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Gender differences on healthcare accessibility and outcomes of a electronic inter-clinician consultation program at the cardiology department in a Galician Health Area

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Abstract

Aims: To assess the longer-term results (hospital admissions and mortality) in women versus men referred to a cardiology department from primary care using an e-consultation in our outpatient care programme.

Methods: We selected 61,306 patients (30,312 women and 30,994 men) who visited the cardiology service at least once between 2010 and 2021: 69.1% (19,997 women and 20,462 men) were attended in e-consultation (from 2013 to 2021) and 30.9% (8920 women and 9136 men) in in-person consultations (from 2010 to 2012) without gender differences in the proportion of patients attended in each period. Using an interrupted time series regression model, we analysed the impact of incorporating e-consultation into the healthcare model and evaluated the elapsed time to cardiology care, heart failure (HF), cardiovascular (CV), and all-cause hospital admissions and mortality during the one-year after cardiology consultation.

Results: The introduction of e-consultation substantially decreased waiting times to cardiology care; during the in-person consultation period, the mean delay for cardiology care was 57.9 (24.8) days in men and 55.8 (22.8) days in women. During the e-consultation period, the waiting time to cardiology care was markedly reduced to 9.41 (4.02) days in men and 9.46 (4.18) in women. After e-consultation implantation, there was a significant reduction in the 1-year rate of hospital admissions and mortality, both in women and men iRR [IC 95%]: 0.95 [0.93–0.96] for HF, 0.90 [0.89–0.91] for CV and 0.70 [0.69–0.71] for all-cause hospitalization; and 0.93 [0.92–0.95] for HF, 0.86 [0.86–0.87] for CV and 0.88 [0.87–0.89] for all-cause mortality in women; and 0.91 [0.89–0.92] for HF, 0.90 [0.89–0.91] for CV and 0.72 [0.71–0.73] for all-cause hospitalization; and 0.96 [0.93–0.97] for HF,

0.87 [95% CI: 0.86–0.87] for CV and 0.87 [0.86–0.87] for all-cause mortality, in men.

Conclusion: Compared with the in-person consultation period, an outpatient care programme that includes an e-consultation significantly reduced waiting time to cardiology care and was safe, with a lower rate of hospital admissions and mortality in the first year, without significative gender differences.

KEYWORDS

cardiovascular outcomes, inter-clinician electronic consultation, women

1 | INTRODUCTION

The different online healthcare models present an opportunity to improve accessibility and efficiency in clinical assistance.[1–3] However, analyses of the effects of outpatient care on healthcare quality, including safety, are very limited, particularly in highly vulnerable populations such as women with suspected or confirmed cardiovascular disease (CVD). Clinician-to-clinician electronic consultation programmes (e-Consult) are emerging healthcare innovations developed to address excessive waiting times for specialist care by enabling primary care physicians (PCPs) to obtain a specialist consultant's expert opinion in a timely manner. E-consultation is characterized by three main features: (a) asynchronous communication between two healthcare professionals; (b) performance of both the consultation and the response in a secure electronic system and their documentation in the patients' official medical records; and (c) the management of a specific clinical problem in the entire medical act.[1,4]

The care of women with suspected or confirmed CVD represents a health challenge. Although age-adjusted mortality for CVD has continuously decreased over the past for decades, it has declined to a lesser extent in women than in men.[5]

Due to the misconception that women are more 'protected' against CVD than men, the risk of CVD in women is often underestimated.[6] Particularly, oestrogen deprivation at menopause has a cluster of adverse effects on cardiovascular structure, function and metabolism, including alterations in body fat volume and distribution, endothelial dysfunction, vascular inflammation, sympathetic tone and a higher insulin resistance, contributing to hypertension and lipid metabolism alterations.[7]

Pathophysiologically, women are more prone to microvascular affectation than men,[8] and have some risk factors that have been identified as increasing the risk of CVD in women, including preterm delivery, pre-eclampsia, gestational diabetes and polycystic ovary syndrome. However, these factors are not included in primary prevention risk stratification tools.[9] There is ongoing debate regarding whether there are still inequities in diagnosis and disease management,[10,11] leading to gender disparities in outcomes among female patients with suspected or confirmed CVD.[12] Women attending primary healthcare services in Australia were less likely than men to have risk factors measured and recorded, which may impact their outcomes.[13]

We have recently published that the inclusion of an e-consultation via our integrated electronic health record at the start of outpatient assistance can reduce delay times for care, visits to the emergency service, hospital admissions and mortality rates.[4,14] In addition, it helps to reduce the direct and indirect costs for the patient and the healthcare system.[15]

The hypothesis of our study was that the inclusion of an e-consultation as the first step in the outpatient care process of female 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 gender differences on the accessibility and health outcomes (total, CV and heart failure—HF-hospitalization and mortality) in female patients compared with men referred to a CD from primary care after inclusion of an e-consultation in outpatient care.

2 | METHODOLOGY

Data availability: the data underlying this article are available in RUNA (https://runa.sergas.gal/) and can be accessed at https://dx.doi.org/10.1111/eci.14012

2.1 | Patients

The Cardiology Department (CD) provides care for a population of 446,603 individuals who are attended by 301

primary care physicians (PCP) who refer their patients to the CD for specialized care. In the present analysis of our database, we included 61,306 patients (30,994 men and 30,312 women) who were referred to the CD between 2010 and 2020.

This study was approved by the local ethics committee on 23 March 2022, under reference number 2021/496.

