ESC European Society of Cardiology

European Heart Journal - Digital Health (2023) **4**, 90–98
https://doi.org/10.1093/ehjdh/ztad004

ORIGINAL ARTICLE

A clinician-to-clinician universal electronic consultation programme at the cardiology department of a Galician healthcare area improves healthcare accessibility and outcomes in elderly patients

Pilar Mazón-Ramos[1,2,3], Sergio Cinza-Sanjurjo [2,3,4,*], David Garcia-Vega[1,2,3], Manuel Portela-Romero [2,3,5], Juan C. Sanmartin-Pena[1,2,3], Daniel Rey-Aldana [2,3,6], Amparo Martinez-Monzonis[1,2,3], Jenifer Espasandín-Domínguez[2,7], Francisco Gude-Sampedro[2,7], and José R. González-Juanatey [1,2,3]

[1]Servicio de Cardiología, Complejo Hospitalario Universitario de Santiago de Compostela, Choupana s/n, CP 15706, Santiago de Compostela, A Coruña, Spain; [2]Instituto de Investigación Sanitaria de Santiago de Compostela (IDIS), Choupana s/n, CP 15706, Santiago de Compostela, A Coruña, Spain; [3]Centro de Investigación Biomédica en Red-Enfermedades Cardiovasculares (CIBERCV), Av. Monforte de Lemos, 3-5. Pabellón 11. Planta 0, CP 28029, Madrid, Spain; [4]Milladoiro Health Center, Santiago de Compostela Health Area, Travesía do Porto, CP 15895, Ames, A Coruña, Spain; [5]Concepción Arenal Health Center, Santiago de Compostela Health Area, Rúa de Santiago León de Caracas, 12, CP 15701, Santiago de Compostela, A Coruña, Spain; [6]A Estrada Health Center, Santiago de Compostela Health Area, Av. Benito Vigo, 110, CP 36680 A Estrada, Pontevedra, Spain; and [7]Epidemiology Clinic Unit, Complejo Hospitalario Universitario de Santiago de Compostela, Choupana s/n, CP 15706, Santiago de Compostela, A Coruña, Spain

Received 29 August 2022; revised 23 November 2022; online publish-ahead-of-print 20 January 2023

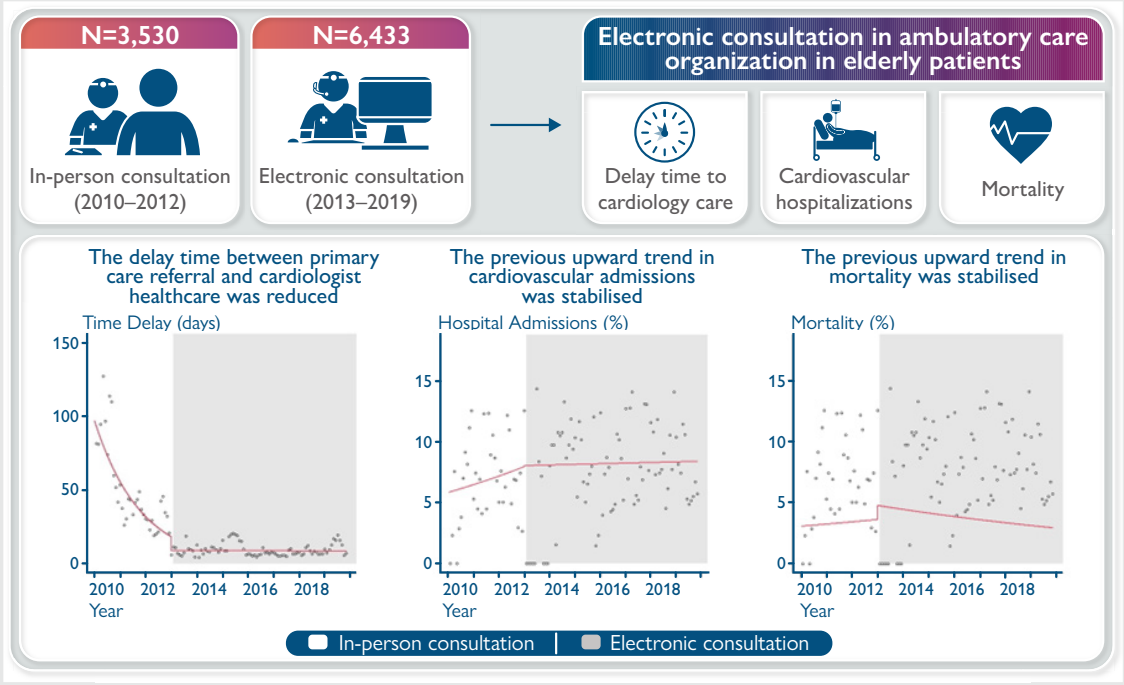
Aims We aimed to assess longer-term results (accessibility, hospital admissions, and mortality) in elderly patients referred to a cardiology department (CD) from primary care using e-consultation in outpatient care.

