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The new ‘normal’: Rapid adoption of telemedicine in orthopaedics during the COVID-19 pandemic



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ABSTRACT

Background: Telemedicine provides a safe and effective means for the delivery of care by physicians amongst many subspecialties. Historically, orthopaedic practices in the United States have not widely utilized telemedicine for the delivery of orthopaedic care. As technology improves the adoption and utilization of telemedicine will likely grow, especially in light of the novel coronavirus (COVID-19) pandemic. Our study aims to assess patient and surgeon satisfaction and efficacy of telemedicine during a rapid adoption due to the global pandemic.

Methods: All patients who completed a telemedicine encounter (telephone or video) with an orthopaedic surgeon were contacted. Patients were individually contacted after their visit, and a standardized validated post-visit satisfaction survey was completed. Orthopaedic surgeons completed a standardized post-encounter survey after each visit. Pre-COVID-19 patient satisfaction data was used for comparison.

Results: Orthopaedic surgeons completed 612 telehealth encounters either via phone or video consultation between April 6, 2020 and May 22, 2020. 95% of patients rated both surgeon sensitivity to their needs and response to their concerns as ‘good’ or ‘very good.’ 93% of patients reported they would participate in a telemedicine encounter again. Surgeons reported high satisfaction with telemedicine encounters (80%, 86% phone and video respectively), and that 78.4% of the time a telemedicine encounter was successful in replacing an in-person visit.

Conclusion: Patients and orthopaedic surgeons documented high levels of satisfaction with telehealth encounters during the novel coronavirus (COVID-19) pandemic. Telemedicine does not appear to be a replacement for all in-person clinic encounters, however, when used in the appropriate context demonstrated favourable results.

Level of Evidence: Level 4 Study.

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Introduction

Widely accepted and utilized by medical physicians across many subspecialties, telemedicine provides a safe and effective avenue for the delivery of healthcare [1]. Telehealth, as defined by Sood et al., is a branch of E-health that uses communications networks for the delivery of healthcare services and medical education from one geographical location to another [1]. Telehealth and the delivery of virtual telemedicine is globally accepted however

remains underutilized in orthopaedic surgery practices across the United States [2].

Since the onset of the novel coronavirus (COVID-19) many orthopaedic new patient consultations, clinic visits, and elective surgeries have been cancelled or rescheduled following the guidelines set forth by the Centers for Medicare and Medicaid Services (CMS) on March 6, 2020 [3]. Specifically, the expansion of the Telehealth 1135 Waiver has allowed Medicare to pay for office, hospital, and other visits furnished via telehealth [3]. This provision increases the orthopaedic surgeon and patient’s capability to communicate virtually, practice shared decision making, provide progress updates safely and effectively, and collect appropriate compensation for the services rendered.

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There have been few studies analysing the utilization of telemedicine within orthopaedic surgery [2,4–9]. Two studies have been completed analysing the effectiveness of virtual post-operative rehabilitation protocols compared to in-person rehabilitation protocols [7,8]. Russel et al. found that following total knee arthroplasty, patients who completed a tele-rehabilitation protocol had similar functional and patient reported outcomes compared to the in-person rehab cohort, with high levels of patient reported satisfaction [8]. Buvik et al. analysed surgeon satisfaction with telemedicine encounters and reported that overall, surgeons viewed the encounters positively [5]. Kane et al. reported outcomes on post-operative telemedicine encounters versus in-person encounters following rotator cuff repair. They found that patients in both groups had similar overall satisfaction scores, however patients in the telemedicine group required less time off work to come to visits and reported less time off work needed for their caregivers [6]. No studies, to our knowledge, have evaluated the practicality, and effectiveness of the broad adoption of telemedicine in orthopaedic care delivery.

With the systemic pressures of a global pandemic and orthopaedic surgery practices striving to deliver high quality and high value care, it is anticipated that this technology will continue to be adopted as part of our patient care paradigm.

To our knowledge, this is the first study that aims to assess patient and surgeon perception and satisfaction with orthopaedic telemedicine encounters as replacement for in-person visits.