2.2 | Consultation models

We analysed two distinct periods. During the first period, from 2010 to 2012, the outpatient programme followed a tradition model that included a single-act in-person consultation as the first step for all PCP referrals. Since 2013 to the present day, we have added an e-consult as the initial step, which allows us to triage referrals and determine whether an in-person consultation is necessary.[4] After the in-person consultation in both models, some patients require follow-up in a special consultation for valvopathies, heart failure, congenital heart disease and other complex conditions.

The e-consult takes place via our integrated electronic health record, which contains all patient information from primary care and hospitals across the Spanish region of Galicia. The e-consult must include all clinically relevant information, and a cardiologist reviews it a few days later along with any additional tests performed in primary care (e.g., electrocardiograms, chest x-rays, blood tests) and previous relevant information about the patient's disease history (e.g., prior hospitalizations for heart failure and their timing). Based on all this information, the cardiologist determines the most appropriate type of consultation for each patient.

2.3 | Variables

We collected the following information for all patients: sex, age at the time of first e-consultation, date of the e-consultation, any cardiovascular risk factor diagnoses, history of previous CVD, date of cardiology consultation, number of follow-up consultations, and whether a face-to-face consultation was conducted after the e-consultation. We also assessed emergency department visits, hospital admissions, the main diagnosis for each visit, and deaths during the first year after the first consultation or e-consultation in the CD.[4,14]

In addition to the descriptive analysis mentioned above, we conducted a temporal trend analysis of waiting times for CD consultation and emergency department assistance, hospital admissions and mortality during the first year after consultation.

2.4 | Statistical analysis

Qualitative variables were reported as percentages (%) and continuous quantitative variables were presented as mean ± standard deviation (SD). The chi-square test was used to assess significant associations between qualitative variables, and Student's *t*-test was used to investigate the association between quantitative variables after confirming normal distribution assumption in both genders. Statistical significance was set at $p < 0.05$.

To investigate the impact of the e-consultation programme on delay time in care, hospital admissions and mortality in both genders, an interrupted time series (ITS) regression analysis was conducted.[16] The predictors entered in the model were time elapsed from the beginning of the study (months), type of consultation (0, in-person consultation; 1, e-consultation), and the interaction between time and type of consultation. Overdispersion was considered and controlled, and we estimated the incidence relative risk (iRR) with a 95% confidence interval for each outcome in three periods.

For each gender, a multivariate logistic regression was performed for each outcome. The variables included in the model were those that could influence prognosis, such as personal characteristics (age, gender), comorbidities (arterial hypertension, diabetes mellitus, ischemic heart disease, heart failure, cerebrovascular disease and peripheral arterial disease) and features related to disease management (delay time until cardiologist evaluation, consultation model and number of visits to the emergency department during the first year after the e-consultation).

Data analysis was performed using SPSS version 25.0 (SPSS Inc., United States), and ITS analyses were conducted using R version 3·5·1, and open-source BayesX software.

3 | RESULTS

3.1 | Overview of the baseline clinical characteristics, comorbidities and outcomes in both genders

A total of 61.306 referrals from 2010 to 2020 were included, with 30,994 men (50.5%) and 30,312 women. Women were older than men ($p < 0.001$). Table 1 presents the baseline epidemiological characteristics, comorbidities and healthcare data in women and men.

Compared to women, men were younger ($p < 0.001$) and had a higher prevalence of hypertension ($p < 0.001$), ischemic heart disease ($p < 0.001$), cerebrovascular disease ($p < 0.001$) and peripheral arterial disease ($p < 0.001$). Men also had a higher history of previous cardiovascular hospitalizations ($p < 0.001$), while the prevalence of heart

TABLE 1 Epidemiological characteristics, comorbidities and healthcare data at 1 year after consultation in both genders.

	Total	Women	Men	p
N	61,306	30,312	30,994	
Years old (mean [SD]) (years)	64.1 (18.4)	65.7 (18.2)	62.5 (18.5)	<0.001
Comorbidities				
Arterial hypertension (%)	56.5%	58.0%	55.0%	<0.001
Diabetes mellitus (%)	20.0%	17.6%	22.3%	<0.001
Ischaemic heart disease (%)	12.2%	8.6%	15.9%	<0.001
Heart failure (%)	22.1%	22.2%	22.1%	0.831
Atrial fibrillation (%)	10.5%	10.5%	10.5%	0.950
Cerebrovascular disease (%)	4.1%	3.8%	4.4%	<0.001
Peripheral arterial disease (%)	3.8%	2.3%	5.2%	<0.001
Previous hospitalization by heart failure				
Without hospitalizations	60.7%	64.6%	57.0%	<0.001
Hospitalizations	39.3%	35.4%	43.0%	
Consultation model				
In-person model	30.9%	30.8%	30.9%	0.958
E-consult model	69.1%	69.2%	69.1%	
E-consult				
e-consulta solves (%)	22.9%	22.5%	23.4%	<0.001
Single-act solves (%)	49.1%	51.0%	47.2%	
Follow-up consultations (%)	28.0%	26.5%	29.5%	
Delay consultation				
Delay in face-to-face consultation (mean [SD]) (days)	22.8 (47.2)	22.3 (44.6)	23.2 (49.6)	0.024
<8 days (%)	50.0%	49.8%	50.3%	0.544
8–14 days (%)	17.2%	17.2%	17.1%	
15–30 days (%)	16.4%	16.6%	16.2%	
>30 days (%)	16.4%	16.4%	16.4%	
Cardiology assistance				
Cardiology tests first year (mean [SD])	0.91 (1.60)	0.86 (1.48)	0.96 (1.71)	<0.001
Emergency visits (mean [SD])	1.93 (4.03)	2.00 (4.24)	1.86 (3.83)	<0.001
Emergency visits (%)	47.4%	48.2%	46.5%	<0.001

Abbreviations: COPD, chronic obstructive pulmonary disease; CV, cardiovascular; HF, heart failure; SD, standard deviation.

