Would you zoom with your doctor? A discrete choice experiment to identify patient preferences for video and in-clinic consultations in German primary care

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Abstract

Introduction: The popularity of video consultations in healthcare has accelerated during the COVID-19 pandemic. Despite increased availability and obvious benefits, many patients remain hesitant to use video consultations. This study investigates the relative importance of the consultation mode compared to other attributes in patients' appointment choices in Germany.

Methods: A discrete choice experiment was conducted to examine the influence of appointment attributes on preferences for video over in-clinic consultations. A total of 350 participants were included in the analysis.

Results: The level of continuity of care (46%) and the waiting time until the next available appointment (22%) were shown to have higher relative importance than consultation mode (18%) and other attributes. Participants with fewer data privacy concerns, higher technology proficiency, and more fear of COVID-19 tended to prefer video over in-clinic consultations. The predicted choice probability of a video over a typical in-clinic consultation and opting out increased from <1% to 40% when the video consultation was improved from the worst-case to the best-case scenario.

Conclusion: This study provides insight into the effect of the consultation mode on appointment choice at a time when telemedicine gains momentum. The results suggest that participants preferred in-clinic over video consultations. Policymakers and service providers should focus on increasing the level of continuity of care and decreasing the time until the next available appointment to prompt the adoption of video consultations. Although participants preferred to talk to their physician in person over consulting via video per se, the demand for video consultations can be increased significantly by improving the other appointment attributes of video consultations such as the level of continuity of care.

Keywords

Discrete choice experiment, video consultation, telehealth, ehealth, primary care

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Introduction

Telemedicine is defined as the provision of clinical services by a physician to a geographically separated patient or the communication of a physician with another geographically separated physician for the prevention, diagnosis, or treatment of a patient via telecommunication and information technologies.[1,2] The COVID-19 pandemic accelerated the adoption of telemedicine.[3,4] Telemedicine first served as a crisis response in the form of remote diagnosis of COVID-19. Yet, it became a means to continue care for other illnesses during the pandemic without the risk of infecting patients and care providers.[5–7]

Video consultation (VC), as an important type of telemedicine, is the remote, synchronous communication between physicians and patients via audio-visual telecommunication technologies.[8] VCs in Germany can be either with a general practitioner (GP) from a clinic or via the website or app of a commercial VC platform. Patients can either choose between these two forms of VC or

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visit a GP for a traditional in-clinic consultation. In Germany, nine in 10 physicians started to offer VCs during the COVID-19 pandemic, and the market of commercial VC platforms is proliferating.[9] According to a study, almost half of the German respondents would prefer video over in-clinic consultations in the future.[10] Studies showed that VCs are easier to access, reduce healthcare costs, and generate better outcomes.[11–13] As Germany has the highest healthcare cost per capita in the European Union,[14] policymakers seek to increase VC usage due to its obvious benefits.[15,16] To promote its adoption, it is crucial to understand which attributes influence patients' preferences between VCs and traditional in-clinic visits and how strong these influences are on patients' appointment choices.

Previous studies found that the attributes of consultation, such as access to a patient's health information, the patient–doctor relationship, and waiting time,[17–19] impact patients' choice between a VC and a traditional in-clinic visit. Some studies aimed to understand preferences among different virtual consultation options.[20–22] However, the literature on appointment choice between virtual and physical consultation is sparse. Most of these studies are qualitative or do not ask participants to trade-off attributes, limiting the insights on the impact of the consultation mode and other attributes on the appointment choice.

Discrete choice experiments (DCE) – a quantitative methodology based on utility theory – are widely used in healthcare management to assess the quantitative relative importance of attributes.[23,24] To our knowledge, Chudner et al.[25] is the only DCE that studied consultation preferences, including both virtual and physical appointments in primary care. However, as their study was conducted before the COVID-19 crisis accelerated the popularity of VCs, it may be difficult to generalize its findings to the current context.

This study aims to investigate the relative importance of the mode of consultation – video and in-clinic – and the trade-offs between appointment attributes when patients choose a primary care appointment in Germany. By conducting a DCE among the general population, we identified the relative importance of the appointment attributes and the effect of individual characteristics on the preference for video versus in-clinic consultations. The findings of this study will offer insights into policymakers and practitioners seeking to prompt VC uptake and help commercial VC platforms prioritize their resources.

Methods

DCE is a stated preference method to elicit the relative impact of generic attributes of certain goods of interest[23] Unlike other methods that frame abstract questions, respondents are asked to make concrete choices between options in a DCE (e.g. car A and car B), which are characterized by pre-defined attributes (e.g. type of engine) with different levels (e.g. electric, hybrid, or gas).[26] In this section, we describe the development of the study design, followed by data collection and data analysis. Additionally, this section contains details on the qualitative interviews and the pilot study we conducted to enhance the robustness of our study design.

Selection of attributes and levels

The first step of conducting a DCE is to select relevant attributes and attribute levels. Attributes are the different aspects used to describe the alternatives that do not vary across the choice tasks.[27] We reviewed the literature to select the attributes and levels.[28–33] We also conducted interviews with seven patients, two primary care nurses, and one in-clinic physician to validate the attributes selected from the literature. For details of the literature review and the interviews, see Appendix 1. Five attributes (i.e. four other attributes and consultation mode) were finally selected, with two to three levels each (Table 1). The definition of 'usual GP' in the survey context was explained to the participants before starting the DCE as 'Your usual GP, whom you usually contact when you have a complaint'. The level 'usual' or 'own' GP has been used in past DCE studies on primary care appointment choice as a level of continuity of care.[25,34] In the German primary care system, patients can freely choose and change their usual GP. According to German healthcare data, 94% of surveyed patients have a GP whom they usually visit. However, some do not have a family doctor or GP that they usually see.[35]

DCE design

Development of the scenario. At the beginning of the questionnaire, a scenario was described as the medical context for the subsequent choice questions. Carefully choosing the context is important, as it may influence the results.[36] Findings from our interviews suggested that patients only considered VCs as a possible alternative if there were no additional cost, and if the symptoms would not, from a patient's layman perspective, rule out a virtual consultation. To avoid bringing a cognitive burden to the respondents and to facilitate patients to imagine our scenario during the experiment, we provided four exemplary symptoms. These symptoms were carefully chosen to meet four criteria. First, the symptoms should elicit the desire to talk to a medical professional. Otherwise, most participants would have preferred to opt out (e.g. only a runny nose), which would have run against our aim to investigate the choice between appointments. Second, the symptoms should be plausible for patients across age groups and genders. Otherwise, some participants in our sample

Table 1. DCE attributes and levels.

Attribute	Level	Explanation and data source
Consultation mode	In-clinic* Via video	Consultation mode was differentiated as in-clinic and via video.
Waiting time until the next available appointment	Today Tomorrow In 3 days*	The waiting time until the next available appointment was crucial to patients during both interviews and past DCEs in the offline world.[69] Levels were set, based on in-clinic data [35] and information from testing commercial VC platforms.
Opening hours	8 h to 16 h* 8 h to 19 h 8 h to 22 h[a]	The opening hours refer to the times during which appointments were offered on the day of the next available appointment. The levels were based on data from primary care clinics [61] and various telemedicine platforms, to ensure realistic levels for both modes.
Waiting time on appointment day	0 min 30 min 60 min*	The waiting time on appointment day indicates the waiting time either in the waiting room for in-clinic consultations or near the device for VCs. In-clinic waiting time data,[35] our expert interviews, and information obtained from various telemedicine platforms were used to set the levels.
Continuity of care	Your usual GP[a] Unfamiliar GP with access to health record Unfamiliar GP with no access to health record*	Continuity of care refers to the familiarity with the GP in the consultation and the GP's access to the patient's health data.[36]

DCE: discrete choice experiments; GP: general practitioner; VC: video consultation.
*Reference level.
[a]The combination of 'your usual GP' and '8 h to 22 h' was prohibited in creating the choice sets, since this combination was deemed implausible by respondents.

(representative in age and gender) could have difficulties imagining the symptoms (e.g. menstrual cramps and high blood pressure). Third, the symptoms should be medically adequate for video and in-clinic consultations in the patient's layman view (e.g. back pain was usually perceived as unsuitable for a VC during our interviews). Consequently, the symptoms should typically not require a physical examination. Fourth, the symptoms should be common. Otherwise, mentioning the symptoms could confuse the participants.

The four exemplary symptoms are fever, headache, stomach problems, and sore throat. Those symptoms are common for all patients and listed as treatable on commercial VC websites.[37–39] We verified in interviews with patients and two German primary care nurses that the selected symptoms are suitable for telemedicine and do not necessarily require a physical examination.

Furthermore, most interviewees indicated that they would only consider VCs if the telemedicine reimbursement was comparable to that of in-clinic consultations. Since German public health insurance covers all VC costs and private insurance reimbursed most of VC costs during COVID-19,[40,41] the scenario thus mentioned full insurance coverage for both video and in-clinic consultations.

The scenario, translated from German, read:

> Imagine you have symptoms (e.g. fever, headache, stomach complaints, or sore throat) for which a consultation with a general practitioner (GP) makes sense, but a physical examination is not necessary. You have had these symptoms for a few days already and tried different things to remedy the complaints yourself, but to no avail. So, you decide now to consult a general practitioner. Your insurance will cover the full costs.