Methods and results We included 9963 patients >80 years from 1 January 2010 to 31 December 2019. Until 2012, all patients attended an in-person consultation (2010–2012). In 2013, we instituted an e-consult programme (2013–2019) for all primary care referrals to cardiologists that preceded a patient's in-person consultation when considered. We used an interrupted time series (ITS) regression approach to investigate the impact of e-consultation on (i) cardiovascular hospital admissions and mortality. We also analysed (ii) the total number and referral rate (population-adjusted referred rate) in both periods, and (iii) the accessibility was measured as the number of consultations and variation according to the distance from the municipality and reference hospital. During e-consultation, the demand for care increased ($12.8 \pm 4.3\%$ vs. $25.5 \pm 11.1\%$ per 1000 inhabitants, $P < 0.001$) and referrals from different areas were equalized. After the implementation of e-consultation, we observed that the increase in hospital admissions and mortality were stabilized [incidence rate ratio (iRR): 1.351 (95% CI, 0.787, 2.317), $P = 0.874$] and [iRR: 1.925 (95% CI: 0.889, 4.168), $P = 0.096$], respectively. The geographic variabilities in hospital admissions and mortality seen during the in-person consultation were stabilized after e-consultation implementation.

Conclusions Implementation of a clinician-to-clinician e-consultation programme in outpatient care was associated with improved accessibility to cardiology healthcare in elderly patients. After e-consultations were implemented, hospital admissions and mortality were stabilized.

* Corresponding author. Tel: +34 60 535 2334, Email: sergio.cinza@usc.es

Graphical Abstract



Keywords Elderly • Electronic consultation • Healthcare • Outcomes health

Introduction

The different online healthcare models are an opportunity to improve the accessibility and efficiency of clinical assistance; however, analyses of the effects of outpatient care on healthcare quality, including safety, are very limited, particularly in highly vulnerable populations such as elderly patients.[1,2] The healthcare systems that have integrated electronic clinical records between different assistance levels provide an electronic consultation (e-consultation) as a first step of ambulatory care for all general practitioner (GP) referrals. In this model, the referral includes the cause for the demand of cardiology care and the results of the complementary exams [electrocardiogram (EKG) and blood examination]. All this information is then included in the patient's medical records and is analysed by a cardiologist. We identified the proportion of patients whose care demands are met without a traditional in-person consultation. For these patients, the cardiologist's report is still included in the medical records, which is explained to the patient by the GP. For the remaining patients in whom a further in-person consultation was required, we identified those whose clinical problems are solved with a one-time patient visit and those who needed subsequent care and were scheduled for follow-up visits; in both situations, the GP provides the patient with an appointment with the cardiology department (CD).[3] We have recently published that the inclusion of e-consultation at the beginning of outpatient assistance can reduce the delay time for care, visits to the emergency service, hospital admissions, and mortality rate. In addition, it helps to reduce the direct and indirect costs for the patient and the health care system, despite an increased demand for care after interventions aimed to improve the access to care.[3–5]

The care of elderly patients (generally >80 years) represents a health challenge that will increase in the coming decades, since, according to forecasts by the World Health Organization, it is expected that the number of people aged 80 and over will triple between 2020 and 2050.[6] This group of patients is usually characterized from a clinical point of view as having more chronic pathologies, particularly more cardiovascular (CV) diseases, resulting in them having a worse risk profile.[7,8] However, this group is also usually characterized by problems with functionality and dependency that can give rise to difficulties in moving from their homes to health care centres, particularly in areas of great geographical dispersion such as in our study.[8,9] Green et al.[10] descripted the results in a remote consultation in primary care during the lockdown in England, which showed that the most deprived populations were less likely to use remote consultations.

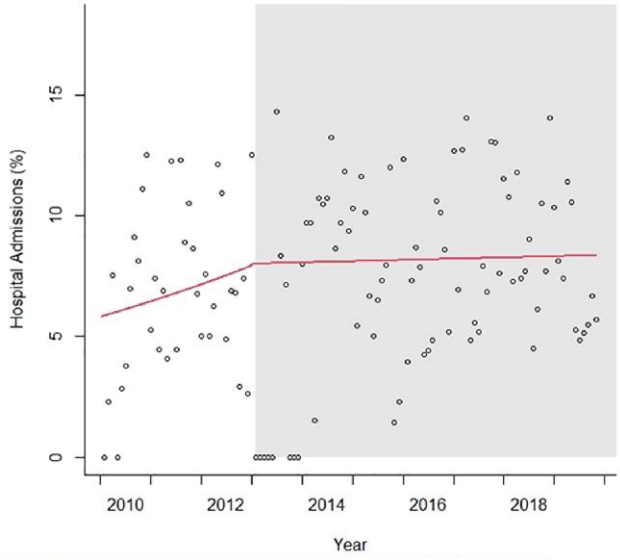
Addressing these challenges requires fundamental changes to healthcare delivery; more equitable outcomes will not be achieved without changing the underlying system. Healthcare systems that include an e-consultation have already shown favourable health outcomes and reduced displacement of the population serve[3–5] and could also improve accessibility to outpatient care, although there are no results to demonstrate its safety in this particular group of high-risk patients.

The hypothesis of our study was that the inclusion of an e-consultation in the outpatient care process of elderly patients referred to a CD improves accessibility to healthcare, as well as health outcomes such as hospitalization and mortality. This study aimed to assess the accessibility and health outcomes (CV hospitalization and mortality) in elderly patients referred to a CD from primary care after the inclusion of an e-consultation in outpatient care.