Note: Cardiology tests and emergency visits during 1-year after cardiology consultation.

failure (HF) and atrial fibrillation was similar in both genders.

The e-consult effectively resolved clinical issues without requiring in-person consultations, with clinical notes by cardiologists in electronic medical records, with similar rates for both genders. However, men required more follow-up in-person consultations ($p < 0.001$) and more cardiology tests ($p < 0.001$). By contrast, women required more emergency service visits ($p < 0.001$) within 1 year of consultation (in-person and e-consultation).

Table 2 summarizes the hospitalization and mortality rates 1-year after consultation for both genders. Women had significantly lower rates of hospitalization than men ($p < 0.001$ for total and cardiovascular hospitalizations and $p < 0.018$ for HF hospitalizations). Total mortality was significantly higher in men ($p < 0.001$), while cardiovascular and HF deaths were similar in both genders ($p = 0.249$ and $p = 0.215$, respectively).

Cancer was the leading cause of death in both genders. We observed differences in CV mortality, with ischemic

TABLE 2 Hospital admissions, mortality and causes of mortality at 1 year after consultation in both genders.

	Total	Women	Men	*p*
N	61,306	30,312	30,994	
Hospitalizations				
All-cause hospitalizations (%)	10.8	10.0	11.6	<0.001
CV hospitalizations (%)	6.1	4.9	7.2	<0.001
HF hospitalizations (%)	0.7	0.6	0.7	0.018
Deaths				
All-cause in the (%)	3.0	2.4	3.5	<0.001
CV death in the (%)	1.2	1.2	1.3	0.249
HF death in the (%)	0.2	0.3	0.2	0.215
Causes of death				
Cancer (%)	21.5	16.4	25.7	<0.001
Ischemic heart disease (%)	8.9	6.5	10.8	
Heart failure (%)	7.7	10.0	5.9	
Ischaemic stroke (%)	5.3	7.2	3.9	
COPD (%)	3.3	1.7	4.6	
Valvular heart disease (%)	3.3	4.5	2.3	
Atrial fibrillation (%)	2.5	3.0	2.1	
Respiratory infection (%)	2.4	2.3	2.4	
Haemorrhagic stroke (%)	1.5	1.7	1.4	
Kidney failure (%)	1.2	1.2	1.3	

Abbreviations: COPD, chronic obstructive pulmonary disease; CV, cardiovascular; HF, heart failure; SD, standard deviation.

