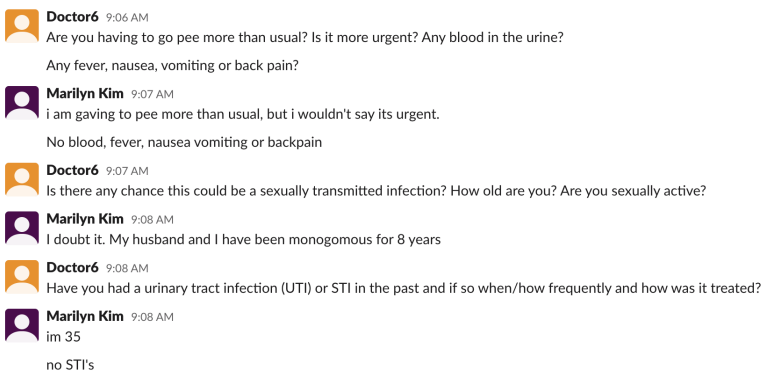
However, extra effort was required to multiplex over the text-based platform. In the event that the SP gave a response to the physician's previous question that was unexpected or otherwise deviated the direction of the conversation, the physician often stored the question they were crafting elsewhere (e.g., via copy-and-paste) and addressed the SP's message before returning to their original line of thinking.

4.2.4 Workaround: Double-barreled Questions. One surprising observation was the frequent use of double-barreled questions — single messages containing multiple questions or topics. Out of the 299 physician-initiated messages containing questions that were sent during the study, we found that 75 (25.1%) were double-barreled. In fact, all of the physicians had at least one double-barreled question during their consultations with the SPs. Fig. 3 provides instances when a physician asked multiple questions at once versus separating them into independent messages. In a debriefing session with the SPs, both of them expressed feeling lost and confused at times when they were asked double-barreled questions:

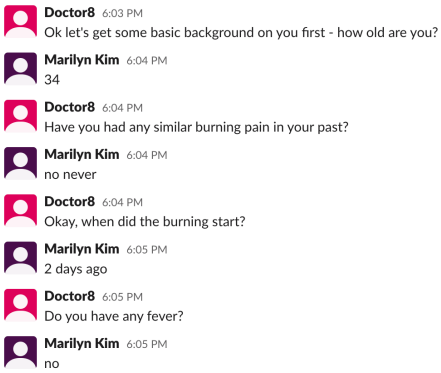
> *It was a little overwhelming responding to all those different points.* [SP1, debrief]
>
> *I think I might have missed a few points because I didn't know which part to respond to. My eyes usually gravitate to the last thing.* [SP2, debrief]

When we asked physicians to reflect on their use of double-barreled questions, some were surprised that they had used them in the first place and believed that it was not something they would do normally with patients in person:

> *I try not to do the double question. Because I know that only one of them gets answered. And it gets missed. And then I missed that information, too.* [P7, interview]



(a) An example of a double-barreled question by P6.



(b) An example of separated questions by P8.

Figure 3: Conversation excerpts illustrating double-barreled and separated questions.

Physicians like P5 hypothesized that they instinctively used double-barreled questions to save time as it allowed them to gather more information at once. In fact, P3 suggested that asking multiple questions at the same time might even make it easier for patients to respond to certain questions in the text-based platform:

> *Now, when [multiple questions are sent] on text, it might be easier because the patient can read the whole message multiple times and respond, but bullet points are probably more appropriate here.* [P3, interview]

4.3 Feedback Constraints

4.3.1 Perceived Challenges. We found that the text modality excluded many of the communication cues physicians use to understand and diagnose a patient. This issue was especially prominent in the anxiety scenario because physicians often rely on visual cues like facial expressions and body language to assess patients' mood and mindset.

> *For mental health, it's a challenge, because a lot of it is the visual of seeing the patient because you can gauge how severe things are. Whereas on text, it's just … you don't know. Because if they look really bad, you'd be more concerned about things such as suicide, or maybe they're not being truthful to you. So that part is a big issue.* [P3, interview]

As highlighted in the previous quote, non-verbal cues were not only important to the physicians for understanding the severity of the issues but also for assessing the veracity of the exchange itself. These concerns were raised both with respect to the authenticity of the responses and the patient themselves. P8 described this matter as follows:

> *I'm not sure, like, is this the actual patient, or is it somebody else typing for them? Sometimes that can happen too, when you can't actually see the patient. If someone doesn't have health insurance and they ask a family member to use their health card. … You don't really see the patient. You don't really know them, and so it's a bit harder.* [P8, interview]

The lack of audio cues like tone and intonation also made it more difficult for the physicians and patients to understand one another. P1 reflected,

> *It's hard to get any inflection or understanding of prosody to be able to understand how someone's feeling. You know, are they feeling a little anxious or a lot anxious? Sometimes we can infer that from how they are talking about things, how they are pausing to talk about things, if they are feeling reluctant, or overall how they sound. That is all very challenging through text.* [P1, interview]

Conversely, the absence of non-verbal cues impacted how the physicians demonstrated active listening and gave feedback to the SPs. Several physicians mentioned that they would often nod or utter small affirmations such as 'mhm' or 'uh-uh' during their face-to-face conversations with patients. These actions were often instinctive and required nominal mental effort. However, it was more challenging to replicate these forms of acknowledgment through text without sounding colloquial.

> *I don't want to type "mhm" out in text like I'd say in real life because that would not look professional.* [P7, interview]

4.3.2 Workaround: Indications of Typing. While the physicians multiplexed their actions, they adjusted their behavior based on the visual indicator provided by Slack showing that the conversational partner is typing. More specifically, some physicians stopped crafting their next message when they saw the indicator to avoid stressing the SP and to emulate active listening. P3 described their thought process as follows,

> *Sometimes you need to give [the patient] time to respond because it's hard for them. But at the same time, you want to make sure they're not like having a crisis. It's not mechanic … but I think I generally wait two to three minutes max to separate things. It just takes some time to process and to share.* [P3, interview]

We noticed that physicians sometimes struggled to balance giving the SPs the space to write while making sure the conversation was

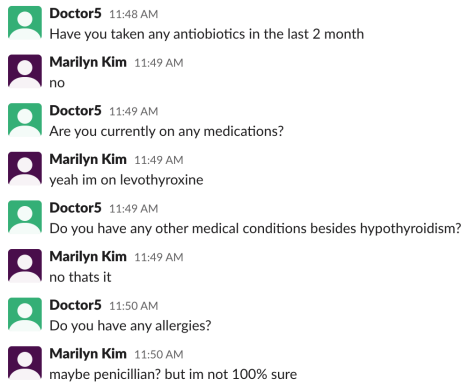


Figure 4: A conversation excerpt from P5 illustrating how typing out a summary led them to infer additional information about the SP.