Methods

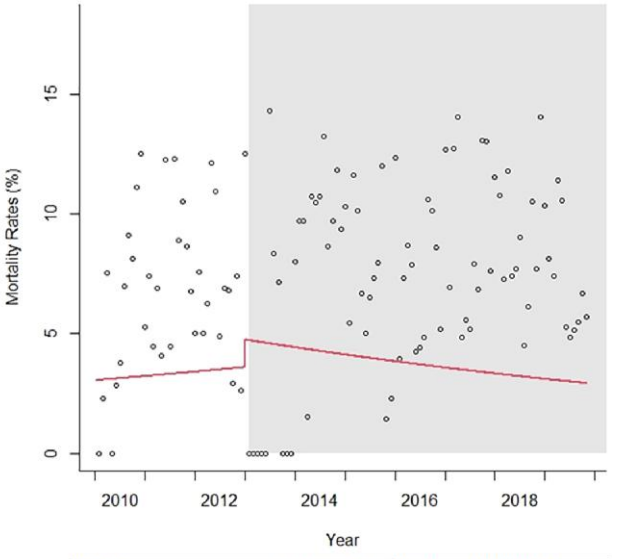
Patients

The Santiago de Compostela Healthcare Area provides healthcare coverage to 446 603 citizens, 38 332 (8.5%) of whom are over 80 years



Predictor	Coefficient	SE	P-value	RR [95%CI]
Intercept	-2.846	0.200	<0.01	
Time (months)	0.009	0.009	0.339	1.009 [0.991, 1.027]
e-consultation	0.301	0.275	0.275	1.351 [0.787, 2.317]
Interaction time × e-consultation	-0.008	0.009	0.382	0.992 [0.974, 1.010]

SE, standard error; RR (95% CI), relative risk (95% confidence interval)



Predictor	Coefficient	SE	P-value	RR [95%CI]
Intercept	-3.491	0.282	0.000	
Time (months)	0.005	0.013	0.721	1.005 [0.980, 1.030]
e-consultation	0.655	0.394	0.096	1.925 [0.889, 4.168]
Interaction time × e-consultation	-0.011	0.013	0.428	0.990 [0.964, 1.016]

SE, standard error; RR (95% CI), relative risk (95% confidence interval)

Figure 1 Analysis of the interrupted temporal trend of cardiovascular hospital admissions in the first year after consultation and summary of estimated linear effects of the ITS model for hospital admissions (left). Analysis of the interrupted temporal trend of cardiovascular mortality in the first year after consultation and summary of estimated linear effects of the ITS model for mortality (right).

of age.[11] This population is characterized by its high geographical dispersion as only 41.1% live less than 15 km from their referral hospital. The healthcare area is endowed with 301 GPs who conduct their healthcare activities in 46 municipalities for the entire population over the age of 14 years. The present study includes 9963 patients who were referred by their GP for at least one consultation with the CD between 2009 and 2019 (*Figure 1*).

We proposed a quality-of-care study. This was an observational and retrospective analysis of the information registered in the Management Control Unit of our Health Area. The information was obtained anonymously and did not pose any risk to the patients; given the impossibility of collecting informed consent, given the number[3,4] of patients and the length of time, the requirements for not requesting them were met. The study was approved by the IRB of Santiago de Compostela University Hospital.

This study was developed according to the relevant guidelines and regulations, and it was approved by the local ethics committee on 23 March 2022, with this 2021/496 reference approved report.

Consultation models

Supplementary material online, *Figure S1* summarizes the patient ambulatory care pathway used in our CD for demands of care from GPs. All requests for cardiology consultations include cause for referral and a recent EKG and laboratory blood examination (hemogram and biochemical determinations).[3,4]

Since the beginning of 2013, an e-consultation was provided as the first step of ambulatory care for all GP referrals to the CD. Their e-consultation is included in the reimbursement for GPs and cardiologists without a specific complement in their salary. The cause for the demand of cardiology care and the results of the complementary exams (EKG and blood examination) were included in the patient's medical records and analysed by a cardiologist within 72 h of primary care referral. In the case the GP considers the patient is in an unstable clinical condition, they may refer the patient to a hospital's emergency department. According to a proposal from a GPs and cardiologists working group, our e-consultation programme was approved by our healthcare area general manager.

We identified the proportion of patients whose care demands were met without a traditional in-person consultation. For these patients, the cardiologist's report was still included in their medical records, which was explained to the patient by the GP.[3,4] For the remaining patients, in whom a further in-person consultation was required, we identified those whose clinical problems were solved with a one-time patient visit and those who needed subsequent care and were scheduled for follow-up visits; in both situations, the GP provided the patient with an appointment at the CD.[3,4]

Variables

Once the list of patients was obtained, the following variables were recorded: sex, age at the date of first e-consultation, the date of e-consultation, diagnoses related to cardiovascular risk factors and cardiovascular disease (CVD), the date of cardiology consultation, number of subsequent consultations, if a face-to-face consultation was conducted after the e-consultation, healthcare centre from which the

e-consultation was made, hospital admissions during the first year after the first consultation or e-consultation in the CD, and in any department in our healthcare area for CV causes as the main diagnosis, and CV deaths during the first year after consultation in the CD.[3,4]

In our healthcare area, the CD provides care for the Santiago de Compostela University Hospital Complex located in the city of Santiago de Compostela and for a regional hospital located in the town of Ribeira.