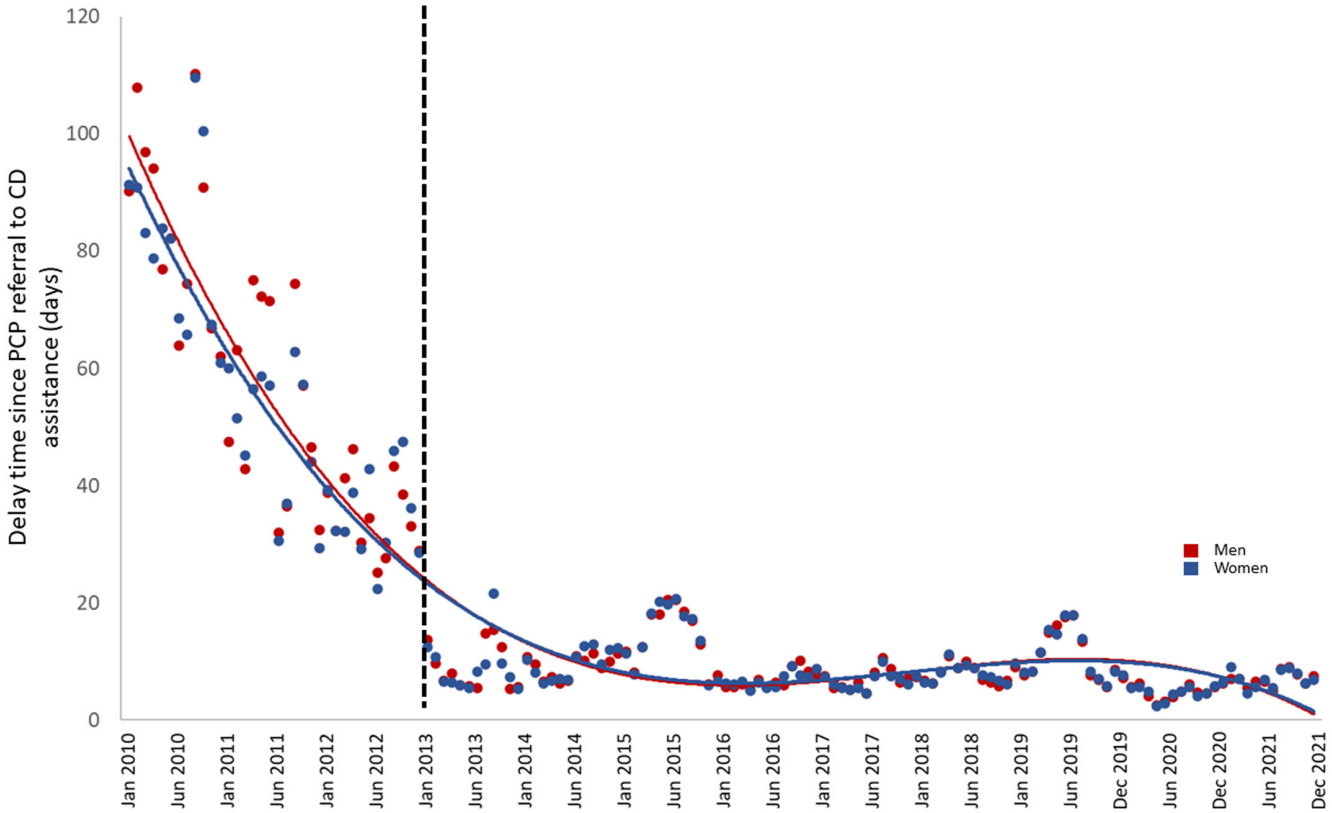

FIGURE 1 Analysis of the interrupted temporal trends of elapsed time to cardiology care in both gender.

heart disease as the main cause of death in men and HF and stroke in women.

3.2 | Results of interrupted time series regression analysis

3.2.1 | Delay from PCPs referral to cardiology consultation

The interrupted temporal trend regression analysis indicated a reduction in the delay between PCP referral and CD assistance after the implementation of the e-consult, for both genders. During the in-person consultation period, the mean delay time for cardiology consultation was 57.9 (24.8) days for men and 55.8 (22.8) days for women. However, during the e-consult period, the mean delay men was reduced to 9.41 (4.02) days and to 9.46 (4.18) days for women. In addition, there was a reduction of 0.6 (0.07) days per year in men and 0.8 (0.08) days per year in women during the e-consultation period, p = 0.008 (Figure 1).

3.2.2 | Hospital admissions at 1-year after consultation

The rate of hospital admissions at 1 year was lower for women throughout the observation period. In both genders, a downward trend was observed during the e-consultation period, reversing the increasing trend observed during the in-person period. All-cause hospital admissions increased during the in-person consultation to 2.5 (95% CI: 2.4–2.6) per 100 patients/month ($p < 0.001$) for men and 2.9 (95% CI: 2.8–2.9) per 100 patients/month ($p < 0.001$) for women. However, they were significantly reduced after the e-consultation programme to 1.8 (95% CI: 1.7–1.8) per 100 patients/month ($p < 0.001$) for men and 2.0 (95% CI: 1.9–2.0) per 100 patients/month ($p < 0.001$) for women. This represents an iRR of 0.72 [0.71–0.73] and 0.70 [0.69–0.71] for both genders, as shown in Figure 2A.

The incidence of CV hospital admissions in men during the in-person consultation was 2.6 (95% CI: 2.5–2.6) per 100 patients/month, while in women, it was 3.0 (95% CI: 2.9–3.1) per 100 patients/month. However, after the e-consultation, this incidence was significantly reduced to 2.3 (95% CI: 2.2–2.3) per 100 patients/month for men and 2.7 (95% CI: 2.6–2.7) per 100 patients/month for women, with an iRR of 0.90 [0.89–0.91] for both genders (Figure 2B). Additionally, the incidence of HF-hospitalization was lower after e-consultation than during the in-person consultation, with an iRR of 0.91 [0.89–0.92] for men and iRR of 0.95 [0.93–0.96] for women (Figure 2C).

3.2.3 | Mortality at 1-year after consultation

The 1-year mortality rates after cardiology consultation was lower in women, except for HF death, which showed a downward trend after the implementation of e-consultations, with a similar magnitude in both genders. During the in-person consultation period, all-cause mortality rates increased by 3.5 (95% CI: 3.4–3.6) per 100 patients per month in men and 3.8 (95% CI: 3.7–3.9) per 100 patients per month in women. However, there was a significant reduction after e-consultations (iRR 0.87 [0.86–0.87] in men and 0.88 [0.87–0.89] in women) (see Figure 3A). Additionally, CV-mortality rates showed a reduction after e-consultation implementation in both men (0.87 [0.86–0.87]) and women (0.86 [0.86–0.87]) (see Figure 3B), while HF-mortality rates also showed a reduction in men (0.96 [0.93–0.97]) and in women (0.93 [0.92–0.95]) (see Figure 3C).

In the multivariate analysis, the elapsed time to cardiology care was significatively associated with an independent increase in 1-year mortality and hospital admission in both genders. Furthermore, the implementation of the e-consult model was associated with a reduction in mortality and hospital admission rates (Tables 3 and 4).

4 | DISCUSSION

Our findings suggest that implementing e-consultation in the cardiology outpatient management model for a large cohort of patients (61,306 total, including 30,312 women and 30,994 men) improves accessibility to healthcare services. We observed a significant reduction in the time elapsed to care in both genders, compared to the previous face-to-face consultation period. Furthermore, we found that e-consultations were safe, as evidenced by a significant reduction in all-cause and CV hospital admissions, as well as mortality at 1-year, likely due to the reduced elapsed time to care.