Development of the DCE design. The DCE design was generated in Ngene (Choice Metrics Pty Ltd, Sydney, Australia). Each choice set included two unlabelled appointment alternatives (Appointment A and Appointment B) and one opt-out option (Figure 1). In an unlabelled design, the choice options are named in generic terms (e.g. Appointment 1 and Appointment 2). In a labelled design, the choice options are named in descriptive terms after an attribute (e.g. VC and in-person consultation). Labelled designs can make alternatives less abstract and increase preference accuracy as respondents can include not explicitly mentioned and yet important attributes associated with the labels.[24] However, labels can lead to biased choices when

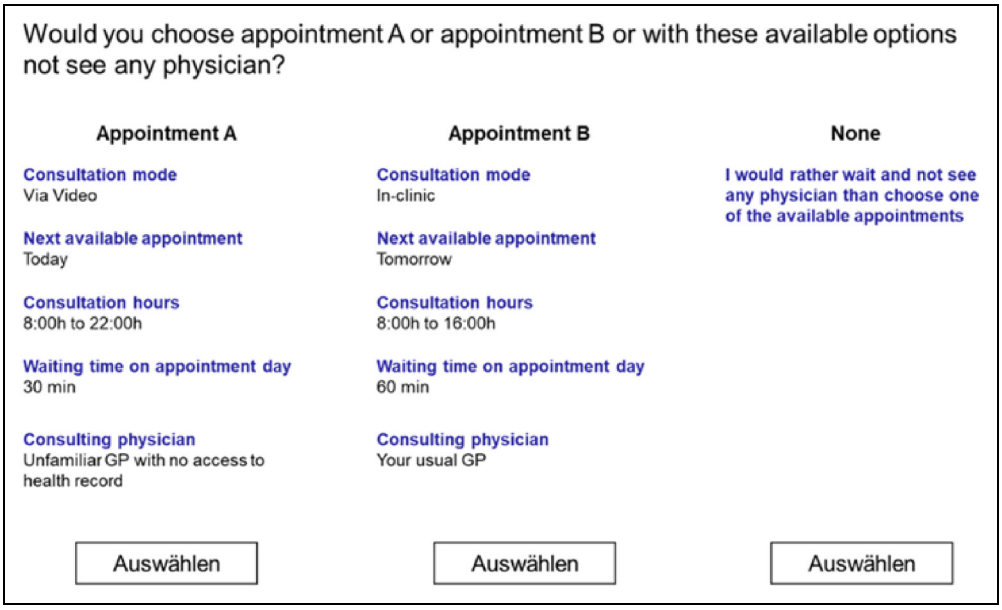

Figure 1. Example of a choice set (translated from German).

respondents place their decision on the labels without properly evaluating the attributes that describe the alternatives.[23] If a label leads to bias, it then should be included as an attribute instead of labels.[23,42] Hence, we included consultation mode (video vs. in-clinic) as an attribute instead of labels, to avoid participants would solely base their choice on the mode without considering other attributes.[23] The opt-out option was described as not visiting a GP, with two other appointment options available. Including opt-out options decreases the risk of overestimating the importance of attributes.[24]

A D-efficient design based on Bayesian priors was adopted to create the choice sets.[27] The implausible combination of the attribute level 'your usual GP' with '8 h to 22 h' was blocked. A pilot study was conducted to obtain the priors for the main DCE design and to test if there is ambiguous phrasing or a sign of fatigue when completing the questionnaire. In total, 116 respondents were included in the pilot study. The data were checked for inconsistencies and implausible answers. A conditional logit model was used to obtain the priors for the main DCE.[43] The details of the methods and results of the pilot study can be found in Appendix 2.

Each respondent received 12 choice sets in the survey. In each choice set, there were two appointment options and a third option of not choosing any appointment. After the choice tasks, participants were asked to rate the perceived difficulty of the choice questions to measure cognitive burden. Individual characteristics were collected through a questionnaire, as shown in Table 2. Technology proficiency, fear of COVID-19, and online privacy concerns were collected and measured by validated 1–5 Likert scales[44–47] (Appendix 3). We tested in the data analysis whether these characteristics might influence the preference for video versus in-clinic consultations. No signs of fatigue when answering the choice tasks and the questions on individual characteristics were noticed in the pilot.

The questionnaire including the choice tasks was created in Sawtooth Lighthouse Studio (Sawtooth Software, Sequim, Washington, USA) and administered in German.

Data collection

We calculated the sample size using the code proposed by de Bekker-Grob et al.[48] in R software (Version 4.1.0; R Core Team 2021). The result showed that the minimum sample size needed is 77. In addition, existing DCE studies widely used a rule of thumb by Johnson and Orme, suggesting a sample of 188 as appropriate.[49,50] Hence, the final number of valid respondents should be at least 188. However, to gain more power to the results, we aimed to recruit 400 respondents since we wanted to include several interaction coefficients and needed to ensure a large enough sample size for statistically valid results in the interaction effects model.

A market research company (Splendid Research GmbH, Hamburg, Germany) was used to recruit the participants and distribute the questionnaires online via their crowdsourcing platform.[51] Everyone aged 15 and above can sign up on the platform, and the platform has more than 43,000 panellists in Germany. Eligible for the study were both users and non-users of telemedicine, living in Germany, aged 18 and above, with German proficiency. Age and gender quotas were defined to represent the German population.[52,53]

The data collection was conducted in December 2020. The market research company invited users of its online platform randomly based on an algorithm to participate in our survey in several waves until the required number of

Table 2. Descriptive results of individual characteristics.

Characteristics ($N = 350$)	Population sample (%)	German census (%)[a]
Gender		
Female	52.6	51
Male	47.1	49
Diverse	0.3	<1
Age		
18–20	4.0	4
21–24	3.7	5
25–39	21.7	23
40–59	30.3	34
60–64	9.7	8
>65	30.0	26
Prefer not to say	0.6	n/a
Occupation		
Self-employed	4.3	
Full-time employed	28.9	
Part-time employed	11.7	
Studying	6.9	
In apprenticeship	1.4	
Retired	35.7	
Not employed	11.1	
Workplace[b,c]		
Working from home due to pandemic	26.1	
Working from home irrespective of pandemic	8.2	
In factory/office/ university	61.4	
Other	4.4	
I don't know/prefer not to say	0	
Health status (compared to others of the same age)		
Excellent	3.7	
Very good	21.7	
Good	40.3	
Medium	28.0	
Bad	6.3	
I don't know/prefer not to say	0	
Frequency of visiting GP (past 12 months)		
0	8.3	
1–5	72.6	
6–10	13.4	
>10	5.7	
I don't know/prefer not to say	0	
Travel time to GP (min)		
0	0.6	
1–5	26.0	
6–10	30.9	
11–15	17.1	
16–20	11.1	
21–30	9.4	
>30	4.0	
I don't know/prefer not to say	0.9	
Telemedicine experience		
No experience	77.4	
Experience	22.6	
Type of telemedicine experience[d,e]		
Consultation via video	31.6	
Consultation via phone	69.6	
Consultation via text/chat	8.9	
Other forms	11.4	
Satisfaction with telemedicine[c,d]		
Very bad	1.3	
Rather bad	0	
Neither good nor bad	38.0	
Rather good	48.1	
Very good	12.7	
Difficulty of DCE tasks		
Easy	26.6	
Rather easy	50.3	
Neither easy nor difficult	17.7	
Rather difficult	5.1	
Difficult	0.3	

DCE: discrete choice experiments; GP: general practitioner.
[a]See references.[52, 53]
[b]Of those not retired and not unemployed (186 of 350 respondents).
[c]Exceeds 100% due to rounding.
[d]Of those with telemedicine experience (79 of 350 respondents).
[e]Exceeds 100% as multiple selections were possible.

responses and the pre-defined quotas of gender and age were met. Participation was voluntary, and the participants were asked for their consent to collect anonymous data. The participants were not allowed to go back to the previous questions, to avoid comparisons across choice sets.[27] Participants could not see the topic of the survey before they started it. Each participant received a small token (1.70€) for completing the questionnaire, which exceeded the pro-rata minimum wage in Germany at the time.[54] In total, the survey was sent to 7931 platform users and started by 456 participants (response rate of 5.7%).

Among them, 426 were eligible based on self-rated German proficiency and consent to collect anonymous data. Eventually, 385 respondents completed the survey. To ensure data quality, we excluded the respondents who displayed flatlining,[55] or took <3 min to complete the survey or missed at least one question. In total, 35 respondents were excluded, leaving 350 respondents in the final data analysis. Table 2 shows their individual characteristics, among which gender and age are comparable to the German population.

Data analysis

Data were analysed with Stata 16 (Stata Corp LLC, College Station, Texas, USA). Three models were built to estimate the overall impacts of the attributes on patients' preferences and the impacts in in-clinic and VC modes, respectively.

(1) *Main-effects model*. In the main-effects model, we estimated the impact of each attribute, including consultation mode, on patients' appointment preferences. The significance of the coefficients in this model indicates whether an attribute has an impact on patients' consultation preferences. Mixed logit models were used to analyse the choice data, which can consider preference heterogeneity among individuals.[56,57] First, we assumed all coefficients as random in the main-effects model to determine which coefficients had a standard deviation significantly different from 0. Then, coefficients with a standard deviation significantly different from 0 were modelled as random effects, while the others were treated as fixed effects in the final main-effects model. All main coefficients were modelled as random except for opening hours 8 h to 19 h and 8 h to 22 h as these two showed a standard deviation not significantly different from 0.

(2) *Interaction model – interaction between consultation mode and other main attributes*. We estimated an interaction model in which the interaction terms were constructed by interacting the consultation mode with other main attributes. In this model, we estimated the impact of each main attribute other than consultation mode, under the condition of in-clinic or VC, respectively.

(3) *Interaction model – interaction between consultation mode and individual characteristics*. We estimated an interaction model in which the interaction terms were constructed by interacting the consultation mode with individual patient characteristics. In this model, we estimated the impact of the individual characteristics on patients' consultation choices under the condition of in-clinic or VC, respectively. The model was constructed by adding the interaction terms with individual characteristics in the first interaction model.[2]

All the main attributes were dummy coded in the main-effects model and the interaction model.[43] The interaction terms were treated as fixed effects and dummy coded.

