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Trends in the use of video consultation in general practice during COVID-19: impact of practice and country characteristics based on the international, cross-sectional PRICOV-19 study

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Abstract

Background The COVID-19 pandemic accelerated the use of telemedicine, specifically video consultations as they provide healthcare access in challenging situations where face-to-face encounters are not possible. Nevertheless, it remains largely unknown to what extent the organisation of general practice and national digital infrastructures have impacted the uptake and use of video consultations.

Objective This study examined the variation in use of video consultations in general practice across Europe during the COVID-19 pandemic and explored associations with practice- and country-level characteristics.

Methods This study is part of the international PRICOV-19 project, using data from an online survey and additional questions from national leads. First, we conducted a rapid literature search to support an evidence-based selection of the PRICOV-19 main survey items and additional questions aligned with our aims. Then, we included five practice-level and nine country-level characteristics, as well as COVID-19 intensity characteristics, as independent variables in the analysis. Finally, we conducted a linear mixed model analysis at the country-level, examining five models incrementally within a one-level random intercept regression model.

Results Data from 5,065 general practices in 38 countries revealed that fewer than half (47.5%) utilized video consultations during the COVID-19 pandemic. Usage was highest in the United Kingdom, Luxembourg, Scandinavia, and France (82.6–94.4%) and the lowest in Portugal, Spain, Serbia, Bosnia and Herzegovina, Switzerland, and the Czech Republic (11.1–23.1%). At practice-level, key factors associated with higher usage included having more patients than average with a history of migration and difficulty speaking the local language, being a self-employed

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general practitioner, having a higher number of registered patients, and being urban-based. At country level, only accessible and affordable internet was statistically significantly associated with use of video consultations.

Conclusions The study corroborates some established trends in telemedicine adoption while also providing new insights into specific practice-level factors that facilitated the use of video consultations in general practice across European countries during COVID-19. While some factors are universally influential, particularly internet access and affordability, others are more context-dependent.

Trial registration Not applicable.

Keywords Telemedicine, Video consultation, COVID-19, general practice, equity

Background

The COVID-19 pandemic accelerated the use of telemedicine, specifically video consultations as they provide healthcare access in challenging situations where face-to-face encounters are not possible. Governmental efforts actively encouraged their utilisation to supplement in-person care [1–3]. Video consultations allowed healthcare providers to remotely assess and monitor COVID-19 patients as well as other acute conditions in general practice. The use of video consultations has also facilitated the care of patients with chronic diseases [4–8] and helped to ensure continued access to outpatient care [9]. The widespread adoption of video consultations in general practice has been slow, despite the global push to digitise healthcare [10], and the evidence showing that video consultations can positively impact the efficient and timely delivery of care in specific conditions [11, 12]. Reasons may include infrastructural and organisational obstacles, especially in rural areas, as well as regulatory, financial, and cultural barriers [13, 14]. General practitioners (GPs) may be sceptical about the usefulness of video consultations compared to other forms of consultation, including telephone consultations [15, 16].

During COVID-19, video consultations for urgent and daytime care in general practice have been rapidly adopted by GPs in some countries, including Australia [17–19], the United States [20], Mexico [21], Singapore [22], Denmark [23–27], Norway [28–30], Sweden [31, 32], and the United Kingdom [33–36]. This has provided valuable insights into the factors driving the transition. Nevertheless, since these are all studies conducted in single countries and often with a limited focus and a small sample sizes [17–22], it remains largely unknown to what extent the organisation of general practice and national digital infrastructures have impacted the uptake and use of video consultations.

Methods

Study aim

This study aimed to (1) describe the variation in the use of video consultations in general practice across Europe during the COVID-19 pandemic, and (2) explore the associations between the use of video consultations and

various factors at both practice-level (e.g., practice size, practice location, patient population composition) and country-level (e.g., digital infrastructures, digital health policies).

Study design

The cross-sectional PRICOV-19 study [37] collected data across 37 European countries and Israel [38], using an online survey and additional data collection. The international PRICOV-19 consortium, established in the summer of 2020, was coordinated by Ghent University (Belgium) and included over 45 research institutes across the 38 participating countries. This paper aligned to the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guideline for cross-sectional studies [39].

Survey development and additional data collection

The team at Ghent University developed the main survey through a structured five-step process, including a scoping literature review, a Delphi procedure with primary care and methodological experts, cognitive interviews with GPs and non-GPs, and pilot testing among 159 general practices in Flanders (Belgium). This process ensured face, content, and construct validity and allowed for cross-cultural adaptation of the instrument [37]. To increase participation and ensure accessibility, the international PRICOV-19 consortium translated the survey into 38 native languages using a forward-backward translation method [37]. The team at Ghent University then made a language-specific survey available to GP practices online using the Research Electronic Data Capture (REDCap) platform, where answers were securely stored [40]. In response to the PRICOV-19 consortium's need for more detailed, country-specific data on general practices during the COVID-19 pandemic, a supplementary survey was conducted. This additional survey provided insights into the impact of national health policies on GPs, capturing changes in roles, task management, and healthcare provider well-being. It offered a comprehensive understanding of the quality and safety measures implemented across different health systems and contributed to the contextualisation of findings across countries [41].

