AUTHORS’ CONTRIBUTIONS

J. Castillo García: concept, methodology, formal analysis, investigation, results, data management, drafting the manuscript, review and editing of the manuscript, supervision, project management. M.I. Barrionuevo Sánchez: concept, methodology, drafting the manuscript, supervision, project management. J.C. Sánchez-Salado: concept, methodology, review and editing of the manuscript, supervision, project management. C-S. Molina Mazón and D. Arbonés Arqué: methodology, writing, review and editing. Albert Ariza-Solé: concept, methodology, drafting the manuscript and review and editing of the manuscript, supervision, project management.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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### Table 1
Human and material resources and volume of activity according to hospital size

<table>
<thead>
<tr>
<th></th>
<th>Beds per hospital</th>
<th></th>
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<tr>
<td></td>
<td>&lt; 250</td>
<td>250-500</td>
<td>500-750</td>
<td>750-1000</td>
<td>&gt; 1000</td>
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<tr>
<td>Hospitals</td>
<td>4</td>
<td>9</td>
<td>11</td>
<td>15</td>
<td>13</td>
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<tr>
<td>Cardiology department, %</td>
<td>25</td>
<td>89</td>
<td>91</td>
<td>100</td>
<td>100</td>
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<tr>
<td>Attending cardiologists</td>
<td>3.5</td>
<td>13.1</td>
<td>23.1</td>
<td>28.2</td>
<td>29.3</td>
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<tr>
<td>Cardiovascular imaging unit, %</td>
<td>25</td>
<td>77.8</td>
<td>90.9</td>
<td>100</td>
<td>92.3</td>
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<tr>
<td>Attending physicians who perform imaging</td>
<td>1.4</td>
<td>3.7</td>
<td>4.1</td>
<td>4.7</td>
<td>5.4</td>
</tr>
<tr>
<td>Attending physicians who spend &gt; 50% of their time on imaging, %</td>
<td>100</td>
<td>72.3</td>
<td>74.2</td>
<td>82.8</td>
<td>68</td>
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<tr>
<td>Registered nurses in imaging</td>
<td>0.8</td>
<td>1.3</td>
<td>1.6</td>
<td>1.8</td>
<td>2.4</td>
</tr>
<tr>
<td>Imaging assistants</td>
<td>0.3</td>
<td>1.2</td>
<td>1.4</td>
<td>1.8</td>
<td>1.5</td>
</tr>
<tr>
<td>Diagnostic imaging technicians</td>
<td>0.3</td>
<td>0.6</td>
<td>0.5</td>
<td>0.6</td>
<td>0.6</td>
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<tr>
<td>Administrative staff in imaging</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
<td>0.7</td>
<td>0.9</td>
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<td>Janitors</td>
<td>0.3</td>
<td>0.3</td>
<td>0.7</td>
<td>1.2</td>
<td>0.9</td>
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<td>Echocardiography systems in cardiology</td>
<td>2.8</td>
<td>7.4</td>
<td>7.3</td>
<td>9.8</td>
<td>10.5</td>
</tr>
<tr>
<td>Echocardiography systems in imaging</td>
<td>2.3 (82)</td>
<td>3.9 (51)</td>
<td>4.3 (62)</td>
<td>6 (61)</td>
<td>5.9 (56)</td>
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<tr>
<td>Echocardiography studies</td>
<td>2,330</td>
<td>7,023</td>
<td>8,205</td>
<td>10,881</td>
<td>12,279</td>
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<tr>
<td>TTE/TEE/stress echocardiography, %</td>
<td>90/4/3</td>
<td>84/7/4</td>
<td>90/4/2</td>
<td>90/4/3</td>
<td>90/4/3</td>
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<tr>
<td>TEE probe</td>
<td>1</td>
<td>1.9</td>
<td>2.5</td>
<td>3.5</td>
<td>3.5</td>
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<tr>
<td>3D/STE machines, %</td>
<td>25/58</td>
<td>38/57</td>
<td>65/88</td>
<td>54/76</td>
<td>71/82</td>
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<tr>
<td>Echocardiography systems &gt; 10 y, %</td>
<td>15.4</td>
<td>18</td>
<td>37.4</td>
<td>39.2</td>
<td>28.3</td>
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<tr>
<td>CT studies</td>
<td>159</td>
<td>179</td>
<td>370</td>
<td>352</td>
<td>734</td>
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<tr>
<td>MRI studies</td>
<td>103</td>
<td>270</td>
<td>459</td>
<td>353</td>
<td>669</td>
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<tr>
<td>SPECT scans</td>
<td>10</td>
<td>300</td>
<td>308</td>
<td>436</td>
<td>550</td>
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<tr>
<td>MUGA studies</td>
<td>5</td>
<td>-</td>
<td>114</td>
<td>-</td>
<td>263</td>
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<tr>
<td>PET studies</td>
<td>10</td>
<td>-</td>
<td>15</td>
<td>16</td>
<td>33</td>
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</table>

3D, 3-dimensional; MUGA, multigated acquisition; PET, positron emission tomography; SPECT, single photon emission computed tomography; STE, speckle-tracking echocardiography; TEE, transesophageal echocardiography; TTE, transthoracic echocardiography. Unless otherwise indicated, values are expressed as No. No. (%) or median.