Based on those results, we calculated the relative importance of the attributes and choice probabilities of different alternatives. Following the ISPOR guideline for DCE studies, we reported the mean values of the results, but not the 95% confidence intervals or their *p*-values.[58]

Relative importance. The relative importance of each attribute in a DCE represents the relative weight of its impact on the choice preferences. It can be calculated as the difference between the largest and smallest level coefficient, divided by the sum of such difference of all main attributes.[59,60] The interaction terms illustrate the difference in effect size between the two consultation modes. We calculated the relative importance in two ways. First, the relative importance of all main attributes (main-effects model). Second, the relative importance of all attributes except consultation mode given that the consultation mode is video or in-clinic, respectively (interaction model).

Choice probabilities. Choice probability is the probability of choosing a certain alternative in a choice set, given its particular attribute levels.[30,59] It varies on a scale from 0% to 100%. A probability of 0% means the willingness of choosing this alternative is approximately zero and one would rather choose another alternative. A choice probability of 100% means one would choose this alternative over the other alternatives. Calculating the choice probability is another way of measuring the relative impact of an attribute (or level), and is widely used in health economics research to predict the uptake of certain alternatives.[30] The choice probability is calculated based on the utilities of the alternatives, which are derived from the different coefficients obtained from the DCE model.[30,59] In other words, the probability of choosing alternative A over alternative B depends on the attribute levels of alternative A and on the attribute levels of alternative B (e.g. choice one: 30 min waiting time vs. 0 min waiting time; choice 2: 30 min waiting time vs. 60 min waiting time).

In this study, we calculated and compared the choice probabilities of VCs under various attribute levels, together with another appointment choice and opting out (not visiting a GP with the two appointment choices given). The following scenarios were considered:

First, we calculated the choice probabilities of a VC, a typical in-clinic consultation, and opting out when varying one attribute level of the VC while keeping the other attributes in the medium case. Afterwards, we changed all attribute levels of the VC from worst to best case simultaneously.[30,60] The levels for a typical in-clinic appointment were set based on German healthcare data.[35,61] The attribute levels of these scenarios are shown in Table 3.

Next, we examined the probability of choosing a typical VC via a commercial platform, when varying its level of continuity of care, over a typical in-clinic consultation and opting out. A typical VC via a commercial platform is described in Table 4.[62,63]

Finally, we compared two forms of VCs: we examined the probability of choosing a typical VC via a commercial platform, when varying its level of continuity of care, over a typical VC by an in-clinic GP (described in Table 4), and opting out.

Ethical statement

This study was approved by the RSM Internal Review Boards of the Erasmus Research Institute of Management, Erasmus University Rotterdam (approval no. 2020/04/24-61392qko).

Results

The impact of consultation mode and other appointment attributes on choosing an appointment – main-effects model

The results of the main-effects model can be found in Table 10 in Appendix 4. The significance level indicates

Table 3. Levels of worst-, medium-, and best-case VC and in-clinic consultation.

(1) Attribute levels of worst-, medium-, and best-case VC			
Attribute	Worst-case VC	Medium-case VC	Best-case VC
Consultation mode	Consultation via video	Consultation via video	Consultation via video
Waiting time until the next available appointment	Appointment in 3 days	Appointment tomorrow	Appointment today
Opening hours	8 h to 16 h	8 h to 22 h	8 h to 19 h
Waiting time on appointment day	60 min	30 min	No waiting time
Continuity of care	Unfamiliar GP with no access to health record	Unfamiliar GP with access to health record	Usual GP of the patient

(2) Attribute levels of typical in-clinic consultation	
Attribute	**Typical in-clinic consultation**
Consultation mode	In-clinic consultation
Waiting time until the next available appointment	Appointment today
Opening hours	8 h to 16 h
Waiting time on appointment day	30 min
Continuity of care	Usual GP of the patient

VC: video consultation; GP: general practitioner.

Table 4. Attribute levels of typical consultations.

Attribute	Typical VC via a commercial platform	Typical VC by in-clinic GP
Consultation mode	Consultation via video	Consultation via video
Waiting time until the next available appointment	Appointment today	Appointment tomorrow
Opening hours	8 h to 22 h	8 h to 16 h
Waiting time on appointment day	No waiting time	No waiting time
Continuity of care	Unfamiliar GP with no access to health record	Usual GP of the patient

VC: video consultation; GP: general practitioner.

whether the attributes have a significant impact on the appointment choice; the signs of the coefficients indicate whether such an impact is positive or negative.[60]

All attribute levels, except those of opening hours, were statistically significant in the final main-effects model, meaning they had a statistically significant impact on the choice between the two appointments and the opt-out option. The most preferred appointment consists of an in-clinic consultation today, with the patient's usual GP and 0 min waiting time on appointment day. The respondents preferred not to see any physicians if all attributes were at the reference levels ($\beta = 1.225$; $P < 0.001$).

Participants preferred in-clinic consultations over VC in general ($\beta = -1.429$, $P < 0.001$). Participants valued a consultation with their usual GP ($\beta = 3.739$, $P < 0.001$) or an unfamiliar GP with access to their health record ($\beta = 1.061$, $P = 0.000$) significantly more than that with an unfamiliar GP with no access to their health record. Participants valued an appointment today ($\beta = 1.794$, $P < .001$) or tomorrow ($\beta = 1.480$, $P < 0.001$) much more than one in three days. Also, participants had a strong preference for 0 min ($\beta = 1.050$, $P < 0.001$) and 30 min ($\beta = 0.619$, $P < .001$) waiting time compared to 60 min.

Figure 2 shows the relative importance of the attributes in choosing an appointment. The most important attribute for participants was the continuity of care, followed by the next available appointment, consultation mode, and the waiting time on the appointment day.

The effect of appointment attributes given the consultation mode on choosing an appointment – interaction between consultation mode and other main attributes

The results of the interaction models are shown in Table 10 in Appendix 4. The significance levels of the main attributes represent whether the attributes have a significant impact on an in-clinic consultation. The results for the in-clinic consultation are similar to those of the main-effects model, except that the longest opening hour 8 h to 22 h ($\beta = -0.680$, $P < 0.001$), was preferred less for in-clinic consultations compared to the reference level open hours of 8 h to 16 h in the interaction model while the coefficients were not significant in the main-effects model.

All interaction terms of the consultation mode with the other appointment attributes were statistically significant, indicating that respondents attached a different importance

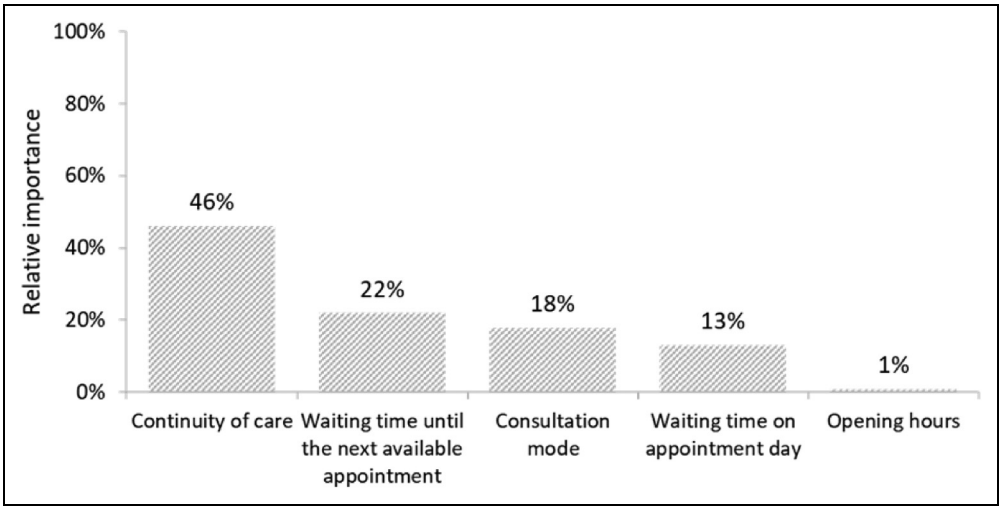

Figure 2. Relative importance of the attributes in the main effect model.

to those attributes for the two consultation modes. For example, if the consultation mode was video compared to in-clinic, respondents attached a higher utility to get an appointment today ($\beta = 00.970$, $P = 0.012$) or tomorrow ($\beta = 0.871$, $P = 0.012$) than to an appointment in three days. Respondents also gained a higher utility for video compared to in-clinic if they only had to wait 0 min ($\beta = 1.19$, $P = 0.004$) or 30 min ($\beta = 1.205$, $P = 0.004$) rather than 60 min on the appointment day. Respondents valued continuity of care, unfamiliar GP with access ($\beta = -1.402$, $P = 0.006$) and usual GP ($\beta = -1.005$, $P = 0.035$) as less important for video compared to in-clinic consultations, relative to the reference level.

The relative importance shown in Figure 3 indicates that given the consultation mode is in-clinic, the respondents attributed the most importance to the continuity of care (54%), next available appointment (27%), waiting time on the appointment day (10%), and opening hours (9%). Given the consultation mode is via video, continuity of care (34%) and the waiting time until the next available appointment (33%) were almost equally important, followed by the waiting time on the appointment day (21%) and opening hours (9%).

The effect of respondents' characteristics on the preference for video versus in-clinic as a consultation mode – interaction between consultation mode and individual characteristics

The results of interacting the consultation mode with individual characteristics are shown in Table 10 in Appendix 4. The statistically significant coefficients indicate that the preferences for the different consultation modes differed with occupation, workplace, frequency of GP visits, technology proficiency, fear of COVID-19, online privacy concerns, and telemedicine experience.