Measurements

The final PRICOV-19 main survey contained a total of 53 items grouped into the following six themes: (a) infection prevention; (b) patient flow for COVID-19- and non-COVID-19 care; (c) management of protocols and new knowledge; (d) communication with patients; (e) wellbeing of the respondent; and (f) characteristics of the practice and respondent. Several items used validated scales, including the Mayo Clinic Wellbeing Index. The majority of questions used closed response categories, such as Likert scales or binary/multiple-choice formats. The international PRICOV-19 consortium was invited to review and culturally adapt the survey [37]. The additional questions included 15 questions related to the (a) composition of the practices, (b) role of GPs during COVID-19, (c) outreach activities, and (d) video consultations. They relied on national-level sources, often citing non-peer-reviewed literature like government reports. Finally, information on the impact of COVID-19 on the health of the country's population was added to the main survey data and additional questions [42].

Recruitment and sampling

Data collection took place between November 2020 and December 2021, with Belgium starting earlier in May 2020 due to prior piloting of the survey. The duration of the data collection varied between countries, ranging from three weeks in Denmark to 35 weeks in Belgium and Ukraine, depending on local pandemic circumstances and organisational capacities. The 38 national leads of the PRICOV-19 study were instructed to recruit between 80 and 200 general practices per country, depending on the total number of practices nationally and logistical feasibility. This recruitment range was agreed upon within the international PRICOV-19 consortium to ensure a manageable yet meaningful sample size for both national and international comparisons. While this target was informed by feasibility rather than strict proportionality to the total number of practices in each country, it allowed sufficient variability and diversity in participating practices across settings [37].

To enhance representativeness, random sampling from national GP registers was encouraged as the preferred recruitment method. At least six countries were able to apply random sampling. In other settings, where random selection was not feasible, national leads used either a mixed approach (combining random and convenience sampling) or a convenience sample. Despite this variation, efforts were made in each country to include practices from different geographical areas and practice types to ensure structural and organisational diversity. All sampling steps were carefully logged by the national leads and reviewed at the consortium level [37]. Practices were invited via email or national GP networks, with the

invitation including a participant information sheet and a unique country-specific link to the online PRICOV-19 main survey, hosted on the REDCap platform. One survey was completed per practice, preferably by a GP or a practice staff member with organisational insight. To complement this data, national leads completed an additional country-level survey in Spring 2022 to provide contextual information on healthcare system features, COVID-19-related policy measures, and broader structural influences on general practice. This enriched the dataset and supported interpretation of practice-level data within national contexts.

Outcome measure

The main outcome measure was the use of video consultations at practice-level during COVID-19. The initial response categories were reclassified into two categories: 'no' (for 'never') and 'yes' (encompassing 'less than once a week', 'weekly', 'daily', and 'multiple times a day').

Independent variables: Practice- and Country-level characteristics

We conducted a rapid literature search on April 4, 2023, using the strategy outlined in the **Supplementary Materials**. Applying a convenience sampling strategy, we reviewed the 595 records identified through our search and selected a mix of recent systematic reviews and theory-informed observational studies employing relevant frameworks, such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). Eleven studies were selected [5, 7, 11, 12, 17, 30, 43–47] to support the evidence-based selection of relevant PRICOV-19 main survey items and additional questions aligned with our study aim (Supplementary Table 1). We included five practice-level characteristics in the analyses as independent variables: (a) payment system, (b) type of employment, (c) practice size (i.e., number of registered patients), (d) practice location (i.e., urban or rural), and (e) patient population composition, compared to other general practices in the country (Supplementary Table 2). In addition, nine country-level characteristics were included as independent variables: (a) integration (i.e., presence of a definition and unlimited use of video for any type of consultation and all patients), (b) reimbursement, (c) guidelines, and (d) internet availability (i.e., accessibility and affordability) (Supplementary Table 3). The variables were recoded into relevant categories. Due to collinearity of variables related to the composition of the patient population, we included only the variable related to patients with a history of migration and difficulty speaking the local language in the subsequent analyses, exhibiting a significant relationship with the outcome variable in bivariate analyses. Finally, the analyses incorporated the intensity of COVID-19 (i.e.,

cases and mortality) as independent variables (Supplementary Table 4).

