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Impact of COVID-19 on the imaging diagnosis of cardiac disease in Europe

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ABSTRACT

Objectives We aimed to explore the impact of the COVID-19 pandemic on cardiac diagnostic testing and practice and to assess its impact in different regions in Europe.

Methods The online survey organised by the International Atomic Energy Agency Division of Human Health collected information on changes in cardiac imaging procedural volumes between March 2019 and March/April 2020. Data were collected from 909 centres in 108 countries.

Results Centres in Northern and Southern Europe were more likely to cancel all outpatient activities compared with Western and Eastern Europe. There was a greater reduction in total procedure volumes in Europe compared with the rest of the world in March 2020 (45% vs 41%, p=0.003), with a more marked reduction in Southern Europe (58%), but by April 2020 this was similar in Europe and the rest of the world (69% vs 63%, p=0.261). Regional variations were apparent between imaging modalities, but the largest reductions were in Southern Europe for nearly all modalities. In March 2020, location in Southern Europe was the only independent predictor of the reduction in procedure volume. However, in April 2020, lower gross domestic product and higher COVID-19 deaths were the only independent predictors.

Conclusion The first wave of the COVID-19 pandemic had a significant impact on care of patients with cardiac disease, with substantial regional variations in Europe. This has potential long-term implications for patients and plans are required to enable the diagnosis of non-COVID-19 conditions during the ongoing pandemic.

Key questions

What is already known about this subject?

- Worldwide COVID-19 has had a dramatic impact on care of patients with cardiovascular disease. However, the impact on cardiac diagnostic testing in Europe has not been studied.

What does this study add?

- The COVID-19 pandemic resulted in a reduction in cardiac imaging in Europe of 45% in March 2020 and 69% in April 2020 compared with 2019, with the largest reduction in Southern Europe. In April 2020, lower gross domestic product and higher COVID-19 deaths were independent predictors of the reduction in cardiac imaging.

How might this impact on clinical practice?

- The considerable variability in the response to the pandemic has important implications for patient care. It is important to identify patients who have missed out on diagnostic testing. In addition, preparation for future waves of the pandemic should address these issues.

INTRODUCTION

Non-communicable diseases, including cardiovascular disease, remain the leading cause of mortality around the world. However, during the COVID-19 pandemic, there has been a dramatic disruption in healthcare provision around the world. Accurate diagnosis is central to the treatment of cardiac disease and delayed or missed diagnoses have the potential to impact long-term morbidity and mortality. After China and some countries in Southeast Asia, Europe became the epicentre of COVID-19 in March 2020. This paper focuses on the impact of the first peak of the COVID-19 pandemic on the management of cardiac disease in Europe compared with the rest of the world, in order to provide important learning opportunities for impending waves of the COVID-19 pandemic and for future pandemics.

Established guidelines have been developed which place non-invasive imaging at the centre of the diagnosis and management of coronary artery disease. However, during the COVID-19 pandemic, both guidelines[1–5] and local practices have changed. We have recently shown in an international survey that the COVID-19 pandemic was associated with a significant reduction in cardiac imaging around the world, with a 64% reduction in cardiac imaging between March 2019 and April 2020.[6] Several studies have shown that during the March/April 2020 COVID-19 peak, there was a reduction in hospital admissions for acute coronary syndromes,[7–9] and an increase in out-of-hospital cardiac arrests[10] with excess cardiovascular mortality around the world.[11] Furthermore, COVID-19 is itself potentially associated with myocardial injury, arrhythmia, and venous and arterial thrombosis.[12 13] It is therefore essential that the diagnosis and management of cardiac disease is optimised during the COVID-19 pandemic.

The International Atomic Energy Agency (IAEA) Division of Human Health aims to support member states to combat cardiovascular diseases, cancer, malnutrition and other diseases through the use of appropriate prevention, diagnostic testing and treatment. In this light, the IAEA coordinated a worldwide survey of cardiac imaging laboratories (the IAEA Noninvasive Cardiology Protocols Study of COVID-19, INCAPS COVID Survey), to assess the impact of the pandemic on the diagnosis of cardiac disease. This analysis of the INCAPS COVID Survey aims to assess the impact of the COVID-19 pandemic on the diagnosis of cardiac diseases in Europe during the first peak of the pandemic, in order to inform future strategies.

METHODS

Study design

Data for this study were collected as part of the IAEA survey on the impact of COVID-19 on cardiac imaging (INCAPS COVID). An online survey was developed by a steering committee which included experts in cardiology and cardiovascular imaging. The survey included questions regarding the healthcare facility, healthcare professionals, personal protective equipment, strategic plans for reopening and changes in procedural volumes for a range of cardiac imaging procedures.

