Worldwide Disparities in Recovery of Cardiac Testing 1 Year Into COVID-19

Brief Title: Cardiac Diagnostic Testing During COVID-19

Andrew J. Einstein MD, PhD[1,2,3], Cole Hirschfeld MD[4], Michelle C. Williams MB, ChB, PhD[5], Joao V. Vitola MD, PhD[6], Nathan Better MB, BS[7], Todd C. Villines MD[8], Rodrigo Cerci MD[6], Leslee J. Shaw PhD[9], Andrew D. Choi MD[10], Sharmila Dorbala MD, MPH[11], Ganesan Karthikeyan MD, DM[12], Bin Lu MD[13], Valentin Sinitsyn MD, PhD[14], Alexey A. Ansheles PhD[15], Takashi Kudo MD, PhD[16], Chiara Bucciarelli-Ducci MD, PhD[17], Bjarne Linde Nørgaard MD, PhD[18], Pál Maurovich-Horvat MD, PhD, MPH[19], Roxana Campisi MD[20], Elisa Milan MD[21], Lizette Louw MD[22], Adel H. Allam MD[23], Mona Bhatia MD[24], Lorenzo Sewanan MD, PhD[2], Eli Malkovskiy[1,2], Yosef Cohen BA[25], Michael Randazzo MD[2], Jagat Narula MD[26], Olga Morozova MA[27], Thomas N. B. Pascual MD, MHPEd[28], Yaroslav Pynda MSc[27], Maurizio Dondi MD, PhD[27], Diana Paez MD, MEd[27], on behalf of the INCAPS COVID 2 Investigators Group

[1]Seymour, Paul and Gloria Milstein Division of Cardiology, Department of Medicine, Columbia University Irving Medical Center and NewYork-Presbyterian Hospital, New York, NY

[2]Department of Medicine, Columbia University Irving Medical Center and NewYork-Presbyterian Hospital, New York, NY

[3]Department of Radiology, Columbia University Irving Medical Center and NewYork-Presbyterian Hospital, New York, NY

[4]Division of Cardiology, Weill Cornell Medicine and NewYork-Presbyterian Hospital, New York, NY

[5]BHF Centre for Cardiovascular Science, University of Edinburgh, United Kingdom

[6]Quanta Diagnostico, Curitiba, Brazil

[7]Royal Melbourne Hospital and University of Melbourne, Australia

[8]University of Virginia, Charlottesville, VA

[9]Blavatnik Family Women's Health Research Institute, Mount Sinai Medical Center, New York, NY

[10]The George Washington University School of Medicine, Washington, DC

[11]Brigham and Women's Hospital, Boston, MA

[12]Department of Cardiology, All India Institute of Medical Sciences, New Delhi, India

[13]National Center for Cardiovascular Diseases, Beijing, China

[14]University Hospital, Lomonosov Moscow State University, Moscow, Russian Federation

[15]National Medical Research Center of Cardiology of Healthcare Ministry, Moscow, Russian Federation

[16]Nagasaki University, Japan

[17]Royal Brompton and Harefield Hospitals, Guys' and St Thomas NHS Trust and King's College London, United Kingdom

[18]Aarhus University Hospital, Aarhus, Denmark

[19]Department of Radiology, Medical Imaging Centre, Semmelweis University, Budapest, Hungary

[20]Diagnóstico Maipú, Buenos Aires, Argentina

[21]Ospedale Cà Foncello, Treviso, Italy

[22]University of the Witwatersrand, Johannesburg, South Africa

[23]Al Azhar University, Cairo, Egypt

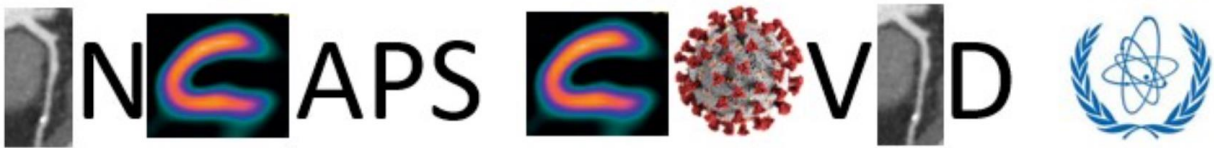
[24]Fortis Escorts Heart Institute, New Delhi, India,

[25]Technion Israel Institute of Technology, Haifa, Israel

[26]Mount Sinai Medical Center, New York, NY

[27]Division of Human Health, Department of Nuclear Sciences and Applications, International Atomic Energy Agency, Vienna, Austria

[28]Philippine Nuclear Research Institute, Quezon City, Philippines



IAEA Noninvasive CArdiology Protocols Survey on the Impact of COVID-19 on Cardiovascular Diagnostic Testing Practices and Working Conditions

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INCAPS COVID 2 Investigators Group