Data analysis

First, we presented the use of video consultations before ($n=5,087$) and during ($n=5,065$) the COVID-19 pandemic (Table 1). We described categorical variables using total counts (n) and relative frequencies (%). Twenty-two GP practices did not complete the survey's section about

video consultation use during the pandemic and were thus excluded from that part of the analysis. Next, we calculated the likelihood of video use in practices related to the five practice-level, nine country-level, and two COVID-19 pandemic intensity characteristics (Table 2). The data showed a high rate of item non-response due to incomplete surveys or the selection of 'I do not know' or 'not applicable' response options. To address data

Table 1 The use of video consultations presented as the number and percentage of general practices before and during the COVID-19 pandemic (alphabetical order)

Country	Before pandemic			During pandemic		
	<i>n</i>	Use	%	<i>n</i>	Use	%
Austria	133	8	6.0	132	38	28.8
Belgium	466	16	3.4	466	129	27.7
Bosnia & Herzegovina	33	3	9.1	32	4	12.5
Bulgaria	93	30	32.3	95	55	57.9
Croatia	132	21	15.9	129	48	37.2
Cyprus	10	6	60.0	10	8	80.0
Czech Republic	105	8	7.6	104	24	23.1
Denmark	36	3	8.3	36	33	91.7
Estonia	111	13	11.7	111	35	31.5
Finland	101	19	18.8	101	44	43.6
France	551	103	18.7	552	490	88.8
Germany	253	22	8.7	256	120	46.9
Greece	91	11	12.1	90	26	28.9
Hungary	196	30	15.3	196	72	36.7
Iceland	28	4	14.3	28	11	39.3
Ireland	175	11	6.3	174	114	65.5
Israel	79	10	12.7	78	37	47.4
Italy	203	26	12.8	202	118	58.4
Kosovo*	72	25	34.7	70	29	41.4
Latvia	133	45	33.8	134	79	59.0
Lithuania	52	6	11.5	52	21	40.4
Luxembourg	18	3	16.7	18	17	94.4
Malta	9	1	11.1	9	4	44.4
Moldova	67	14	20.9	66	33	50.0
North Macedonia	43	22	51.2	39	25	64.1
Norway	127	25	19.7	128	115	89.8
Poland	194	16	8.2	193	57	29.5
Portugal	200	6	3.0	199	35	17.6
Romania	93	29	31.2	92	59	64.1
Serbia	117	8	6.8	117	13	11.1
Slovenia	175	17	9.7	175	59	33.7
Spain	281	7	2.5	278	50	18.0
Sweden	76	46	60.5	76	70	92.1
Switzerland	83	6	7.2	83	17	20.5
The Netherlands	161	10	6.2	159	103	64.8
Turkey	128	10	7.8	128	28	21.9
Ukraine	239	104	43.5	234	165	70.5
United Kingdom	23	1	4.3	23	19	82.6
Total	5,087	745	14.6	5,065	2,404	47.5

Notes: *n* = number of general practices; use = practices that responded either 'less than once a week', 'weekly', 'daily', or 'multiple times a day' about the use of video consultations as outcome variable. Twenty-two GP practices did not complete the survey's section about video consultation use during the pandemic.

Table 2 The likelihood of video use in general practices related to five practice-level, nine country-level, and two COVID-19 pandemic intensity characteristics (accumulated data of all 38 countries; OR, 95% confidence intervals, and *p*-values)

Practice-level		N	%	OR	95% CI		P
Number of patients with a history of migration and difficulty speaking the local language, compared to the average practice population	Below	2,374	54.8	ref.			
	Average	1,160	26.8	1.29	1.09	1.52	0.003
	Above	795	18.4	1.65	1.36	2.00	0.000
Main payment system	Salary-/capitation-based	2,333	51.6	ref.			
	Fee-for-service/performance based	2,191	48.4	0.96	0.78	1.18	0.691
Type of employment for GPs	Salaried/employed	2,693	58.0	ref.			
	Self-employed	1,951	42.0	1.21	1.01	1.45	0.036
Number of patients listed	< 3,000	2,204	47.5	ref.			
	3,000–10,000	1,413	30.4	1.68	1.41	2.00	0.000
	> 10,000	1,027	22.1	1.89	1.51	2.37	0.000
Location	Rural	1,741	37.9	ref.			
	Urban	2,856	62.1	1.43	1.24	1.64	0.000
Country-level							
Areas with no or limited internet access	No	2,043	44.0	ref.			
	Yes	2,302	49.6	0.97	0.43	2.17	0.933
	Don't know	299	6.4	0.48	0.08	2.75	0.413
Affordable internet for nearly all persons	No	705	15.2	ref.			
	Yes	3,476	74.8	4.34	1.67	11.27	0.003
	Don't know	463	10.0	2.68	0.61	11.71	0.190
Video consultations can be billed/reimbursed	No	1,909	54.7	ref.			
	Yes - in part by patient	122	3.5	4.30	0.85	21.75	0.077
	Yes- by healthcare system	1,461	41.8	2.70	1.25	5.85	0.012
Definition of video consultation in place	No	515	11.1	ref.			
	Yes	4,129	88.9	2.69	1.02	7.10	0.045
Video used for all kinds of consultations	No	3,823	91.3	ref.			
	Yes	365	8.7	0.83	0.23	2.97	0.776
Video consultations offered to all patients	No	838	20.0	ref.			
	Yes	3,350	80.0	1.10	0.31	3.91	0.881
Guidelines on tele consultations in place	No	2,866	61.7	ref.			
	Yes	1,415	30.5	1.87	0.74	4.72	0.186
	Don't know	363	7.8	0.59	0.15	2.32	0.447
COVID-19 intensity							
Deaths per capita 1 month prior to data collection	Low	1,214	26.1	0.82	0.33	2.08	0.680
	Medium	1,649	35.5	ref.			
	High	1,781	38.4	1.67	0.63	4.44	0.306
Cases per capita 1 month prior to data collection	Low	925	19.9	1.89	0.74	4.83	0.184
	Medium	1,190	25.6	ref.			
	High	2,529	54.5	2.03	0.81	5.10	0.130

