

ABSTRACT

Background: The ubiquitous use of electronic health records (EHRs) during medical office visits using a computer monitor and keyboard can be distracting and disrupt patient-healthcare provider (HCP) non-verbal eye contact cues, which are integral to effective communication. Provider use of a remote medical scribe with face-mounted eyeglass technology, such as Google Glass (GG), may preserve patient-HCP communication dynamics in the healthcare setting by allowing providers to maintain direct eye contact with their patients, all while still having access to the patient's relevant EHR information. The medical scribe is able to chart patient encounters in real-time working on or off site, documenting the visit directly into the EHR and freeing the HCP to focus only on the patient.

Objective: The purpose of this study was to examine patient perceptions of their interaction with a HCP who used GG with a remote medical scribe during office visits. This includes an examination of any associations between patient privacy and trust in their HCP when GG is used in the medical office setting.

Methods: For this descriptive, cross-sectional study, a convenience sample of patients was recruited from an outpatient dermatology clinic in Northern California. Participants provided demographic data and completed a 12-item questionnaire to assess their familiarity, comfort, privacy, and perceptions following routine office visits with a HCP where GG was used to document the clinical encounter. Data were analyzed using appropriate descriptive and inferential statistics.

Results: Over half (59.4%, $n = 102$) of the 170 study participants were female, Caucasian (60%, $n = 102$), Asian (24.1%, $n = 41$), college-educated (89%, $n = 151$), and ranged between 18 and 90 years of age ($M = 50.5$, $SD = 17.4$). The majority of participants (69.4%, $n = 118$) were

familiar with GG, not concerned with privacy issues (77.6%, $n = 132$), and stated the use of GG did not affect their trust in the HCP (81.8%, $n = 139$). Moreover, participants comfortable with the use of GG were less likely to be concerned about privacy ($p < .001$) and participants who trusted their HCP were less likely to be concerned about them using GG ($p < .009$). Almost one third (29%, $n = 49$) self-identified as early technology adopters and 87% ($n = 148$) preferred their HCP use GG if it delivered better care.

Conclusions: Our study findings support patient acceptance of the use of GG for outpatient dermatology visits. Future research should explore the use of GG in other areas of healthcare and strive to include a diverse socioeconomic patient population in study samples.

KEYWORDS: acceptance, clinician burnout, communication, Google Glass, healthcare provider, patient, remote scribing, trust

INTRODUCTION

In an effort to improve healthcare quality, outcomes, and reduce healthcare costs, the Health Information Technology for Economic and Clinical Health (HITECH) Act [1] mandated use of electronic health records (EHRs). Across the country, EHRs are now almost ubiquitously being used to support patient care by means of clinical decision support and reduction of medical errors, however they have been associated with unintended consequences for health care providers (HCPs). HCPs are citing increased EHR administrative tasks as a key cause of clinician burnout [2]. In fact, time log studies have demonstrated that HCPs are spending more time with administrative tasks such as charting and less time face-to-face with their patients [3, 4]. Increased administrative burden affecting provider's work-life balance leads to decreased physician job satisfaction and burnout [5]. Increased burnout may prompt providers to leave the field of medicine. Furthermore, EHR use changes the patient-provider communication dynamic by drawing HCP attention away from patients [6, 7] despite evidence that direct eye contact promotes effective patient-HCP communication [8]. Poor communication between patients and HCP can also affect rapport, patient satisfaction, adherence to treatment, clinical outcomes, and patient trust [9, 10], highlighting the importance and need for solutions to preserve the connection that patients need with their clinicians.