Data collection

Survey data were collected using a secure software platform used by the IAEA, the International Research Integration System (https://iris.iaea.org). Participation was encouraged using email and social media activity, from the IAEA, national and international cardiology and imaging societies and from national coordinators. No patient-specific or confidential data were collected. Patients or the public were not involved in the design, conduct, reporting or dissemination plans of this publication. During data collection, the Data Coordination Committee reviewed entries and reached out to survey participants with questions regarding missing, implausible, duplicate or inconsistent data. Participants were provided the opportunity to clarify and correct response as needed. For each centre, only one entry was included in the final dataset. Final database cleaning was completed on 1 July 2020. Entries were excluded for reasons such as missing or incomplete responses to the questionnaire. As data were provided in confidence to the IAEA by survey respondents, sharing of the underlying data is not possible.

Population data were based on data obtained from World Bank from 2019.[14] Data on COVID-19 cases and deaths in March and April 2020 were obtained from the WHO COVID-19 dashboard.[15] Territories were not included in per country COVID-19 case numbers. Information on gross domestic product (GDP) was obtained from the World Bank for 2019.[14] Income group was defined using the World Bank classification of high, upper-middle, lower-middle and low.[16]

Cardiac imaging procedure volumes

Participants were asked to provide estimates of procedure volumes from March 2019, March 2020 and April 2020, including both anatomical and functional imaging. Anatomical imaging included transthoracic echocardiography (TTE), transoesophageal echocardiography (TOE), cardiac magnetic resonance (CMR, non-stress), positron emission tomography (PET) infection studies, coronary artery calcium scanning, coronary CT angiography (CCTA) and invasive coronary angiography (ICA). Functional imaging included stress ECG, stress echocardiography, stress single-photon emission CT (SPECT), stress PET and stress CMR. Stress nuclear imaging included combined data from stress SPECT and stress PET. Data were aggregated on a regional level. Countries in Europe were defined using the United Nations geoscheme.[17] European countries were divided into Northern, Southern, Eastern and Western regions, with Turkey and Cyprus included in the Eastern region.

Statistical analysis

In total, 936 questionnaires were submitted, and 27 duplicates were excluded from the results. Statistical analysis was performed using R (V.4.0.1, R Development Core Team, Vienna, Austria). Survey question responses are presented as number and percentage. Continuous data that are not normally distributed are presented as median and interquartile interval. Percentage change in procedure volume was compared between March 2019 and March or April 2020. A linear regression model was constructed to assess the impact of European region, population, GDP and COVID-19 deaths at a country level, on procedure volume reduction at a centre level in March and April 2020 compared with March 2019. COVID-19 cases and COVID-19 deaths were strongly correlated on a per country basis, but as the availability of COVID-19 testing was variable across countries, particularly in the early stages of the pandemic, COVID-19 deaths were chosen for inclusion in the linear regression

Table 1 Information on centres providing data for the survey in different European regions and comparisons between Europe and the rest of the world

	European region							
	Western	Southern	Eastern	Northern	P value	Europe	World	P value
Centres	38	95	38	70	–	241	605	–
Number of countries	8	12	11	9		40	66	–
Centre type								
Inpatient	92% (35)	97% (92)	87% (33)	97% (68)	0.080	95% (228)	76% (457)	**<0.001**
Outpatient	8% (3)	3% (3)	13% (5)	3% (2)		5% (13)	25% (148)	
Teaching facility	74% (28)	78% (74)	76% (29)	87% (61)	0.295	80% (192)	61% (369)	**<0.001**
Number of beds	900 [615–1110]	700 [290–999]	480 [225–1000]	633 [358–878]	**0.034**	700 [345–999]	450 [200–800]	**<0.001**
COVID-19 cases*	423 337	462 863	286 308	233 676	–	1 406 184	1 560 392	–
COVID-19 deaths*	45 053	54 289	6478	31 003	–	136 823	83 368	–

Numbers indicate absolute percentage and absolute values in parentheses. IQRs are shown in square brackets.
Bold text indicates a p value of <0.05.
*Per country providing procedure volume data and summed per region. COVID-19 cases and deaths in March and April 2020 from the WHO COVID-19 dashboard.[15]

model. Population, GDP and COVID-19 deaths were log transformed for analysis.

RESULTS

Centres

Around the world data were collected from 909 centres in 108 countries, and of these 845 centres in 106 countries provided data on procedure volumes. In Europe, data were collected from 241 centres in 40 countries, including 38 (16%) centres in Western Europe, 95 (39%) in Southern Europe, 38 (16%) in Eastern Europe and 70 (29%) in Northern Europe (table 1). Compared with the rest of the world, European centres were more likely to have inpatient facilities (95% vs 76%, p<0.001), teaching facilities (80% vs 61%, p<0.001) and had more hospital beds (700 (IQI 345–999) vs 450 (IQI 200–800), p<0.001; table 1). The number of hospital beds per centre was largest in Western Europe (table 1, p=0.034), but there were no other differences in facility type between European regions.