Executive Committee: Andrew J. Einstein (chair), Diana Paez (IAEA section head), Maurizio Dondi (IAEA project lead); (alphabetically) Nathan Better, Rodrigo Cerci, Sharmila Dorbala, Ganesan Karthikeyan, Thomas N. B. Pascual, Leslee J. Shaw, Todd C. Villines, Joao V. Vitola, Michelle C. Williams

Information Technology and Statistics Committee: Yaroslav Pynda (chair); (alphabetically): Gerd Hinterleitner, Yao Lu, Olga Morozova, Zhuoran Xu

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Nepal: Ram Ghimire, Madhu Neupane

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Uruguay: Mario Beretta, Rodolfo Ferrando, Miguel Kapitan, Fernando Mut

Uzbekistan: Omoa Djuraev, Gulnora Rozikhodjaeva

Venezuela: Luisa Vera

Vietnam: Binh Duong Duc, Xuan Canh Nguyen, Phuoc Minh Hiep Nguyen

Supplemental Methods.

Study Design

The IAEA Noninvasive Cardiology Protocols Study (INCAPS) executive committees, comprised of experts in clinical cardiology and cardiac imaging from around the world, have for the past decade conducted numerous studies under the auspices of the IAEA Nuclear Medicine and Diagnostic Imaging Section, aimed at characterizing and addressing worldwide practice variation and use of best practices in cardiovascular disease diagnosis. With the onset of the COVID-19 pandemic, the INCAPS COVID executive committee was convened and conducted an initial study characterizing the impact of the first two months of the pandemic on worldwide cardiovascular diagnostic care delivery. To characterize intermediate-term trends in the utilization and practice of cardiac diagnostic testing, the executive committee devised and conducted a follow-up survey, INCAPS COVID 2, one year after the first study. For purposes of this analysis, we included the following testing modalities: transthoracic (TTE) and transesophageal echocardiography (TEE), cardiac magnetic resonance (CMR), stress testing (stress electrocardiography, echocardiography, single-photon emission computed tomography [SPECT], positron emission tomography [PET], and CMR), PET infection studies, coronary artery calcium (CAC) scanning, coronary computed tomography angiography (CCTA), and invasive coronary angiography (ICA). We designed a questionnaire to capture information on four domains: 1) descriptors of participating healthcare facilities and healthcare professionals, 2) supplies of materials, practices and protocols, 3) perceptions of psychological stress to practitioners, and 4) changes in procedural volume for a range of cardiovascular diagnostic procedures.

Data were obtained from each participating site at pre-COVID baseline in March 2019, and also in April 2020 and April 2021. For those centers which participated in INCAPS COVID 1, procedure volumes from that initial data collection were utilized for 2019 and 2020, while new data were collected for 2021; for centers which had not participated in INCAPS COVID 1, procedure volumes were collected for all three years. Additional country-specific data compiled within the IAEA on COVID-19 include the number of confirmed cases, deaths, and number of recovered cases. Data were aggregated at country-wide, region-specific, and income levels. Data from a territory (e.g., Greenland, Puerto Rico) were counted towards that of the country of jurisdiction (Denmark and United States, respectively). We used IAEA-standard country coding[2] for 8 world regions: Africa, Eastern Europe, Far East, Latin America, Middle East and South Asia, North America (i.e. Canada and United States), South East Asia and the Pacific, and Western Europe. Participating countries in each world region are specified in the Appendix. We categorized countries as low, lower-middle, upper-middle, and high income in accordance with the World Bank classification.[3]

Data Collection

In order to improve representativeness of our data, we made all efforts to be inclusive in our site selection worldwide. We enrolled both private and public healthcare organizations, irrespective of the size of their practices. Outreach to encourage participation from sites performing cardiac imaging was undertaken through a variety of methods. These included emails from the IAEA, the executive committee, and national coordinators to potential participants including INCAPS COVID 1 participants, those registered in IAEA-compiled databases of healthcare facilities, e.g. NUclear Medicine DataBase (NUMDAB; https://www.iaea.org/resources/databases/numdab), incorporating sites from other INCAPS studies, and past participants in IAEA cardiac imaging

research and educational projects. Other outreach included emails from IAEA to cardiology and imaging societies, communication from professional societies to their memberships, and a direct appeal to international clinicians and imaging practitioners on social media platforms (Twitter, LinkedIn, and Facebook) conducted by a dedicated Communications Committee experienced with cardiology and imaging social media. Based on the IAEA standardized methodology, a web-based data entry system was devised to collect data using a secure software platform, the International Research Integration System (IRIS), for questionnaire data collection. In INCAPS COVID 2 no patient-specific or confidential data were collected, and all participation by study sites was voluntary, therefore it was deemed no external ethics committee review was required; the study complies with the Declaration of Helsinki. Moreover, the Columbia University Institutional Review Board determined that the work does not meet the criteria to be considered human subjects research under 45 CFR 46, as there is no interaction with subjects, there is no intervention, and private, identifiable information is not being collected.