Part-time employed individuals derived a higher utility from VC than in-clinic consultations compared to unemployed individuals. However, 'part-time employed' was the only level in the attribute 'occupation' that showed statistical significance and given that full-time employed was not significant, this variable should be interpreted with caution. Of those employed or studying, respondents who worked from home attributed a higher utility to VC than in-clinic consultations compared to those not working from home. Moreover, a higher GP visiting frequency was associated with a utility decrease for VC compared to in-clinic consultations. Individuals with higher technology proficiency, more fear of COVID-19, and fewer online privacy concerns derived a higher utility from VC than from in-clinic consultations. Besides, individuals with good telemedicine experience derived a higher utility from VC than in-clinic consultations compared to those with no experience.

In summary, the results of this interaction model showed that participants with the following characteristics attached higher utility to VC than to in-clinic consultations: part-time employed, working from home among those who were employed or studied, lower GP visiting frequency, higher technology proficiency, more fear of COVID-19, fewer online privacy concerns, and with good telemedicine experience. Contrary to the literature and evidence from the interviews, travel time, gender, and age had no significant effect on the utility of the different consultation modes.[34,64]

Predictive analyses for choosing one appointment over the other based on the DCE results

Impact of changing the attributes of VC on the probability of choosing VC over an in-clinic consultation. When changing only one attribute of VC at a time while keeping the other attributes at the medium level, the probability of choosing a VC

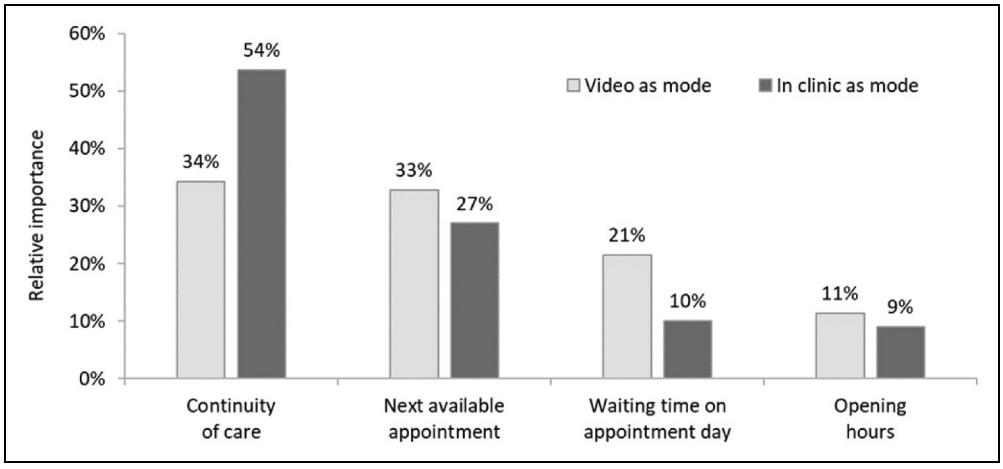

Figure 3. Relative attribute importance depending on the consultation mode.

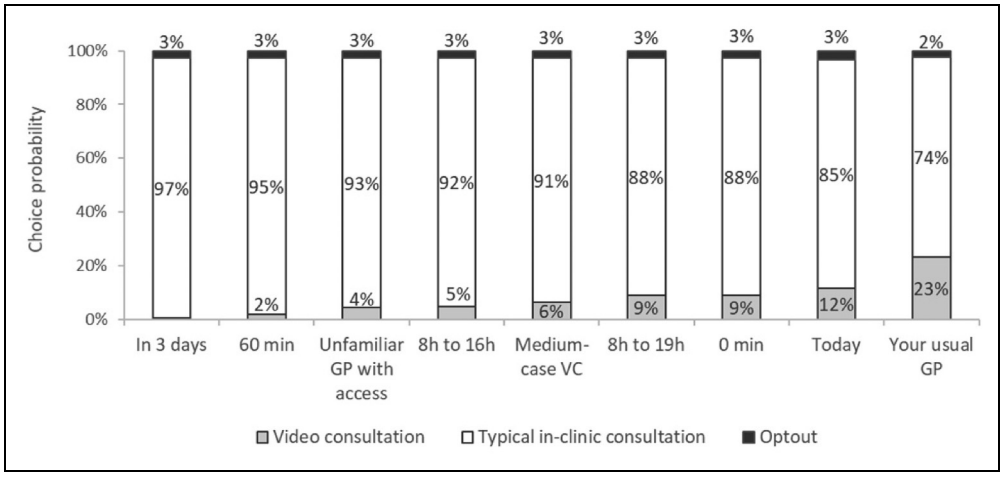

Figure 4. The probabilities of choosing video consultation (VC), typical in-clinic consultation, and opting out for one-by-one attribute level changes of a medium-case VC.

over a typical in-clinic consultation (as defined above) and opting out (not visiting a GP given the two appointment choices) was between 0% and 23% (Figure 4). The largest change (23%) resulted from changing the level of continuity of care from 'unfamiliar GP with no access to the patient's health record' to 'your usual GP'.

When changing all attributes of VC simultaneously, the probability of choosing a VC over a typical in-clinic consultation (as defined above) and opting out increased from <1% at the worst-case attribute levels of the VC to 40% at the best-case levels (Figure 5). However, there was still a significant reluctance to VC even if the VC attributes improved to the best case.

Impact of increasing the continuity of care of VC on the probability of choosing VC over an in-clinic consultation. With continuity of care being the most important attribute, we modelled the predicted choice probabilities of choosing a VC when changing its level of continuity of care in two scenarios. First, we compared a typical VC booked via a commercial platform to a typical in-clinic consultation and opting out (Figure 6). Introducing informational continuity in the form of access to the patient's health record for the VC via a commercial platform option would reduce the probability of choosing the VC from 11% to 9%. In comparison, the probability increases to 32% when introducing both informational and relational continuity for the VC meaning the VC would be conducted with the patient's 'usual GP'.

Second, we compared a typical VC booked via a commercial platform to a typical VC performed by an in-clinic GP and opting out (Figure 7). Introducing access to the patient's health record (informational continuity) for the VC booked via a commercial platform would reduce its choice probability from 25% to 19%, while introducing both informational and relational continuity in form of

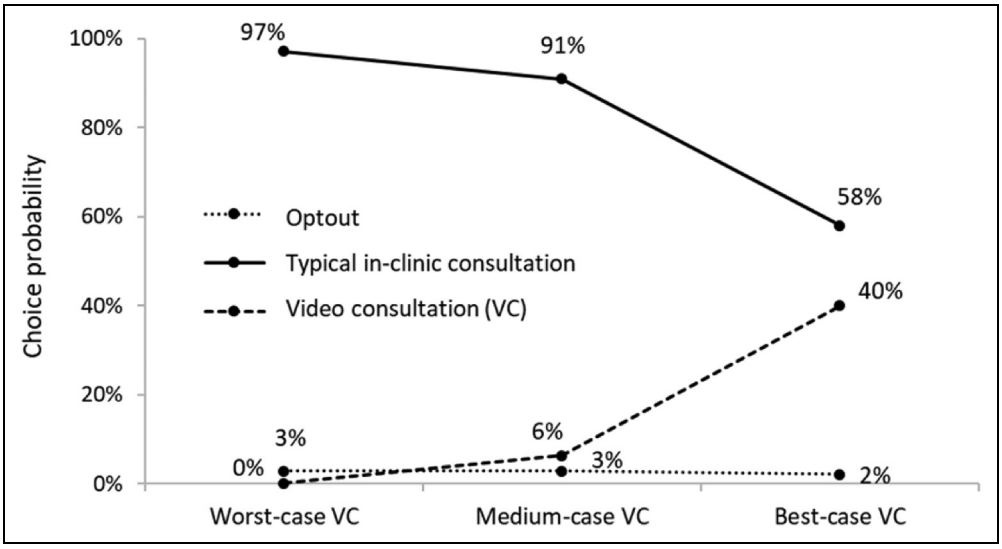

Figure 5. The probabilities of choosing a worst-, medium-, and best-case video consultation(VC) versus a typical in-clinic consultation and opting out.

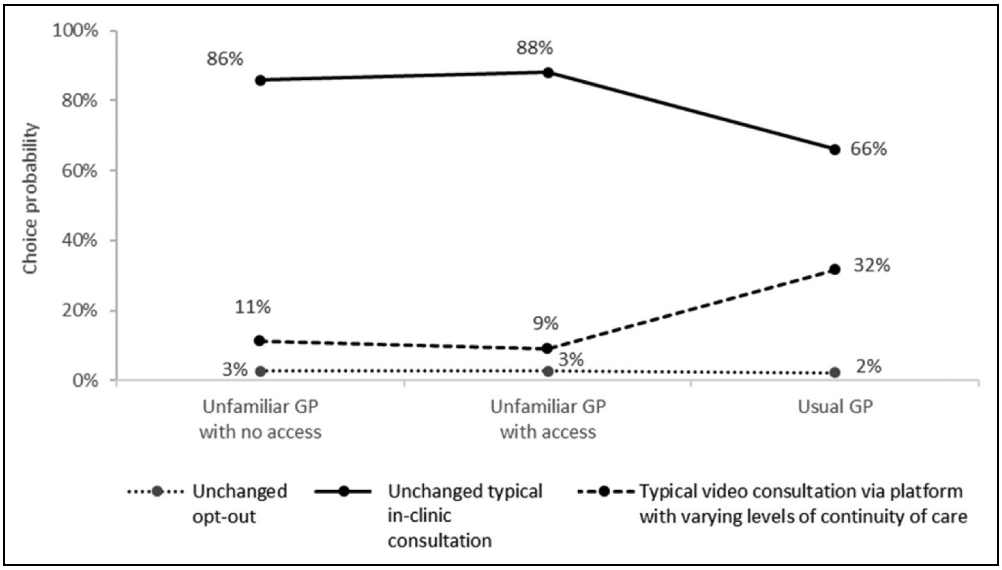

Figure 6. Choice probabilities of a typical video consultation (VC) booked via a platform, a typical in-clinic consultation, and opting out. (The *x*-axis represents the variation in the continuity of care of a typical VC booked via a platform).

seeing the patient's usual GP would increase the choice probability of the VC via a commercial platform to 61%.