Changes to imaging procedure volumes

In surveyed European centres, a total of 142 463 procedures were performed in March 2019. There was a 45% reduction in total procedure volume in March 2020 (n=78 969) and a 69% reduction in April 2020 (n=44 469). For functional imaging in Europe in April 2020, the largest reductions in procedure volume compared with March 2019 were identified in stress echocardiography (84%), followed by stress ECG (83%), stress SPECT (79%), stress CMR (68%) and stress PET (42%, table 2). For anatomical imaging in Europe in April 2020 compared with March 2019, reductions in procedures by modality were identified in CT calcium score (78%), followed by TEE (74%), CMR (non-stress, 72%), CCTA (69%), TTE (67%), PET studies for infection (53%) and ICA (51%, table 2). In April 2020, procedure volume reductions were similar in Europe compared with the rest of the world for all modalities, except for larger reductions in stress SPECT (79% vs 73%, p=0.002), stress nuclear (77% vs 72%, p=0.012) and CCTA (69% vs 50%, p=0.003, table 2).

There were regional and country variations in the reduction in total procedures (figure 1). In March 2020, there was a larger reduction in total procedures in Europe compared with the rest of the world (45% vs 41%, p=0.003), with the largest reductions in Southern Europe (58%, p<0.001, table 2). In April 2020, the reduction in total procedures was similar in Europe and the rest of the world (69% vs 63%, p=0.261), and Southern Europe remained the region with the highest total procedure reduction (78%, p<0.001).

For all modalities, the reduction in procedure volume was higher in April 2020 compared with March 2020 (figures 2 and 3). Regional variations were apparent with the largest reductions in Southern Europe in both March and April 2020 for all modalities apart from CT calcium score, stress echocardiography and PET infection studies. In April 2020, procedure volume reductions were highest in Southern Europe for stress PET (94% reduction, p=0.006), stress nuclear (84% reduction, p=0.014), CMR (non-stress, 78% reduction, p=0.010) and invasive coronary angiography (63% reduction, p=0.009, table 2). Reduction in PET infection studies was highest in Eastern Europe (71% and 92%, respectively, p<0.001). Reductions in stress CMR and non-stress CMR were highest in Southern and Northern Europe (table 2).

Table 2 Reduction in procedure volumes across European regions compared with the rest of the world

	European region							
	Western	Southern	Eastern	Northern	P value	Europe	World	P value
Centres	38	95	38	70	–	241	605	–
Total procedure volume								
March 2019	24 018	48 340	13 149	56 956	–	142 463	536 175	–
March 2020	13 433	20 517	10 343	34 676	–	78 969	315 656	–
April 2020	9060	10 865	5819	18 725	–	44 469	199 967	–
Reduction in total procedures								
March 2019–March 2020	44%	58%	21%	39%	**<0.001**	45%	41%	**0.003**
March 2019–April 2020	62%	78%	56%	67%	**<0.001**	69%	63%	0.261
Reduction in procedures by modality (March 2019–April 2020)—functional imaging								
Stress ECG	76%	93%	49%	82%	0.115	83%	85%	0.923
Stress echocardiography	86%	89%	51%	93%	0.160	84%	82%	0.428
Stress SPECT	73%	83%	76%	77%	0.112	79%	73%	**0.002**
Stress PET	0	94%	88%	13%	**0.006**	42%	59%	0.739
Stress nuclear (SPECT and PET)	67%	84%	78%	72%	**0.014**	77%	72%	**0.012**
Stress CMR	45%	89%	40%	76%	0.081	68%	75%	0.948
Reduction in procedures by modality (March 2019–April 2020)—anatomical imaging								
CT calcium score	88%	77%	45%	93%	0.552	78%	70%	0.534
CCTA	58%	75%	68%	68%	0.896	69%	50%	**0.003**
TTE	67%	73%	50%	66%	0.174	67%	57%	0.331
TEE	65%	84%	54%	72%	0.139	74%	76%	0.070
PET infection	27%	71%	92%	13%	**<0.001**	53%	71%	0.714
CMR (non-stress)	45%	78%	55%	78%	**0.010**	72%	59%	0.067
Invasive coronary angiography	34%	63%	45%	50%	**0.009**	51%	59%	0.951

Bold text indicates a p value of <0.05.
CCTA, coronary CT angiography; CMR, cardiac magnetic resonance; PET, positron emission tomography; SPECT, single-photon emission CT; TEE, transoesophageal echocardiography; TTE, transthoracic echocardiography.