Besides the descriptive analysis discussed above, an analysis was conducted on the variations after e-consultations were implemented, which included: waiting time for assistance from the time of CD consultation and hospital admissions in the first year after consultation. Regarding the changes after the implementation of e-consultation, we analysed the following: the total number and referral rate (population-adjusted referred rate) in both periods (in-person consultation and e-consultation), the accessibility was measured as (i) average and variability in delay time from GP referral to the cardiology consultation, both globally and spatial-temporal adjusting by age and municipality; (ii) the population-adjusted consultation rates (per 1000 inhabitants).[3,4]

Statistical analysis

The study results are expressed as absolute frequencies (%) for qualitative variables and as mean ± standard deviation or median (25th percentile, 75th percentile) in the case of quantitative variables. The χ^2 test was used to assess significant associations between qualitative variables, and Student's *t*-tests or analysis of variance were used to investigate the association between quantitative and qualitative variables after checking the assumptions of a normal distribution. Statistical significance was set at $P < 0.05$.

To investigate the effect of the e-consultation programme on (i) delay time in care, (ii) CV hospital admissions, and (iii) CV mortality 1-year after cardiology consultation, an ITS regression approach was performed.[12] Time elapsed from the beginning of the study (months), type of consultation (0, in-person consultation; 1, e-consultation), and interaction time × type of consultation were entered as predictors. Overdispersion was considered and controlled.

To investigate spatial trends in the CD, a spatial analysis was conducted using a structured additive regression (STAR) model.[13] STAR models Cubic P-splines[14] were used with 20 knots equidistant and a second-order random walk prior. For the correlated spatial effects, we assumed a generalization of the first random walk called the Markov random field.[13] Inference for STAR models was performed using Markov chain Monte Carlo simulation techniques. Statistical analyses were conducted using R version 3.5.1, and open-source BayesX software.

Role of the funding source

The authors did not receive any funding for the development of this study in the design; in the collection, analysis, and interpretation of data; in the writing of the report; and in the decision to submit the paper for publication.

Results

Overview of the sample

We analysed 9963 consultation demands from GPs between 2010 and 2019 regarding patients older than 80 years. Supplementary material online, *Figure S1* summarizes the number of patients in the ambulatory care pathway during this period. Of these patients, 33.4% were from the in-person one-time consultation model and 64.6% were from the e-consultation model. Among patients who attended the in-person one-time consultation model, 42.9% were included in the follow-up cardiology programme with subsequent in-person visits. Among those who attended the e-consultation model, 18.9% were solved without an in-person consultation.

Table 1 shows the epidemiological characteristics, personal history, and healthcare data of the patients in the total sample and both periods (in-person consultation and e-consultation).

More than half of the participants were women, with a mean age of 84.4 ± 3.6 years. The most frequent personal histories included arterial hypertension (74.9%), chronic ischaemic heart disease (44.5%), atrial fibrillation (35.3%), and diabetes mellitus (24.7%).

Changes after e-consultation implementation

The population-adjusted consultation rates (per 1000 inhabitants) were higher in the e-consultation period (25.5 ± 11.1) than in the single-act period (12.8 ± 4.3; $P < 0.001$). The introduction of e-consultation in the outpatient management model is associated with an increased demand for care and improved accessibility to healthcare services for all patients, especially those furthest from the referral hospital.

Delay from GP referral to cardiology consultation

Supplementary material online, *Figure S2* summarizes the delay from GP referral to cardiology consultation. During the cardiology in-person consultation period, we observed a progressive reduction in delay [−0.955 days per month, 95% CI (−0.943, −0.966), $P < 0.001$], which was additionally reduced with e-consultation [−0.094 days; 95% CI (−0.063, −0.140), $P < 0.001$].

Supplementary material online, *Figure S2* shows the temporal trend in time delay. In the in-person consultation period, this delay was reduced to very low times. After the e-consultation period, this delay was similar and stable over the years.

Supplementary material online, *Figure S3* shows the effect of age on delay in both periods. During the in-person consultation period, the variability on the delay time of the referrals was higher, whereas, during the e-consultation period, this age-dependent delay was not observed, and all the referrals had the same delay.

The delay time is not uniformly distributed over the healthcare area (see Supplementary material online, *Figure S4*). In general, higher delay times were recorded in the area of Ribeira, where the regional hospital is located. As shown in Supplementary material online, *Figure S4*, this difference is lower in the e-consultation period than in the in-person consultation period and the delay is similar in Ribeira than in the other areas.

Hospital admissions at 1-year after consultation

Throughout the first year after consultation with the CD, 827 patients, (8.3%) presented a total of 1015 hospital admissions for CV causes. The median time from CD consultation to first admission was 87 days (34 208); 83 (34 209) days in the cardiology in-person consultation period and 95 (36 199) days after e-consultation implementation.