To our knowledge, this is the first study to report the results of an e-consultation project in women compared with men with suspected or confirmed CVD referred for cardiology care from PCPs. Our experience managing the demand for care through an integrated electronic medical record system across all healthcare levels can improve accessibility to cardiology care for patients with a high prevalence of comorbidities, advanced cardiovascular pathologies and difficulties accessing healthcare services.[11] Our outpatient management model may be applicable to

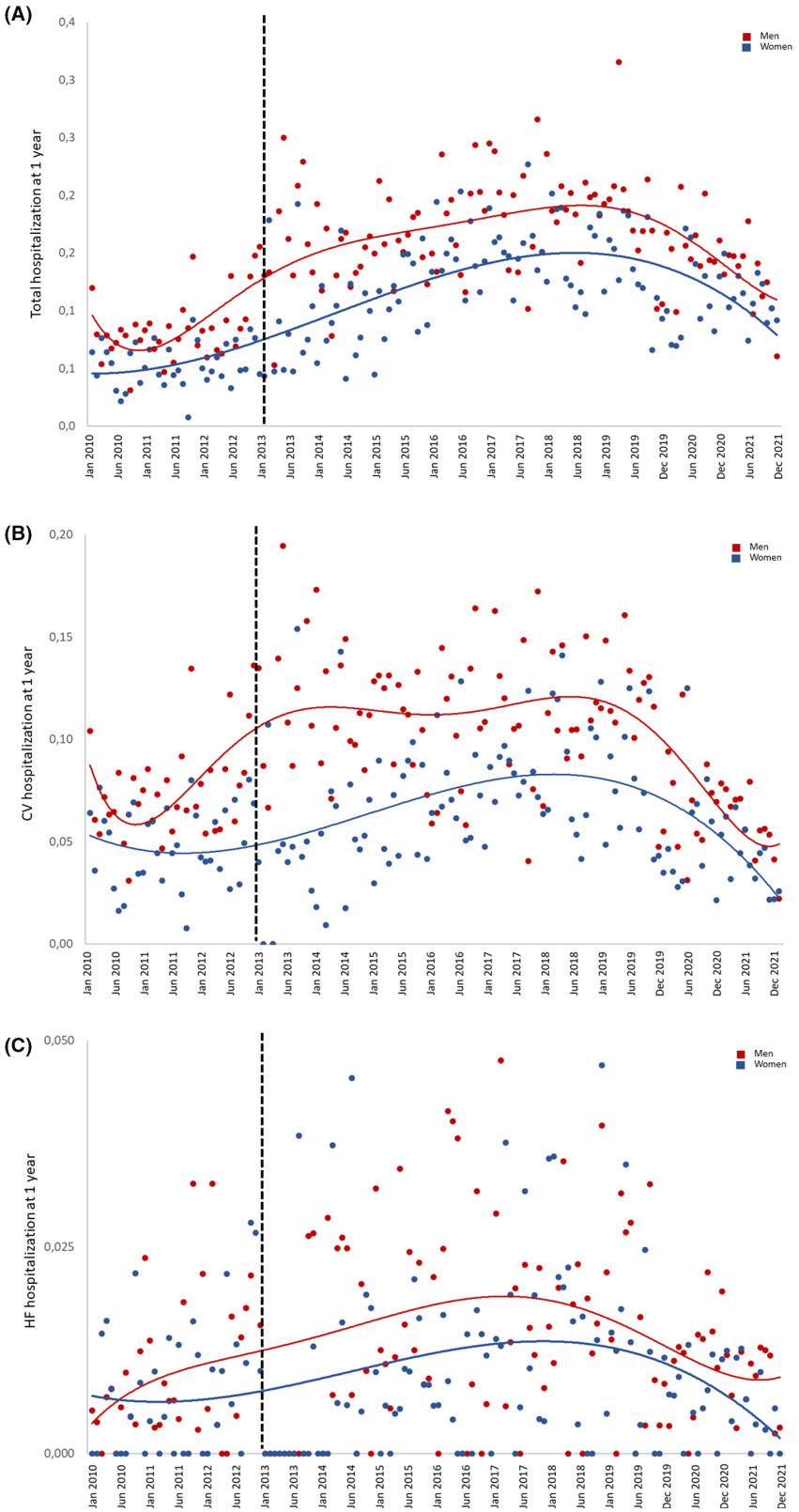

FIGURE 2 Analysis of the interrupted temporal trends of hospital admissions for all cause (A), cardiovascular disease (B) and heart failure (C) in the first year after consultation in both gender.

other health areas, particularly those with high geographical dispersion and for groups of patients with difficulties in healthcare accessibility.[14] Additionally, improved interdisciplinary and cooperative care in women's health has recently been suggested as an attractive model to target cardiovascular health inequalities between women and men linked to modifiable risk factors and social and healthcare systems determinants of health.[17–19]

Women with acute coronary syndrome and other CV pathologies continue to experience higher patient and