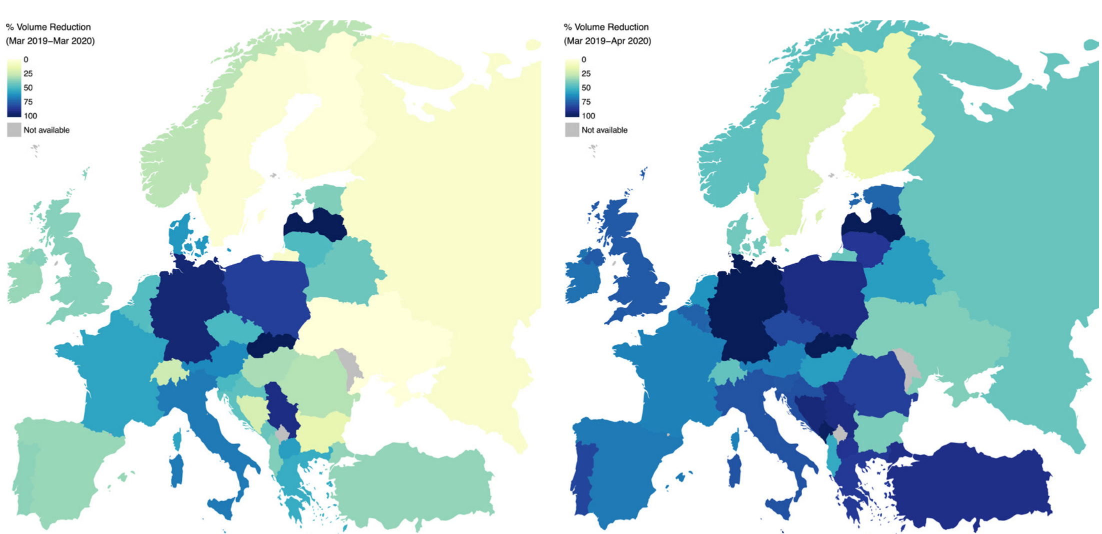

Figure 1 Reduction in total cardiac imaging procedure volume (March 2019–March 2020 and March 2019–April 2020).

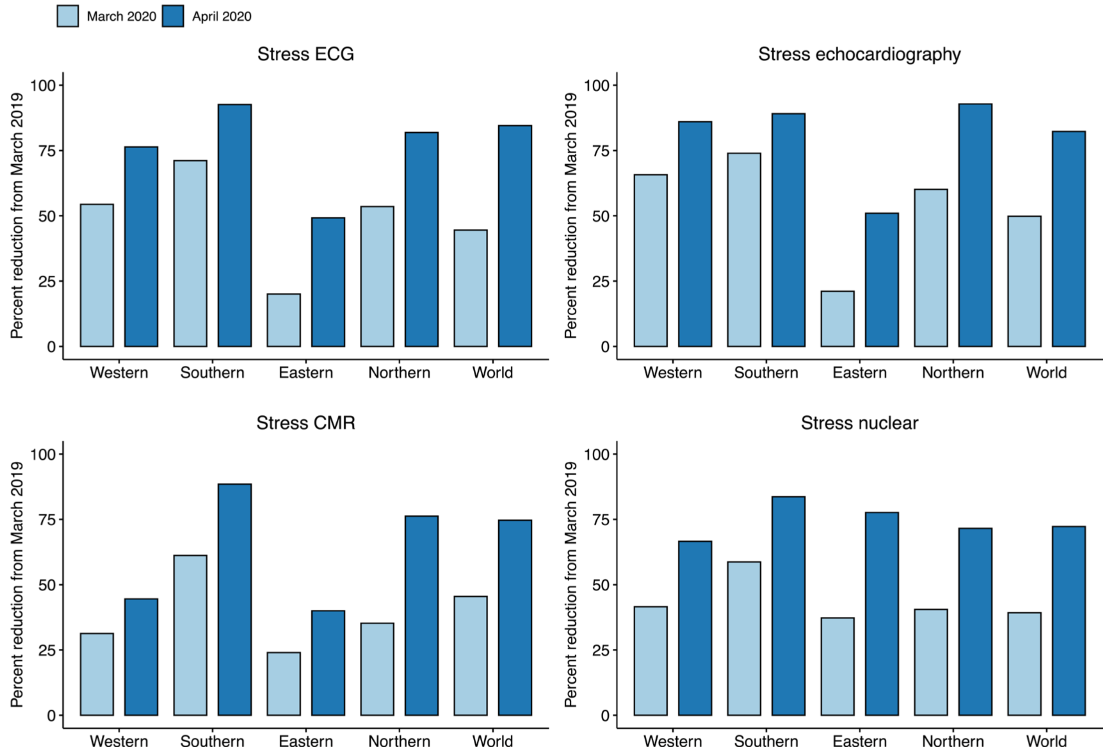

Figure 2 Reduction in procedure volume for functional imaging in different regions of Europe from March 2019 to March 2020 and April 2020. CMR, cardiac magnetic resonance.