Throughout enrollment, the Data Coordination Committee reviewed data and reached out to survey participants with questions regarding missing or erroneous data and duplicate and/or inconsistent entries from the same institution. Participants were given an opportunity to clarify details and correct their response as needed. Only one entry from a given center was included in the final dataset. Final database cleaning was completed on July 25, 2021. Entries were excluded for reasons such as missing or incomplete responses to the questionnaire.

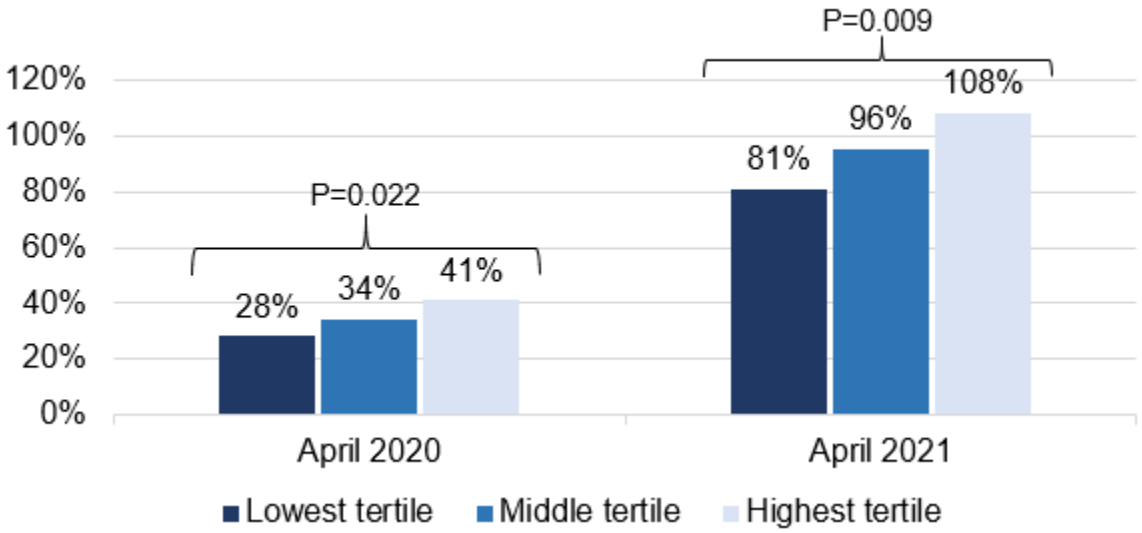
Statistical Analysis

Recovery rates from early-stage COVID-19-related decreases in procedure volumes were calculated as 100% * (1 - ((March 2019 volume - April 2021 volume) / (March 2019 volume - April 2020 volume))). Pearson's chi-squared and Fisher's exact tests were performed to compare

center characteristics between world regions. Nonparametric statistics using Wilcoxon rank sum and Kruskal-Wallis tests with asymptotic two-sided p values were used to compare differences in test volumes between timepoints and differences in continuous variables between world regions. A robust regression model employing Huber's M-estimator to minimize the effect of influential outliers was used to determine factors associated with procedure volume recovery rate. Variables considered in the analysis were country income level (as defined by the World Bank), March 2019 (i.e. baseline) procedure volume, teaching facility (versus non-teaching facility), hospital facility (versus non-hospital facility), and the rate of COVID-19 vaccinations in the country in which the facility operates (vaccinations per 100 people of the country population). Numbers of vaccinations were compiled from national governments and the World Health Organization, while population estimates used to determine rates were based on United Nations World Population Prospects, all via Our World in Data.[5] Variables with a p-value ≤ 0.25 in univariable analyses were included in the full multivariable model. Statistical analysis was performed using Stata/SE 16.0 (Stata Corporation, LLC, College Station, Texas), and Excel for Microsoft 365 (Microsoft, Redmond, WA). Maps were created using rnaturalearth and tmap packages in R version 4.0.1 (R Development Core Team, Vienna, Austria).

Supplemental Figure 1.

TITLE: Procedure Volumes Compared to 2019 Baseline in Hospital Facilities, by Number of Hospital Beds



CAPTION: The bar graph demonstrates greater reduction in the number of cardiac diagnostic procedures during the early phase of the pandemic in smaller hospitals, and one year later a persisting reduction in small hospitals but recovery in larger hospitals.