Discussion

Principle findings

To our knowledge, this paper is the first DCE on video versus in-clinic appointment choice that has been conducted after the Coronavirus-19 pandemic unfolded. The results showed that participants preferred in-clinic over VCs per se. The level of continuity of care (46%) and the waiting time until the next available appointment (22%) were shown to be more important in the participant's appointment choice than the consultation mode (18%). For in-clinic consultations, participants attached the highest importance to the level of continuity of care (54%) and the time until the next available appointment (22%), while these two attributes were shown to be almost equally important for VCs (34% and 33%, respectively). Participants with fewer data privacy concerns, higher technology proficiency, and more fear of

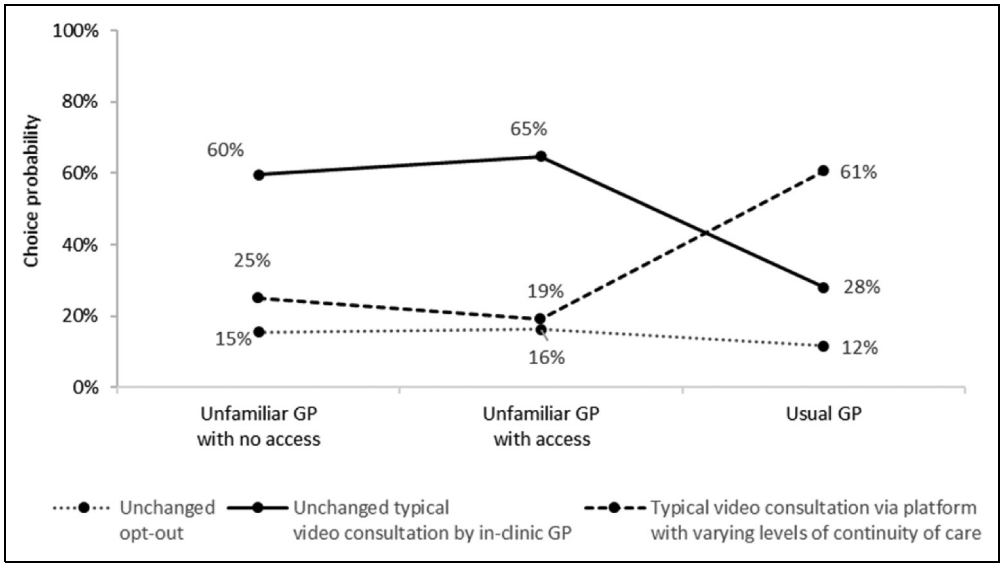

Figure 7. Probabilities of choosing a typical VC booked via a platform, an unchanged typical VC by an in-clinic GP, and opting out. (The *x*-axis represents the variation in the continuity of care of a typical VC booked via a platform).
VC: video consultation; GP: general practitioner.

COVID-19 tended to prefer video over in-clinic consultations. The probability of choosing a video over a typical in-clinic consultation and opting out (not visiting any GP given the two appointment choices) increased from <1% to 40% when the attribute levels of the VC were improved from the worst-case to the best-case levels.

Results interpretation and comparison to the existing literature

We found that participants perceived the level of continuity of care and the waiting time until the next available appointment to be more important than other attributes, such as the waiting time on appointment day. Besides, our results indicated that continuity of care was considered the most important in both consultation modes, which is in line with several other studies.[64,65] However, two other studies reported that waiting time is more important than continuity of care.[25,34] These differences may be explained by the findings that the relative importance of these two attributes depends on the urgency and uncertainty of the symptoms mentioned in the DCE scenario.[36,66]

While at first, opening hours seemed to be not important for a participant in choosing an appointment in the main-effects model, a more detailed investigation with our interaction effects model showed that opening hours have an effect on the appointment choice. However, the effect is in the opposite direction for video versus in-clinic consultations: while longer opening hours (8 h to 22 h) were viewed as inferior to shorter hours for in-clinic consultations, these longer hours were perceived as better than shorter hours for VC. Respondents may have misinterpreted the opening hours for in-clinic consultations as being forced to take an inconveniently late appointment instead of having the flexibility to choose a later time slot if desired.

Changing the attributes of VCs from the worst to the best case could significantly increase the probability of choosing a VC over a typical in-clinic consultation and opting out (not visiting a GP given the two appointment choices) from <1% to 40%. It shows that the demand for VCs depends on the appointment attributes. Although the average German adult prefers in-clinic consultations over VC, more Germans will choose VC over in-clinic appointments if the offered VC has sufficiently good appointment attributes (such as high continuity of care and low waiting time until the next available appointment).

Chudner et al.[25] found a similar trend in the uptake of VC. However, they reported that the probability of choosing a VC over an in-clinic appointment might reach 68% for Israeli primary care patients while in our study the probability of choosing a VC was not higher than 40% (best-case scenario). The difference in the probability of choosing a VC may be due to the designs of the studies: (1) in our study, we included the opt-out option to avoid overestimating choice probabilities,[24] while in Chudner et al.[25] there were only two appointment options available to choose and no opt-out option; (2) we adopted an unlabelled design while Chudner et al.[25] labelled the alternatives. However, an unlabelled design is considered to be more suitable to investigate trade-offs between attributes as the inclusion of labels may reduce the attention respondents give to the attributes.[23]

Continuity of care is a key indicator of a strong primary care system, which has shown to bring benefits to population

health.[67,68] Our study showed that continuity of care is the most important appointment attribute for German primary care patients. It has been widely discussed in the existing literature that the respondents usually attached high importance to the continuity of care.[21,22,69,70] However, it has not been investigated explicitly as a significant attribute in the VC context in DCEs. We found that to motivate patients to use VC instead of in-clinic consultations, the patient's familiarity with the physician seems to play a key role. This finding has implications for future VC policy. Introducing VC options with higher continuity of care such as consulting with your usual in-clinic GP via video might result in higher VC uptake and increase the digitization in the overall primary care system in Germany which is currently at a moderate level.[67] The existing literature shows that trust is important for patients in a VC context as they mentioned concerns about lack of trust in physicians when the physician is not in the same room as the patient.[71] Currently, many commercial VC platforms tend to advertise the convenience of their service – long opening hours and reduced waiting times until the next available appointment as well as short waiting times on appointment day[40,62] – but with no focus on continuity of care. Our findings suggest that the platform providers should focus on improving the level of the continuity of care for VCs, especially relational continuity while maintaining a short waiting time until the next available appointment.

Literature broadly discussed that telehealth might bring benefits to various aspects of healthcare provision, such as potentially increasing health care access,[72,73] saving cost, and improving efficiency,[74] compared to typical in-clinic visits. Additionally, studies showed that telehealth delivers care effectively in various clinical settings.[73,75,76] The adoption and necessity of telehealth, including VCs, has been accelerated by the COVID-19 pandemic,[72,73,77] first as a crisis response and then as an alternative to face-to-face consultations to adhere to social distancing measures.[3,4]

Germany has the highest healthcare cost per capita in the European Union and a relatively low adoption rate of VCs compared to other developed countries.[78] Since VC demand in German primary care has been lower than in specialist care,[79] the German primary care system may be a promising lever to increase healthcare cost efficiency in Germany. In addition, studies identified GP shortages in Germany with some areas being more affected than others.[80,81] Since healthcare practitioners can be in a different city than their patients for VCs, adopting more VCs can relieve the GP shortage in affected areas. Our findings facilitate the design of preferred VC offerings and can eventually increase cost efficiency and GP availability in Germany.

Limitations

First, the attributes chosen for this study represent a subset of all variables that patients consider when choosing an appointment as only a limited number of attributes can be included in the DCE design. For example, an attribute regarding the quality of care or whether the patient's clinical concerns were met, which was an attribute in other publications,[25,30] was not included in the current study, although it was in the list of identified attributes from the literature review. We conducted a literature review, interviews, and a pilot study to ensure that the selected attributes represented the most important variables German patients consider in their primary care appointment choice.

Second, the unlabelled design required that the attribute levels are plausible for both VC and in-clinic consultations, which restricted level selection. As a result, not all possible levels that patients usually face in real appointment choices could be considered. Verifying with experts throughout the study and examining commercial VC platforms likely helped to include the most common levels for both modes.[29]

In addition, some attribute levels might have been misinterpreted by some participants, including the terms 'usual/own GP' and 'health record'. The term 'usual/own GP' was used to represent a level of continuity of care in our study, similar to other DCE studies on primary care appointment choice.[25,34] However, the respondents might have associated aspects other than relational and informational continuity with the term, such as medical or interpersonal skills of their specific usual GP. It limits the ability of the results to suggest the impact of continuity of care. Besides, some participants might have misinterpreted health record access as an infringement of their data privacy, although it was clearly explained that the GP can only access the patient's health record with the patient's consent. These possible misinterpretations could have had an impact on appointment choices. To mitigate this risk, the DCE attributes and levels were thoroughly explained in three description screens at the beginning of the survey before participants could start the experiment. Participants could only continue to the next description screen after a minimum of 5 s.