During March and April 2020, there were 1 406 184 COVID-19 cases recorded in European countries represented in the survey, with more occurring in Western and Southern Europe compared with Northern or Eastern Europe (table 1). When centres providing information were stratified by World Bank income group, there were 210 European centres located in high-income countries, 29 in upper middle-income countries and 2 in low/middle-income countries. In April 2020, the European reduction in procedure volumes was highest in Europe in upper middle-income countries (77%), compared with high-income countries (68%) and lower middle-income countries (36%, p=0.017). Multivariable analysis showed that in March 2020, location in Southern Europe was the only independent predictor of a reduction in cardiac imaging procedure volume (figure 4). However, in April 2020, multivariable analysis showed that lower GDP and higher COVID-19 deaths were the only independent predictors of a reduction in imaging procedure volume (figure 4).

Changes in practice, imaging protocols and staffing

In Europe, 85% of centres reduced outpatient activities during March/April 2020, while 44% of centres cancelled all outpatient activities, similar to the rest of the world (table 3). Among European regions, the proportion of centres cancelling all outpatient activities was lower in Eastern and Western Europe compared with the other regions. European centres were also more likely to be planning phased reopening compared with the rest of the world (58% vs 51%, p=0.003), and this was particularly common in Western Europe (85%, p=0.001).

European centres were more likely to use extended working hours but less likely to use telehealth and remote reporting, compared with the rest of the world (table 2). Within Europe, the use of remote reporting was more common in Western and Northern Europe. European centres were less likely to perform temperature measurements, symptom screening and COVID-19 testing in imaging centres compared with the rest of the world. There were regional variations in the planning of patient arrivals, physical distancing in waiting areas, separate spaces for patients with COVID-19, limiting visitors, use of temperature measurements, masks for patients/visitors and increasing time for cleaning. European centres were less likely to change imaging protocols compared with the rest of the world (table 4), with regional variations in the use of exercise stress and modifications to cardiac nuclear and CT protocols. Redeployment of imaging staff was less frequent in Europe compared with the rest of the world (15% vs 22%, p=0.011). Use of furlough, reducing salaries or laying off staff was less frequent in Europe compared with the rest of the world (table 4).

DISCUSSION

The COVID-19 pandemic has had a dramatic impact on the provision of healthcare around the world. In this international survey of 108 countries, we have shown the substantial impact of the COVID-19 pandemic on the care of patients with cardiac disease. Responses to the COVID-19 pandemic varied throughout European countries and European regions, with a 45% reduction