Supplemental Table 1. Number and Percentage of Responding Centers Performing Each Type of Cardiac Diagnostic Testing

Type of test	Africa n=38	Eastern Europe n=53	Far East n=82	Latin America n=135	Middle East & South Asia n=63	US & Canada n=102	Southeast Asia & Pacific n=45	Western Europe n=151	Total n=669
Stress ECG	15 (39%)	13 (25%)	30 (37%)	50 (37%)	25 (40%)	60 (59%)	14 (31%)	66 (44%)	273 (41%)
Stress Echocardiography	7 (18%)	13 (25%)	21 (26%)	34 (25%)	21 (33%)	57 (56%)	15 (33%)	52 (34%)	220 (33%)
Stress SPECT	17 (45%)	29 (55%)	48 (59%)	86 (64%)	36 (57%)	75 (74%)	34 (76%)	89 (59%)	414 (62%)
Stress PET	1 (3%)	2 (4%)	3 (4%)	7 (5%)	12 (19%)	26 (25%)	0 (0%)	14 (9%)	65 (10%)
Stress CMR	1 (3%)	7 (13%)	6 (7%)	32 (24%)	6 (10%)	26 (25%)	3 (7%)	36 (24%)	117 (17%)
CT coronary calcium	5 (13%)	16 (30%)	14 (17%)	44 (33%)	16 (25%)	48 (47%)	14 (31%)	35 (23%)	192 (29%)
CT coronary angiography	7 (18%)	22 (42%)	53 (65%)	56 (41%)	24 (38%)	60 (59%)	24 (53%)	77 (51%)	323 (48%)
TTE	11 (29%)	15 (28%)	38 (46%)	36 (27%)	22 (35%)	64 (63%)	15 (33%)	73 (48%)	274 (41%)
TEE	7 (18%)	12 (23%)	30 (37%)	26 (19%)	20 (32%)	51 (50%)	14 (31%)	65 (43%)	225 (34%)
PET infection	0 (0%)	7 (13%)	5 (6%)	13 (10%)	9 (14%)	11 (11%)	2 (4%)	39 (26%)	86 (13%)
CMR	6 (16%)	18 (34%)	41 (50%)	42 (31%)	15 (24%)	53 (52%)	13 (29%)	69 (46%)	257 (38%)
Invasive coronary angiography	7 (18%)	14 (26%)	42 (51%)	30 (22%)	22 (35%)	49 (48%)	15 (33%)	52 (34%)	231 (35%)

Supplemental Table 2. Percent Changes in Cardiac Diagnostic Testing Procedure Volumes, by Type of Procedure, Region, and Type of Facility

	TTE		TEE		CMR		PET Infection		CAC		CCTA		Invasive		Stress Tests												Total	
															ECG		SPECT		PET		Echo		CMR		All Stress			
Region																												
Africa	-78	-58	-77	-28	-81	115			-61	65	-63	-4	-59	-24	-72	-12	-81	-20	-50	140	-81	-19	-100	300	-78	-16	-76	-42
Eastern Europe	-57	9	-40	27	-60	17	-68	-20	-60	13	-69	-1	-65	-27	-80	3	-84	-6	-100	33	-64	78	-23	-3	-77	11	-63	0
Far East	-38	-6	-46	31	-38	25	-16	26	-79	85	-43	25	-60	26	-73	26	-21	0	39	433	-76	-28	39	59	-53	13	-43	7
Latin America	-75	-9	-69	1	-73	23	-90	353	-85	-16	-70	-2	-57	-4	-84	-23	-80	-34	-92	129	-82	-26	-73	8	-82	-26	-78	-17
Middle East & South Asia	-79	-21	-82	-45	-84	-27	-90	-84	-69	45	-61	-15	-75	-46	-86	-62	-79	-31	-84	-43	-81	-63	-97	-41	-82	-49	-79	-33
US & Canada	-63	11	-78	16	-57	47	-68	-7	-89	8	-61	21	-65	34	-88	1	-77	0	-57	32	-82	-5	-67	36	-78	3	-68	13
Southeast Asia & Pacific	-46	37	-56	4	-31	50	-8	42	-61	23	-45	-19	-43	-20	-67	-34	-53	-29			-74	-2	-73	-46	-62	-24	-51	4
Western Europe	-60	-7	-70	51	-73	6	-52	61	-74	4	-61	15	-51	2	-80	-3	-67	-4	-66	22	-82	91	-73	42	-74	12	-63	3
Type of facility*																												
Hospital Inpatient Only	-53	36	-63	-14	-69	92	-79	31	-38	91	-49	13	-50	-22	-71	-5	-73	-19	-70	28	-72	-13	-71	-7	-71	-10	-56	16
Hospital Inpatient and Outpatient	-59	-6	-72	20	-63	18	-64	25	-85	14	-54	14	-62	1	-83	-18	-72	-16	-69	22	-81	0	-68	31	-77	-12	-64	-3
Hospital Outpatient Only	-3	280			-57	57	-40	131	-81	-22	-62	-6			-85	-49	-83	18							-82	6	-70	39
Outpatient Imaging Center	-57	-10			-46	120			-66	72	-52	12			-83	-19	-77	-33			2	92	-64	-19	-82	-21	-74	-14
Outpatient Physician Practice	-53	88	-69	283	-64	216	-64	-13	-65	8	-60	12	-51	43	-60	34	-60	-2	-34	36	-79	10	-60	125	-59	14	-57	36
Teaching Center Status																												
Teaching	-57	-6	-68	20	-61	23	-64	16	-82	17	-52	15	-60	-3	-80	-12	-73	-12	-63	25	-78	-12	-65	31	-80	-17	-62	-2
Non-teaching	-63	9	-73	20	-73	20	-61	52	-80	25	-61	9	-64	14	-84	-22	-70	-29	-57	21	-84	31	-74	13	-76	-9	-70	0
Number of beds																												
Lowest Tertile	-68	-19	-76	0	-79	-9	-83	13	-78	2	-66	-9	-62	-25	-83	-34	-78	-30	-78	-26	-82	27	-76	12	-81	-22	-72	-19
Middle Tertile	-62	-4	-71	-4	-64	13	-47	-4	-75	15	-55	16	-59	-5	-85	-14	-78	-18	-57	16	-79	-26	-65	51	-79	-15	-66	-4
Highest Tertile	-53	4	-69	42	-56	39	-65	28	-90	25	-50	18	-63	18	-80	4	-68	-10	-71	45	-85	-6	-66	32	-74	-2	-59	8
Income level																												
Low	-75	-50	-100	-100									-57	-57	-98	-55	-100	200							-98	-43	-74	-52
Lower-middle	-79	-41	-60	-40	-66	-10	-67	-60	-72	69	-58	-23	-72	-53	-81	-52	-87	-32	-79	-63	-75	-58	-30	-12	-81	-46	-77	-42
Upper-middle	-57	-1	-71	100	-67	32	-77	243	-82	35	-54	18	-69	7	-84	-16	-79	-33	-87	98	-80	-6	-73	9	-82	-19	-67	-1
High	-55	3	-70	13	-62	22	-63	10	-82	8	-54	14	-53	9	-80	-8	-66	-5	-61	28	-81	16	-69	38	-73	1	-60	5

