

**CORRESPONDENCE**

# Hospital care of patients with inherited cardiomyopathies in Germany during the Covid-19 pandemic insights from the German-wide Helios hospital network

To the Editor

While there are numerous reports (Anderson et al., 2020, Baum & Schwartz, 2020, Bollmann, Hohenstein, et al., 2020, Bollmann, Pellissier, et al., 2020) that describe hospital admissions and care pathways for several medical and surgical conditions during the Covid-19 pandemic, there are only very limited publications that have addressed the continuity of care for patients with genetic disorders during the pandemic (Elmonem et al., 2020, Pereira et al., 2020).

Thus, a recent paper in this journal (Hamad et al., 2020) not only recommended measures for the efficient care of patients with genetic disorders during the pandemic but suggested also to study the impact of Covid-19 on diagnosis, management, and treatment of genetic disorders. Although this paper focused on low- and middle-income countries, we believe that due to scarcity of data the latter applies also to upper-middle-income countries. With this research correspondence, we wish to complement this report by providing up-to-date hospitalization and management data for patients with inherited cardiomyopathies, namely, hypertrophic (HCM) and arrhythmogenic right ventricular cardiomyopathy (ARVC).

We performed a retrospective analysis of claims data of Helios hospitals in Germany. The Helios hospital group operates metropolitan and regional acute care hospitals ranging from basic to maximum care, outpatient clinics, and prevention centers across Germany (<https://www.helios-gesundheit.de/>). Patients have free choice of healthcare providers independent of insurance status. Helios hospitals provide inpatient care to about 1.2 million patients annually that corresponds to about 7% of all hospitalizations in Germany.

Consecutive cases with an in- or outpatient hospital admission between January 3 and November 19, 2020 (study period) were analyzed and compared to a corresponding period covering the same weeks in 2019 (control period). Cause-specific hospitalizations were defined on the basis of primary discharge diagnosis according to International Statistical Classification of Diseases and Related Health Problems [ICD-10-GM (German Modification)] codes for HCM (I42.1, I42.2) and ARVC (I42.80). Interventional treatments were defined according to the German procedure classification ("Operationen und Prozedurenschlüssel," OPS) for catheter ablations (8-835), implantation of cardiac rhythm management devices (CRM devices; pacemakers, defibrillators and event recorders; 5-377, 5-378) and transcatheter ablation of septal hypertrophy (8-837.70).

This study was approved by the Ethics Committee at the Medical Faculty, Leipzig University (#490/20-ek).