flowing. For example, when P1 sent out a message and did not see the indicator that the SP was typing, they said aloud,

> *Are they there? … Oh yes, they are just taking some time to respond.* [P1, interview]

Some physicians also took note of the fact that the typing indicator was being displayed on both sides of the conversation. P6 worried that the SP was using the indicator to gauge how attentive they were being in the conversation:

> *One thing with that is, the other person can see you typing something, which may look like you're not really paying attention to what they are about to say. I don't want to give that impression.* [P6, interview]

4.3.3 Workaround: Encouraging More Typing From Patients. The lack of verbal cues required more follow-up and creative ways to keep the conversation going, so the physicians stated that they asked more questions than usual as a means of getting the SPs to provide more information. They often did this by asking open-ended questions such as "`Can you tell me more about this?`" or "`In your own words, how would you describe what you're feeling?`". P7 explained that open-ended questions allow patients to temporarily take the lead with the conversation, and once there is enough information for them to work with, they would follow with closed-ended questions to get more precise details.

However, the physicians recommended against probing deeper without considering the patient's chief complaints, mental state, or the potential risks involved. This became apparent in our anxiety scenario, which led P4 to explain that consultations involving the risk of committing bodily harm were "awkward" and ineffective to have through text.

4.3.4 Workaround: Acknowledging Effort and Emotions. To demonstrate empathy and active listening, physicians compensated for the lack of non-verbal feedback by explicitly typing phrases of acknowledgment. In analyzing the conversation scripts, we noticed that these phrases took three different forms:

(1) **Short affirmations:** The physicians frequently used short phrases like "`I see`", "`understood`", and "`this is helpful`" throughout the conversation to acknowledge that they had read and understood the information provided by the SPs. As P7 describes,

> *So if I didn't say "I see" or "okay" but then go straight into my next question, it would just be like, I didn't really absorb what the patient just told me. I would hope that the patient would think that I'm actually listening to what they're saying.* [P7, interview]

We also noticed that these phrases were often paired with follow-up questions to continue the flow of the conversation. For example, P1 pushed a conversation along using the following message:

> `OK. No worries. The concern regarding your anxiety, has it been something that you have previously discussed with your old family doctor?` [P1 in response to SP2, conversation transcript]

When asked about these short phrases of acknowledgement, P7 replied,

> *I think these are phrases that I use in real life. I kind of felt like it was the same things that I would say, I was just writing down.* [P7, interview]

Although the word choice was similar to what they would say during in-person consultations, many physicians felt they were compelled to use these phrases more frequently on the text-based platform.

(2) **Long summaries:** The physicians also used longer expressions of acknowledgement to summarize the information they had gathered up until that point. For example, P6 said the following to the SP during the anxiety scenario:

> `So from what I have heard so far, it seems like you've had a long history of on-and-off anxiety that you have self-managed until now. Due to recent work situation, this anxiety has gotten worse and you would like some help for that.` [P6 in response to SP2, conversation transcript]

In some cases, the physicians repeated what was said by the SPs in an attempt to infer or deduce further information. As shown by the conversation snippet in Fig. 4, P5 inferred that the SP had hyperthyroidism when the medication levothyroxine was mentioned, so they followed-up by asking the SP about any other medical conditions they were experiencing.

(3) **Expressions of compassion:** The physicians often attempted to convey empathy when the SPs shared sensitive information. These acknowledgements were often used at the beginning of the consultations when the SPs mentioned why they were seeking medical help, taking the form of statements like "`I am sorry to hear about that`" or "`That sounds very stressful`". Similarly, condolences were often given when the SPs brought up past issues in their medical or family history (e.g., knee pain, death of a close family member), even when the issues were seemingly unrelated to the their immediate concerns. Although most physicians felt that it was natural to express compassion during patient consultations, they found it difficult to convey such emotions over text. For instance, P2 noted that conveying empathy through text felt "robotic and "less efficient".

4.4 Unique Affordances of Text-Based Modality

Despite the aforementioned constraints, the physicians were generally optimistic about the potential of synchronous text-based consultations to better support remote patient care. Provided that they would be adequately compensated for their time consulting with patients, physicians like P5 expressed the following sentiment:

> *I would be okay with it, because it's actually more time-saving [for patients] than seeing doctors in person, booking an appointment, and all that.* [P5, interview]

Physicians also surfaced positive affordances specific to text-based platforms, which we summarize below.

4.4.1 Potential for Incorporating Standardized Questionnaires. On a few occasions, physicians searched online for relevant standardized questionnaire in their browser so that they could copy-and-paste the questions into Slack. There were other instances when physicians lamented not considering this practice:

> *Like in the questionnaire it can be more structured, so you can group similar questions together. Whereas when you're just doing this, I was all over the place. … Actually, I forgot to ask whether he is using cocaine and how often he uses marijuana. Whereas in a questionnaire, it's like, you've had time to perfect the questionnaire. So it, it won't miss anything. You'll probably get too much information, if anything, when you have to review it.* [P5, interview]

When asked about their typical consultation workflow, six of the physicians mentioned the use of standardized questionnaires like the PHQ-9 for depression screening. The physicians explained that they often use questionnaires to provide a logical structure to their information gathering process so that their notes can easily be incorporated into an electronic medical record system. They also saw questionnaires as a means of ensuring that they would not forget to ask an important question. Perhaps most importantly, physicians valued questionnaires because they removed the cognitive load required to formulate and articulate questions. As P2 explains,

> *But I think like a bunch of that stuff I was rhyming off, should be collected in a template or a questionnaire like, "Do you drink?", "Do you smoke?", "Do you do drugs?", "What's your past medical history", etc. All that there's no benefit to me asking that question.* [P2, interview]

While questionnaires are commonly used in clinical practice, they are not without their limitations. Most notably, the physicians often pointed out that questionnaires can be rigid. P7 mentioned that they sometimes make slight modifications to questionnaire content based on the personality or health status of the patient. Responses from patients can lead to deviations:

> *But the negative is that in this case, I might ask a question where the patient says something, and that may lead me to a different direction, which the questionnaire won't be able to do.* [P5, interview]

The use of standardized questionnaires in the text-based platform also came with its own challenges. As shown in Fig. 5, there was a situation when P8 tried to integrate a standard anxiety questionnaire into their line of questioning. However, the SP did not realize that the physician was asking questions directly taken from a formal assessment. Instead of selecting an answer out of the set of options included with each question, the SP simply gave free-form answers as they saw fit. It was not until P8 explicitly mentioned that the questions were taken from a standardized questionnaire that the SP began to frame their responses around the provided options.