Methods

Initiation of virtual visits

In mid-March 2020, following institution and state guidelines regarding social distancing and shelter in place orders to prevent the spread of the COVID-19 pandemic, orthopaedic outpatient clinic operations at our institution were significantly restricted. We analysed visit volume and visit type data during pre-COVID and the study period to evaluate the effect of the pandemic on our orthopaedic ambulatory outpatient productivity. In-person visits were restricted to only those visits deemed medically necessary and time sensitive for safe patient care. A telemedicine framework was created at an institutional level, using the existing electronic medical record (EMR) layered with telecommunications technology to allow for scheduled and billable telephone or video encounters. These encounters were available to both established and new patients. The determination of encounters’ appropriateness for telemedicine was at the discretion of the surgeon. All patients affected by the clinic closures were contacted to re-schedule their in-person visit. As of April 6, 2020, we were able to offer these patients the option of a telemedicine visit. The choice of telemedicine method (video vs phone) was a shared decision between surgeon and patient, considering patient technological capabilities and objectives for the encounter.

Pre-pandemic data collection

Pre-COVID-19 institutional patient satisfaction data was collected prospectively via a secure patient portal. Patients are invited to complete a validated satisfaction survey following all outpatient encounters. We used data from January 1, 2020 – February 29, 2020 as our baseline patient satisfaction comparison group. These surveys are administered by the Patient Experience Team, and survey results are available in an anonymized, aggregated format at regular time intervals to all clinic surgeons.

Telehealth data collection and analysis

At the initiation of this project, patient and surgeon surveys were created (Appendix A). A patient telemedicine satisfaction survey was modelled off the validated pre-pandemic patient satisfaction survey. We reviewed the pre-pandemic questionnaire removing those questions that pertained specifically to the physical space, and in-person experience (ie. How well staff protected your safety (by washing hands, wearing gloves etc...)) and retained those which were relevant to both in-person and virtual encounters. Patient and surgeon surveys consisted of multiple-choice responses with an optional free-form response for comments or clarifications. A surgeon survey was created with the visit type and level of service specified within the questionnaire. Institutional Review Board (IRB) approval was obtained for surveys, consents, and project protocol. Electronic written consent for participation was obtained from surgeons while verbal consent for participation was obtained from patients.

All orthopaedic outpatient schedules from 4/6/2020 to 5/22/2020 for all surgeons were searched for telemedicine encounters. Orthopaedic clinic patients receiving both surgical and non-surgical care were included in this study. Inclusion criteria: English-speaking individuals 18 years of age or greater and a completed telemedicine encounter. We excluded patients under 18 years of age as they are not seen in our Adult Orthopaedic clinic. Patients were contacted via telephone and asked to participate in the survey. Surveyors attempted to reach patients up to three times, and patients were free to decline participation at any time. No incentives were offered for participation, and no funding was necessary for the completion of this study. All responses were recorded into an encrypted HIPPA-compliant RedCap Database. Electronic consent and survey invitations were also distributed to orthopaedic surgeons. Following research protocols and IRB guidelines, deidentified survey data was exported from the database. Data was analysed using Microsoft Excel (Microsoft Corporation 2018, Redmond, WA) and JASP (Amsterdam, NL). Chi-Square analysis was used for categorical variables and *t*-test for continuous data. Statistical significance was set at *p*<0.05.

Results

Pre-COVID orthopaedic visit volumes at our institution during January and February totalled; 7990 in-person visits, and 0 telemedicine visits. During April and May (months during the initial telemedicine implementation as a result of the COVID pandemic), total orthopaedic visit volumes totalled: 1675 in-person visits, 379 video visits and 395 telephone visits. Thus only 31% of pre-COVID volume was obtained during this time. During our study period, 612 telehealth encounters were completed in the Department of Orthopaedic Surgery by phone or video consultation between April 6, 2020 and May 22, 2020 (Fig. 1, Table 1).

Table 1
Visit distribution by month January 2019 through May 2019.

	In-person visits	Video visits	Telephone visits
January	4228	0	0
February	3762	0	0
March (Clinic Closures 03/17)	2223	0	0
April	417	134	213
May	1258	245	182

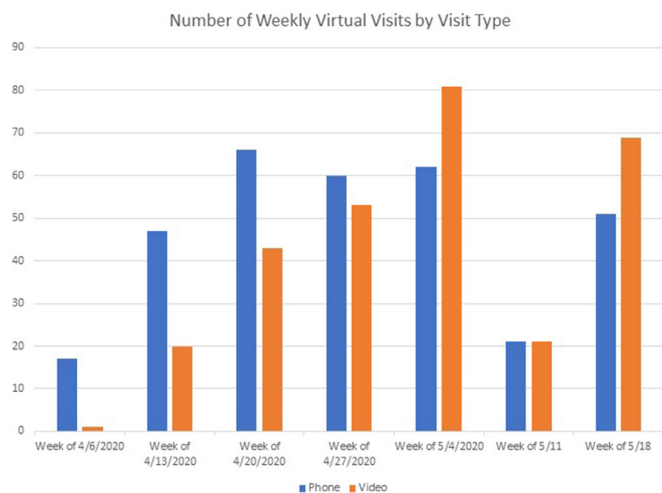


Fig. 1. Number of weekly virtual visits by visit type.