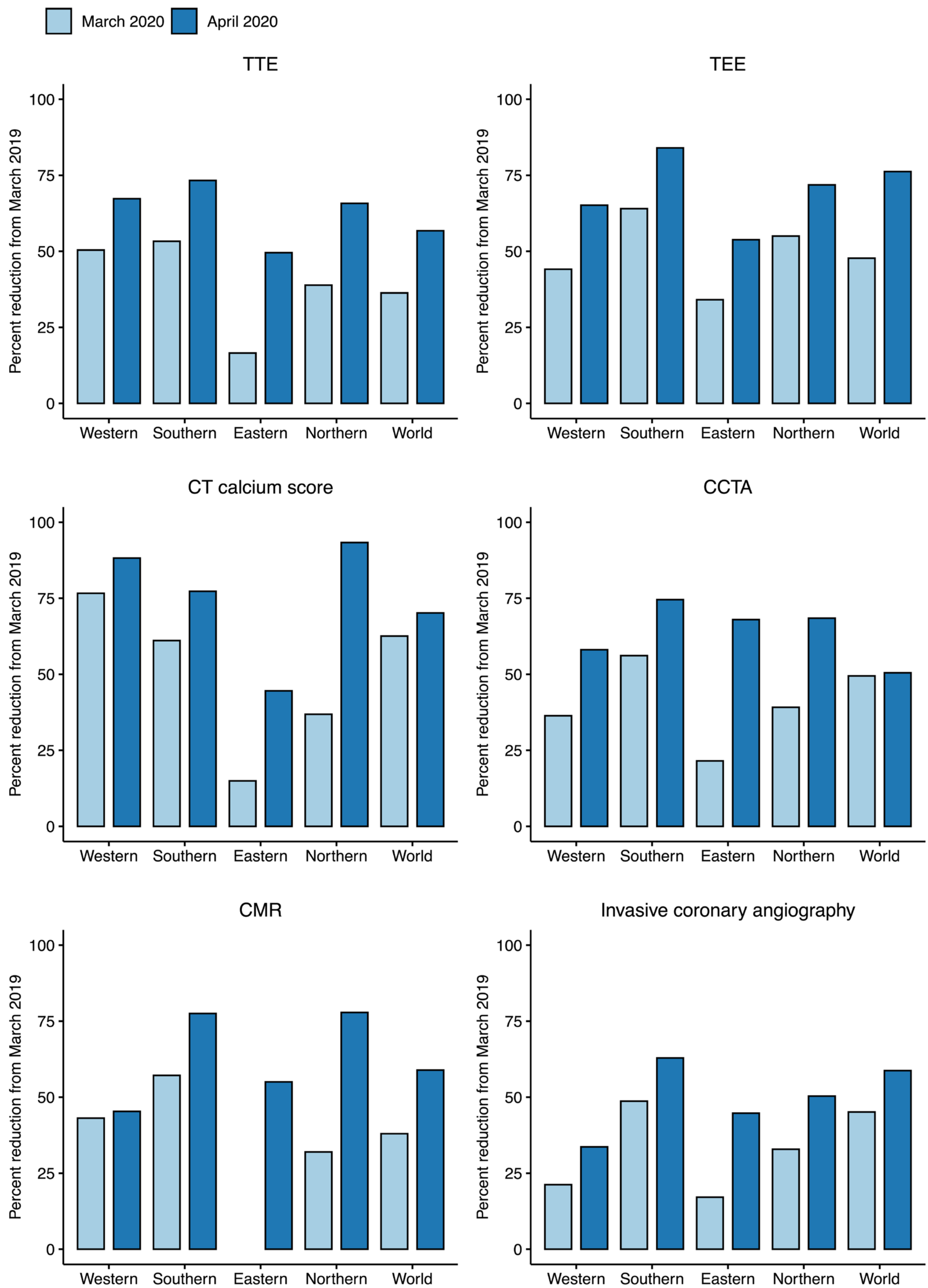

Figure 3 Reduction in procedure volume for anatomical imaging in different regions of Europe from March 2019 to March 2020 and April 2020. CCTA, coronary CT angiography; CMR, cardiac magnetic resonance (non-stress); TEE, transoesophageal echocardiography; TTE, transthoracic echocardiography.

in total cardiac imaging in March 2020 and a 69% reduction in April 2020. Reductions in cardiac imaging and changes to practices were greater in Europe compared with the rest of the world, particularly in Southern Europe, reflecting the trajectory of the pandemic at the time of the survey. Only location in Southern Europe was a predictor of the reduction of cardiac imaging in March 2020, whereas lower GDP and higher COVID-19 deaths were independent predictors in April 2020. This highlights the considerable variability in the response to the pandemic, which has important implications for patient care.