Finally, although we clearly mentioned that participants should imagine symptoms medically adequate for VC and consulted multiple sources, including patients, primary care nurses, relevant literature, and VC websites,[38,39,82] some participants might find our selected symptoms as medically inadequate for VC. Hence, the results should be interpreted with caution.

Conclusion

Participants perceived continuity of care and the waiting time until the next available appointment as more important than the consultation mode, opening hours, and waiting time on the appointment day in choosing an appointment. Individuals with higher technology proficiency, fewer online privacy concerns, and more fear of COVID-19

showed an increased preference for VC over in-clinic consultations. Although participants generally preferred in-clinic consultations to VCs, changing the attributes of a VC from worst- to best-case might increase the probability of choosing a VC over an in-clinic consultation and opting out (not visiting a GP given the two appointment choices) from <1% to 40%. This study provides evidence for healthcare providers and policymakers to identify the most promising target groups and strategies to prompt VC uptake. It will also help commercial platforms to design a more attractive offering and prioritize their resources investments to improve the attributes most valued by prospective patients.

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Appendix 1. Details on the qualitative approaches to identify attributes and attribute levels

To select attributes and levels an evidence review and interviews were conducted, which is common practice in DCE.[28–30,32,83,84] We first conducted a literature review to identify potential attributes from the literature, then interviewed patients and experts to validate the identified attributes and decided on the list of final selected attributes.

Literature review

As suggested by Janssen et al.[85] an evidence review was used for initial attribute identification and level setting and consisted of a literature review and desk research. Desk research revealed more recent insights on VCs, which might not yet be reflected in academic literature due to the rapid evolvement of telemedicine.[3,4] We conducted a rapid review of empirical studies on the preferences for different consultation modes. The search terms used to identify the literature included: preferences, VC, and telemedicine. We categorized the yielded publications by the consultation mode included and the time of preference elicitation. Given that the interest of this study lies in the preferences between VC and in-clinic consultation, we mainly focused on the literature that would fit in any of the following four categories:

1. Ex-ante preferences between telemedicine and in-clinic consultations.
2. Ex-post preferences between telemedicine and in-clinic consultations.
3. Ex-ante preferences between telemedicine consultations.
4. Ex-ante preferences between in-clinic consultations.

While the interest of this study is (1) Ex-ante preferences between appointments, in which both a video and an in-clinic option are offered, the review was extended to include all four categories to ensure the included literature is as inclusive as possible. In the following sections, we provided a brief description of the identified studies and the considerations on the selection of attributes.

Ex-ante preferences between telemedicine and in-clinic consultations

The most comprehensive study on ex-ante preferences between VC versus in-clinic consultation and the only DCE on video versus in-clinic appointment choice in primary care has been conducted by Chudner et al.[25] in Israel. The paper identified the quality of the consultation, the waiting time until the next available appointment, the level of continuity of care, and the waiting time on appointment day as the most important attributes for patients in descending order. Two other studies confirmed that the waiting time until the next available appointment is important for ex-ante preferences between in-clinic and telemedicine consultations.[86,87] Qureshi et al.[87] showed that patients have a higher willingness to pay (WTP) for telemedicine if telemedicine leads to earlier appointment availability. Other important attributes include the cost of consultation[86] and convenience.[87]

Some of these findings must be seen critically. In their qualitative study, Qureshi et al.[87] reasoned convenience is an important attribute because one in five interviewees chose the telemedicine option when offered a virtual and an in-clinic consultation with identical waiting times until the next available appointment. The authors concluded that participants attributed some form of convenience to telemedicine since the waiting time until the next available appointment

stayed constant. While convenience can comprise many aspects such as travel time, travel cost, and flexibility,[87] patients might have associated attributes other than convenience with the term telemedicine. The quality of the consultation could be an important choice attribute as shown by Chudner et al.,[25] and implicitly assumed to be better with telemedicine due to fewer interruptions. It might be wrong to assume convenience to be the 'major determining factor in the choice given'[87] solely based on the reasoning that the waiting time until the next available appointment stayed constant.

Furthermore, Deidda et al.[86] included telemedicine via a physician and telemedicine via a pharmacist as two of five scanning modes for cardiac patients, and thus not every choice set included a telemedicine alternative. All three studies have been conducted before the Coronavirus-19 pandemic unfolded in Israel, Sardinia, and the U.S., respectively.[25,86,87] There might be other trade-offs for German patients during and beyond the Coronavirus-19 pandemic.

Ex-post preferences between telemedicine and in-clinic consultations

A systematic review of seven empirical studies in primary healthcare[88] and a systematic review of 17 randomized clinical trials in specialist healthcare[89] showed that although patients prefer in-clinic consultation over VC, patient satisfaction with VC is at least as high as with traditional consultations. For telephone consultations, patient satisfaction is also high but lower compared to VC.[89–91] Reasons for high satisfaction among telemedicine users were avoided travel time,[90–92] avoided travel cost,[88,90,91,93] shorter waiting time on appointment day,[91–93] shorter waiting time until next available appointment,[88] increased flexibility of appointment time,[93] longer opening hours,[92] and more convenience.[90,91,93] Barriers to telemedicine included a lack of privacy due to the physical environment of the patient, technical issues, medical concerns (lack of physical examination and clarity of treatment plan), and communication obstacles.[88,90,93]

Ballester et al.[91] quantitatively showed a shorter waiting time on appointment days as well as travel time savings for telemedicine users in the United States. Dixon and Stahl[94] reported no change in the WTP for VCs when usual travel times were up to 4 h and usual travel costs were up to $40 among participants in the United States. The fact that patients living as close as 0.9 miles to the care facility chose telemedicine over in-clinic consultations also indicates that attributes other than travel time are important to patients.[91] Watson et al.[92] reported that only 40% of participants in the telemedicine group, who had access to a portal at any time of the day, used the platform during office hours of the care facility. This might indicate that long opening hours are valued by users of telemedicine.

There are limitations to these findings. Many ex-post preference studies stated convenience as an attribute without describing what patients understand by convenience.[90,91,93] Convenience could include the flexibility of appointment time, opening hours, travel time, or even travel mode. Additionally, in one paper, the most cited benefits were travel time, convenience, and travel/parking, respectively.[91] Although travel/parking might refer to travel and parking cost since it does not refer to travel time and not to the convenience of (not) travelling as those are distinct attributes in the study, it is not mentioned how travelling/parking was explained to participants.

Ex-ante preferences between telemedicine consultations

The attributes in this section were identified by scholars examining preferences for two different telemedicine offerings either of the same or different telemedicine forms. A survey of 4300 adults in the U.S. found the level of continuity of care to be important when deciding between two VCs in primary care as respondents indicated preferences for their GP over a different GP from their healthcare organization over a different GP from a different healthcare organization.[22] More than half of the respondents stressed the importance of an established relationship with their GP, which reflects relational continuity, and for the GP to have access to their health records, which reflects informational continuity.[22] Another study found that the personalization of the consultation is important for diabetes management platforms, which might refer to some form of continuity.[21]

Two DCE studies on telemedicine options revealed that cost (e.g. monthly fee) and time (e.g. reply time) are important attributes.[20,21] Park et al.[21] tested the importance of distance to the nearest offline care location which could refer to travel time, travel cost, or convenience. As in the work of Ballester et al.,[91] it is not clear what underlying aspects patients assess when they are given the distance to the nearest care location. Park et al.[21] also included the attribute 24/7 access, which could indicate the relevance of longer opening hours, shorter waiting times until the next available appointment, or both. Other attributes mentioned in the two DCEs included the scope of the service, the attitude of the physician towards telemedicine, and whether a mobile version was offered.[20,21]

Park et al.[21] found that privacy and security were less important for patients when choosing between different telemedicine options. However, as mentioned by the authors, this could be due to relatively acceptable levels of data confidentiality failures used in the experiment (1% and 1%–5% failures). A larger range would have ensured that participants can detect differences between the levels.[24]

Ex-ante preferences between in-clinic consultations

Since there are plentiful studies on ex-ante preferences between two in-clinic consultations, this section focuses only on DCEs in primary care except for one qualitative survey.[70] A systematic review of 18 DCEs

in primary care found that the attributes waiting time until the next available appointment (12 of 18 studies) and profession of care provider – nurser versus physician – (8 of 12 studies) were the most studied attributes and most frequently identified as the most important ones (4 of 18 and 4 of 18, respectively).[69] Another study confirms that waiting time until the next available appointment is critical for patients.[95] Gerard and Lattimer[96] stated that the most important attribute in their urgent primary healthcare DCE was information on expected waiting time for which patients were willing to accept 2 h of additional waiting time on the day of the emergency. However, the information on expected waiting time might be more important in urgent than non-urgent primary care due to acute pain.

Other important attributes are the degree of patient's participation in the decision making,[95] the duration of the consultation,[97] the quality of consultation,[96] the level of continuity of care,[70,98] the scope of services and cost.[70] Pedersen et al.[97] showed that distance to the practice is only relevant for patients when choosing a new GP but not when their current GP was an available option. The importance of the travel time and cost, which are likely related to distance, might thus only be important if a new GP has to be chosen.

The identified attributes are summarized below list, which was used as a basis for the second step to reach a refined list of attributes:

- Waiting time until the next available appointment.
- Waiting time on appointment day.
- Information on expected waiting time.
- Opening hours.
- Flexibility of appointment time.
- Duration of consultation.
- Level of continuity of care.
- Consulting care provider (nurse or physician).
- Quality of consultation.
- Communication skills of a physician.
- Attitude of the physician towards telemedicine.
- Scope of service.
- Cost of consultation.
- Travel time and cost.
- Data privacy and security of consultation.