### Table 2
Comparison of cardiovascular imaging activity between II and Ill Spanish Cardiovascular Imaging Registry Surveys

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2020</th>
<th>Difference</th>
<th>P</th>
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<tr>
<td>Attending physicians in imaging</td>
<td>4.2</td>
<td>4.4</td>
<td>0.2</td>
<td>.54</td>
</tr>
<tr>
<td>Echocardiography</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Echocardiography systems in cardiology</td>
<td>7.6</td>
<td>8.6</td>
<td>1</td>
<td>.19</td>
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<tr>
<td>Echocardiography systems in cardiovascular imaging unit</td>
<td>4.7 (61.8)</td>
<td>5.0 (58.2)</td>
<td>0.3</td>
<td>.45</td>
</tr>
<tr>
<td>Echocardiography systems &gt; 10 y, %</td>
<td>25.4</td>
<td>26.6</td>
<td>1.2</td>
<td>.76</td>
</tr>
<tr>
<td>Studies</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Transsthoracic echocardiography</td>
<td>9.411</td>
<td>8.260</td>
<td>–1.151 (–12.2)</td>
<td>.04</td>
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<tr>
<td>Transesophageal echocardiography</td>
<td>435</td>
<td>502</td>
<td>67 (15.4)</td>
<td>.64</td>
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<tr>
<td>Stress echocardiography</td>
<td>340</td>
<td>275</td>
<td>–65 (–19.2)</td>
<td>.02</td>
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<tr>
<td>Computed tomography</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Studies</td>
<td>403</td>
<td>419</td>
<td>16 (4)</td>
<td>.61</td>
</tr>
<tr>
<td>Attending physicians</td>
<td>1.9</td>
<td>2.1</td>
<td>0.2</td>
<td>.61</td>
</tr>
<tr>
<td>Time spent, h/wk</td>
<td>10</td>
<td>12.5</td>
<td>2.5</td>
<td>.28</td>
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<tr>
<td>Age of systems, y</td>
<td>4.9</td>
<td>3.9</td>
<td>–1</td>
<td>.20</td>
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<td>Magnetic resonance imaging</td>
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<td>Studies</td>
<td>428</td>
<td>422</td>
<td>–6 (–1.4)</td>
<td>.83</td>
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<tr>
<td>Attending physicians</td>
<td>1.9</td>
<td>2.1</td>
<td>0.2</td>
<td>.54</td>
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<tr>
<td>Time spent, h/wk</td>
<td>12.7</td>
<td>12.3</td>
<td>–0.4</td>
<td>.87</td>
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<tr>
<td>Age of systems, y</td>
<td>5.9</td>
<td>5.8</td>
<td>–0.1</td>
<td>.91</td>
</tr>
<tr>
<td>Nuclear medicine</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>SPECT studies</td>
<td>578</td>
<td>503</td>
<td>–75 (–13)</td>
<td>.43</td>
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<tr>
<td>MUGA studies</td>
<td>165</td>
<td>119</td>
<td>–46 (–28.5)</td>
<td>.12</td>
</tr>
<tr>
<td>PET studies</td>
<td>50</td>
<td>39</td>
<td>–11 (–22)</td>
<td>.07</td>
</tr>
</tbody>
</table>

MRI, magnetic resonance imaging; MUGA, multigated acquisition; PET, positron emission tomography; SPECT, single photon emission computed tomography. Unless otherwise indicated, values are expressed as No. No. (%) or median.

Comparison between 50 hospitals that participated in both surveys (7.7% had < 250 beds, 17.3% had 250-500 beds, 21.2% had 500-750 beds, 28.8% had 750-1000 beds, and 25% had > 1000 beds).
piece 2 (FFP2) masks, and 52% of personal protective equipment (PPE). Eighty-three percent cut their activity by at least 50% and restricted tests involving a high risk of infection to emergency situations. In subsequent waves of the pandemic, 71% of hospitals did not implement measures to reduce activity and 60% applied extraordinary measures to catch up with backlogs (61% increased working hours/volume of activity and 29% modified indications). Just over half of the hospitals (52%) recovered prepandemic response times. Most echocardiographic studies of patients with COVID-19 were performed by cardiovascular imaging staff (63% studied unstable patients and 87% studied unstable patients). The most common indications were clinical instability, clinical suspicion of myocarditis, thromboembolism, infective endocarditis, and elevated myocardial injury markers in blood tests. Use of cardiac CT scanning as an alternative to transesophageal echocardiography, stress echocardiography, and invasive coronary angiography increased in 20% of hospitals. Seventeen hospitals performed cardiac MRI in patients with COVID-19; the indications were acute infection in 46% of cases and follow-up of persistent symptoms in 54%. At the time of the survey, 73% of hospitals continued to use FFP2 masks and PPE and required polymerase chain reaction tests before transesophageal and stress echocardiograms.

Registries are essential tools for standardizing and reducing variability in health care. The current findings complement other initiatives such as the RECALCAR (Resources and Quality in Cardiology Units) project. The results of the third edition of the Spanish Cardiovascular Imaging survey reflect the impact of the COVID-19 pandemic and in particular show a reduction in echocardiography and nuclear medicine practice. They also highlight the continuing trend for echocardiographic studies to be performed outside cardiovascular imaging units and for focus cardiac ultrasound examination to be performed by noncardiologists. Improvements continued to be noted in a number of areas, notably the performance of echocardiography studies outside cardiovascular imaging units, increasing accreditation rates for certain techniques, and a growing use of advanced imaging techniques with low annual volumes in most hospitals.

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None

**AUTHORS’ CONTRIBUTIONS**

Design: M. Barreiro-Pérez, L. J. Jiménez-Borreguero, A. Martínez-Monzonis. Data collection and analysis and preparation of draft manuscript: M. Barreiro-Pérez. All the authors critically reviewed the manuscript.

**CONFLICTS OF INTEREST**

None declared.

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