Notes: use = practices that responded either 'less than once a week', 'weekly', 'daily', or 'multiple times a day' about the use of video consultations as outcome variable.

missing at random and to reduce bias, we excluded entire data points that were missing information.

We then conducted a linear mixed models analysis [48] at the country level (Table 3), which was theory-driven and built stepwise to isolate the impact of practice-, country-, and pandemic-level characteristics. We examined five models incrementally within a one-level random intercept regression model, informed by theory and the rapid literature search conducted, rather than data-driven metrics like AIC/BIC, to manage multicollinearity, reduce missing data bias, and isolate contribution of each group of predictors as well as to prevent overfitting.

The empty model (Model 0, $n = 4,644$) only analysed the use of video consultations for each of the 38 countries, serving as a baseline for assessing the proportion of variance attributable to between-country differences to justify further model complexity. To account for variability and reduce the influence of outliers and extremes, thus providing more robust estimates for each country, we adjusted the individual estimates for each country towards the overall mean (Fig. 1).

Following, we developed five models to incrementally explore the influence of practice-level (Model 1), internet access (Model 2), country-level integration/

Table 3 The results of the linear mixed models analyses with the use of video consultations as outcome variable

Model	M0	M1	C1	P	M2	CI	P	M3	CI	P	M4	CI	P	M5	CI	P
n	4,644	4,239			4,644			3,036			4,644			2,765		
Practice-level characteristics																
Number of patients with a history of migration and difficulty speaking the local language	ref.	1.20	(1.01,1.43)	*										ref.	(1.08,1.65)	**
Main payment system		1.48	(1.21,1.80)	***										1.34	(1.21,1.98)	***
Employment for GPs	ref.	0.97	(0.78,1.20)											1.55		
Number of patients listed	ref.	1.16	(0.95,1.41)											ref.	(0.80,1.30)	
> 3,000														1.02		
3,000–10,000		1.69	(1.40,2.03)	***										ref.	(1.01,1.64)	*
> 10,000		1.67	(1.30,2.15)	***										1.29		
Rural	ref.													ref.	(1.34,2.19)	***
Urban	1.25	(1.08,1.46)	**											1.82	(1.33,2.48)	***
Country-level characteristics																
Areas with no or limited Internet access					ref.									ref.	(1.06,1.56)	**
Affordable Internet for nearly all persons					1.87	(0.83,4.21)								1.05	(0.41,2.72)	
Billed or reimbursed VC					0.47	(0.04,6.01)								0.89	(0.02,37.67)	
Yes, by patient					ref.									ref.		
Yes, by system					6.44	(2.24,18.46)	***							4.17	(0.72,24.25)	
Definition of VC in place					6.72	(0.79,56.91)								3.27	(0.17,62.97)	
Video used for all consultations														ref.		
VC offered to all patients														3.20	(0.43,23.92)	
Guidelines on tele consultations in place														2.07	(0.80,5.38)	
														ref.	(0.13,10.95)	
														1.20		
														ref.	(0.20,3.69)	
														0.85		
														ref.	(0.12,4.33)	
														0.72		
														ref.	(0.31,3.96)	
														1.11		
														0.65	(0.09,4.73)	

Table 3 (continued)