The integration of medical scribes into clinical care has been introduced as one method used to preserve patient-HCP eye contact, communication, and reduce HCP workload/charting [5]. By having a scribe perform EHR documentation of the clinical visit, providers can focus their attention towards the patient. In this capacity, medical scribes can be present in the examination room during the medical visit or could work remotely. Remote "virtual scribes" are also able to chart patient encounters in real-time working on or off site from a HIPAA-secure

location, significantly reducing data entry workload that EHRs place on HCPs [11]. The addition of a virtual scribe can play a critical role in the provider-patient experience by decreasing charting and allowing the provider to fully engage with the patient, thereby positively impacting the patient experience [5]

Google Glass™ (GG), a face-mounted wearable technology is emerging as a tool in the healthcare setting. It has been used in several patient care areas including remote electrocardiogram interpretation [12], evaluation accuracy and triage times among paramedics in the field [13], and radiological intervention procedures [14]. While such studies have demonstrated the value of using GG in healthcare, and yet little to date is known about patient perceptions around provider use of this technology. Prochaska and colleagues [15] surveyed patient perceptions of GG in a sample of hospitalized patients. In that sample, most respondents were unfamiliar with Google Glass, nearly half of respondents were concerned about privacy but most patients were open to their providers using GG if it would improve their care.

At our organization, remote scribing via GG was implemented to tackle the issue of burnout by connecting clinicians with remote medical scribes during patient visits and enabling real-time documentation in the EHR. Initial data has demonstrated a promising reduction in HCP EHR documentation burden in our experience. However, with growing use of remote scribing via GG in patient care, little empirical attention has been given to GG and patient perceptions of its use in the outpatient realm. The purpose of this study was to examine how the use of remote scribing with GG by HCPs is perceived by patients in an outpatient clinical setting.

METHODS

This descriptive cross-sectional study was approved by Fresno State University and Sutter Health's Institutional Review Boards. A convenience sample of patients over 18 years of

age, who could read and understand English, and who were being seen for an outpatient dermatology office visit by an HCP who used GG were invited to participate. At the time of data collection four out of 11 HCPs in the outpatient dermatology clinic used GG.

Study Recruitment

Participants were approached by the principal investigator (PI) after their clinic office visit and provided with a description of the study. Interested participants were taken to a private room in the clinic where the PI or research assistant verified that study criteria were met and provided informed consent. Study questionnaires were completed on computer tablets, taking 5-10 minutes. Data collection occurred over a four-day period in September 2017.

Measures

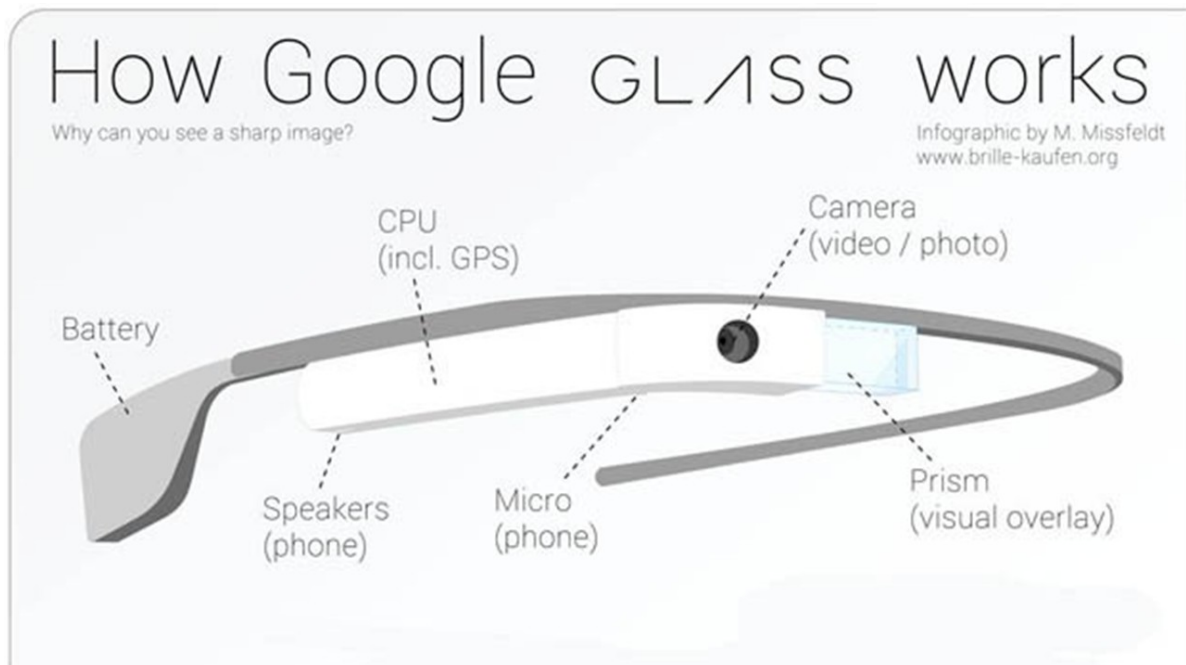
Participants were asked to provide general demographic data including gender, age, race, and education level. Following this, they completed a 12-item questionnaire, adapted from the questionnaire developed by Prochaska and colleagues [15] with added questions regarding level of technology and privacy. Items assessed patient familiarity, comfort, and privacy level with GG as well as their trust, relationship, and communication with their HCP. Patient trust in their HCP was rated on a 4-point Likert scale from 1 to 4 (more likely to trust provider, no change, less likely to trust provider or I don't know). Relationship and communication with the HCP was rated on a 10-point scale, from 1 (poor relationship/communication) to 10 (excellent relationship/communication). Participants were also asked to rate their level of technology adoption (innovator, early adopter, early majority, late majority, laggard). Space was left at the end of the questionnaire for participants to add any additional comments.