Table 2 shows the clinical–epidemiological characteristics and care activities of patients who presented with some form of CV admission in the first year in comparison to the rest of the sample. Patients with admissions were of similar age (84.3 ± 3.5 vs. 84.4 ± 3.5 years, $P = 0.176$) and had a higher prevalence of all chronic CVD analysed at the time of consultation ($P < 0.001$). Both types of patients had a similar time delay until in-person consultation in the CD and a similar number of follow-up visits. Death incidence was higher in patients admitted for CV reasons [odds ratio (OR) = 1.38; $P < 0.001$]. Heart failure (49.2%) and ischaemic heart disease (16.8%) were the two most frequent causes of hospital admissions.

Table 1 Epidemiological characteristics, personal history, and healthcare data of patients in the sample in each programme (in-person consultation and e-consultation)

	Total	In-person consultation	e-consultation	*P*-value
N	9963	3530	6433	—
Women (%)	57.3	56.9	57.6	0.474
Age (years)	84.4 ± 3.6	84.1 ± 3.5	84.5 ± 3.6	0.212
Personal history				
Arterial hypertension (%)	74.9	65.4	80.2	<0.001
Diabetes mellitus (%)	24.7	22.0	26.2	<0.001
Ischaemic heart disease (%)	44.5	46.2	43.5	0.009
Atrial fibrillation (%)	35.3	29.7	38.3	<0.001
Heart failure (%)	22.6	22.5	22.7	0.765
Cerebral vascular disease (%)	8.9	10.2	8.19	0.746
Peripheral arterial disease (%)	5.6	5.2	5.9	0.161
Healthcare assistance				
Delay in face-to-face consultation (days)[a]	26.2 ± 51.2	56.6 ± 76.3	9.6 ± 9.2	<0.001
Number of cardiology tests[a]	1.5 ± 2.3	1.1 ± 1.8	1.7 ± 2.6	<0.001
Emergencies first year[a]	2.8 ± 2.8	2.8 ± 2.6	2.8 ± 2.9	0.611
CV hospital admission first year (%)	8.3	8.3	8.3	0.990
CV death first year (%)	3.5	3.5	3.4	0.471
Causes of death				
Cancer (%)	15.1	15.3	14.8	0.545
Ischaemic heart disease (%)	8.6	9.0	7.9	0.061
Heart failure (%)	11.2	11.2	11.2	0.99
Ischaemic stroke (%)	5.7	6.6	4.2	<0.001
Valvular heart disease (%)	4.9	4.6	5.4	0.010
COPD (%)	4.3	4.6	3.8	<0.001
Respiratory infection (%)	3.4	2.9	4.2	<0.001
Haemorrhagic stroke (%)	1.7	1.6	1.8	0.062

CV, cardiovascular; COPD, chronic obstructive pulmonary disease.
[a]Data are expressed as means (SD).

Table 2 Comparison of the clinical–epidemiological characteristics and the care activity for patients admitted to the hospital in the first year after e-consultation and those with no hospital admission

Total	Hospital admission	No hospital admission	*P*-value
N	4978	4985	—
Women	54.6	60.0	<0.001
Age (years)[a]	84.3 (3.5)	84.4 (3.5)	0.176
Personal history			
Ischemic heart disease (%)	19.3	14.2	<0.001
Atrial fibrillation (%)	37.4	33.1	<0.001
Heart failure (%)	28.2	17.0	<0.001
Cerebrovascular disease (%)	1.0	0.6	0.012
Pulmonary embolism (%)	1.3	1.1	0.640
Arterial hypertension (%)	73.2	76.7	<0.001
Diabetes mellitus (%)	26.0	23.3	0.002
Healthcare assistance			
Consultation delay (days)[b]	10 (5, 25)	9 (5, 20)	—
Consultations after the first cardiology visit[b]	1 (0.4)	1 (0, 3)	—
Death in the first year (%)	4.5	1.9	<0.001

[a]Data are expressed as means (SD) or
[b]Data are expressed as median (25th percentile, 75th percentile).