Model	M0	M1	C1	P	M2	CI	P	M3	CI	P	M4	CI	P	M5	CI	P
COVID-19 intensity																
Deaths per capita 1 month																
Low											0.80	(0.31,2.05)		1.04	(0.30,3.64)	
Medium											ref.			ref.		
High											1.84	(0.70,4.82)		1.44	(0.47,4.40)	
Cases per capita 1 month											2.31	(0.89,6.00)		1.48	(0.49,4.48)	
Low											ref.			ref.		
Medium											1.71	(0.67,4.37)		1.75	(0.46,6.68)	
High											27.36			20.42		
Intraclass correlation (%)	30.01	31.75			23.03			24.62								

Notes: Linear mixed model analyses were performed for each model separately, e.g., M0 = model 0, M1 = model 1, etc., to assess associations between the chosen characteristics and video use in a stepwise procedure. VC = video consultation; * $P < .05$; ** $P < .01$; *** $P < .001$; CI = confidence interval.

reimbursement/policy variables (Model 3), pandemic intensity (Model 4), and all variables combined (Model 5). First, we investigated video use associated with characteristics of general practices by adding the five practice-level variables (Model 1, $n = 4,239$). Next, we investigated the association between video use and nine country-level characteristics in two separate models: internet access and affordability (Model 2, $n = 4,644$), as well as integration, reimbursement, and guidelines (Model 3, $n = 3,036$). We also explored the association between video use and the intensity of COVID-19 (Model 4, $n = 4,644$). Finally, the last model included all the five practice-level and the nine country-level characteristics (Model 5, $n = 2,765$). Models 3 ($n = 3,036$) and 5 ($n = 2,765$) had smaller sample sizes due to item nonresponse in country-level variables. We excluded incomplete responses to preserve analytical validity. We set the significance criterion (p , two-sided) at $P < .05$. To assess the reliability of the linear mixed models, we calculated the Intraclass Correlation Coefficient (ICC), which provides an estimate of the proportion of total variance that can be attributed to differences between countries, indicating the consistency of the linear mixed models within each country. We analysed the data using SPSS Statistics for Windows, version 28.0 (IBM Corp., Armonk, NY, USA), and performed the linear mixed models analysis using Stata (version 18.0).

Results

Variation in the use of video consultations in general practice

The analysis included a total of 5,065 general practices from 38 different countries. At the time of the survey, fewer than half of the practices (47.5%) had used video consultations during the COVID-19 pandemic ($n = 2,404$), as shown in Table 1.

Table 1. *The use of video consultations in the participating countries before and during the COVID-19 pandemic (alphabetical order).*

General practices in the United Kingdom, Luxembourg, the Scandinavian countries, and France reported the highest use of video consultations during COVID-19 of all countries, ranging between 82.6 and 94.4%, while Portugal, Spain, Serbia, Bosnia and Herzegovina, Switzerland, and the Czech Republic the lowest usage, ranging between 11.1 and 23.1%.

Characteristics associated with the use of video consultations: crude

The practice-level characteristics of the participating general practices and the country-level characteristics of the 38 participating countries are included as independent variables in the analyses (Table 2). Having a self-reported equal (OR = 1.29, 95% CI [1.09, 1.52], ref. below average) or higher number of migrants (OR = 1.65, 95%