Technology and Equipment

Google Glass is a face-mounted device, similar to eyeglasses. The GG unit has the capability to connect to a phone via WIFI enabling hands-free internet access. A small optical display is mounted above the right eye and a camera, microphone, speaker and wireless connectivity is built into an eyeglass frame which is operated through voice commands and a touchpad (see Figure 1). Each HCP in the study facility were assigned their own pair of GG. Custom lens compatible with GG were available for HCPs requiring prescription glasses. Patients provided verbal permission for the HCP to use GG at the beginning of each visit. In cases where permission was not granted, HCPs removed the GG device and remote documentation did not occur for the visit.

Google Glass Specifications.

Reprinted from <https://www.outsource-force.com/blog/google-glass-specs-revealed/>



The remote scribe observes the clinician-patient interaction and performs the documentation of the visit with the HCP speaking “out loud” about the subjective history, objective findings, and the assessment and the plan. Any comments or clarifications that the remote scribe has are communicated back via written messages that appear on the GG display and are only visible to the HCP. Remote scribes can also provide patient information within the field of vision via GG such as requests for data look up from the EHR, so the HCP can simultaneously perform other tasks or procedures. HCPs have the ability to receive data and input patient information through the small screen within the GG lens from the remote scribe which is only discernible to the wearer. This reduces the need for the HCP to look away to the desktop screen, allowing them instead to focus on the patient.

At the time of data collection for this study, HCPs had been using GG for about 12 months. Each HCP was assigned their own GG device and remote scribe. All communication between the remote scribe and HCP was encrypted and followed HIPAA operational, security, and privacy protocols to safeguard patient information. All remote scribe facilities completed a rigorous security and privacy review conducted by an independent third-party auditor prior to use by HCPs with patients.

Data Analysis

Descriptive data including participant characteristics and some questionnaire data were analyzed using descriptive statistics (frequencies, means, and measures of central tendency). Appropriate inferential statistics including Chi Square and ANOVA tests were used to identify associations between variables. Narrative comments were reviewed by the research team for common themes.

RESULTS

Participant Characteristics

Of the 170 participants who completed study questionnaires, over half (59.4%, $n = 102$) were female. The largest ethnic demographic was Caucasian (60%, $n = 102$) and second was Asian (24.1%, $n = 41$). The majority were college-educated or beyond (89%, $n = 151$). Patient age ranged between 18 and 90 years of age ($M = 50.5$, $SD = 17.4$) (Table 1).