For each procedure type, the left column shows percent change in procedure volume from March 2019 to April 2020, while the right column shows percent change in procedure volume from= March 2019 to April 2021.
Colors and shading of individual cells were performed in Excel using a continuous 3-color scale with minimum value -100 colored red, midpoint 0 colored yellow, and maximum 100 colored green; thus darkest red denotes -100% change in procedure volume i.e. number of procedures decreased to 0, light yellow denotes no change, and darkest green denotes +100% or greater change.
*Percent changes are not displayed when baseline (2019) procedure volumes < 25, since a small change in absolute number can result in oversized percent changes (e.g. 1 CMR in 2019 to 10 in 2021 would have been shown as a 1000% increase)
Number of beds only includes hospital facilities.

Supplemental Table 3. COVID-19 Testing policies

	Africa	Eastern Europe	Far East	Latin America	Middle East & South Asia	United States and Canada	S.E. Asia & the Pacific	Western Europe	Worldwide
Prior to stress testing									
All patients	7 (19%)	12 (24%)	16 (20%)	14 (11%)	17 (27%)	31 (31%)	4 (9%)	30 (20%)	131 (20%)
Non-vaccinated only	4 (11%)	4 (8%)	3 (4%)	11 (8%)	7 (11%)	17 (17%)	1 (2%)	12 (8%)	59 (9%)
No patients	25 (69%)	35 (69%)	61 (76%)	108 (81%)	38 (61%)	53 (52%)	38 (88%)	105 (71%)	463 (71%)
Prior to noninvasive cardiac imaging									
All patients	8 (23%)	13 (25%)	14 (18%)	13 (10%)	14 (23%)	17 (17%)	2 (5%)	22 (15%)	103 (16%)
Non-vaccinated only	3 (9%)	4 (8%)	6 (8%)	6 (5%)	8 (13%)	9 (9%)	1 (2%)	10 (7%)	47 (7%)
No patients	24 (69%)	35 (67%)	59 (75%)	113 (86%)	38 (63%)	75 (74%)	39 (93%)	115 (78%)	498 (77%)
Prior to transesophageal echocardiography									
All patients	12 (41%)	24 (53%)	32 (42%)	38 (32%)	26 (51%)	73 (74%)	7 (18%)	74 (59%)	286 (49%)
Non-vaccinated only	2 (7%)	4 (9%)	2 (3%)	6 (5%)	8 (16%)	10 (10%)	1 (3%)	8 (6%)	41 (7%)
No patients	15 (52%)	17 (38%)	43 (56%)	73 (62%)	17 (33%)	16 (16%)	32 (80%)	43 (34%)	256 (44%)
Prior to diagnostic cardiac catheterization									
All patients	16 (55%)	35 (74%)	47 (60%)	41 (36%)	34 (64%)	71 (71%)	9 (23%)	84 (65%)	337 (57%)
Non-vaccinated only	0 (0%)	4 (9%)	2 (3%)	6 (5%)	4 (8%)	11 (11%)	0 (0%)	9 (7%)	36 (6%)
No patients	13 (45%)	8 (17%)	29 (37%)	67 (59%)	15 (28%)	18 (18%)	31 (78%)	37 (28%)	218 (37%)

Percentages in columns may not sum to 100% due to rounding.