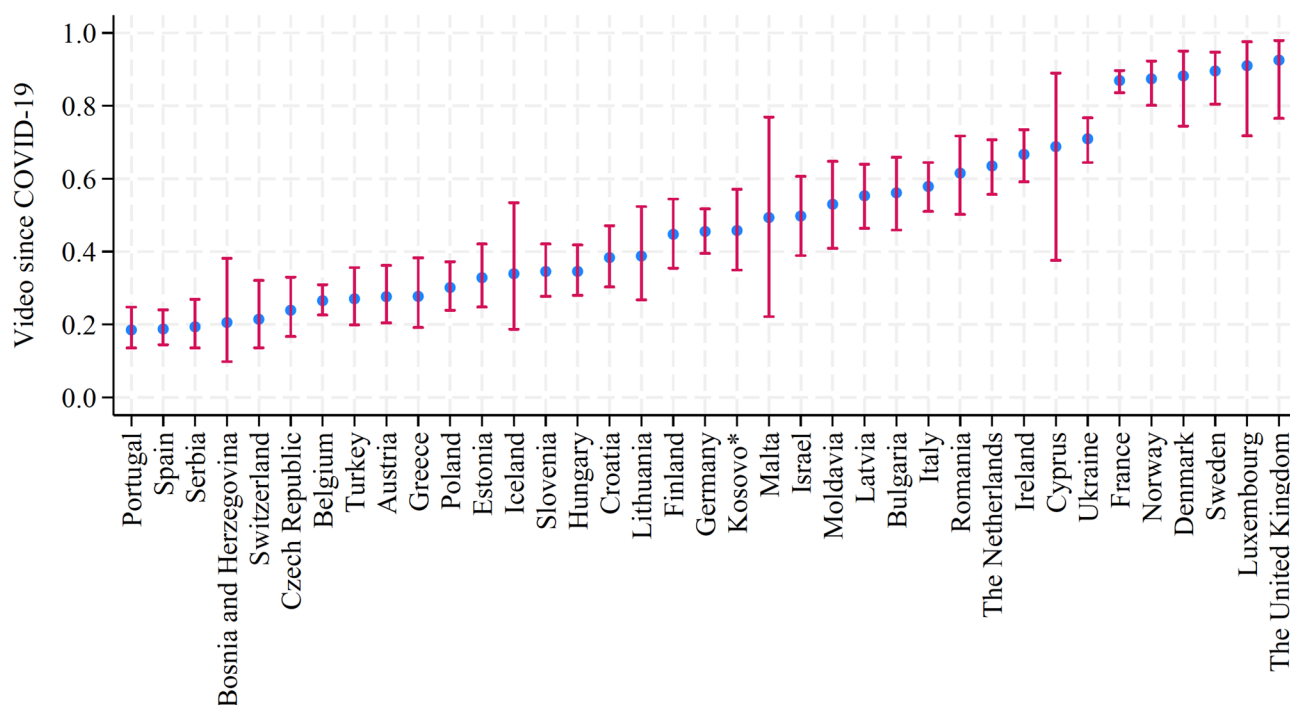


Fig. 1 Caterpillar plot of the outcome variable with 95% confidence intervals, only analysing the use of video consultations for each of the 38 countries in the linear mixed models analyses (Model 0, $n = 4,644$). Notes: The Y-axis shows the use of video consultations with 95% confidence intervals for each of the 38 countries in the linear mixed model analyses. In this empty model (Model 0), the individual estimates for each country are adjusted towards the overall mean; use = practices that responded either 'less than once a week', 'weekly', 'daily', or 'multiple times a day' about the use of video consultations as outcome variable.

CI [1.36, 2.00]) than the average practice, being a mainly self-employed practice (OR = 1.21, 95% CI [1.01, 1.45], ref. salaried/employed), having 3,000–10,000 patients registered (OR = 1.68, 95% CI [1.41, 2.00], ref. below 3,000 patients) or more than 10,000 patients registered (OR = 1.89, 95% CI [1.51, 2.37], ref. below 3,000 patients), and being predominantly urban-based (OR = 1.43, 95% CI [1.24, 1.64], ref. rural) were all positively associated with use of video consultations during COVID-19 at the practice-level. At the country-level, having access to affordable internet (OR = 4.34, 95% CI [1.67, 11.27], ref. no affordability), offering reimbursement for video consultations to the practice by the healthcare system (OR = 2.70, 95% CI [1.25, 5.85], ref. no reimbursement), and having defined video consultations (OR = 2.69, 95% CI [1.02, 7.10], ref. no definition) were positively associated with the use of video consultations.

Characteristics associated with the use of video consultations: modelling

Figure 1 displays the use of video consultations for each of the 38 countries in the linear mixed models analyses (Model 0), reducing the influence of outliers and extremes by adjusting the individual estimates for each country towards the overall mean.

Similar to Table 1, general practices in the United Kingdom, Luxembourg, the Scandinavian countries, and

France reported the highest use of video consultations during COVID-19. However, Ukraine swapped places with Cyprus, when their estimates were adjusted towards the mean.

Table 3 shows the results of the linear mixed models analyses. In the first model covering the five practice-level characteristics, the use of video consultations was positively related to the self-reported number of patients with a history of migration and difficulty speaking the local language (average: OR = 1.20, 95% CI [1.01, 1.43]; above average: OR = 1.48, 95% CI [1.21, 1.80], ref. below average number), the number of patients registered with the practice (3,000–10,000: OR = 1.69, 95% CI [1.40, 2.03]; >10,000: OR = 1.67, 95% CI [1.30, 2.15], ref. below 3,000), and the location of the practice (urban: OR = 1.25, 95% CI [1.08, 1.46], ref. rural). In the models including the nine country-level characteristics (Model 2–4), use of video consultations was significantly related to affordable internet access for nearly all persons in that country (OR = 6.44, 95% CI [2.24, 18.46], ref. no affordability). In our final model, including all five practice- and nine country-level characteristics, the use of video consultations was positively related to the self-reported number of patients with a history of migration and difficulty speaking the local language (above average: OR = 1.55, 95% CI [1.21, 1.98]; average: OR = 1.34, 95% CI [1.08, 1.65], ref. below average number), being self-employed

(OR=1.29, 95% CI [1.01, 1.64], ref. employed), the number of patients registered with the practice (3,000–10,000: OR=1.71, 95% CI [1.34, 2.19]; >10,000: OR=1.82, 95% CI [1.33, 2.48], ref. below 3,000), and the location of the practice (urban: OR=1.29, 95% CI [1.06, 1.56], ref. rural). The country variance (ICC) varied from 30.01 in the empty model (Model 0) to 20.42 in the full model (Model 5), indicating that 20% of the variance in use of video consultations in general practice during COVID-19 was attributable to the country variable.