4.4.2 Supporting Reflection and Review. Although the physicians often felt that they were wasting time typing and waiting on the responses from the SPs, they acknowledged that these moments allowed them to pause and reflect on the right words to use. From our observations, physicians spent up to 85 seconds during each conversation revising their messages before sending them out. This affordance was both foreign and appreciated by many physicians, as highlighted in P2's comment:

> *Sometimes, doctors will say things and they'll stop themselves, but when typing, they have time to think about it. So there's going to be a lot more like manicured responses.* [P2, interview]

The pauses in the consultation also enabled the physicians to scroll through the conversation history. Doing so allowed them to review the SPs' responses and to remind themselves of the questions they had already asked, which was especially helpful since the physicians were often multiplexing. P5 said,

> *I am just looking to see what I had already asked. Because basically, I find my mind to work at a mile a minute. And sometimes, like, especially if I'm writing, I can actually see the questions I've done.* [P5, interview]

When the flow of the conversation was non-linear, the ability to review messages was even more beneficial. As mentioned earlier, physicians commented on how patients can get easily side-tracked from the conversation structure the physicians had in mind. The additional effort required to type made tangents less common on the text-based platform. When they did happen, the physicians believed that it was their responsibility to steer the conversation back on track:

> *So I'll look at that as a prompt, "I already double-checked this" or "I've asked this already" … because in the flow of conversation, I could have miss that, because I'm following what they're saying. The interface allows me to check what's already been said or if I need to expand on anything.* [P7, interview]

Physicians anticipated that patients would also benefit from the ability to reference the conversation history. Just as how they reflected back to earlier parts of the consultation to remind themselves of what had been said, they expected that SPs were doing the same when reflecting on whether or not they had answered all of the physician's questions. The physicians suspected this was a particularly useful affordance given their subconscious use of double-barreled questions during our study. Although P5 emphasized that they did not ask such questions in-person or over the phone, they expected that patients would be able to tease apart the requests and answer them individually by referring back to previous messages.

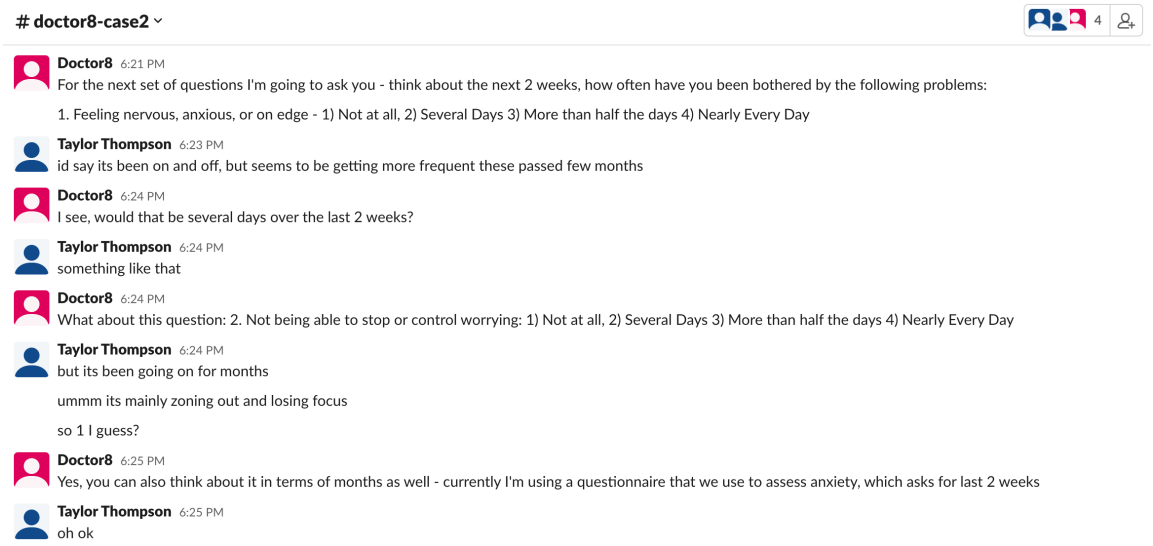


Figure 5: A conversation excerpt between P8 and SP2 illustrating confusion over the use of questions from a standardized questionnaire.

4.4.3 Supporting Privacy During Sensitive Conversations. While the lack of audio and video feedback made it difficult for physicians to pick up on the non-verbal cues they often leverage during in-person consultations, they hypothesized that the ability for patients to "hide behind their keyboard" would make them feel more free to discuss sensitive topics at their discretion. P7 suggested that text may be a better modality for supporting patients than phone or video calls since it removes identifiers like the patient's face or voice that would otherwise tie the patient's concerns to their identity.

> *I know for some people, the anonymity helps provide cover and they are more comfortable. That's where text-messaging could have an advantage over verbal dialogues.* [P7, interview]

The utility of privacy is not unique to virtual health and text-based platforms. P4 recounted a related strategy they often use in their practice to allow patients to express their concerns outside of face-to-face consultations:

> *I can say, for my male patients with erectile dysfunction, it's an incredibly common issue, but extremely uncomfortable for men to talk about. They'll book a physical (consultation), and they'll say "I'm tired" when they come in, but what they really want to talk about is a prescription for Viagra. I'll try to get through questions best I can, but if they're just like a clam shell, I'll say, "Look, I'm gonna send you this survey with some questions to take home".* [P4, interview]

P4 later elaborated that forms and surveys create an opportunity for patients to comfortably respond to questions while alleviating some of the perceived stigma that worried patients.

5 DISCUSSION

In this section, we first summarize the key findings of our work and discuss their applicability across situations. We then suggest opportunities for future text-based consultation platforms to address some of the challenges that were identified by our work.

5.1 Key Findings

Since the structure of the conversations in our study were similar to how physicians conduct their in-person consultations, the physicians in our study generally felt that they would be able to provide comparable quality in care using synchronous text-based platforms. As reflected by the logical flow of the conversations, the physicians did their best to apply the strategies that they usually employ in their clinical practice. However, limited time with patients is often a chief complaint by physicians when it comes to scaffolding relationships [90], and the physicians in our study worried that they were being even less efficient with their time while using the text-based platform since they had to type and wait for responses. Literature has shown that although people can both read and listen to information at roughly the same rate [27, 66], typing is nearly three times slower than speaking [21, 32]. Therefore, the inefficiency perceived by our physicians aligns with the research community's understanding of communication in other contexts. We found that physicians were able to adapt to the perceived inefficiency of text-based messaging by asking double-barreled questions, multiplexing their actions, and communicating with more precise and succinct language. The slower nature of text communication also influenced the physicians to be more thorough and precise with their messages, a finding that is supported by prior work in cognitive psychology [75].