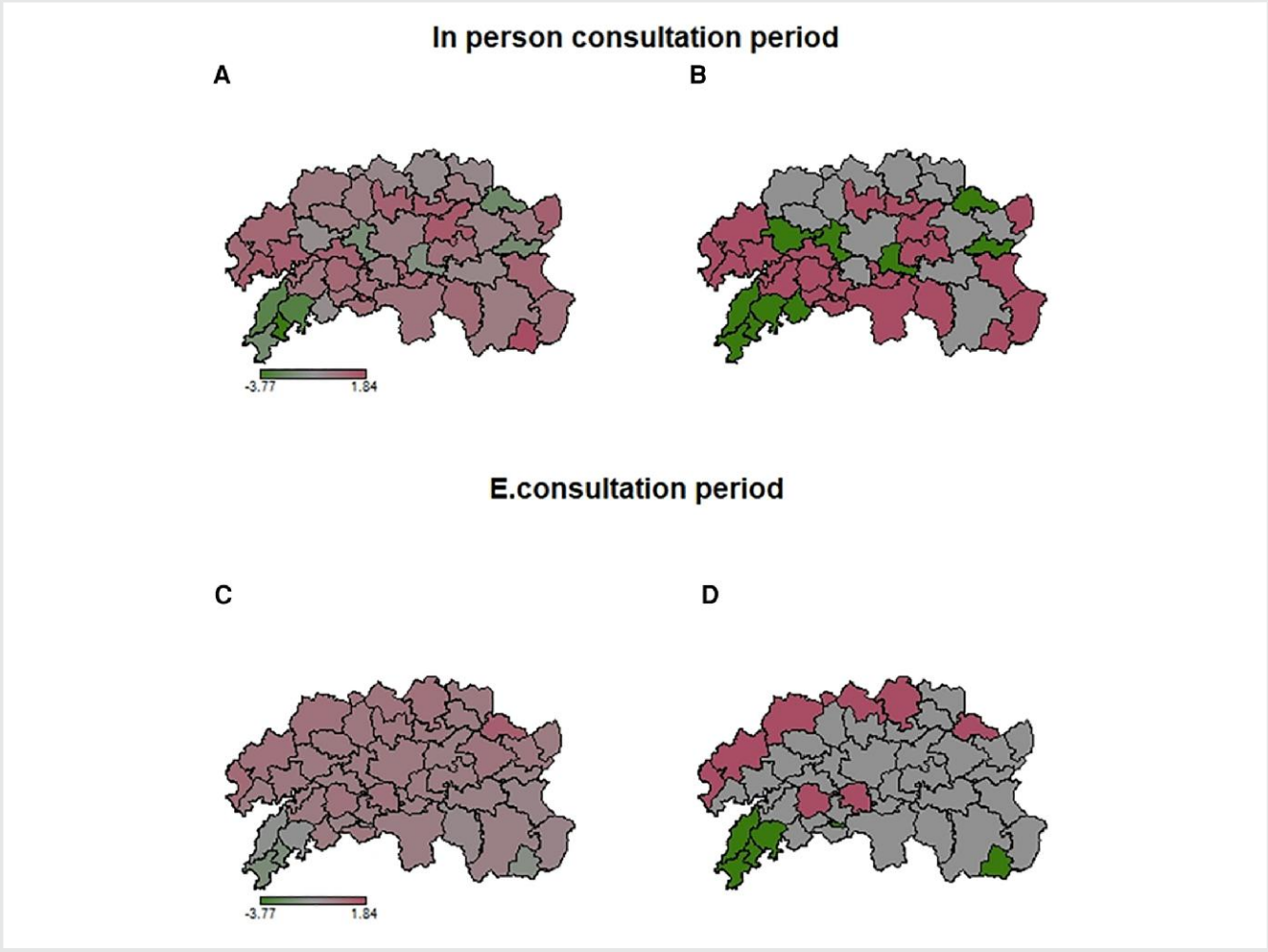


Figure 2 Estimated spatial effects of the cardiovascular hospital admission rate (panels *A* and *B*) and pointwise 95% significance map (panels c and d) for the in-person consultation and e-consultation periods. In the right panels (*B*) and (*D*), it is showed the districts with strictly negative and positive credible intervals in contrast with the districts without changes in both periods.

The ITS analysis showed that the number of CV hospital admissions during the cardiology in-person consultation period increased by ~0.9% per month (incidence rate ratio [iRR]: 1.009 [95% CI, 0.991, 1.027], $P = 0.339$). After the implementation of e-consultation, this upward trend was stabilized with a constant trend [iRR: 1.351 (95% CI, 0.787, 2.317), $P = 0.874$] (*Figure 1*, left).

The results of the spatial models are summarized in *Figure 2*. We can see that spatial differences between CV hospital admission rates were stabilized uniformly in most municipalities after the e-consultation implementation.

Mortality at 1-year after consultation

The CV mortality at 1-year after cardiologist consultation was slightly lower in the e-consultation period (3.4% vs. 3.5%), but without statistical significance, $P = 0.471$. Cancer was the most frequent cause of death (15.1%) without differences in both groups ($P = 0.545$), and heart failure death was the first CV cause of death (11.2%), also without differences ($P = 0.999$). It was observed that differences in the CV causes of death only for ischaemic stroke are more frequent in the in-person consultation period, and for valvular heart disease, more frequent in the e-consultation period; *Table 1*.

The ITS analysis showed that the CV mortality rate during the cardiology in-person consultation period was very constant without changes [iRR: 1.005 (95% CI: 0.980, 1.030), $P = 0.721$]. After the implementation of e-consultation, this trend is similar [iRR: 1.925 (95% CI: 0.889, 4.168), $P = 0.096$] (*Figure 1*, right).

The results on the CV mortality rate of the spatial models are summarized in *Figure 3*. We can see that the mortality was higher in places near to Santiago de Compostela during the in-person consultation period, whereas after the implementation of e-consultations, the mortality rate was stabilized uniformly in most models.

Discussion

Our findings suggest that the introduction of e-consultation in the cardiology outpatient management model of patients older than 80 years of age is associated with an increased demand for care and improved accessibility to healthcare services for all patients, especially those furthest from the referral hospital in a large cohort of patients.