Discussion

Principal results

Our study showed that fewer than half of the participating general practices from 38 countries had used video consultations during COVID-19 at the time of the survey, with United Kingdom, Luxembourg, the Scandinavian countries, and France reporting the highest use. At the practice level, having more patients than average with a history of migration and difficulty speaking the local language, being a self-employed GP, having more patients registered with the practice, and being urban-based were positively related to the use of video consultations during COVID-19. At the country level, only accessible and affordable internet was statistically significantly associated with the use of video consultations.

Comparison with prior research findings

Our findings add to a growing body of literature examining the complexity of adoption of video consultations in general practice during the COVID-19 pandemic. Consistent with several other studies that have reported low use and slow uptake of video consultations during COVID-19 in general practice [15, 23, 25, 31, 34], we found that video consultations were used in all countries, but in less than half of the participating general practices overall and with large variation in level of use. In line with other studies, we found that general practices in the United Kingdom [15, 34, 35], Luxembourg, the Scandinavian countries [23–32], and France reported the highest use of all countries.

Four practice-level characteristics were positively related to the use of video consultations, i.e., being urban-based, having a larger practice, having more patients than average with a history of migration and difficulty speaking the local language, and being self-employed. Earlier research also found that urban-based general practices were more likely to adopt video consultations [25, 32, 43]. This urban-rural divide has been attributed to better infrastructure [44, 46, 47], higher patient demand [17], and greater availability of resources in urban settings [46], resulting in higher rates of digital adaptation and skills in urban than in rural areas [49]. One study found that general practice had a good overall digital maturity

score, but practicing in a rural setting was negatively associated with digital maturity [50], compared to practicing in urban areas.

Moreover, self-employed GPs were more likely to adopt video consultations. This could be related to earlier research highlighting that GPs who are familiar with the technology [16, 51] and appreciate the flexibility and independence it offers [26, 52], particularly in the early stages of adoption [53], can promote the successful uptake of a new technology and services over time [54]. However, resistance to change and lack of engagement [27, 34] could also hinder the adoption of video consultations in general practice in Europe.

Several studies found that the size and composition of the patient population of the practice was related to the use of video consultations [30, 45, 47]. Some studies have found that younger patients in particular are more likely to have video consultations [23, 25, 31]. Moreover, benefits of implementing new technologies are known to be more pronounced in larger practices [15, 16, 34], which may also reflect economies of scale and publication bias.

The finding of a positive association between use of video consultations and practices reporting more patients than average with a history of migration and difficulty speaking the local language extends prior work that suggests telemedicine can enhance access to care for underserved populations [9, 43, 46, 55], while maintaining the quality of care and reduce workload in general practice [7]. By facilitating communication through visual cues and potentially easier access to translation services, video consultations may mitigate some barriers faced by these patient groups. On the contrary, other studies found that patients with language non-concordance are more difficult to assess remotely [56–58].

Although previous studies have suggested that country-level characteristics could drive telemedicine adoption, such as digital health policies [2] and digital infrastructure [11], our study did not find significant associations between these characteristics and the use of video consultations, with the exception of accessible and affordable internet.

Limitations

This cross-sectional study spanning 38 countries, incorporating the PRICOV-19 survey [37], exhibits a formidable strength in its broad scope. However, caution is warranted when interpreting the results due to the limitations inherent of this study. Since the study participants are GPs who voluntarily responded to the invitation, selection bias cannot be ruled out. The sample of general practices from 38 countries included in the study may not accurately represent those countries, as these GPs may have a greater interest in improving quality and managing their practice and were prepared to assign time to the

study to do so. In addition, samples may not fully reflect the distribution of practices in each country due to voluntary participation and recruitment constraints. Findings from countries with very small samples (e.g., Malta, Iceland) should also be interpreted with caution due to limited representativeness.

Furthermore, we asked GPs whether their practice used video and to what extent, compiling all that did into one category of video ‘users’. By including those practices that used video quite rarely as users, this group may represent a heterogeneous group of practices. Although the response rate was quite acceptable for this type of research, the lower rate could have introduced additional bias. The variation in response rates and the characteristics of the respondents could impact the generalisability of the findings [39]. Moreover, self-reported data from GPs could also risk recall bias and information bias. Reported perceptions and experiences may not accurately portray actual practices or outcomes, contributing to social desirability bias.