The physicians also struggled with the inability to have physical interactions with the SPs. Prior work has noted that virtual care precludes many forms of physical examination [5, 16], but our

work highlights additional constraints in synchronous text-based consultation that may not be as salient in phone or video calls. Physicians often rely on tonal inflection, facial expressions, and body language to understand a patient's personality and medical state. The lack of these non-verbal cues during synchronous text-based conversations limited the expressiveness that both physicians and SPs were able to convey [68, 69, 84]. The physicians and SPs also lacked the means to demonstrate active listening, such as face scrunching to indicate confusion or vocal fillers like 'hmm' or 'yeah'. The physicians were quick to adapt to the text-based platform, encouraging longer responses from patients using explicit expressions of acknowledgement.

Finally, our findings highlighted unique opportunities provided by text-based platforms to make clinical consultations more efficient and fruitful. We saw that physicians borrowed questions from standardized questionnaires that they would normally use in their practice to facilitate data collection. The slower pace of the conversation also provided both the physicians and SPs additional time to reflect back on the conversation history, as we observed several instances of physicians scrolling up to review previous messages or to relocate their initial line of questioning before being carried off on a tangent. Finally, the physicians commented on how the lack of video or voice could make patients feel more comfortable disclosing sensitive information about their health.

5.2 Applicability of Medical Text-based Platforms Across Situations

We elicited our findings based on two semi-structured scenarios: one involving a patient with a urinary tract infection (UTI) and another one involving a patient with anxiety issues. We also used two SPs who were instructed to act as patients who were initially apprehensive to give information but eventually willing to answer questions. Imposing these constraints on our study design enabled us to compare how different physicians approached the same situation without too many experimental variables, but we recognize that doing so may have also narrowed the potential scope of our findings. We highlight a few important dimensions for how synchronous text-based messaging would be best suited for physician's day-to-day practice below:

5.2.1 Medical Concerns. Supporting the findings by Ekman et al. [26], the UTI case was generally viewed as being more appropriate for text-based platforms compared to the anxiety scenario. This is because the physicians were generally supportive of using text-based platforms for medical concerns that were more straightforward to diagnose. Other linear tasks like prescription renewals and laboratory test requisitions were viewed as equally appropriate for similar reasons. Complex and convoluted medical scenarios, particularly with new patients, were perceived to be less favorable for text-based platforms. For example, a new patient with an extended medical history and several co-existing issues may have difficulties covering all of their concerns without significant typing effort, so it may be best to redirect these patients to another platform that ensures that all of their needs can be accommodated. This sentiment was shared by some physicians regarding the anxiety scenario of our study, during which they felt that they needed more time to interact with the SP. Perhaps more importantly, the physicians noted that they would feel more comfortable speaking with patients face-to-face when there are serious concerns of self-harm as those would need to be addressed before identifying a treatment plan.

5.2.2 Patient Demography. Many of the physicians posited that texting would be particularly appealing for younger individuals. This hypothesis is well supported by the literature, as texting has been shown to be popular amongst those who have grown up with smartphones and social media [19]. Furthermore, texting has also been used as a medium for clinical intervention among adolescents [67]. The physicians also suggested that familiar patients with recurrent meetings would be more receptive to text-based interactions provided that their medical needs could be addressed remotely. As demonstrated by Kelley et al. [44], patients with periodic meetings through text eventually build a rapport with their physician, making subsequent consultations easier.

5.2.3 Patient Environment. Many physicians praised the fact that virtual care platforms have given them the ability to reach patients who are too busy or too far away from their clinic. Although phone and video calls have affordances that the physicians in our study missed, they recognized that there can be situations when a person is unable to engage through such modalities. For example, a patient may be in a noisy environment where they cannot hear the conversation, or they may be in a quiet room where they do not want to disturb others. Even though it still takes cognitive effort to engage in a conversation over text, patient can easily take breaks or move around if they need to relocate before continuing the conversation.

5.3 Future Directions for Text-Based Consultation Platforms

Our findings elicited many design recommendations and opportunities for future text-based consultation platforms.

5.3.1 Supporting Routine Procedures. Healthcare delivery is most effective when it is personalized to the patient, but physicians often base their process on a standard procedure. Examples of these procedures included the OPQRST mnemonic [63] for gathering information about the patient's chief complaints and standardized questionnaires designed for clinical screening. The physicians appreciated the ability to deviate from procedures as needed, but the flexibility also led to inefficiency. With standardized questionnaires, for example, the physicians had to either copy-and-paste questions or type the questions out themselves in the interface. This process was not only mundane for physicians, but also confusing for the patients as they were not always aware of why the line of questioning had suddenly become more formal.

Automating the entire consultation process is likely to be unrealistic, but using the mixed-initiative principles described by Horvitz [38], we believe that text-based platforms can facilitate the routine components of the process. Future designs could either suggest or auto-complete commonly used phrases and questions, but the timeliness and relevance of these suggestion requires further investigation. Platforms could also allow physicians to upload a database of standardized questionnaires ahead of time so that they can be launched as a subroutine on command. Moving a step further, platforms could automatically suggest appropriate questionnaires when relevant subjects are detected during conversation. Regardless of

how the subroutine is initiated, it should be clear to the patient that the line of questioning has changed, and the interface should provide additional guidance on the kinds of answers that are expected.

5.3.2 Conveying Active Listening. Active listening is an important skill for medical professionals to demonstrate in clinical practice [69]. Medical schools have dedicated programs for training physicians to be effective active listeners [43, 64]. However, these programs have historically been catered to in-person consultations, and we found that the physicians in our study had difficulties adapting best practices to the virtual context. In particular, the physicians often remarked on how they had to make an explicit effort to convey active listening. Many achieved this by inserting phrases and messages to acknowledge what the SP had said, while others stopped typing when they saw that the SP was typing on the interface.

Existing messaging platforms like Facebook Messenger and WhatsApp provide visual indicators that show when a message has been received and read during a conversation. In the case of clinical consultations, however, it may be equally important to show that the user is contemplating a response without actually typing. This feature could be implemented with face-tracking software designed to identify when the user is facing their screen. For more fine-grained information, gaze trackers could be used to identify when the user is looking at the chat interface. No matter the underlying technology being used to track the user's attention, such designs would need to accommodate a variety of expected behaviors. For instance, platforms should not display information that would lead patients to believe that physicians are being inattentive simply because they are looking at a different interface to craft their next set of questions.