Participant Characteristics ($n = 170$)

Characteristic		n (%)
Age		
	Range 18 - 90	
	Mean 50.5 (SD=17.4)	
Gender		
	Female	101 (59.4%)
	Male	69 (40.6%)
Ethnicity		
	Caucasian	102 (60%)
	Asian	41 (24.1%)
	Hispanic/Latino	12 (7.1%)
	African American	4 (2.4%)
	Other	11 (6.4 %)
Education Level		

	Completed high school	11 (5.9%)
	Some college, no degree	16 (9.4%)
	College degree	60 (35.3%)
	Post graduate	75 (44.1%)
	Other/prefer not to answer	9 (5.3%)

Patient Perception of Google Glass

Level of technology. When asked to describe feelings about new technologies, 25 participants (14.7%) classified themselves as innovators (the first to adopt new technologies) and 24 (14.1%) were early majority (adopt new technology when it's still new but most people don't have it). Seventy-three (42.9%) classified themselves as early adopters (selective in adopting new technology), 41 (24.1%) rated themselves as late majority (adopt new technology after the majority of people are using it and it becomes commonplace), and 7 (4.1%) were laggards (one of the last to adopt new technology, you wait until all the bugs are out and it's inexpensive to purchase). Participants with a higher level of education were significantly more likely be among the first to adopt new technology [$\chi^2(24, N = 170) = 64.83, p < .001$].

When asked about having any concerns with the use of GG, the majority (73.9%, $n = 122$) stated having no concerns, few (8.8%, $n = 15$) stated having concerns with security, and very few (1.2%, $n = 2$) stated GG might be distracting.

Familiarity and Comfort with Google Glass. A large number of participants (69.4%, $n = 118$) reported being very or somewhat familiar with GG, 87.1% ($n = 148$) were extremely or somewhat comfortable with their HCP using GG during the office visit, and 87.1% ($n = 148$)

preferred their HCP use GG if it helped them deliver better care. Additionally, participants who were comfortable with their HCP using GG were less likely to be concerned about privacy [$\chi^2(16, N = 170) = 89.40, p <.001$].

Privacy and Trust. Few (22.4%, $n = 38$) participants reported being very or somewhat concerned with privacy. The majority (81.8%, $n = 139$) reported no change in their level of trust with the use of GG with 12.9% ($n = 22$) reporting the use of GG would increase trust in their HCP. A significant relationship was noted between participant's level of privacy with the use of GG and trust in their HCP [$\chi^2(12, N = 170) = 26.51, p <.009$].

Relationship and Communication. Participants relationship with their HCP was rated on average of 9.4 ($sd = 0.93$) and communication was rated on average of 9.5 ($sd = 1.10$) on 10-point scales (Table 2). Chi square tests of independence were performed to examine relationships between variables. Please see Table 2 for complete survey results.

Perception of Google Glass (N = 170)

Question	N (%)
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<p>Are you familiar with Google Glass?</p> <p>Very Familiar</p> <p>Somewhat familiar</p> <p>Neither familiar or unfamiliar</p> <p>Somewhat unfamiliar</p> <p>Very unfamiliar</p>	<p>16 (9.4%)</p> <p>102 (60.0%)</p> <p>16 (9.4%)</p> <p>11 (6.5%)</p> <p>25 (14.7%)</p>
<p>How comfortable were you when your dermatology provider was wearing GG for documenting your visit?</p> <p>Extremely comfortable</p> <p>Somewhat comfortable</p> <p>Neither comfortable or uncomfortable</p> <p>Somewhat uncomfortable</p> <p>Extremely uncomfortable</p>	<p>110 (64.7%)</p> <p>38 (22.4%)</p> <p>19 (11.2%)</p> <p>2 (1.2%)</p> <p>1 (0.6%)</p>