Supplemental Table 4. Impact of Healthcare Worker Stress on Patient Care in Facilities Performing and Not Performing Advanced Imaging

	Performs CT, MRI, or PET		
Impact of psychological stress on patient care	No n=194	Yes n=467	Total n=661
None	45 (23%)	98 (21%)	143 (22%)
Mild	80 (41%)	235 (50%)	315 (48%)
Moderate	46 (24%)	103 (22%)	149 (23%)
Profound	23 (12%)	31 (7%)	54 (8%)

P-value for Pearson chi-square = 0.060

Supplemental Table 5: Impact of Staff Furloughs and Layoffs on Procedure Volumes and Psychological Stress by World Region

	Procedure volume change from March 2019 to April 2021 (%)			Clinical staff with excess psychological stress related to pandemic (%)*		
	Staffing changes	No staffing changes	P	Staffing changes	No staffing changes	P
Africa	20 (11.8, 26.2)	20.6 (-69.5, 39.2)	0.73	20 (10, 50)	30 (10, 60)	0.53
Eastern Europe	8.9 (-54.5, 26.7)	-2.9 (-105.3, 17.5)	0.49	13 (8, 50)	25 (10, 70)	0.50
Far East	0 (-452.4, 25.3)	-8.3 (-43.5, 8.9)	0.83	15 (10, 70)	25 (10, 60)	0.86
Latin America	21.6 (-16.7, 45.2)	18.8 (-19.6, 46.7)	0.92	50 (20, 80)	30 (20, 60)	0.21
Middle East and	43.7 (7.9, 50)	41.6 (16.4, 62.1)	0.73	25 (15, 50)	30 (10, 60)	0.55
North America	-8.9 (-19.8, 2.9)	0 (-14.1, 14.3)	0.11	30 (10, 50)	30 (20, 80)	0.46
South East Asia	8 (-4.6, 10.2)	6.9 (-8.6, 33.3)	0.75	26 (0, 50)	10 (0, 50)	0.93
Western Europe	-5.1 (-25.3, 13)	-1 (-21.2, 19.7)	0.77	18 (8, 55)	20 (5, 50)	0.84
Worldwide	*7.2 (-16.7, 35.7)*	*2.6 (-21.4, 29.0)*	0.40	*30 (10, 60)*	*30 (10, 50)*	0.25

Values shown as median (interquartile range)
*Physician staff

Supplemental Table 6: Association of Country and Facility Factors with Procedure Volume Recovery Rate

	Univariable analysis				Multivariable analysis			
		95% CI				95% CI		
Variables	Mean volume change*	Lower	Upper	*P*	Mean volume change*	Lower	Upper	*P*
Low- or low-middle-income country	-36.4	-53.1	-19.7	<0.001	-28.1	-45.4	-10.8	0.002
Pandemic-related psychological stress**	-0.25	-0.42	-0.09	0.002	-0.2	-0.4	-0.1	0.004
Hospital facility	-11.1	-28.2	5.9	0.200	-10.4	-26.4	5.6	0.202
Baseline procedure volume	-0.17	-0.44	0.11	0.240	-0.15	-0.41	0.11	0.253
Vaccination rate	0.49	0.30	0.68	<0.001	0.39	0.20	0.59	<0.001
Teaching facility***	-2.9	-14.8	8.9	0.629				

*Percentage change that can be expected in the mean volume recovery. For example, in multivariable analysis, mean volume recovery is 30.9% lower in low- or lower-middle income countries than in upper-middle- or high-income countries, and every increase in 1% of estimated physicians in cardiac diagnostic testing with excess psychological stress is expected to decrease mean volume recovery of a facility by an additional 0.24%.
**Reported estimate of the percentage of physicians in cardiac diagnostic testing with excess psychological stress related to pandemic
***Independent variables with p-value > 0.25 in univariable analysis were excluded from the full multivariable model.

Country Participation

We used IAEA-specific coding for world regions. Specifically, region participation included the following countries:

- **Africa** (n=14 countries): Algeria, Burkina Faso, Egypt, Ghana, Kenya, Mali, Mauritania, Mauritius, Morocco, Niger, Nigeria, South Africa, Sudan, Uganda
- **Eastern Europe** (n=21 countries): Albania, Armenia, Belarus, Bosnia - Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, Poland, Republic of North Macedonia, Republic of Slovenia, Romania, Russian Federation, Serbia, Slovak Republic, Ukraine, Uzbekistan
- **Far East** (n=7 countries): Cambodia, Japan, Mongolia, People's Republic of China, Philippines, Republic of Korea, Vietnam
- **Latin America** (n=19 countries): Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Panama, Paraguay, Peru, Uruguay, Venezuela
- **Middle East and South Asia** (n=15): India, Iraq, Islamic Republic of Iran, Israel, Jordan, Kuwait, Lebanon, Nepal, Oman, Pakistan, People's Republic of Bangladesh, Qatar, Saudi Arabia, Sri Lanka, Yemen
- **North America** (n=2 countries): Canada, United States of America
- **South East Asia and the Pacific** (n=9 countries): Australia, Brunei Darussalam, Indonesia, Malaysia, Myanmar, New Zealand, Papua New Guinea, Singapore, Thailand
- **Western Europe** (n=20 countries): Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Italy, Malta, Monaco, Netherlands, Norway, Portugal, Republic of Ireland, Spain, Sweden, Switzerland, Turkey, United Kingdom