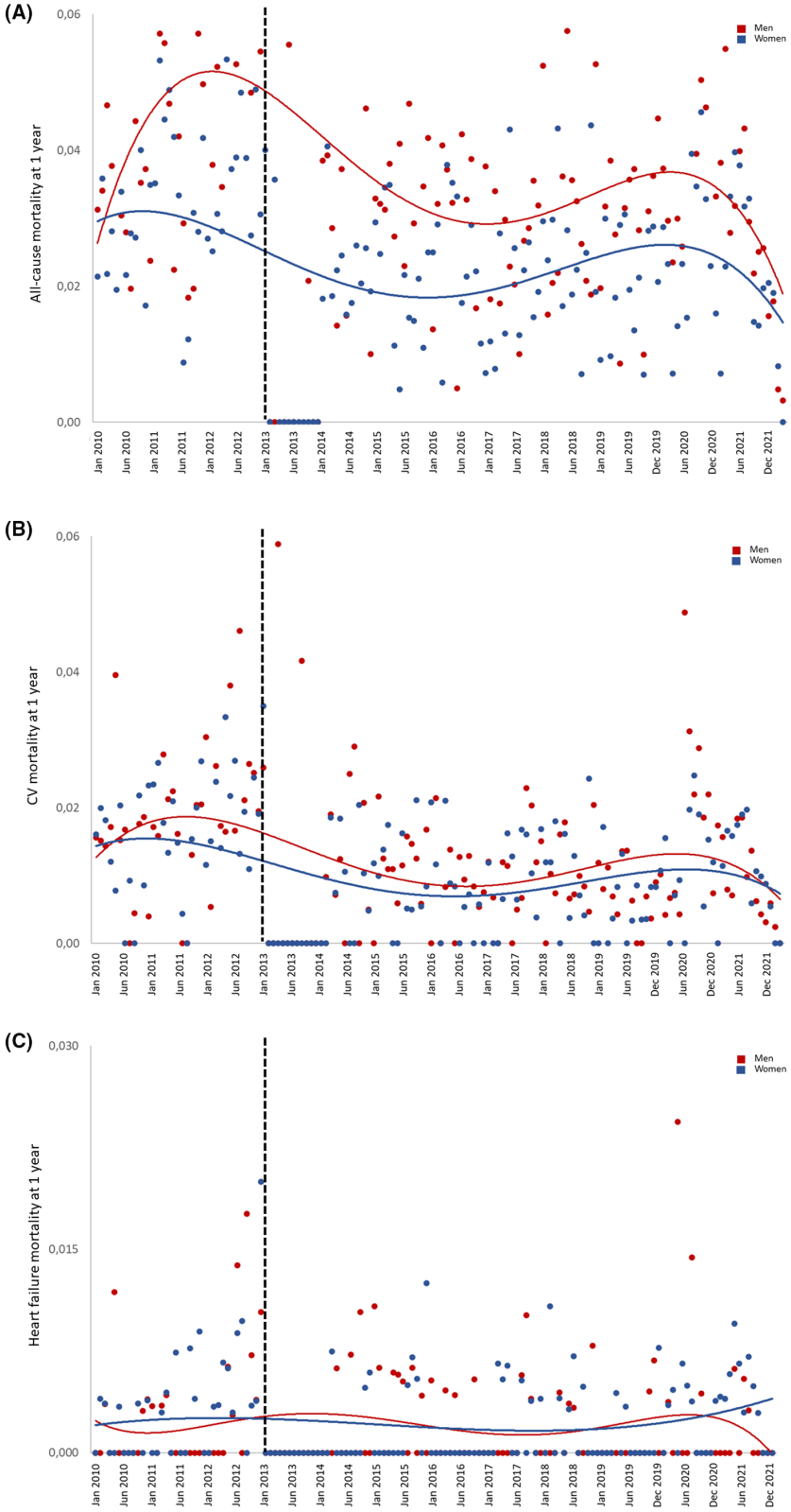

FIGURE 3 Analysis of the interrupted temporal trends of mortality for all cause (A), cardiovascular disease (B) and heart failure (C) in the first year after consultation in both gender.

system delays and receive less aggressive invasive treatment and pharmacotherapies compared with men.[20,21] Our experience with e-consultation may provide a way to achieve more efficient interdisciplinary care in women with suspected or confirmed CVD and contribute to overcoming some of the care barriers for women.[6]

The demographics and CVD profile of women referred by the PCPs for cardiology consultation (face-to-face and e-consultation) significantly differed from those of men. Women had a significantly higher mean age, a lower prevalence of a previous history of IHD, cerebrovascular disease and peripheral artery disease and a similar

TABLE 3 Multivariate analysis of factors linked to hospital admissions and death at 1 year after consultation in women.

	HF hospitalization	CV hospitalization	All-cause hospitalization	HF mortality	CV mortality	All-cause mortality
	OR (CI 95%)	OR (CI 95%)	OR (CI 95%)	OR (CI 95%)	OR (CI 95%)	OR (CI 95%)
Age	1.03 (1.01–1.04)	1.02 (1.016–1.025)	1.016 (1.013–1.019)	1.15 (1.11–1.19)	1.13 (1.11–1.15)	1.12 (1.11–1.13)
Comorbidities						
Arterial hypertension	0.69 (0.49–0.97)	0.83 (0.73–0.95)	0.91 (0.83–1.01)	0.59 (0.36–0.98)	0.70 (0.55–0.89)	0.63 (0.53–0.75)
Diabetes mellitus	1.20 (0.89–1.61)	1.16 (1.02–1.33)	1.13 (1.02–1.26)	1.18 (0.69–2.01)	1.25 (0.97–1.61)	1.27 (1.06–1.52)
Ischemic heart disease	1.08 (0.75–1.55)	2.16 (1.87–2.50)	1.58 (1.40–1.79)	1.03 (0.52–2.02)	1.27 (0.93–1.74)	1.10 (0.87–1.39)
Atrial fibrillation	1.03 (0.79–1.36)	1.04 (0.91–1.19)	1.11 (0.99–1.22)	1.03 (0.52–2.03)	0.76 (0.59–0.98)	0.81 (0.68–0.97)
Heart failure	-	2.43 (2.12–2.79)	2.05 (1.84–2.29)	3.98 (2.45–6.47)	2.55 (1.99–3.26)	1.87 (1.56–2.24)
Cerebrovascular disease	0.71 (0.40–1.25)	1.84 (1.50–1.27)	1.34 (1.11–1.60)	1.29 (0.58–2.91)	1.50 (1.02–2.22)	1.16 (0.86–1.57)
Peripheral arterial disease	1.23 (0.70–2.15)	1.19 (0.89–1.59)	1.22 (0.97–1.53)	1.72 (0.67–4.43)	1.71 (1.05–2.78)	1.15 (0.77–1.71)
Healthcare activity						
Number of visits to the emergency department (1 year)	1.05 (1.02–1.07)	1.04 (1.03–1.05)	1.06 (1.05–1.07)	0.88 (0.79–0.97)	0.83 (0.79–0.88)	0.92 (0.89–0.95)
Waiting time until the e-consultation is answered						
0–7 days (ref)	1.00	1.00	1.00	1.00	1.00	1.00
8–14 days	1.42 (1.05–1.94)	1.40 (1.23–1.59)	1.30 (1.18–1.44)	2.49 (1.47–4.25)	1.91 (1.50–2.46)	1.56 (1.31–1.86)
15–30 days	0.93 (0.57–1.51)	1.23 (1.02–1.49)	1.29 (1.11–1.49)	1.70 (0.72–4.05)	1.37 (0.93–2.02)	1.63 (1.27–2.10)
>30 days	1.07 (0.61–1.90)	1.15 (0.92–1.44)	1.23 (1.01–1.49)	0.77 (0.28–2.15)	0.79 (0.52–1.21)	0.93 (0.69–1.25)
Consultation model						
E-consult model (ref)	1.00	1.00	1.00	1.00	1.00	1.00
In-person consultation model	1.75 (1.13–2.72)	1.22 (1.03–1.45)	3.22 (2.75–3.76)	1.26 (1.14–1.47)	1.21 (1.16–1.27)	1.33 (1.26–1.41)