5.3.3 Balancing Privacy, Trust, and Effective Communication. The design of future text-based consultation platforms should also account for the benefits of providing patients privacy without sacrificing effective communication. The physicians in our study had varied opinions on the fact that the patients could "hide behind their keyboard". On the one hand, they believed that perceived anonymity from the perspective of patients would inspire them to be more open with sharing sensitive information that could be crucial for the medical diagnosis. This observation aligns with literature that shows people are more open and expressive in anonymous online environments like chat rooms, therapy sessions, and chatbots [12, 45]. On the other hand, the physicians felt that giving patients complete anonymity could lead to ineffective communication as they lacked the non-verbal cues that helped them deliver care. The physicians also suggested that unless they already knew the patient well, they would be suspicious about whether the conversational partner in the text-based platform was the patient they expected. These two issues are intertwined, as physicians can use non-verbal cues to further verify the identity of the patient and the information they are providing. Further research could explore how non-verbal cues could be better translated through platforms that only support text.

One way of facilitating emotional expression in a private manner is through the use of emoticons. Prior literature has shown that emoticons can add a personable touch to messages [29] and convey empathy [53]. However, the physicians in our study did not use any emoticons — even common ones like 👍 or 😀. When asked about this, physicians reminded us of their desire to appear professional and worried that emoticons would detract from those efforts. This suggests that other forms of conveying empathy and concern should be explored. Future work could seek out a subset of emoticons that are suitable for professional use or even propose a new set of emoticons that are agreed upon by both patients and physicians to be appropriate for the medical context.

5.3.4 Facilitating Clarity. One more way that mixed-initiative principles [38] could be applied to text-based consultation platforms is in the handling of double-barreled questions. As we highlighted in the results, the SPs were sometimes confused when physicians asked several questions all at once, but the physicians subconsciously used doubled-barreled questions in an attempt to help the SPs better understand the aim of their queries. Whenever a physician asks such a question, platforms could initiate a warning notifying them that such questions may be confusing or overwhelming for the patient. Platforms could even suggest an alternative wording of the question that helps the clinician split the questions into two separate messages. Regardless of the solution, physicians should have the final say on the content of messages that are sent to patients.

5.3.5 Preventing Physician Burnout. The Maslach Burnout Inventory defines workplace burnout according to three constructs: (1) emotional exhaustion, (2) depersonalization, and (3) a low sense of personal accomplishment [58]. Although new technologies for clinical workflows are often designed with the intention of making physicians' work more efficient and reducing burnout, there is always the possibility that they can do the exact opposite [62]. Synchronous text-based consultation platforms are already being used in clinical settings, but little is known about their long-term impact on physicians. To address this gap in the literature, our work identifies pain points that may eventually contribute to burnout, yet future work is needed to assess the magnitude of their influence over time as physicians become more accustomed to synchronous text-based platforms in the clinical context.

6 CONCLUSION

In response to the rising use of synchronous text for virtual care, we investigated the extent to which physicians are able to leverage their training and experience from in-person consultations for this emergent modality. Although the physicians in our study felt that interacting with SPs over text was a laborious process, they tried to compensate by making their messages more succinct and their actions more efficient. Physicians also lamented the lack of non-verbal cues, but they were able to adapt by adding overt expressions of empathy and active listening. These adaptations required additional effort on the part of the physicians, which highlights opportunities for researchers and designers to improve clinical consultation workflows. We also uncovered features that are specific to text-based platforms, creating further opportunities for innovative designs. We anticipate similar studies in the near future that focus on patients' perspectives towards synchronous text-based consultation platforms, and when the findings from such investigations are combined with our own, we look forward to seeing designs that better accommodate all stakeholders.

REFERENCES

[1] Anne Adams, Peter Lunt, and Paul Cairns. 2008. *A qualitative approach to HCI research.* Cambridge University Press, New York, USA, 138–157. https://doi.org/10.1017/CBO9780511814570.008

[2] Hege K Andreassen, Marianne Trondsen, Per Egil Kummervold, Deede Gammon, and Per Hjortdahl. 2006. Patients who use e-mediated communication with their doctor: new constructions of trust in the patient-doctor relationship. *Qualitative health research* 16, 2 (2006), 238–248.

[3] Edward Barayev, Omri Shental, Dotan Yaari, Elchanan Zloczower, Itai Shemesh, Michael Shapiro, Elon Glassberg, and Racheli Magnezi. 2021. WhatsApp Tele-Medicine–usage patterns and physicians views on the platform. *Israel journal of health policy research* 10, 1 (2021), 1–9.

[4] Howard S Barrows et al. 1993. An overview of the uses of standardized patients for teaching and evaluating clinical skills. *Academic Medicine – Philadelphia* 68 (1993), 443–443.

[5] David Bergman, Christina Bethell, Narangerel Gombojav, Sandra Hassink, and Kurt C Stange. 2020. Physical distancing with social connectedness. *The Annals of Family Medicine* 18, 3 (2020), 272–277.

[6] Oleg Bestsennyy, Greg Gilbert, Alex Harris, Jennifer Rost, et al. 2021. Telehealth: a quarter-trillion-dollar post-COVID-19 reality. *McKinsey & Company* 22 (2021), 1–10.

[7] J Beullens, JJ Rethans, Jo Goedhuys, and Frank Buntinx. 1997. The use of standardized patients in research in general practice. *Family practice* 14, 1 (1997), 58–62.

[8] Karthik S Bhat, Mohit Jain, and Neha Kumar. 2021. Infrastructuring Telehealth in (In)Formal Patient-Doctor Contexts. *Proceedings of ACM Human-Computer Interaction* 5, CSCW2, Article 323 (oct 2021), 28 pages. https://doi.org/10.1145/3476064

[9] R Sacha Bhatia, Cherry Chu, Andrea Pang, Mina Tadrous, Vess Stamenova, and Peter Cram. 2021. Virtual care use before and during the COVID-19 pandemic: a repeated cross-sectional study. *Canadian Medical Association Open Access Journal* 9, 1 (2021), E107–E114.

[10] Anna Bell Björk, Helene Hillborg, Marika Augutis, and Göran Umefjord. 2017. Evolving techniques in text-based medical consultation–Physicians' long-term experiences at an Ask the doctor service. *International journal of medical informatics* 105 (2017), 83–88.

[11] Cajsa Björndell and Åsa Premberg. 2021. Physicians' experiences of video consultation with patients at a public virtual primary care clinic: a qualitative interview study. *Scandinavian Journal of Primary Health Care* 39, 1 (2021), 67–76.

[12] Tim Blumer and Nicola Döring. 2012. Are we the same online? The expression of the five factor personality traits on the computer and the Internet. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace* 6, 3 (2012), 5.

[13] Lucie Bosméan, Philippe Chaffanjon, and Alexandre Bellier. 2022. Impact of physician–patient relationship training on medical students' interpersonal skills during simulated medical consultations: a cross-sectional study. *BMC Medical Education* 22, 1 (2022), 1–8.