This study also has some methodological limitations. The main PRICOV-19 survey utilised was validated and tested exclusively within a single country (Belgium), which may limit the generalisability of the findings to other cultural or geographical contexts [41]. Sample sizes were also not proportional to the total number of GP practices in each country, which may impact the generalizability of the findings. This survey also had limitations regarding the number of questions we could include into the survey or gather additionally, e.g., it did not include key variables related to digital adaptation, such as the GP’s age and digital training. As a result, some important aspects, including national digital infrastructure and digital health literacy, which are crucial for implementing video consultations across countries, might not be fully addressed. In addition, the use of country-level variables, often based on reports from the national PRICOV-19 leads when official data are unavailable, involves an element of estimation, possibly introducing some information bias. Furthermore, the listwise deletion of missing data may introduce bias and reduce generalizability, particularly in models including country-level predictors.

Finally, the cross-sectional nature of this study limits its ability to establish causality, as it only provided a momentary snapshot at the moment of survey administration, which may not accurately reflect the situation throughout the entire period of COVID-19. Data were collected at different times during the pandemic across countries, potentially affecting responses due to varying public health measures. It is important to acknowledge that while the study mostly uses quantitative methods, which provide valuable insights, adding qualitative data could improve our understanding of the experiences and challenges related to implementing video consultations.

Further research

Further research is essential to deepen our understanding of the dynamics surrounding the implementation of video consultations in healthcare systems, to be able to address how the introduction and routinisation of video consultations in general practice can best be supported. This requires a thorough understanding of the mechanisms involved in the implementation process, including the barriers and facilitators that influence their uptake. We also need to develop robust patient-level outcome measures on video consultation, assess their cost-effectiveness, and ensure the quality and safety of remote care in general practice [9, 10]. Moreover, patients and their families need to be engaged in this research. Our current investigation highlights the necessity for comprehensive data gathering to uncover generative causation. In addition, future analyses could group countries by health system type (e.g., Social Health Insurance vs. National Health Service) or GDP per capita to explore structural drivers of telehealth adoption. For this reason, researchers should develop a more nuanced understanding of the intricate interplay of factors influencing the uptake and effectiveness of video consultations, by elucidating their impact as the technology itself is advancing. Research employing a realist approach holds the potential to furnish actionable recommendations in the future, by revealing what works, for whom, in what circumstances, and why.

Conclusions

The study corroborates some established trends in telemedicine adoption while also providing new insights into specific practice-level factors that facilitated the use of video consultations in general practice across European countries during COVID-19. While some factors are universally influential, particularly internet access and affordability, others are more context-dependent. To ensure equitable adoption of video consultations, policy-makers should invest in national broadband access and ensure reimbursement pathways for teleconsultations as well as provide training for digital health use in small and rural practices. Preparedness for future pandemics or crises depends on such dual-level strategies.

Supplementary Information

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Supplementary Material 1

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Author contributions

UK conducted the rapid literature search, designed and contributed to the analyses, wrote the first draft of the paper, produced the publication plan, and reviewed the manuscript drafts. MP provided additional national information and reviewed the manuscript drafts. KH generated the initial idea, design, and methodology; contributed to national data collection and additional national information; and reviewed the manuscript drafts. FS contributed to the initial idea and reviewed the manuscript drafts. EP was responsible for national data collection, additional national information, data cleaning, and reviewed the manuscript drafts. CV performed the analyses. AH contributed to the design, methodology, and manuscript reviews. AT was involved in national data collection, additional national information, collected COVID-19 data around the time of the survey in each country, and reviewed the manuscript drafts. FP contributed to writing the introduction and reviewed the manuscript drafts. AN, RB, CM, GB, AR, and PB reviewed the manuscript drafts. RA was involved in the national data collection, additional national information and reviewed the manuscript drafts. CC contributed to national data collection and reviewed the manuscript drafts. SW was the principal investigator of the PRICOV-19 study and reviewed the manuscript drafts. ADR, FB, and LH co-supervised UK and reviewed the manuscript drafts. All authors have read and agreed to the published version of the manuscript.

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Data availability

The anonymized data is stored at Ghent University and can be accessed by participating PRICOV-19 partners for further analysis after signing a suitable usage agreement.

Declarations

Ethics approval and consent to participate

The Research Ethics Committee of Ghent University Hospital approved the protocol of the PRICOV-19 study (BC-07617), which was conducted in accordance with the guidelines of the Declaration of Helsinki. Additional approval was obtained from local Research Ethics Committees in partner countries where required. Informed consent was obtained from all participants on the first page of the online questionnaire. All data were anonymised, and any raw data that could potentially identify respondents were permanently removed.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Note

*All references to Kosovo in this project, whether to the territory, institutions, or population, shall be understood in full compliance with the United Nations Security Council Resolution 1244 and the ICJ Opinion on the Kosovo's Declaration of independence, without prejudice to the status of Kosovo.

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