<p>Was privacy a concern when your dermatology provider was using GG?</p> <p>Very concerned</p> <p>Somewhat concerned</p> <p>Neither concerned or unconcerned</p> <p>Somewhat unconcerned</p> <p>Very unconcerned</p>	<p>10 (5.9%)</p> <p>28 (16.5%)</p> <p>35 (20.6%)</p> <p>15 (8.8%)</p> <p>82 (48.2%)</p>
<p>How does GG affect your trust in your dermatology provider?</p> <p>More likely to trust my provider</p> <p>No change</p> <p>Less likely to trust my provider</p> <p>I don't know</p>	<p>22 (12.9%)</p> <p>139 (81.8%)</p> <p>2 (1.2%)</p> <p>7 (4.1%)</p>
<p>If your dermatology provider said GG helped them deliver better care, would you want them to wear GG in your next visit?</p> <p>Yes</p> <p>No</p> <p>I don't Know</p> <p>I need to know more</p>	<p>148 (87.1%)</p> <p>3 (1.8%)</p> <p>11 (6.5%)</p> <p>8 (4.7%)</p>

<p>Would you have concerns if your dermatology provider used GG during a visit?</p> <p>Check all that apply</p> <p>I would have no concerns</p> <p>Security</p> <p>Privacy</p> <p>It may be distracting</p> <p>Unfamiliar with GG</p> <p>Other: Security and Privacy</p> <p>Multiple answers</p>	<p>122 (73.9%)</p> <p>15 (8.8%)</p> <p>28 (16.5%)</p> <p>2 (1.2)</p> <p>7 (4.1%)</p> <p>8 (4.7%)</p> <p>11 (6.6%)</p>
<p>Choose the phrase from the list below that best describes your feelings about new technologies You are:</p> <p>An Innovator = First to adopt new technology</p> <p>An Early Adopter = Selective in adopting new technology</p> <p>An Early Majority = Adopt new technology when it's still new but most people don't have it</p> <p>A Late Majority = Adopt new technology after the majority of people are using it and it becomes commonplace.</p> <p>A Laggard = One of the last to adopt new technology, you wait until all the bugs are out and it's inexpensive to purchase</p>	<p>25 (14.7%)</p> <p>73 (42.9%)</p> <p>24 (14.1%)</p> <p>41 (24.1%)</p> <p>7 (4.1%)</p>

If your dermatology provider said GG helped them deliver better care, would you want them to wear GG in your next visit?	
Yes	148 (87.1%)
No	3 (1.8%)
I don't Know	11 (6.5%)
I need to know more	8 (4.7%)

Participant Narrative Comments

Fifty-five participants (32.4%) provided narrative comments at the end of their surveys. Comments conveyed not noticing the HCP was using GG, for example “I was so involved in our visit, I didn’t even notice,” and “I didn’t really even notice GG for most of the visit,” as well as an overall feeling of GG providing better care, “If it helps her keep track of my care, I am all for it,” “I feel more details are being documented,” and “If it helps with transcription then it is a great idea.” Comments also conveyed patient satisfaction, for example, “If it provides more face time with the doctor, I think it is worth it,” and “It is nice to have more interaction with the doctor versus them looking at the computer to take notes.”

Discussion

To our knowledge, this is the first study to examine patient perceptions of GG in an outpatient clinical setting, and it builds upon the work of Prochaska and colleagues [15] who examined patient perceptions of GG in the hospital setting. Although the primary reason GG was implemented at our organization was to decrease charting documentation time and reduce clinician burnout, our study shows an additional valuable benefit of allowing providers to improve their interaction with their patients. Remote medical scribes can alleviate HCP documentation burden and our findings support the use of virtual scribes and GG given that few participants endorsed concern (22.4%) with the use of GG, 81.8% reported no change in their level of trust with the use of GG, and 87.1% wanted their HCP to use GG if it helped them deliver better care. Overall, our findings are in agreement Prochaska and colleagues [15] who found 65% of respondents would want their doctor to wear GG if it improved their care.

A key consideration with the deployment of remote scribes is how GG might affect privacy and trust between the clinician and patient. Contextually, this is interesting because unlike in-person scribes that are physically present in the exam room at time of the clinical encounter, the remote scribe is not known nor ever visualized by the patient. In contrast to Prochaska and colleagues [15], where nearly half of respondents were concerned about privacy, fewer participants ($n = 38$, 22%) in our study were concerned with their privacy of personal health information, participant comments reflected little concern with trust and privacy, and use of GG did not change their level of trust in the provider. Patients preferred their HCP use GG (87.1%) if it helped deliver better care. Our institution's deployment of remote scribing over 4 years and patient experience of the benefits versus a survey of theoretical use of GG surveyed in a hospital setting may explain the difference in concerns about privacy in our sample.