Surgeon response data

At initiation of the study, the Department of Orthopaedic Surgery had 15 attending surgeons who conducted adult outpatient clinics before the onset of the COVID-19 pandemic. Of those, 12 consented to participation in the surgeon survey (12/15; 80.0%), these surgeons spanned all subspecialties (Table 2). All consented surgeons completed in-person and telemedicine encounters during the study period. Of the 3 surgeons who did not consent to participate, two performed telemedicine encounters while one did not. Surgeon surveys were distributed for encounters from April 6, 2020 to May 22, 2020. In an effort to collect equal subgroups of video and telephone data, surgeon survey results were collected beyond the timeframe of patient survey responses. This allowed for nearly equal numbers of both telephone and video visits particularly as the early virtual visits were largely telephone in nature

Table 2 Surgeon distribution by surgical subspecialty.

Surgeon subspecialty	Number of surgeons who participated
Trauma	1
Foot and Ankle	1
Hand and Upper Extremity	3
Sports	1
Adult Joint Reconstruction	3
Spine	1
Musculoskeletal Oncology	2

due to slow early adoption and infrastructure in our facility. As the learning curve and thus adoption of video visits increased over time this later analysis allowed for improved recruitment of video visit data. Consented surgeons completed 591 (591/612; 96.6% of all telemedicine encounters), and of those, a total of 466 satisfaction surveys were completed (overall response rate 466/591; 78.6%) (Fig. 2).

Surgeon surveys were subdivided into visits completed by phone or by video. Surgeons completed 272 satisfaction surveys after a telephone encounter and rated their satisfaction with the encounter as 'satisfied' or 'highly satisfied' 80.0% (217/271) of the time. 90.8% (246/271) of the time, surgeons reported that the goals of the encounter were completed successfully, and that the encounter successfully replaced an in-person visit in 78.6% (213/271) of encounters.

Surgeons completed 194 surveys after a video encounter. 86.0% (166/193) of surgeons rated their satisfaction with the video encounter as 'satisfied' or 'highly satisfied.' The goals of the encounter were completed 90.7% (176/194) of the time, and 78.2% (151/193) of surgeons reported that the video encounter was successful in replacing an in-person visit.

When surgeon satisfaction is grouped as 'satisfied' or 'highly satisfied' versus 'highly unsatisfied,' 'unsatisfied' and 'neither satisfied or unsatisfied,' there was no statistically significant difference in satisfaction between care delivery modalities (telephone/video)