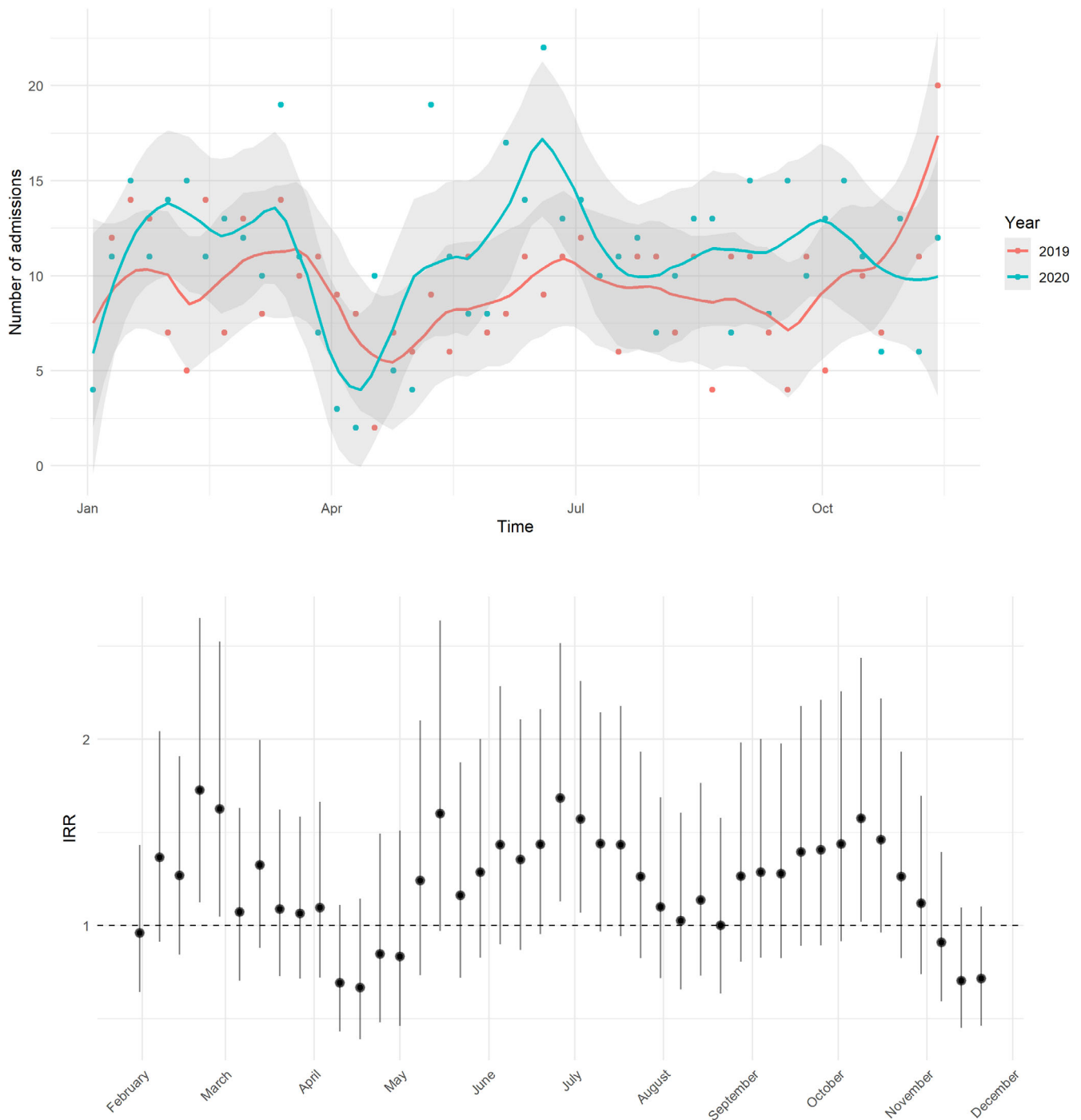
Incidence rates for admissions and treatments were calculated by dividing the number of cumulative events by the number of weeks for each time period. Incidence-rate ratios (IRRs) or odds ratios (ORs) were calculated using Poisson regression to model the number of hospitalizations and logistic regression to model the proportions of treatments per period, respectively. To identify short-term admission trends over time, rolling IRRs were calculated for 4-week intervals with 3-week overlap resulting in one IRR every week. Inferential statistics were based on generalized linear mixed models specifying hospitals as random factor. We report IRR or OR (calculated by exponentiation of the regression coefficients) together with 95% confidence intervals (CIs) for the comparisons of the different periods and *p* values for the interactions. The *p* values were adjusted for multiple comparisons using a Benjamin-Hochberg correction and a two-tailed 5% error criterion for significance was applied.

A total of 948 hospital admissions (512 in 2020 and 436 in 2019) in 54 hospitals (median 4 hospitalizations/hospital, IQR [2, 11]) were included. There were 861 HCM (461 in 2020 and 400 in 2019) and 87 ARVC cases (51 in 2020 and 36 in 2019). There was a decrease in hospitalizations between mid-March and early April 2020 but, using sliding 4-week IRR, this was not statistically different compared to 2019 (Figure 1).

In total, more weekly hospitalizations (10.9 vs 9.3, OR [IRR] 1.17 (95% CI 1.03–1.32, *p* = .01) were observed in 2020 than in 2019 (Figure 1 and Table 1). The magnitude was similar for in- and outpatient hospitalizations but significant only for the latter. There were no interactions between change in hospitalization and patient characteristics or hospitalization type (Table 1).

Patient characteristics are summarized in Table 2 and were comparable between 2019 and 2020 with respect to age, sex, and comorbidities. There were no cases with confirmed (U7.1) or suspected (U7.2) SARS-CoV-2 infection in the study cohort.

In-hospital treatments and outcomes are also summarized in Table 2 and were comparable between 2019 and 2020 with respect to CRM device implantation (OR 0.75, 95% CI 0.42–1.32, *p* = 0.32), catheter ablation (OR 1.76, 95% CI 0.16–19.56, *p* = 0.65), and transcatheter ablation of septal hypertrophy (OR 1.03, 95% CI 0.47–2.29, *p* = 0.93) as well as length of hospital stay and in-hospital mortality (OR 0.43, 95% CI 0.08–2.39, *p* = 0.34).



**FIGURE 1** Left: Total weekly hospital admissions. Smooth curves for weekly admission rates were fitted via locally weighted scatterplot smoothing with a degree of smoothing of  $\alpha = .25$ . Gray areas represent 95% confidence intervals (CIs). Right: Rolling incidence-rate ratios of hospitalizations in 4-week intervals with 95% CI. Please note that there was no significant deficit interval during 2020 [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.com)]

In contrast to previous studies (Anderson et al., 2020, Baum & Schwartz, 2020, Bollmann, Hohenstein, et al., 2020, Bollmann, Pellissier, et al., 2020) that found reduced hospitalizations for several medical and surgical conditions during the Covid-19 pandemic, hospital care was not disrupted overall in patients with inherited cardiomyopathies in the largest German-wide hospital network. On the

contrary, there were slightly more cases in 2020 compared with 2019. In addition, care pathways with respect to interventional treatments, length of stay, and in-hospital mortality were not affected during the 2020 pandemic.