INCAPS COVID 2: IAEA Noninvasive CArdiology Protocols Survey 2 on the impact of COVID-19 on cardiac imaging practices and working conditions

Kindly complete no more than one survey from each laboratory/centre. We ask individuals within each centre to talk with their colleagues and share the information so that only one survey is completed per facility. If you are affiliated with multiple laboratories/centres, we would be grateful if you would complete the survey separately for each. The deadline for completing the survey is July 16.

About Yourself

* Your First/Given Name (Example: Diana)

* Your Family Name/Surname (Example: Paez)

Your Title (example: MD, PhD)

* Would you like to be listed as a member of INCAPS COVID Investigators Group for publications? ◯ Yes ◯ No

* Your Email

Your Telephone Number (include country code)

* Your Profession (choose one, reflecting your major specialty)

- ◯ Cardiologist
- ◯ Radiologist
- ◯ Nuclear Medicine Physician
- ◯ Technologist/Radiographer
- ◯ Nurse Practitioner
- ◯ Physician Assistant
- ◯ Physicist
- ◯ Other

* Cardiac modality/modalities practiced

☐ CT ☐ SPECT ☐ PET ☐ Echocardiography ☐ MRI ☐ Interventional Cardiology ☐ Invasive Cardiology ☐ EP

Number of years post-training performing cardiac imaging/testing

About second individual who contributed data to this survey

* Is there a second individual who contributed data to this survey and would like to be listed as a member of INCAPS COVID Investigators Group for publications? ◯ Yes ◯ No

Their First/Given Name (Example: Rodrigo)

Their Family Name/Surname (Example: Cerci)

Their Title(s) (Example: MD)

Their Email:

About Your Facility

* Name of Facility

* Type of Site

- ◯ Hospital Inpatient
- ◯ Hospital Mixed Inpatient/Outpatient
- ◯ Hospital Outpatient
- ◯ Outpatient Facility With Physician Practices
- ◯ Outpatient Imaging-only Facility
- ◯ Emergency Department
- ◯ Observation Unit

* University-Affiliated Teaching Facility? ◯ Yes ◯ No

Number of beds (if Hospital):

Address

* *Country/Administrative Area* — Choose one of the following...

Province/State/Territory — Choose one of the following...

Province/State/Territory

* *City*

Zip Code/Postal Code

How do you characterize the institution's supply of the following materials to meet the needs of cardiac diagnostic testing during the pandemic, comparing 2021 to 2020?

	Always Been Sufficient	Insufficient at times, more available in 2021 than 2020	Insufficient at times, similar in 2021 and 2020	Insufficient at times, less available in 2021 than 2020	Never Available
Surgical Masks	○	○	○	○	○
N95/KN95/KF94/FFP2 Masks	○	○	○	○	○
Gloves	○	○	○	○	○
Gowns	○	○	○	○	○
Eye Shielding	○	○	○	○	○

Laboratory/Facility

For each of the following activities, with reference to cardiac diagnostic testing, please select whether your laboratory or facility uses it:

	Currently Using	Has Used but Not Currently Using	Has Not Used
Extended hours compared to pre-pandemic	○	○	○
New weekend hours compared to pre-pandemic	○	○	○
Reduced hours compared to pre-pandemic	○	○	○
Systemic approach to rescheduling/testing patients whose studies were cancelled/postponed due to pandemic	○	○	○
Use telehealth for patient interaction aspects (registration, consent)	○	○	○
Use remote reading/reporting of studies (telehealth)	○	○	○
Use telehealth for review of studies with referring providers	○	○	○

Patients/Visitors

For each of the following, with reference to cardiac diagnostic testing modalities during the COVID-19 pandemic, please select whether the laboratory or facility is currently using it, has used it at some time during the pandemic but is not currently using it, or has not used it during the pandemic:

	Currently Using	Has Used but Not Currently Using	Has Not Used
Alteration in patient transport, e.g. spacing use of elevators	○	○	○
Change in waiting areas to allow physical distancing	○	○	○
Separate spaces for patients with and without COVID-19	○	○	○
Reduced patient time in waiting room	○	○	○
Limitation of accompanying family members and/or visitors	○	○	○
Temperature measurements for all patients/visitors	○	○	○
Screening questionnaire to all patients/visitors	○	○	○
Test for COVID19 in patients prior to all diagnostic testing	○	○	○
Test for COVID19 in patients prior to some diagnostic testing	○	○	○
Require cloth/surgical mask for all patients/visitors	○	○	○