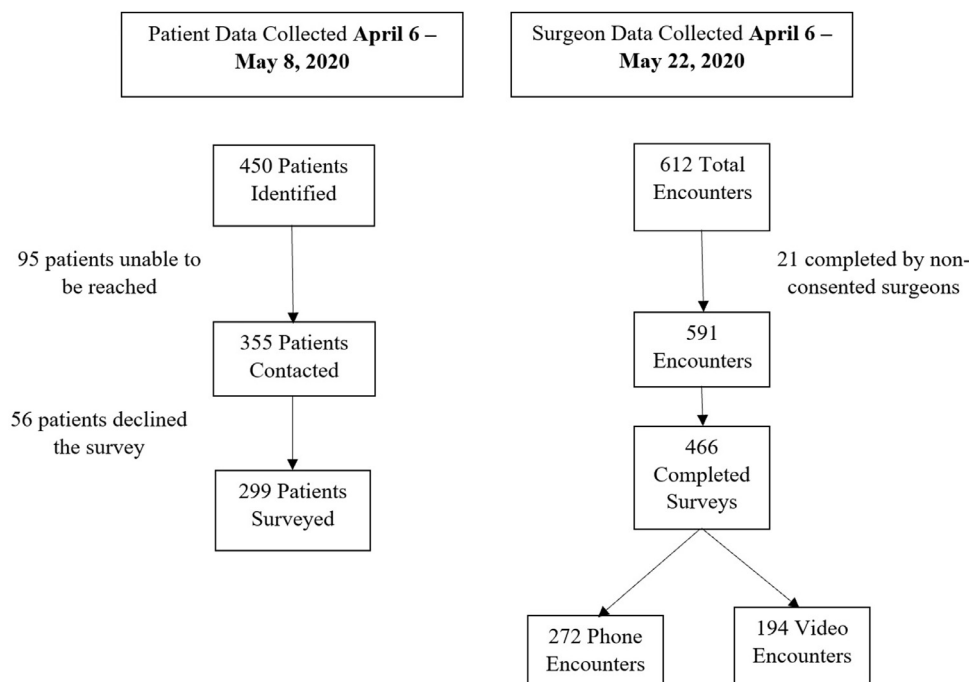


Fig. 2. Consort diagram demonstrating breakdown of patient and surgeon survey data.

Table 3
Chi-square association when stratified by visit type (new, return, post-op) for phone and video visit encounters.

	Chi Square	p-value
Phone		
vs. visit type		
Satisfaction	11.17	0.192
Goals of visit completed successfully	4.71	0.095
Success in replacing in-person visit	5.71	0.058
Video		
vs. visit type	2.29	0.891
Satisfaction		
Goals of visit completed successfully	0.60	0.742
Success in replacing in-person visit	4.311	0.116

Table 4
Total visit distribution by visit type.

Type of visit	Phone	Video	Total
New	19	33	52
Return	232	140	372
Post-op	20	21	41

Patient Perception of Physician Sensitivity and Response to Concerns

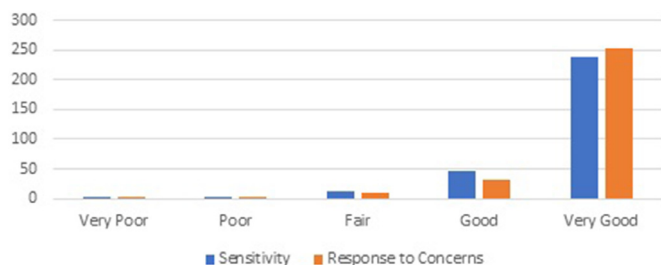


Fig. 3. Patient perception of surgeon sensitivity and response to needs.

($\chi^2=2.38, p = 0.123$). Additionally, there was no significant difference between modalities in achievement of goals ($\chi^2=3.18, p = 0.074$) or successfully replacing an in-person visit ($\chi^2=1.00, p = 0.934$).

Lastly, we categorized all visits into new, return, or post-operative visits. No significant associations were found between visit type and surgeon satisfaction, the goals of the visit being completed successfully, and ability for the virtual visit to replace an in-person visit (Table 3). However, there was a trend towards significance in the ability of a phone visit to replace an in-person visit when stratified by visit type ($p = 0.058$).

Patient response data

During the study period, we attempted to reach 450 patients with 355 patients successfully contacted. Of those contacted, 299 patients consented to participation in the study and were included in our analysis (response rate 299/450; 66.4%) (Fig. 2). The patient population for the study consisted of patients from a broad range of orthopaedic subspecialty clinics. Stratification of encounter by visit type can be seen in Table 4.

Patients reported that surgeons were able to be sensitive to their needs and demonstrated appropriate response to their concerns rating the surgeon as ‘good’ or ‘very good’ 95% of the time (284/299 and 283/299, respectively) (Fig. 3). When asked if they would complete another telemedicine encounter again, if given the chance, 92.9% (278/299) of patients reported they would.

Pre-pandemic, 94.8% (479/505) of patients reported that they perceived surgeon’s sensitivity to their needs as ‘good’ or ‘very good’, and 94.4% (457/484) rated the surgeon’s response to their concerns as ‘good’ or ‘very good.’

Patient response data from pre-pandemic in-person and telemedicine encounters was analysed. The five-response questions were grouped ‘good’ and ‘very good’ versus ‘very poor,’ ‘poor’ and ‘fair.’ There was no statistical difference in patient-reported surgeon sensitivity ($\chi^2=0.00, p = 1.00$) and response to concerns ($\chi^2=0.44, p = 0.506$).