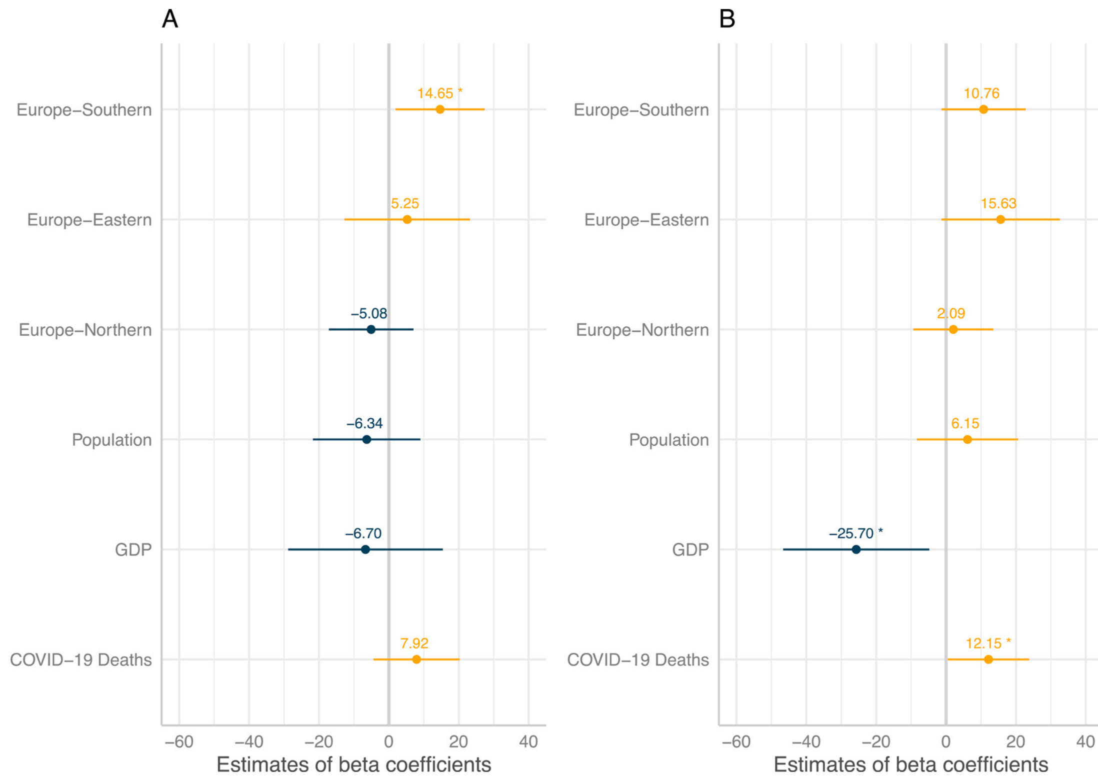

Figure 4 Multivariable models for the reduction in procedure volume at centres from March 2019 to (A) March 2020 and (B) April 2020. Population, GDP and COVID-19 deaths were log transformed for analysis (log10). Graphs show estimate of the beta coefficients and SE. * indicates a p value of <0.05. European regions were compared with Western Europe as the baseline. GDP, gross domestic product.

Cardiac imaging is central to the diagnostic pathway for many patients, with both acute and chronic conditions. Without accurate diagnoses, appropriate treatment cannot be provided. The COVID-19 pandemic has caused both delay and complete inability to obtain a diagnosis for many patients with cardiac conditions around the world. In Europe, in particular, only half the usual number of procedures were performed in March 2020, and one-third in April 2020. This may have important short-term and long-term health implications. In addition, patients with underlying cardiovascular disease are at an increased risk of poor outcomes following COVID-19 infection.[18–21]

During the COVID-19 pandemic, several studies have reported an increase in out-of-hospital cardiac arrests[10 22] and excess cardiovascular mortality.[11] In March 2020, there was a 48% reduction in admissions with acute myocardial infarction to Italian coronary care units[23] and in April 2020, there was a 52% increase in out-of-hospital cardiac arrests in some regions in Italy.[22] Similarly, in England in March 2020, there was a 40% reduction in hospital admissions for acute coronary syndromes compared with the previous year.[7] The worldwide reduction in hospital admissions with acute coronary syndromes[7–9 23–25] is particularly concerning, as rapid diagnosis and treatment of this condition has been responsible for significant improvements in morbidity and mortality in recent years. Delays in cardiac diagnostic imaging may also impact other cardiovascular treatments such as transcatheter aortic valve implantation[26] and cardiac surgery.[27]

The long-term implications of delays in making an accurate diagnosis of cardiac diseases are currently uncertain, but our survey shows that there are many thousands of patients who have had their diagnosis delayed or prevented. It is possible that we may see later presentations or more severe presentations of cardiac conditions. Over the longer term, these patients may not be receiving appropriate preventative treatments because of their delayed diagnosis, and this may have downstream implications on cardiac morbidity and mortality. Guidelines have been developed to aid with the restarting of cardiac imaging services.[1 2 5 28 29] Addressing this issue in a timely manner will be an important issue for health policymakers as countries deal with future waves of the COVID-19 pandemic and subsequent recovery.

Responses to the COVID-19 pandemic have varied between and within countries throughout Europe, influenced by a variety of factors including COVID-19 case numbers, the underlying healthcare system and political factors. We have shown that there were patterns in the application of these policies for healthcare in different regions in Europe, which initially reflected regional location but by April 2020 reflected COVID-19 deaths and GDP. Countries with a lower GDP were more likely to reduce cardiac imaging procedures in April 2020, likely in an attempt to prevent their healthcare