Testing protocols

For each of the following, with reference to cardiac diagnostic testing modalities during the COVID-19 pandemic, please select whether the laboratory or facility is currently using it, has used it at some time during the pandemic but is not currently using it, or has not used it during the pandemic:

	Currently Using	Has Used but Not Currently Using	Has Not Used
Pharmacologic stress testing preferred over exercise to reduce risk of COVID-19 transmission	○	○	○
Allocate additional time for each study to allow for thorough cleaning/disinfection between patients	○	○	○
Expedited imaging protocols	○	○	○
- SPECT myocardial perfusion imaging (e.g. stress-first/stress-only)	○	○	○
- PET myocardial perfusion imaging (e.g. shorter protocols)	○	○	○
- MRI (e.g. single gadolinium injection for MRI)	○	○	○
- CT (e.g. modify rate control protocols such as increased use of pre-scan oral beta blocker)	○	○	○
- Transthoracic echocardiography (e.g. focused exam)	○	○	○
- Transesophageal echocardiography (e.g. focused exam)	○	○	○
- Catheterization (e.g. limited views)	○	○	○

For each of the following, with reference to cardiac diagnostic testing modalities on April 30, 2021, please select which patients are required to undergo COVID-19 testing prior to undergoing cardiac diagnostic testing.

	All Patients	Just Non-Vaccinated Patients	No Patients
Test patients for COVID-19 prior to stress testing	○	○	○
Test patients for COVID-19 prior to noninvasive cardiac imaging	○	○	○

Test patients for COVID-19 prior to transesophageal echocardiography	○	○	○
Test patients for COVID-19 prior to diagnostic cardiac catheterization	○	○	○

Staff Conditions

For each of the following, with reference to cardiac diagnostic testing modalities during the COVID-19 pandemic, please select whether the laboratory or facility is currently using it, has used it at some time during the pandemic but is not currently using it, or has not used it during the pandemic:

	Currently Using	Has Used but Not Currently Using	Has Not Used
Limiting staff proximity to patients	○	○	○
Mandating personal protective equipment	○	○	○
Altering or eliminating protocols requiring close patient contact for extended time	○	○	○
Rotating staff work shifts	○	○	○

Psychological stress

Please answer the following three questions regarding pandemic-related psychological stress.

What percentage of non-physician clinical staff in cardiac diagnostic testing would you estimate have excess psychological stress related to the pandemic?

What percentage of physicians in cardiac diagnostic testing would you estimate have excess psychological stress related to the pandemic?

How has pandemic-related psychological stress in staff members impacted patient care in your cardiac diagnostic testing practice?

- ○ No Impact
- ○ Mild Impact
- ○ Moderate Impact
- ○ Profound Impact

Employment

For each of the following activities, with reference to cardiac diagnostic testing modalities during the COVID-19 pandemic, please select whether the laboratory or facility is currently using it, has used it at some time during the pandemic but is not currently using it, or has not used it during the pandemic:

	Currently Using	Has Used but Not Currently Using	Has Not Used
Temporarily furloughed (placed on unpaid leave) some cardiac testing physicians due to economic crisis from COVID-19	○	○	○
Temporarily furloughed (placed on unpaid leave) some cardiac testing staff due to economic crisis from COVID-19	○	○	○
Reduced salaries of some imaging physicians due to economic crisis from COVID-19	○	○	○
Reduced salaries of some cardiac testing staff due to economic crisis from COVID-19	○	○	○
Laid off/fired some cardiac testing physicians due to economic crisis from COVID-19	○	○	○
Laid off/fired some cardiac testing staff due to economic crisis from COVID-19	○	○	○

Procedure Number Estimates

* Did you participate in the INCAPS COVID-19 survey last year? If "Yes", please ignore columns "March 2019", "April 2020" and focus on the data for April 2021. Visit a page to check the list of the participants ◯ Yes ◯ No

This is the last page of the survey, and the most important data being collected. Please estimate the number of procedures in each category performed in your facility for each of the following months. Kindly speak with colleagues in these areas if you do not have sufficient expertise to estimate with reasonable accuracy. If you are unable to obtain the information, you can leave a cell blank. Thank you for your help in completing the survey.

	March 2019	April 2020	April 2021
Stress ECG (treadmill or bicycle, no imaging)			
Stress Echocardiogram			
Stress SPECT Myocardial Perfusion Imaging			
Stress PET Myocardial Perfusion Imaging			
Stress Cardiac MRI			
CT Coronary Artery Calcium Scoring Alone			
CT Coronary Angiography (with or without Calcium Scoring)			
Transthoracic Echocardiogram (TTE, rest)			
Transesophageal Echocardiogram (TEE)			
PET for Endocarditis Evaluation			
Cardiac MRI (without stress)			
Invasive Coronary Angiography			

Submit survey