Discussion

The rapid expansion of telemedicine in the orthopaedic setting during the initial months of the COVID-19 pandemic was driven by public health, institutional guidelines, and changes in reimbursement frameworks to allow for billing comparable to in-person encounters [2]. It occurred without the knowledge whether telemedicine could adequately replace visits and uncertain attitudes from surgeons and patients. During our study period, over 600 telemedicine encounters were performed with extremely favourable ratings from patients and surgeons. Telemedicine appears to have quickly established itself as a useful orthopaedic outpatient care modality in selected patients and will continue to be utilized in the post-pandemic era.

The acceptance of orthopaedic telemedicine in our truly outpatient setting is a novel finding. Pre-pandemic literature largely focused on the utilization of communications technology to facilitate in-patient and in-clinic encounters in settings where access to care by orthopaedic surgeons was limited by large geographic distances [5,10–12]. However, these applications were reliant on trained professionals guiding the telemedicine encounter. Since the onset of the COVID-19 pandemic, expanded interest in telemedicine has led to the publishing of guidelines and techniques for video-based physical assessment without trained assistants [13]. Most recently, Tenforde et al. surveyed patients and providers completing telemedicine encounters from a physical medicine and rehabilitation practice where 119 patients and 13 physiatrists conveyed overall positive and useful ratings of the encounters [14]. In our practice of patients receiving both surgical and non-surgical care, 95.0% rated providers as good or very good which is comparable to pre-pandemic in patient encounters (95.0%). Additionally, responsiveness to concerns was also the same (95.0 vs 94.4%) with no statistical difference between in-person and telemedicine ratings.

There is limited information regarding physician or surgeon attitudes on telehealth encounters performed without a trained representative with the patient. In the psychiatry based study, over 90% of surgeons were satisfied with their encounters and became comfortable with telemedicine within 4 to 10 visits [14]. At our institution, we had similar satisfaction with both video and telephone encounters with no significant difference between modalities. Goals were accomplished in greater than 90% of telemedicine encounters however there remained a proportion of visits (76%) that surgeons felt did successfully replace in-person encounters. Furthermore, when stratifying encounters by new, return, or post-operative visit, there were no statistical differences in surgeon satisfaction, surgeon ability to accomplish the goals of the encounter, or ability for the encounter to replace an in-person visit. This suggests that telemedicine, either via phone or video, can be utilized appropriately in all facets of outpatient orthopaedic care. We did not stratify the results of our patient satisfaction data by age, however, there has been a previously documented influence in telehealth satisfaction [15,16].

The current study, while an important first question in evaluating telehealth applications, does not provide a complete picture of the nuances and outcomes important to its eventual success. Adop-

tion of this technology must first be accessible and acceptable to those that use it; this was the primary focus of the current paper. However, the efficacy and safety of this technology must also be proven, something that will require additional study and further review. Our survey was unable to determine the reason for the discrepancy in why some visits did not successfully replace in-person visits. Overall, however, the vast majority of encounters were deemed useful by the surgeons. Further investigation is required to evaluate potential variables that may modulate the effectiveness of telemedicine care in orthopaedics. In the future, when in-person visits are more available, telemedicine encounters may be more appropriately reserved for encounters that can fully replace in-person visits.

There were several limitations of our survey-based study. First, our survey was conducted in a large, tertiary referral, academic medical centre. Given the current pandemic setting, many patients expressed concern for exposure when presenting to the outpatient clinics of the medical centre which may have enhanced the patient's willingness to perform telemedicine. Patient satisfaction and willingness to repeat telemedicine encounters may be diminished if concern for exposure is diminished, and furthermore patient satisfaction could be related more simply to the fact that they did not have to present to an institution treating Covid-19 patients. Additionally, our patient response rate was 66.4% and therefore does not represent the entire population of patients participating in telemedicine visits; however it approaches 70% which is good for an unsolicited telephone survey. Additionally, the discrepancy between the patient and surgeon response rate (66.4% v 78.6%) can likely be contributed to the fact that all providers who consented were included and more likely engaged in the project given their commitment to the study. Second, the expansion of telemedicine was enabled in part by the CMS waiver allowing for increased reimbursement for remote encounters. It is unclear how long these financial incentives will remain in place. Third, the decision to indicate a patient for in-person vs telemedicine encounter was at the discretion of the surgeon. This raises a number of potential biases regarding the selection of appropriateness for telemedicine visits. While there are described, validated telehealth physical examination findings these remain limited [9,17,18]. Additionally, visits requiring imaging or small procedures (suture removal etc.) cannot currently be addressed through a telemedicine visit. Thus, our patient population represents a highly selected population. For this reason, we are not suggesting that a blanket replacement of all in-person visits is a viable solution, rather, is successful when providers participate in the triage of clinical encounter type. While this does not disqualify our favourable results, we acknowledge that telemedicine in the current form will not be a replacement for many orthopaedic encounters. Lastly, this study occurred during a period of rapid and unexpected implementation of telemedicine at the time of the pandemic. This required a steep learning curve for patients and providers which was not without nuance. Providers have, over the course of the study period, continued to refine and develop strategies to manage these visits. This suggests that overall, an algorithmic approach incorporating visit type, chief complaint, and the potential need for additional imaging/physical examination may further refine the deployment of telemedicine.