Abbreviations: OR, odds ratio; CI 95%, 95% confidence interval; CV, cardiovascular; HF, heart failure.

TABLE 4 Multivariate analysis of factors linked to hospital admissions and death at 1 year after consultation in men.

	HF hospitalization	CV hospitalization	All-cause hospitalization	HF mortality	CV mortality	All-cause mortality
	OR (CI 95%)	OR (CI 95%)	OR (CI 95%)	OR (CI 95%)	OR (CI 95%)	OR (CI 95%)
Age	1.00 (0.98–1.01)	1.01 (1.01–1.02)	1.02 (1.017–1.023)	1.13 (1.09–1.17)	1.10 (1.08–1.11)	1.10 (1.09–1.11)
Comorbidities						
Arterial hypertension	0.77 (0.58–1.01)	0.94 (0.85–1.04)	0.95 (0.87–1.03)	0.75 (0.43–1.29)	0.87 (0.69–1.08)	0.63 (0.55–0.72)
Diabetes mellitus	1.22 (0.87–1.42)	1.40 (1.26–1.55)	1.30 (1.20–1.42)	1.63 (0.96–2.75)	1.33 (1.07–1.66)	1.30 (1.13–1.50)
Ischemic heart disease	1.16 (0.89–1.51)	2.59 (2.34–2.87)	1.81 (1.66–1.98)	0.59 (0.29–0.96)	1.62 (1.29–2.04)	1.22 (1.04–1.42)
Atrial fibrillation	1.30 (1.03–1.65)	1.04 (0.93–1.17)	1.01 (0.93–1.11)	0.53 (0.29–0.96)	0.69 (0.54–0.89)	0.89 (0.76–1.03)
Heart failure	-	2.02 (1.79–2.28)	1.72 (1.56–1.91)	5.54 (3.25–9.43)	2.57 (2.03–3.25)	1.98 (1.70–2.31)
Cerebrovascular disease	1.14 (0.77–1.68)	1.37 (1.14–1.63)	1.34 (1.15–1.56)	2.17 (1.08–4.33)	1.14 (0.79–1.65)	0.86 (0.66–1.11)
Peripheral arterial disease	1.05 (0.71–1.55)	1.19 (1.00–1.41)	1.21 (1.05–1.39)	1.67 (0.74–3.75)	1.34 (0.94–1.92)	1.43 (1.14–1.79)
Healthcare activity						
Number of visits to the emergency department (1 year)	1.06 (1.04–1.08)	1.04 (1.03–1.05)	1.07 (1.06–1.40)	0.90 (0.82–0.99)	0.86 (0.82–0.89)	0.92 (0.90–0.95)
Waiting time until the e-consultation is answered						
0–7 days (ref)	1.00	1.00	1.00	1.00	1.00	1.00
8–14 days	1.33 (1.01–1.75)	1.45 (1.30–1.62)	1.44 (1.32–1.57)	1.67 (1.17–2.40)	2.13 (1.21–3.74)	1.72 (1.49–1.99)
15–30 days	0.97 (0.64–1.47)	1.25 (1.07–1.46)	1.30 (1.14–1.48)	1.16 (0.65–2.06)	1.53 (0.64–3.66)	1.42 (1.15–1.76)
>30 days	0.94 (0.57–1.57)	1.30 (1.08–1.57)	1.24 (1.05–1.47)	0.73 (0.35–1.55)	1.69 (0.59–4.79)	0.95 (0.75–1.22)
Consultation model						
E-consult model (ref)	1.00	1.00	1.00	1.00	1.00	1.00
In-person consultation model	2.61 (1.74–3.91)	1.07 (0.93–1.23)	2.40 (2.11–2.74)	1.27 (1.14–1.53)	1.21 (1.16–1.27)	1.31 (1.26–1.37)

Abbreviations: CI 95%, 95% confidence interval; CV, cardiovascular; HF, heart failure; OR, odds ratio.

prevalence of AF and HF. These observations were consistent with the described CVD burden in the general population.[11] Men had significantly higher previous hospital admissions for CV causes. At 1-year after cardiology consultation, the rate of hospital admissions for CV reasons was significantly lower in women, with no differences in CV mortality, despite a higher rate of all-cause mortality in men. The baseline CV profile in both sexes may explain these differences.