Patient interviews

Seven semi-structured interviews with patients were conducted to select the most relevant attributes from the list of identified attributes in the last step. Appointment choices in real life are likely made without the influence of other individuals, which makes separate interviews preferable over focus groups to prevent peer pressure dynamics.[25] The process followed an iterative design of interview guidelines, convenience and snowball sampling of both users and non-users, and the data saturation principle to determine the sample size.[25,29] Respondent characteristics are shown in Table 5.

We conducted the interviews following the procedures described in Text Box 1. The interviews were conducted following Consolidated Criteria for Reporting Qualitative Research.[99] Interviewees were approached via social media, email, or phone and interviewed in English or German via Zoom (Zoom Video Communication Inc., San Jose). Some interviewees knew the interviewer before, and all interviewees were informed about the study rationale. Interviews lasted between 20 and 45 min and were audio- and video-recorded unless the interviewee did not consent to the recording. In case of no consent, notes were taken by the interviewer. No non-participants were present during the interviews, no participants dropped out during the study and no interviews were repeated. The interviewer followed an interview guide that was not visible to the interviewees.

The results of the interviews found that the following attributes were the most relevant attributes in patients' decision making process of selecting the consultation mode:

- Waiting time until the next available appointment.
- Waiting time on appointment day.
- Opening hours.
- Level of continuity of care.

Table 5. Descriptive statistics of patient interviews.

Characteristics ($N = 7$)	Percentage (%)
Gender	
Female	44
Male	56
Age	
18–45 years	71
46–65 years	29
Occupation	
Employed	43
Self-employed	14
Student	29
Not employed	14
Main location of residence within the last year	
Germany	29
Europe but not Germany	14
Outside Europe	57
Visited general physician (GP) within the last year	
Yes	100
No	0
Video consultation experience	
With GP	29
Not with GP but with other physician	43
No experience	29
Usual mode of consultation with GP	
Usually via video	0
Usually in person	71
Both	29

Note: Numbers might not foot due to rounding.

Text Box 1. Interview guide for patient interviews.

Part 1: Introduction
The interviewer introduced himself, the research objective, and the interview structure. Any open questions of the interviewee were addressed.

Part 2: Open questions
A scenario was read to the interviewee to start an open discussion:
Imagine you have a common cold with a headache:

- Not severe
- *not urgent but acute*
- *not requiring a physical examination*

Your insurance fully covers either an in-clinic or a video consultation (from your computer or smartphone) with a general practitioner (GP).

Then the respondents are asked to answer the following questions:

Q1: How would you make this decision? What factors are important to you to decide between a video and an in-clinic consultation with your GP?

Q2: In what case would you not do the video consultation? When would you do an in-clinic consultation?

Q3: In what case would you not do the in-clinic consultation? When would you do a video consultation?

Part 3: Specific attributes
This section probed attributes not proactively mentioned by the interviewee but identified in the evidence review or mentioned by other interviewees. Due to the iterative design of the questionnaires, these attributes and their wording changed throughout the interviews. Thus, a list of example attributes will be given:

(a) Time until the next available appointment
(b) Waiting time on the day of the appointment
(c) Continuity of care/ choice of physician (your usual doctor or any other doctor)
(d) Opening hours
(e) Infection risk (flu season, Coronavirus)
(f) Travel time to the in-clinic appointment
(g) Available options for travel mode (public transport, own car, uber)
(h) Administrative effort (signing up for video platform, paperwork in doctor's office, etc.)

Then the respondents are asked to answer the following question:

Q4: Per attribute: Do you consider this attribute as important for your decision? Why or why not?

The scenario was read aloud again, and the list of attributes shown to the interviewee via screen share. Then the respondents are asked to answer the following question:

Q5: If you had to select the four most important attributes for your decision, what would they be?

If needed, follow-up questions are asked regarding the reasoning why a certain attribute is important or an attribute that has been mentioned in Part 2 is not considered among the four most important.

Part 4: Attribute levels
Then the respondents are asked to answer the following question on the levels for selected attributes. An example is given for the attribute waiting time in line.

Q6. What is the usual time you wait in the waiting room of your GP?

Q7. What was the shortest time you have waited in the waiting room of your GP?

Q8. What would be the maximum time you are willing to wait in the waiting room of your GP?

Part 5: End
Any remaining questions of the interviewee were answered. The interviewee was asked to fill in the Google form (Google Inc., Mountain View, California, USA) for socio-demographic information.

Expert interviews

Lastly, experts were consulted to validate the findings from patient interviews since experts have a more objective understanding.[29,32,100] Two primary care nurses, one in-clinic physician who uses VCs, and a partner of a consulting firm with extensive digital healthcare experience were interviewed for 30 to 60 min. During the interview, they were asked to examine the validity of each attribute selected in the last step and the corresponding levels from the perspective of their respective role as health care workers. Due to privacy concerns regarding the small sample size, no respondent characteristics were recorded. The experts acknowledged that the selected attributes were sensible and adequate to use as the attributes in our study setting.

Appendix 2. Details on the pilot study

The objectives of the pilot study were to assess if there was any fatigue sign, cognitive burden, or misunderstanding when completing the choice questions, and to obtain the priors for the main DCE design.

Methods

First, we conducted think-aloud exercises with three individuals who did not participate in any previous interviews. Individuals were presented with the attributes and the corresponding levels, then they were asked to explain their understanding of the attributes. The procedure enables researchers to identify differences between the intended and actual understanding of attributes and levels.[101]

Second, the DCE design of the 12 choice tasks for the pilot study was constructed in Ngene using a D-efficient design with fixed priors. While it is not advisable to use the coefficients of other studies as the priors due to differences in scale, it is common practice to use small positive or negative numbers to indicate the sign.[102] The sign can be determined from previous DCE studies or reasoning. For example, a coefficient of −0.001 was used for the waiting time until the next available appointment since an increase in the waiting time until the next available appointment is hypothesized to lead to a decrease in the utility of the appointment alternative.[25,103]

The pilot survey was created in Sawtooth Lighthouse Studio (Sawtooth Software, Sequim, Washington, USA) and distributed online in early November 2020 to a convenience sample of German-speaking users and non-users of telemedicine aged 18 and above, who were living in Germany at the time. The pilot study had a cleaned sample of 116 responses, which was deemed sufficient taking into account the likely data size requirements of the final study.[104] The data were checked for inconsistencies and implausible answers. Incomplete responses were included to obtain as much information as possible for the priors. A conditional logit model was used to obtain the priors for the main DCE as shown below.[43]

Results

The think-aloud exercises showed that only minor rephrasing was needed to improve the questionnaire. There were no signs of fatigue or of respondents applying heuristics to choose an appointment option.

The pilot sample roughly represented the German population in terms of age while females were oversampled as illustrated in Table 6. The median duration to answer the survey was 10 min. Most participants (70%) found the choice tasks (very or rather) easy and only 13 (13%) found the tasks (very or rather) difficult, which indicates low cognitive burden. Most respondents (59, 61%) perceived the survey length as neither too short nor too long, and only 16 (17%) as (very or rather) long. Another question asking about the likelihood that the symptoms provided in the DCE scenario indicated a Coronavirus-19 infection showed that most participants were not interpreting the exemplary medical conditions as symptoms of the novel virus, which otherwise indicated considerable generalizability of this study beyond the current pandemic. Qualitative feedback was obtained to further refine the survey. The questions on survey length and the likelihood of a Coronavirus-19 infection were removed in the main survey to reduce its length. The results of the conditional logit model on the data from the pilot study are shown in Table 7 and used as priors for the main design.

Table 6. Descriptive statistics of pilot respondents (N = 116).

Characteristics	Population sample (%)	German census (%)[a]
Gender		
Female	67	51
Male	32	49
Diverse	1	<1
Age		
18–20	6	4
21–24	22	5
25–39	19	23
40–59	29	34
60–64	8	8
>65	11	26
Prefer not to say	4	0
Occupation		
Self-employed	1	
Full-time employed	37	
Part-time employed	16	
Studying	28	
In apprenticeship	1	

(continued)

Table 6. Continued.

Characteristics	Population sample (%)	German census (%)[a]
Retired	12	
Not employed	4	
Workplace[b]		
In home office due to pandemic	44	
In principle in home office irrespective of pandemic	2	
In factory/office/ university	48	
Other	5	
I don't know/prefer not to say	1	
Health status		
Excellent	18	
Very good	40	
Good	30	
Medium	7	
Bad	2	
I don't know/prefer not to say	2	
Frequency of visiting GP		
0	20	
1–5	72	
6–10	8	
>10	0	
I don't know/prefer not to say	0	
Travel time to GP (min)		
0	0	
1–5	36	
6–10	40	
11–15	15	
16–20	3	
21–30	2	
>30	2	
I don't know/prefer not to say	1	
Telemedicine experience		
No experience	78	
Experience	22	
Kind of telemedicine experience[c,d]		
Consultation via video	27	
Consultation via phone	68	
Consultation via text/chat	18	
Other forms	14	
Satisfaction with telemedicine[c]		
(Very or rather) bad	10	
Neither good nor bad	29	
(Very or rather) good	62	
Difficulty of DCE tasks		
(Rather) easy	70	
Neither easy nor difficult	17	
(Rather) difficult	13	
Length of survey		
(Very or rather) short	22	
Neither too long nor too short	61	
(Very or rather) long	17	
Likelihood that scenario indicates a Coronavirus-19 infection		
(Very or rather) unlikely	53	
Neither likely nor unlikely	32	
(Very or rather) likely	12	
I don't know	3	

DCE: discrete choice experiments; GP: general practitioner.
Note: Numbers might not foot due to rounding. The sample size might vary slightly across variables due to respondents terminating the survey before completion of all demographic questions.
[a]Source: Statista .[52,53]
[b]Of those not retired and not unemployed (83 respondents).
[c]Of those with telemedicine experience (22 respondents).
[d]Exceeds 100% as multiple selections were possible.