Future directions in the maturation of telemedicine applications in orthopaedic surgery are numerous, especially gaining a better understanding of what criteria make a telemedicine visit a reasonable or even favourable option for a patient encounter. This may include factors such as body area (i.e. hand vs. spine), acuity of the presenting problem or whether a patient is new or established in the practice. Additionally, further research into the economic impact of telemedicine on the delivery of care both at an institutional and societal level will be critical to determining the value of this mode of care.

Conclusion

Our findings suggest that there is utility for the incorporation for telemedicine into outpatient orthopaedic care. Telemedicine does not appear to be a replacement for all in-person clinic encounters, however, when used in the appropriate context patients and surgeons viewed the encounters favourably and this tool successfully facilitates the delivery of orthopaedic outpatient care.

Declaration of Competing Interest

None of our authors have conflicts of interests to disclose. We have no sources of funding for this manuscript to declare.

Appendix A. Survey Instruments

Faculty phone survey

- 1) Patient MRN-_____
 - 2) Type/Duration of encounter (select one)
Return 5–10 min, Return 11–20 min, Return 21+ minutes, New 5–10 min, New 11–20 min, New 21+ minutes, Post-op (in global period)
 - 3) Were you satisfied with the encounter?
Highly Unsatisfied, Unsatisfied, Neither Satisfied nor Unsatisfied, Satisfied, Highly Satisfied
 - 4) Were your goals for the visit completed successfully?
No, Yes
 - 5) In your opinion, was this visit successful in replacing an in-person visit?
Yes, No
- Any additional comments or clarification you would like to make about your previous responses? _____

Faculty video survey

- 1) Patient MRN-_____
- 2) Type/Duration of encounter (select one)
Return 5 min, Return 10 min, Return 15 min, Return 25 min, Return 40 min, New 10 min, New 20 min, New 30 min, New 45 min, New 60 min, Post-op (in global period)
- 3) Were you satisfied with the encounter?
Highly Unsatisfied, Unsatisfied, Neither Satisfied nor Unsatisfied, Satisfied, Highly Satisfied
- 4) Were your goals for the visit completed successfully?
No, Yes
- 5) In your opinion, was this visit successful in replacing an in-person visit?
Yes, No
- 6) Any additional comments or clarification you would like to make about your previous responses?

Patient phone survey with verbal consent

- 1) Patient MRN _____
- 2) Hello Mr./Ms. _____, my name is _____ from the XXXXXX Department of orthopaedic Surgery. We are calling to ask you to participate in a brief phone survey as part of a research study about your recent telehealth doctor's visit. The purpose of this research is to evaluate patient and doctor's satisfaction with phone or video visits and should only take about one to two minutes. No identifying information will be collected about you for this research, but your responses to survey questions will be used for this research. Your participation in this survey is optional. There

will be no penalty for refusing to participate. This means that you do not have to participate if you do not want to, and have the ability to end your participation at any time during the phone call. If you agree to participate you have the right to only answer questions you choose to answer. If you have any questions regarding the study you can always contact the principal investigators Drs. XXXXX and XXXXX at XXXXX for further information. Do you have any questions?

Do you agree to voluntarily participate in the survey?

Yes, No

3) Would you recommend this doctor's office to your family and friends?

No, Yes, somewhat Yes, definitely

4) How would you rate our doctor's sensitivity to your needs?

Very Poor, Poor, Fair, Good, Very Good

5) During the virtual visit, did the doctor show respect for what you had to say?

No Yes, somewhat Yes, definitely

6) How would you rate our doctor's response to your concerns throughout the visit?

Very Poor, Poor, Fair, Good, Very Good

7) If given the chance, would you do a virtual visit again?

No, Yes

8) Any clarifications that you would like to make to the previous responses?

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