[14] John R Boulet, M Friedman Ben-David, Amitai Ziv, William P Burdick, Michael Curtis, Steve Peitzman, and Nancy E Gary. 1998. Using standardized patients to assess the interpersonal skills of physicians. *Academic Medicine – Philadelphia* 73 (1998), S94–S96.

[15] Heather Brant, Helen Atherton, Sue Ziebland, Brian McKinstry, John L Campbell, and Chris Salisbury. 2016. Using alternatives to face-to-face consultations: a survey of prevalence and attitudes in general practice. *British Journal of General Practice* 66, 648 (2016), e460–e466.

[16] Mylaine Breton, Nadia Deville-Stoetzel, Isabelle Gaboury, Mélanie Ann Smithman, Janusz Kaczorowski, Marie-Thérèse Lussier, Jeannie Haggerty, Aude Motulsky, Peter Nugus, Géraldine Layani, et al. 2021. Telehealth in primary healthcare: a portrait of its rapid implementation during the COVID-19 pandemic. *Healthcare Policy* 17, 1 (2021), 73.

[17] Prerna Chikersal, Danielle Belgrave, Gavin Doherty, Angel Enrique, Jorge E Palacios, Derek Richards, and Anja Thieme. 2020. Understanding client support strategies to improve clinical outcomes in an online mental health intervention. In *Proceedings of the 2020 CHI conference on human factors in computing systems*. Association for Computing Machinery, New York, NY, USA, 1–16.

[18] Jonathan Cook and Tad Hirsch. 2014. Monologger: visualizing engagement in doctor-patient conversation. In *Proceedings of the 2014 companion publication on Designing interactive systems*. Association for Computing Machinery, New York, NY, USA, 37–40. https://doi.org/10.1145/2598784.2602776

[19] Sarah M Coyne, Laura M Padilla-Walker, and Hailey G Holmgren. 2018. A six-year longitudinal study of texting trajectories during adolescence. *Child Development* 89, 1 (2018), 58–65.

[20] Amol Deshpande, Shariq Khoja, Julio Lorca, Ann McKibbon, Carlos Rizo, Donald Husereau, and Alejandro R Jadad. 2009. Asynchronous telehealth: a scoping review of analytic studies. *Open Medicine* 3, 2 (2009), e69.

[21] Vivek Dhakal, Anna Maria Feit, Per Ola Kristensson, and Antti Oulasvirta. 2018. Observations on typing from 136 million keystrokes. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) *(CHI '18)*. Association for Computing Machinery, New York, NY, USA, 1–12. https://doi.org/10.1145/3173574.3174220

[22] Kevin Doherty, Marguerite Barry, José Marcano Belisario, Cecily Morrison, Josip Car, and Gavin Doherty. 2020. Personal information and public health: Design tensions in sharing and monitoring wellbeing in pregnancy. *International journal of human-computer studies* 135 (2020), 102373.

[23] Sathyanarayanan Doraiswamy, Amit Abraham, Ravinder Mamtani, Sohaila Cheema, et al. 2020. Use of telehealth during the COVID-19 pandemic: scoping review. *Journal of medical Internet research* 22, 12 (2020), e24087.

[24] Mitchell Dowling and Debra Rickwood. 2013. Online counseling and therapy for mental health problems: A systematic review of individual synchronous interventions using chat. *Journal of Technology in Human Services* 31, 1 (2013), 1–21.

[25] Stephen Duckett. 2020. What should primary care look like after the COVID-19 pandemic? *Australian Journal of Primary Health* 26, 3 (2020), 207–211.

[26] Björn Ekman, Hans Thulesius, Jens Wilkens, Anna Lindgren, Olof Cronberg, and Eva Arvidsson. 2019. Utilization of digital primary care in Sweden: descriptive analysis of claims data on demographics, socioeconomics, and diagnoses. *International Journal of Medical Informatics* 127 (2019), 134–140.

[27] Emerson Foulke. 1968. Listening comprehension as a function of word rate. *Journal of Communication* 18, 3 (1968), 198–206.

[28] Shilpa N Gajarawala and Jessica N Pelkowski. 2021. Telehealth benefits and barriers. *The Journal for Nurse Practitioners* 17, 2 (2021), 218–221.

[29] Jing Ge. 2019. Emoji sequence use in enacting personal identity. In *Companion proceedings of the 2019 world wide web conference* (San Francisco, USA) *(WWW '19)*. Association for Computing Machinery, New York, NY, USA, 426–438. https://doi.org/10.1145/3308560.3316545

[30] William Gibbs, Linda D Simpson, and Ronan S Bernas. 2008. An analysis of temporal norms in online discussions. *International Journal of Instructional Media* 35, 1 (2008), 63–76.

[31] Rebecca Grainger, Bonnie White, Catherine Morton, Karen Day, et al. 2017. A Health Professional–Led Synchronous Discussion on Facebook: Descriptive Analysis of Users and Activities. *JMIR formative research* 1, 1 (2017), e7257.

[32] Roger Griffiths. 1990. Speech rate and NNS comprehension: A preliminary study in time-benefit analysis. *Language Learning* 40, 3 (1990), 311–336.

[33] Victoria Hammersley, Eddie Donaghy, Richard Parker, Hannah McNeilly, Helen Atherton, Annemieke Bikker, John Campbell, and Brian McKinstry. 2019. Comparing the content and quality of video, telephone, and face-to-face consultations: a non-randomised, quasi-experimental, exploratory study in UK primary care. *British Journal of General Practice* 69, 686 (2019), e595–e604.

[34] Bradford W Hesse, Carol M Werner, and Irwin Altman. 1988. Temporal aspects of computer-mediated communication. *Computers in Human Behavior* 4, 2 (1988), 147–165.

[35] Donald M Hilty, John Torous, Michelle Burke Parish, Steven R Chan, Glen Xiong, Lorin Scher, and Peter M Yellowlees. 2021. A literature review comparing clinicians' approaches and skills to in-person, synchronous, and asynchronous care: moving toward competencies to ensure quality care. *Telemedicine and e-Health* 27, 4 (2021), 356–373.

[36] Simon Hoermann, Kathryn L McCabe, David N Milne, Rafael A Calvo, et al. 2017. Application of synchronous text-based dialogue systems in mental health interventions: systematic review. *Journal of medical Internet research* 19, 8 (2017), e7023.

[37] A Jay Holmgren, N Lance Downing, Mitchell Tang, Christopher Sharp, Christopher Longhurst, and Robert S Huckman. 2022. Assessing the impact of the COVID-19 pandemic on clinician ambulatory electronic health record use. *Journal of the American Medical Informatics Association* 29, 3 (2022), 453–460.