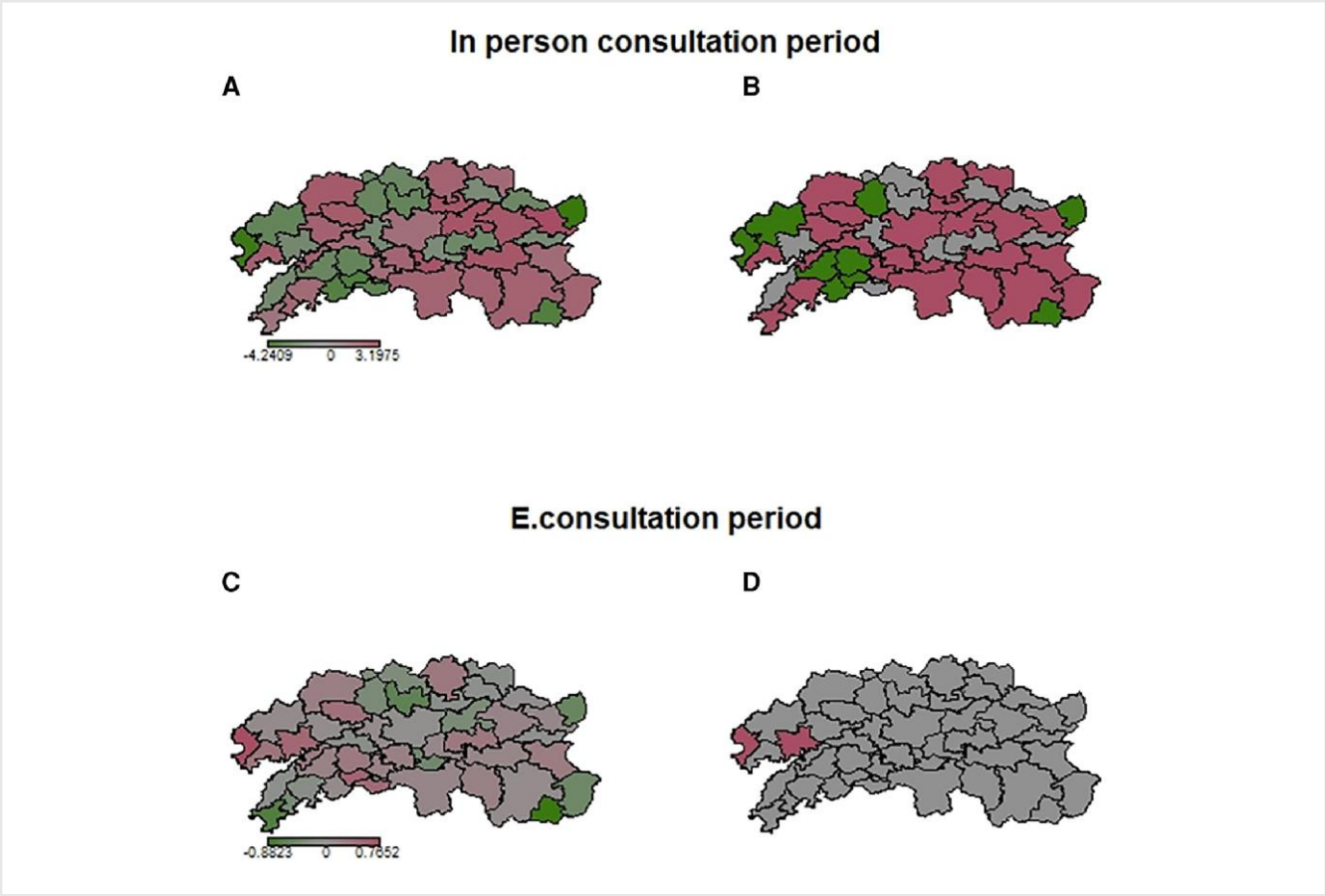


Figure 3 Estimated spatial effects of the cardiovascular mortality rate (panels *A* and *B*) and pointwise 95% significance map (panels c and d) for the in-person consultation and e-consultation periods. In the right panels (*B*) and (*D*), it is showed the districts with strictly negative and positive credible intervals in contrast with the districts without changes in both periods.

Furthermore, it was found to be safe since the need for CV hospital admissions and mortality was stabilized during the e-consultation period.

To our knowledge, this is the first study describing the results of an e-consultation project in elderly patients referred for cardiology care from GPs. We think that our experience with a highly vulnerable group of patients and managing the demand for care through an integrated electronic medical record throughout all healthcare levels, can improve the accessibility to cardiology care of this group of patients with more complex clinical conditions characterized by the high prevalence of comorbidities, more advanced CV pathologies, and limitations for accessing healthcare services. We observed that the hospitalized patients had significantly more CV diseases such as AF, HF, cerebrovascular disease, etc (*Table 2*). These findings are expected since the more comorbid patients had the highest risk of worst outcomes, in this case, increased risk of hospital admissions. Moreover, our model of elderly outpatient management may be of interest to the care organization in other health areas, particularly those with high geographical dispersion, and groups of patients with difficulties in healthcare accessibility. This may be a good strategy to expedite care delivery and of particular interest after the healthcare restrictions, such as in the setting of the coronavirus disease pandemic.

Our observations suggest that implementing telematics consultation systems for health professionals (physicians and nurses) would be a good strategy for improving patient accessibility and quality of care, particularly for frail and older patients,[15,16] and this may be of particular interest for the care of elderly patients with limitations in the access and use of digital technologies.[17] In contrast, these systems improve accessibility and equity for patients who live further away from the referral hospital centres and in rural regions, avoiding unnecessary travel for patients and those accompanying, and enhancing the relationship between levels of care without affecting the quality of care, as we describe in our data analysis.