Table 7. Conditional logic model for pilot data.

	Coefficient[a]	SE[b]	(95% Confidence interval)	
Consultation mode				
In clinic[c]	0	n/a		
Via video	−0.401***	0.103	−.060	−0.199
Waiting time until the next available appointment				
In three days[c]	0	n/a		
Tomorrow	1.269***	0.163	0.950	1.587
Today	1.580***	0.179	1.230	1.930
Opening hours				
8 h to 16 h[c]	0	n/a		
8 h to 19 h	0.092	0.078	−0.059	0.244
8 h to 22 h	0.135	0.098	−0.058	0.327
Waiting time on appointment day				
60 min[c]	0	n/a		
30 min	0.498***	0.156	0.193	0.803
0 min	0.561***	0.122	0.3444	0.779
Continuity				
Unfamiliar with no access[c]	0	n/a		
Unfamiliar with access	0.435***	0.130	0.180	0.689
Familiar doctor	1.433***	0.189	1.062	1.804
No appointment (opt-out)	1.580***	0.301	0.724	1.903
Model fit				
Log pseudolikelihood = −1065.4069				

Note: Respondent = 116; observations = 3894.
[a]Significance denoted by *** and ** for 0.01 and 0.05 level, respectively.
[b]Standard error.
[c]Reference level.

Appendix 3. Questionnaires on fear of COVID-19, technology proficiency, and online privacy concerns items and descriptive results

Table 8. Fear of COVID-19 scale.

Item	Population (%)
I am most afraid of COVID-19[1]	
Fully agree	14.9
Rather agree	22.6
Neither agree nor disagree	28.3
Rather not agree	21.4
Do not agree at all	12.9
It makes me uncomfortable to think about COVID-19	
Fully agree	18.6
Rather agree	30.3
Neither agree nor disagree	27.1
Rather not agree	16.0
Do not agree at all	8.0
When watching news and stories about COVID-19 on (social) media, I become nervous or anxious[1]	
Fully agree	6.3
Rather agree	12.3
Neither agree nor disagree	30.9
Rather not agree	32.9
Do not agree at all	17.7

Table 9. Technology proficiency scale.

Item	Population (%)
I can figure out new high-tech products and services without help from others[1]	
Fully applies	25.4
Rather applies	30.6
Sometimes applies	29.7
Does rather not apply	9.1
Does not apply at all	5.1
I seem to have fewer problems than other people in making technology work	
Fully applies	21.1
Rather applies	28.9
Sometimes applies	33.4
Does rather not apply	12.3
Does not apply at all	4.3
Other people come to me for advice on new technologies	
Fully applies	12.0
Rather applies	15.7
Sometimes applies	27.7
Does rather not apply	26.9
Does not apply at all	17.7
I enjoy figuring out how to use new technologies[1]	
Fully applies	20.9
Rather applies	26.3
Sometimes applies	36.3
Does rather not apply	10.9
Does not apply at all	5.7

Table 10. Online privacy concerns scale.

Item	Population (%)
Are you concerned that you are asked for too much personal information when you register or make online purchases?	
Fully concerned	7.4
Rather concerned	22.6
Neither concerned nor not concerned	37.7
Rather not concerned	26.3
Not at all concerned	6.0
Are you concerned that a message you send someone via the Internet may be read by someone else besides the person you sent it to?	
Fully concerned	8.9
Rather concerned	15.4
Neither concerned nor not concerned	32.3
Rather not concerned	32.0
Not at all concerned	11.4
Are you concerned that if you use your credit/debit card to buy something on the Internet your card will be mischarged?	
Fully concerned	12.0
Rather concerned	16.3
Neither concerned nor not concerned	27.7
Rather not concerned	36.9
Not at all concerned	7.1

[a]Does not foot to 100% due to rounding.

Appendix 4. Discrete choice experiment results from the main-effects model and the interaction models

Table 11. Discrete choice experiment result.

Utility function	Main-effects model					Interaction effects model				
	Coef.[a]	SE[b]	*P*-value	SD[a,c]	SE[b]	Coef.[a]	SE[b]	*P*-value	SD[a,c]	SE[b]
Consultation mode										
In clinic[d]	0			–		0			–	–
Via video	−1.429***	0.151	<0.001	2.226***	0.151	−4.558***	1.135	<0.001	1.871***	0.149
Time to next available appointment										
In 3 days[d]	0			n/a		0			–	–
Tomorrow	1.480***	0.170	<0.001	1.896***	0.201	1.768***	0.246	<0.001	1.749***	0.180
Today	1.794***	0.203	<0.001	2.384***	0.218	2.002***	0.260	<0.001	2.282***	0.201
Opening hours										
8 h to 16 h[d]	0			–		0			–	
8 h to 19 h[e]	−0.008	0.080	0.921	–		−0.294	0.169	0.082	–	
8 h to 22 h[e]	−0.079	0.097	0.417	–		−0.680***	0.172	<0.001	–	
Waiting time on the appointment day										
60 min[d]	0			-		0			–	
30 min	0.619***	0.117	<0.001	1.048***	0.158	0.501**	0.207	0.016	0.995***	0.148
0 min	1.050***	0.130	<0.001	1.429***	0.154	0.755***	0.248	0.002	1.455***	0.158
Continuity of care										
Unfamiliar GP with no access[d]	0			–		0			–	
Unfamiliar GP with access	1.061***	0.133	<0.001	1.513***	0.142	1.281***	0.213	<0.001	1.633***	0.160
Your usual GP	3.739***	0.233	<0.001	3.058***	0.208	3.985***	0.287	<0.001	2.923***	0.256
Opt-out										
Not see any doctor	1.225***	0.301	<0.001	4.887***	0.310	0.962***	0.318	0.002	4.505***	0.297
APPOINTMENT ATTRIBUTE LEVELS × VIDEO										
Time to next available appointment										
In 3 days[d]	–					0				
Tomorrow	–	–	–	–	–	0.871***	0.346	0.012		
Today	–	–	–	–	–	0.970***	0.385	0.012		
Opening hours										
8 h to 16 h[d]	–	–	–	–	–	0				
8 h to 19 h	–	–	–	–	–	1.325***	0.402	0.001		
8 h to 22 h	–	–	–	–	–	1.115***	0.345	0.001		
Waiting time on the appointment day										
60 min[d]	–					0				
30 min	–	–	–	–	–	1.205***	0.417	0.004		
0 min	–	–	–	–	–	1.190***	0.413	0.004		
Continuity of care										
Unfamiliar GP with no access[d]						0				
Unfamiliar GP with access	–	–	–	–	–	−1.402***	0.510	0.006		
Your usual GP	–	–	–	–	–	−1.005**	0.477	0.035		
INDIVIDUAL CHARACTERISTICS × VIDEO										
Gender										
Male[d]	–					0				
Female	–	–	–	–	–	0.059	0.251	0.814		
Diverse	–	–	–	–	–	−0.592	2.901	0.838		
Age	–	–	–	–	–	0.001	0.012	0.965		
Occupation										
Not employed[d]	–					0				
Self-employed	–	–	–	–	–	−0.389	0.789	0.622		

(continued)

Table 11. Continued.

Utility function	Main-effects model					Interaction effects model				
	Coef.[a]	SE[b]	*P*-value	SD[a,c]	SE[b]	Coef.[a]	SE[b]	*P*-value	SD[a,c]	SE[b]
Full-time	–	–	–	–	–	0.436	0.435	0.317		
Part-time	–	–	–	–	–	1.258***	0.492	0.011		
Studying	–	–	–	–	–	−0.818	0.728	0.262		
Apprentice	–	–	–	–	–	1.059	0.857	0.217		
Retired	–	–	–	–	–	0.143	0.472	0.762		
Workplace										
Working not from home[d]	–					0				
Working from home	–	–	–	–	–	0.887**	0.381	0.020		
Other workplaces	–	–	–	–	–	−0.946	0.781	0.226		
Health status										
Good health[d]	–					0				
Bad health	–	–	–	–	–	−0.174	0.302	0.565		
Frequency of general physician (GP) visits	–	–	–	–	–	−0.120***	0.035	0.001		
Travel time to usual GP	–	–	–	–	–	0.015	0.012	0.214		
Technology proficiency	–	–	–	–	–	0.524***	0.137	0.000		
Fear of COVID-19	–	–	–	–	–	0.278**	0.118	0.018		
Online privacy concerns	–	–	–	–	–	−0.435***	0.136	0.001		
Telemedicine experience										
No telemedicine experience[d]	–					0				
Bad telemedicine experience	–	–	–	–	–	−0.878	2.203	0.690		
Neutral telemedicine experience	–	–	–	–	–	0.104	0.428	0.809		
Good telemedicine experience	–	–	–	–	–	0.864**	0.370	0.020		
Model fit										
Log likelihood	−2980.942					−2876.487				
Akaike information criterion	6053.884					5900.973				
Respondents	350					345[f]				
Observations	12,600					12,420				

[a]Significance denoted by *** and ** for 0.01 and 0.05 level, respectively.
[b]Standard error.
[c]Standard deviation.
[d]Reference level.
[e]Coefficients of 8 h to 19 h and 8 h to 22 h not modelled as random since the model with all coefficients modelled as random showed that standard deviation was not significantly different from 0 for these two coefficients.
[f]Lower respondents number in interaction compared to main-effects model since some participants indicated 'Prefer not to say' for data-sensitive questions and thus could not be included in interactions model.