[38] Eric Horvitz. 1999. Principles of mixed-initiative user interfaces. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems* (Pittsburgh, Pennsylvania, USA) *(CHI '99)*. Association for Computing Machinery, New York, NY, USA, 159–166. https://doi.org/10.1145/302979.303030

[39] Yalda Jabbarpour, Anuradha Jetty, Matthew Westfall, and John Westfall. 2021. Not telehealth: which primary care visits need in-person care? *The Journal of the American Board of Family Medicine* 34, Supplement (2021), S162–S169.

[40] Brandy M Jenner and Kit C Myers. 2019. Intimacy, rapport, and exceptional disclosure: a comparison of in-person and mediated interview contexts. *International Journal of Social Research Methodology* 22, 2 (2019), 165–177.

[41] Anders Johansson, Monica Larsson, and Bodil Ivarsson. 2020. General practitioners' experiences of digital written patient dialogues: A pilot study using a mixed method. *Journal of Primary Care & Community Health* 11 (2020), 2150132720909656.

[42] Genevieve Marie Johnson. 2006. Synchronous and asynchronous text-based CMC in educational contexts: A review of recent research. *TechTrends* 50, 4 (2006), 46–53.

[43] Lianna Karp. 2015. Can empathy be taught? Reflections from a medical student active-listening workshop. *Rhode Island medical journal* 98, 6 (2015), 14-16 pages.

[44] Leah T Kelley, Michelle Phung, Vess Stamenova, Jamie Fujioka, Payal Agarwal, Nike Onabajo, Ivy Wong, Megan Nguyen, R Sacha Bhatia, and Onil Bhattacharyya. 2020. Exploring how virtual primary care visits affect patient burden of treatment.

International Journal of Medical Informatics 141 (2020), 104228.

[45] Margaret L Kern, Johannes C Eichstaedt, H Andrew Schwartz, Lukasz Dziurzynski, Lyle H Ungar, David J Stillwell, Michal Kosinski, Stephanie M Ramones, and Martin EP Seligman. 2014. The online social self: An open vocabulary approach to personality. *Assessment* 21, 2 (2014), 158–169.

[46] Stacey Kimmel and Jenne Heise. 2001. Being there: Tools for online synchronous reference. *Online* 25, 6 (2001), 30–30.

[47] Lisa M Koonin, Brooke Hoots, Clarisse A Tsang, Zanie Leroy, Kevin Farris, Brandon Jolly, Peter Antall, Bridget McCabe, Cynthia BR Zelis, Ian Tong, et al. 2020. Trends in the use of telehealth during the emergence of the COVID-19 pandemic—United States, January–March 2020. *Morbidity and Mortality Weekly Report* 69, 43 (2020), 1595.

[48] Elizabeth A Krupinski and Jordana Bernard. 2014. Standards and guidelines in telemedicine and telehealth. In *Healthcare*, Vol. 2. MDPI, Healthcare (Basel), Switzerland, Basel, 74–93.

[49] Laura Krynski, Guillermo Goldfarb, and Ignacio Maglio. 2018. Technology-mediated communication with patients: WhatsApp Messenger, e-mail, patient portals. A challenge for pediatricians in the digital era. *Arch Argent Pediatr* 116, 4 (2018), e554–e559.

[50] Yi-Cheng Ku, Tsai-Hsin Chu, and Chen-Hsiang Tseng. 2013. Gratifications for using CMC technologies: A comparison among SNS, IM, and e-mail. *Computers in human behavior* 29, 1 (2013), 226–234.

[51] Brenna Li, Noah Crampton, Thomas Yeates, Yu Xia, Xirong Tian, and Khai Truong. 2021. Automating Clinical Documentation with Digital Scribes: Understanding the Impact on Physicians. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–12. https://doi.org/10.1145/3411764.3445172

[52] Cindy Li, Elizabeth M Borycki, and Andre W Kushniruk. 2021. Connecting the world of healthcare virtually: a scoping review on virtual care delivery. *Healthcare* 9, 10 (2021), 1325.

[53] Wanying Liao, Yi Zhang, Xiaohan Huang, Xiaoyu Xu, and Xiaozhe Peng. 2021. "Emoji, I can feel your pain"–Neural responses to facial and emoji expressions of pain. *Biological Psychology* 163 (2021), 108134.

[54] Xiao Liu, Yoshie Sawada, Takako Takizawa, Hiroko Sato, Mahito Sato, Hironosuke Sakamoto, Toshihiro Utsugi, Kunio Sato, Hiroyuki Sumino, Shinichi Okamura, et al. 2007. Doctor-Patient communication: a comparison between Telemedicine consultation and face-to-face consultation. *Internal Medicine* 46, 5 (2007), 227–232.

[55] Jane Lockwood. 2017. An analysis of web-chat in an outsourced customer service account in the Philippines. *English for Specific Purposes* 47 (2017), 26–39.

[56] Rowena Luk, Melissa Ho, and Paul M Aoki. 2008. Asynchronous remote medical consultation for Ghana. In *Proceedings of the SIGCHI conference on human factors in computing systems*. Association for Computing Machinery, New York, NY, USA, 743–752. https://doi.org/10.1145/1357054.1357173

[57] Michael J Mallen, Indria M Jenkins, David L Vogel, and Susan X Day. 2011. Online counselling: An initial examination of the process in a synchronous chat environment. *Counselling and Psychotherapy Research* 11, 3 (2011), 220–227.

[58] Christina Maslach, Susan E Jackson, and Michael P Leiter. 1997. *Maslach burnout inventory*. Scarecrow Education, California, USA.

[59] James C McCroskey and Virginia P Richmond. 1990. Willingness to communicate: Differing cultural perspectives. *Southern Journal of Communication* 56, 1 (1990), 72–77.

[60] Deen Mirza. 2019. The need for new GP consultation models. *InnovAiT* 12, 1 (2019), 33–37.

[61] Israel Junior Borges do Nascimento, João Antonio de Queiroz Oliveira, Iago Souza Wolff, Laura Defensor Ribeiro, Clareci Silva Cardoso, Maurice Mars, Antonio Luiz Ribeiro, Milena Soriano Marcolino, et al. 2020. Use of smartphone-based instant messaging services in medical practice: a cross-sectional study. *Sao Paulo Medical Journal* 138 (2020), 86–92.

[62] Bidisha Nath, Brian Williams, Molly M Jeffery, Ryan O'Connell, Richard Goldstein, Christine A Sinsky, and Edward R Melnick. 2021. Trends in electronic health record inbox messaging during the COVID-19 pandemic in an ambulatory practice network in New England. *JAMA network open* 4, 10 (2021), e2131490–e2131490.