Primary care physicians are typically responsible for the prevention, diagnosis, management, and treatment of a wide array of clinical conditions. Basu et al. recently reported an association of GPs supply with population mortality in the United States from 2005 to 2015. The largest decrease in cause-specific mortality associated with an increased density of GPs was for CVD, cancer, and respiratory tract disease conditions with strong evidence of amenability to primary care management or with delayed mortality conditional on early screening through primary care.[18] The improvement in the communication between GPs and cardiologists through e-consultation programmes included in electronic medical records may also influence GPs clinical skills for better diagnosis, risk stratification, treatment, and patient follow-up.

Little is known about the impact of cardiology e-consultation programmes on patient care accessibility, demand for care, patient and health providers' satisfaction, costs, and most importantly, the safety of the patients. In a systematic bibliographic review, we observed a very limited number of publications with a small cohort of highly selected patients describing the findings of e-consultation programmes. The results were focused on healthcare accessibility, satisfaction, and patient characteristics without information on the prognostic impact

of this healthcare modality.[19] McAdams et al. from the Veterans Health Administration in the US department report the initial experience with the implementation of an e-consult system for GPs and medical subspecialties in a large healthcare system. GPs were generally satisfied with the e-consult system and reported that the system yielded tangible benefits to patients, such as quicker specialty input and avoidance of face-to-face visits and travel; however, specialists were somewhat less satisfied than their GPs colleagues.[20] Wasfy et al. from the Massachusetts General Hospital describe the results of an e-consult programme; only 10% of the referrals to the cardiologist were e-consultations, which was associated with a reduction in traditional referrals to cardiologists. In addition, the e-consult patients were younger than the traditional consult patients and 75.6% of patients did not have any type of traditional cardiology visit during the follow-up period.[21]

To date, the impact of an e-consultation programme on elderly patients has not been described. Our results extend previous findings with our e-consultation system in a highly prevalent group of patients older than 80 years of age describing the improvement in healthcare accessibility and safety in this particular high-risk patient group, since the need for CV hospital admissions and mortality was stabilized during the e-consultation period. The reduction in the time elapsed to care after e-consultation implementation was associated with a longer time from cardiology consultation to the first hospital admission.

Weakness and strength of our study

We recognize that our study design, based on a large retrospective cohort of elderly patients, does not allow for a clear direct-causality effect to be established, as other factors may have also influenced our findings. Regarding information bias, our data is retrospective and, although we are aware of all the deaths that happened during the follow-up period, in many cases, it is not possible to know the exact cause of death and this could have nuanced some of our findings. Besides, we have no data on any visits that some patients may have paid to private healthcare providers, which could also influence our results. Anyhow, we think these limitations are not enough to dismiss our experience with a large cohort of elderly patients referred by the GPs for cardiology consultation, on whom we have relatable demographic, clinical, and prognostic information, all of it included in an integrated electronic health record. These characteristics make our data relevant both clinically and for healthcare management purposes in this particularly high-risk patient group.

ITS regression analyses are one of the strongest evaluative designs when randomization is not possible; furthermore, they often allow a more detailed assessment of the longitudinal impact of an intervention than may be possible with an RCT and, given that they are frequently undertaken in real-world settings, may have stronger external validity. Nevertheless, there are some threats to the validity of ITS analyses, perhaps the most important of which include the potential for the erroneous conclusion of intervention effectiveness due to data-driven model specification, and lack of control for time-varying confounders. With carefully planned analyses and handling of potential threats to validity, ITS can provide valuable evidence about the effectiveness of health interventions; in our study was the implementation of e-consultation as a first step for ambulatory cardiology care for all the GPs referrals.

The focus of our study on one specialty in the public health system of one western European region may limit the results' applicability to other healthcare specialties and healthcare systems.

Based on our findings, we can conclude that the implementation of an outpatient care programme in a CD that includes e-consultation in a large cohort of elderly patients was associated with improved access to cardiology healthcare for all patients, but mainly for those furthest from the referral hospital. After the implementation of e-consultation, the upward trend in hospital admissions for CV causes and mortality at one year during the in-person consultation period stabilized with a slight non-significant downward trend.

Author contributions

P.M.-R., M.P.-R., and S.C.-S. conceived the study, its design, performed part of the literature review, and helped to draft the manuscript; D.G.-V. and J.C.S.-P. performed part of the literature review and helped to draft the manuscript; D.R.-A. and J.R.G.-J. conceived the study, its design, performed part of the literature review, and coordinated to draft the manuscript; A.M.M. performed part of the literature review and helped to draft the manuscript; J.E.-D. and F.G.-S. analysed the data and helped to draft the manuscript.

Ethics committee approval

The study was approved by the IRB of Santiago de Compostela University Hospital.

Supplementary material

Supplementary material is available at the *European Heart Journal – Digital Health*.

Funding

The authors did not receive any funding for the development of this study.

Conflict of interest: The authors declare no conflicts of interest in relation to this article.

Data availability

The data underlying this article are available in RUNA (https://runa.sergas.gal/xmlui/handle/20.500.11940/15301) and can be accessed at https://doi.org/10.1093/ehjdh/ztad004.

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