Telemedicine based healthcare systems and new technologies may enhance the relationship between levels of care and solve incidents in patient's clinical progress, leading to cost savings, improved health outcomes and maintaining an adequate level of satisfaction.[18]

The implementation of inter-clinicians e-consultation must analyse not only parameters associated with the accessibility of medical care facilities but also the influence on hard clinical outcomes, such as need for emergency department visits, mortality or hospital admissions.[22] To date, very limited data are available on the impact of e-consultation programmes on clinical outcomes, and there is no published information on the gender influence, to our knowledge. This is a very relevant issue since inequities in the care of women with suspected or confirmed CVD have been described.[10]

In the ARIC study, McGinn et al. found that the delay time to assistance for women with acute CVD has not decreased over the past 20 years, and this lack of improvement may be contributing to poor outcomes improvement in this group of patients. Digital health technologies have been proposed to improve accessibility to care in patient pathways. In our experience, after implementing e-consults for both women and men, there was a significant reduction in the elapsed time to cardiology care. This implementation was independently associated with a marked improvement in the one-year rate of emergency department visits, hospital admissions and mortality. One possible explanation for these findings is that patients who needed specialist care were identified much sooner than under the traditional model, and they were able to schedule their first cardiology visit sooner, potentially leading to better outcomes. Løvlien M et al. found a significant association between elapsed time to care and cardiovascular outcomes in patients referred by PCPs to cardiology care, with a higher delay in women. However, the study design based on a large retrospective cohort of patients does not allow for a clear direct-causality effect to be established, as other factors may have influenced the findings.

Based on the clinical information provided by PCPs that justified the cardiology referral and additional information included in the integrated electronic medical record, a proportion of the e-consults were resolved without the need for an in-person visit (around 25% of e-consults with no relevant differences observed among women and men). This group of patients had better outcomes compared with those considered for in-person visits, possibly due to a better cardiovascular risk profile.

We have previously published our experience using a universal e-consultation programme between PCPs and CDs for over 10 years, which has shown promising results in managing referrals. Our study has demonstrated that this programme is associated with a reduction in waiting lists and better health outcomes, for all patients[4,14] including those with a previous diagnosis of cardiac disease such as HF[23] and AF.[24] In addition, this programme has significantly improved the accessibility of the CD for patients who live far from the hospital, particularly those over 80 years old.[25] Our study has also highlighted that clinician-to-clinician programmes, such as e-consultation, can enhance healthcare equity and quality, which is especially important for vulnerable patients, including women. We have previously reported inequalities in the care of women and believe that our findings address this issue.

While our study has certain limitations managing a large cohort of patients with demographical, clinical and prognostic data integrated into an electronic medical record system strengthens the relevance of our findings for the ambulatory care of women.

However, we acknowledge that we do not know the specific reasons for primary care physician referrals and cannot identify whether patients had contact with professionals outside our public health system, which may have influenced our results. Furthermore, excluding patients referred to cardiology consultation from other hospital services could have introduced selection bias and limited the external validity of our results.

We also acknowledge that our data are retrospective, and while we are aware of all deaths that occurred during the follow-up period, it was not always possible to determine the exact cause of death, which may have affected our findings.

Despite these limitations, we believe that our experience with a large cohort of patients referred by primary care physicians for cardiology consultation is clinically and managerially relevant. We attribute the observed results solely to the modification in outpatient assistance because treatment modifications would not produce such rapid changes. Moreover, the use of temporal-trend series analysis in our study design is among the most robust quasi-experimental methods for evaluating the effect of an intervention in nonrandomized studies. This approach allows for better control of changes related to an intervention, in our case, the implementation of an e-consult programme in the care of female and male patients.

An additional strength of our analysis is the intuitive assessment of the dynamic change response after

e-consult implementation compared with the previous in-person consultation model, which shows the temporal trend of the effects. We can determine if these effects are immediately apparent after the intervention, if there is a time delay, or if these findings are persistent or reversible.

In conclusion, our findings provide important insights into the potential benefits of e-consultation programmes in improving healthcare equity and quality, particularly for vulnerable patients, including women. Further research in this area is needed to fully understand the impact of e-consultation on patient outcomes and healthcare management.

5 | CONCLUSIONS

Our study provides novel evidence that implementing a clinician-to-clinician e-consultation as the first step in outpatient management, followed by an in-person visit when necessary, is associated with a significant reduction in the time elapsed to cardiology care for all PCP referrals and improved 1-year outcomes, compared with the previous face-to-face visit model for all referrals, without differences in findings between men and women. Throughout the follow-up period, the reduction in elapsed time to care was independently associated with better 1-year outcomes in both genders. We believe that our experience can inform the development of a more efficient ambulatory patient care pathway for women with suspected or confirmed cardiovascular disease and contribute to overcoming healthcare organization barriers in women.

AUTHOR CONTRIBUTIONS

PMR has designed research/study, performed research/study, collected data, analysed data, wrote paper and reviewed the last version. DRA designed research/study, analysed data, wrote paper and reviewed the last version. DGV has performed research/study, collected data and reviewed the last version. MPR designed research/study, analysed data, wrote paper and reviewed the last version. MRM has performed research/study, collected data and reviewed the last version. RLF has performed research/study and reviewed the last version. SCS has designed research/study, performed research/study, collected data, analysed data, wrote paper and reviewed the last version. JGJ has designed research/study, performed research/study, collected data, analysed data, wrote paper and reviewed the last version.

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CONFLICT OF INTEREST STATEMENT

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

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