[63] Val Nixon. 2013. *History taking*. John Wiley & Sons, Ltd, NJ, USA, Chapter 1, 1–21. https://doi.org/10.1002/9781119464389.ch1

[64] Jennifer B Plotkin and Robert Shochet. 2018. Beyond words: What can help first year medical students practice effective empathic communication? *Patient education and counseling* 101, 11 (2018), 2005–2010.

[65] Rhea E Powell, Jeffrey M Henstenburg, Grace Cooper, Judd E Hollander, and Kristin L Rising. 2017. Patient perceptions of telehealth primary care video visits. *The Annals of Family Medicine* 15, 3 (2017), 225–229.

[66] Keith Rayner, Timothy J Slattery, and Nathalie N Bélanger. 2010. Eye movements, the perceptual span, and reading speed. *Psychonomic bulletin & review* 17, 6 (2010), 834–839.

[67] Gwen R Rempel, Ross T Ballantyne, Joyce Magill-Evans, David B Nicholas, and Andrew S Mackie. 2014. Texting teens in transition: the use of text messages in clinical intervention research. *JMIR mHealth and uHealth* 2, 4 (2014), e3232.

[68] Elizabeth A Rider and Constance H Keefer. 2006. Communication skills competencies: definitions and a teaching toolbox. *Medical education* 40, 7 (2006), 624–629.

[69] Kathryn Robertson. 2005. Active listening: more than just paying attention. *Australian family physician* 34, 12 (2005), 1053–1055.

[70] Ashleigh Shelby Rosette, Jeanne M Brett, Zoe Barsness, and Anne L Lytle. 2012. When cultures clash electronically: The impact of email and social norms on negotiation behavior and outcomes. *Journal of Cross-Cultural Psychology* 43, 4 (2012), 628–643.

[71] Lisa S Rotenstein, A Jay Holmgren, N Lance Downing, Christopher A Longhurst, and David W Bates. 2021. Differences in clinician electronic health record use across adult and pediatric primary care specialties. *JAMA network open* 4, 7 (2021), e2116375–e2116375.

[72] Debra Roter and Judith A Hall. 2006. *Doctors talking with patients-patients talking with doctors: improving communication in medical visits*. Greenwood Publishing Group, Connecticut, USA.

[73] Perihan Savas. 2011. A case study of contextual and individual factors that shape linguistic variation in synchronous text-based computer-mediated communication. *Journal of Pragmatics* 43, 1 (2011), 298–313.

[74] Barbara C Schouten and Ludwien Meeuwesen. 2006. Cultural differences in medical communication: a review of the literature. *Patient education and counseling* 64, 1-3 (2006), 21–34.

[75] Anne Schüler, Katharina Scheiter, and Peter Gerjets. 2013. Is spoken text always better? Investigating the modality and redundancy effect with longer text presentation. *Computers in Human Behavior* 29, 4 (2013), 1590–1601.

[76] Jodi B Segal, Vadim Dukhanin, and Stacey Davis. 2022. Telemedicine in primary care: qualitative work towards a framework for appropriate use. *The Journal of the American Board of Family Medicine* 35, 3 (2022), 507–516.

[77] Lauren E Sherman, Minas Michikyan, and Patricia M Greenfield. 2013. The effects of text, audio, video, and in-person communication on bonding between friends. *Cyberpsychology: Journal of psychosocial research on cyberspace* 7, 2 (2013), 1–13.

[78] Centaine L Snoswell and Tracy A Comans. 2021. Does the choice between a telehealth and an in-person appointment change patient attendance? *Telemedicine and e-Health* 27, 7 (2021), 733–738.

[79] Vess Stamenova, Payal Agarwal, Leah Kelley, Jamie Fujioka, Megan Nguyen, Michelle Phung, Ivy Wong, Nike Onabajo, R Sacha Bhatia, and Onil Bhattacharyya. 2020. Uptake and patient and provider communication modality preferences of virtual visits in primary care: a retrospective cohort study in Canada. *BMJ open* 10, 7 (2020), e037064.

[80] David S Stein, Constance E Wanstreet, Hilda R Glazer, Cheryl L Engle, Ruth A Harris, Susan M Johnston, Mona R Simons, and Lynn A Trinko. 2007. Creating shared understanding through chats in a community of inquiry. *The Internet and Higher Education* 10, 2 (2007), 103–115.

[81] Anselm Strauss and Juliet M Corbin. 1997. *Grounded theory in practice*. Sage, California, USA.

[82] Emma E Thomas, Helen M Haydon, Ateev Mehrotra, Liam J Caffery, Centaine L Snoswell, Annie Banbury, and Anthony C Smith. 2022. Building on the momentum: sustaining telehealth beyond COVID-19. *Journal of telemedicine and telecare* 28, 4 (2022), 301–308.

[83] Annette Marie Totten, Dana M Womack, Karen B Eden, Marian S McDonagh, Jessica C Griffin, Sara Grusing, and William R Hersh. 2016. *Telehealth: mapping the evidence for patient outcomes from systematic reviews*. Agency for Healthcare Research and Quality US, Rockville, Maryland.

[84] John M Travaline, Robert Ruchinskas, and Gilbert E D'Alonzo. 2005. Patient-physician communication: why and how. *Journal of Osteopathic Medicine* 105, 1 (2005), 13–18.

[85] Göran Umefjord, Herbert Sandström, Hans Malker, and Göran Petersson. 2008. Medical text-based consultations on the Internet: a 4-year study. *International journal of medical informatics* 77, 2 (2008), 114–121.

[86] Marta van Zanten, John R Boulet, and Danette McKinley. 2007. Using standardized patients to assess the interpersonal skills of physicians: six years' experience with a high-stakes certification examination. *Health communication* 22, 3 (2007), 195–205.

[87] Diane Walker and Florence Myrick. 2006. Grounded theory: An exploration of process and procedure. *Qualitative health research* 16, 4 (2006), 547–559.

[88] Paul Webster. 2020. Virtual health care in the era of COVID-19. *The Lancet* 395, 10231 (2020), 1180–1181.

[89] Jedrek Wosik, Marat Fudim, Blake Cameron, Ziad F Gellad, Alex Cho, Donna Phinney, Simon Curtis, Matthew Roman, Eric G Poon, Jeffrey Ferranti, et al. 2020. Telehealth transformation: COVID-19 and the rise of virtual care. *Journal of the American Medical Informatics Association* 27, 6 (2020), 957–962.

[90] Kimberly SH Yarnall, Kathryn I Pollak, Truls Østbye, Katrina M Krause, and J Lloyd Michener. 2003. Primary care: is there enough time for prevention? *American journal of public health* 93, 4 (2003), 635–641.