Patients in our study were more familiar with GG (69.4%) than the Prochaska [15] study (27%). The majority of our study participants ($n = 122$, 71.7%) considered themselves early adopters of technology. This could in part be explained by the fact that the study was conducted in Silicon Valley, the nation's technology center. The workforce and the community within this geographic region may reflect the actual employees of technology companies, their families and other businesses catering to the technologically savvy and highly educated citizens. For many of Silicon Valley residents, leading edge technology is part of their normal lives [16]. This familiarity and comfort may again be a consequence of overall higher technology adoption in our geographic region. Another potential factor leading to higher familiarity in our patient sample could be time. Prochaska's [15] study was completed just one year after GG became offered to the public, and at that time it was a relatively unknown and obscure technology to most people as one of the only face-mounted technology devices available. By the time our study was

completed, GG had been available for approximately 2.5 years and was likely more widely known. Although otherwise ethnically diverse, this study's population was largely college educated ($n = 151$, 88%) which could also contribute to their comfort and acceptance of the technology.

Study participants gave HCP's who used GG high ratings (9.5 out of 10) regarding perceptions of effective communication. Patients perceived that HCPs using GG provided better attention, had greater focus, and communicated greater empathy. Also based on patient comments, participants were more satisfied with their visit and felt that HCPs delivered a more personal experience by spending less time on the computer. This is supported by literature which demonstrates that HCPs who spend more time communicating face-to-face, focusing attention on the patient and less on the EHR, can positively influence the communication with the patient [6]. Furthermore, patients noted that the improved interaction with their HCP made them less aware of the use of the GG technology itself.

The use of remote scribing via GG in the outpatient dermatology setting has the potential to reduce HCP documentation time, increase efficiency, reduce charting errors/omissions and reduce workflow stress. Healthcare providers can simply interact with their patient, discovering their clinical history and examination findings, empowered by a remote scribe who enters data directly into the patient's EHR in real-time. This novel approach may facilitate more meaningful use of the EHR and realization of its benefits in clinical care, without adding an administrative burden to the HCPs. Since EHRs are now an integral part of clinical practice, healthcare organizations should continue to seek new methods of using EHR in ways that improve provider satisfaction, organizational efficiencies, and patient-provider interactions.

Limitations

Study findings should be interpreted with caution given the largely insured and well-educated sample, limiting generalizability to lower socioeconomic populations. Additionally, the study sample was drawn from one Northern California clinic located in Silicon Valley where technology may be more readily accepted than in other parts of the United States. This technology acumen could account for the participants' lack of concerns when using GG and it is possible that acceptance of GG would decrease in more rural and conservative areas.

Conclusions

Our study findings identified a high level of patient acceptance to GG in the dermatology clinic setting, which was implemented in an effort to reduce provider burnout through the use of virtual remote scribes. Future research examining wearable technology such as GG should strive to include patients from other clinical settings, and from diverse geographic areas and socioeconomic backgrounds. Other outcomes, for example, HCP satisfaction with GG, whether the use of GG increases HCP efficiency/productivity, HCP relationship with the medical scribe, and experiences of medical scribes should also be examined.

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Conflict of Interest

The authors do not have a conflict of interest. Sutter Health is a strategic investor in Augmedix Inc. (San Francisco, CA), the provider of the remote scribing solution.

Abbreviations

ANOVA: Analysis of variance

EHR: Electronic Health Record

GG: Google Glass

HCP: Healthcare provider

HIPAA: Health Insurance Portability and Accountability Act of 1996

HITECH: Health Information Technology for Economic and Clinical Health

PI: Primary Investigator

SD: standard deviation

X²: Chi Square

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