Table 3 Imaging departments' change in capacity and practice

	European region							
	Western	Southern	Eastern	Northern	P value	Europe	World	P value
	41	96	42	72	–	251	658	–
Change in capacity								
Some outpatient activities cancelled	98%	79%	81%	88%	0.217	85%	82%	0.076
All outpatient activities cancelled	37%	48%	33%	50%	**0.009**	44%	45%	0.512
Phased reopening	85%	51%	50%	53%	**0.001**	58%	51%	**0.003**
Extended hours	24%	23%	12%	17%	0.104	20%	11%	**0.003**
New weekend hours	17%	12%	10%	8%	0.237	11%	9%	0.735
Use telehealth for patient care	46%	45%	33%	53%	0.133	45%	59%	**<0.001**
Remote reporting	49%	28%	38%	57%	**0.013**	41%	51%	**0.018**
Change in practice								
Alterations in patient arrival	73%	61%	55%	81%	**0.006**	68%	73%	0.454
Physical distancing in waiting areas	95%	83%	79%	93%	**0.007**	87%	89%	0.383
Separate spaces for patients with COVID-19	90%	82%	62%	82%	**0.016**	80%	78%	0.847
Reducing patient time in waiting rooms	78%	91%	69%	81%	0.081	82%	81%	0.775
Limit accompanying family members and/or visitors	95%	95%	79%	94%	**0.014**	92%	92%	0.877
Temperature measurements	44%	74%	88%	18%	**<0.001**	55%	72%	**<0.001**
Symptom screening	73%	62%	71%	69%	0.357	68%	82%	**<0.001**
COVID-19 testing	10%	7%	12%	10%	0.330	9%	17%	**0.003**
Require masks for patients/visitors	68%	90%	88%	42%	**<0.001**	72%	76%	**0.013**
Increase time for cleaning	63%	75%	71%	76%	**0.012**	73%	72%	0.177

Light grey, <50%; dark grey, ≥50%; bold, p<0.05.

systems becoming overwhelmed. In addition to policies cancelling non-urgent investigations, other important factors may have driven the decline in performance of imaging procedures, such as patient's inability or reluctance to seek healthcare advice during the COVID-19 pandemic. This includes factors such as fear, a desire

Table 4 Imaging departments' change in imaging protocols and staffing

	European region							
	Western	Southern	Eastern	Northern	P value	Europe	World	P value
	41	96	42	72	–	251	658	–
Changes to imaging protocols								
Limiting staff proximity to patients	90%	83%	76%	83%	0.166	83%	83%	0.830
Mandate personal protective equipment	93%	89%	88%	88%	0.151	88%	86%	0.611
Eliminate protocols requiring close contact	52%	51%	48%	65%	0.100	55%	64%	**0.026**
Avoid exercise stress testing	34%	51%	31%	39%	**0.025**	41%	51%	**0.018**
Modify cardiac nuclear imaging protocols	7%	31%	12%	10%	**<0.001**	18%	28%	**0.009**
Modify cardiac CT protocols	2%	15%	2%	14%	**<0.001**	10%	15%	0.139
Changes to staffing								
Redeployment	10%	16%	17%	15%	0.799	15%	23%	**0.011**
Rotating staff work shifts	54%	69%	62%	69%	0.091	66%	68%	0.451
Furloughed imaging physicians	7%	9%	10%	4%	1	8%	17%	**<0.001**
Furloughed non-physician imaging staff	10%	8%	12%	3%	0.288	8%	23%	**<0.001**
Reduced salaries of imaging physicians	7%	5%	12%	4%	0.638	6%	24%	**<0.001**
Reduced salaries of non-physician imaging staff	7%	3%	12%	4%	0.289	6%	22%	**<0.001**
Laid off imaging physicians	2%	0	5%	1%	0.374	2%	2%	0.038
Laid off non-physician imaging staff	2%	1%	2%	1%	0.660	2%	7%	**<0.001**

Light grey, <50%; dark grey, ≥50%; bold, p<0.05.

to avoid potential infection, access to public transport and other essential axillary services. This appears to be part of a general pattern of reduced healthcare utility for non-COVID-19 conditions during the pandemic. For example, emergency department visits decreased 41%–64% in the USA[30] and delayed cancer diagnoses are predicted to result in a significant increase in mortality over the next 5 years.[31] It is therefore essential that we optimise healthcare access for patients with non-COVID-19 conditions during the pandemic.

This was a self-reported survey and thus has some limitations. Efforts were made to distribute this survey widely, but we cannot exclude that the included sites represent outliers in each country. Sampling and response bias are a potential issue with these data, as with any survey. This analysis was not based on national reporting of procedure numbers which may have been more thorough in some countries, but is not available or is inconsistent in many countries around the world. Country-level data for income and COVID-19 cases and deaths were used rather than centre-level data. Information for this survey was obtained during March and April 2020, which represented the initial peak of the COVID-19 pandemic in some countries. However, for some countries around the world, the peak came later, and for China the peak came earlier. We plan further surveys to assess further changes in practice. We found that in Europe, the reduction in procedure volumes was highest in upper middle-income countries compared with high or lower middle-income countries, which is different from the pattern observed worldwide.[6] This may reflect the small number of lower middle-income European countries included in this survey and the distribution of countries of different income groups relative to the geographical epicentres of the early pandemic. In addition, country-based variations in the recording of COVID-19 cases and deaths may impact results.

In conclusion, we have shown the significant impact of the COVID-19 pandemic on the performance of diagnostic imaging for cardiac disease in Europe. This survey provides important information, as we now need to learn how to deal with an ongoing viral pandemic at the same time as managing patients with cardiac diseases.

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