Non-urgent admissions and procedures had to be postponed in Germany between March 16 and end of April, 2020 which coincides

|                                                       | 2019<br>N = 436 | 2020<br>N = 512 | Incidence-rate ratio (95%<br>confidence interval) | p for<br>interaction |
|-------------------------------------------------------|-----------------|-----------------|---------------------------------------------------|----------------------|
| Total                                                 | 9.3             | 10.9            | 1.17 (1.03–1.33)                                  |                      |
| Main diagnosis                                        |                 |                 |                                                   |                      |
| Arrhythmogenic right<br>ventricular<br>cardiomyopathy | 0.8             | 1.1             | 1.42 (0.92–2.17)                                  |                      |
| Hypertrophic<br>cardiomyopathy                        | 8.5             | 9.8             | 1.15 (1.01–1.32)                                  | .71                  |
| Hospitalization type                                  |                 |                 |                                                   |                      |
| Inpatient                                             | 4.1             | 4.6             | 1.14 (0.94–1.38)                                  |                      |
| Outpatient                                            | 5.2             | 6.3             | 1.20 (1.01–1.42)                                  | .83                  |
| Age                                                   |                 |                 |                                                   |                      |
| ≤64 years                                             | 6.0             | 7.6             | 1.26 (1.08–1.47)                                  |                      |
| 65–74 years                                           | 1.6             | 1.8             | 1.13 (0.83–1.55)                                  | .78                  |
| ≥75 years                                             | 1.7             | 1.5             | 0.90 (0.65–1.24)                                  | .26                  |
| Sex                                                   |                 |                 |                                                   |                      |
| Male                                                  | 5.4             | 6.8             | 1.26 (1.07–1.48)                                  |                      |
| Female                                                | 3.9             | 4.1             | 1.05 (0.87–1.29)                                  | .57                  |
| Charlson comorbidity index                            |                 |                 |                                                   |                      |
| 0–1                                                   | 7.4             | 8.9             | 1.21 (1.05–1.39)                                  |                      |
| 2–4                                                   | 1.5             | 1.6             | 1.10 (0.80–1.52)                                  | .78                  |
| ≥5                                                    | 0.4             | 0.3             | 0.83 (0.42–1.65)                                  | .71                  |

**TABLE 1** Hospitalizations for inherited cardiomyopathies in the German-wide Helios hospital network during the Covid-19 pandemic

|                                          | 2019N = 436 | 2020N = 512 | p value   |     |
|------------------------------------------|-------------|-------------|-----------|-----|
| Patient characteristics                  |             |             |           |     |
| ≤64 years                                | 64.9 (283)  | 69.7 (357)  | .45       |     |
| 65–74 years                              | 17.2 (75)   | 16.6 (85)   | .98       |     |
| ≥75 years                                | 17.9 (78)   | 13.7 (70)   | .45       |     |
| Female sex                               | 42.0 (183)  | 37.7 (193)  | .63       |     |
| CCI score 0–1                            | 79.8 (348)  | 82.0 (420)  | .81       |     |
| CCI score 2–4                            | 16.1 (70)   | 15.0 (77)   | .97       |     |
| CCI score ≥ 5                            | 4.1 (18)    | 2.9 (15)    | .81       |     |
| Hypertension                             | 30.0 (131)  | 28.7 (147)  | .97       |     |
| Cardiac arrhythmias                      | 21.6 (94)   | 21.5 (110)  | .98       |     |
| Obesity                                  | 9.6 (42)    | 9.2 (47)    | .98       |     |
| Diabetes mellitus                        | 7.6 (33)    | 4.5 (23)    | .45       |     |
| Chronic kidney disease                   | 11.0 (48)   | 10.4 (53)   | .98       |     |
| Treatments                               |             |             |           |     |
| Catheter ablation                        | 0.5 (1)     | 0.9 (2)     | .81       |     |
| Cardiac rhythm management device implant | 16.2 (31)   | 12.4 (27)   | .56       |     |
| TASH <sup>a</sup>                        | 16.8 (17)   | 18.8 (25)   | .93       |     |
| Outcomes                                 |             |             |           |     |
| In-hospital mortality                    |             | 2.1 (4)     | 0.9 (2)   | .56 |
| Length of stay, days                     |             | 4.8 ± 4.0   | 5.3 ± 5.4 | .29 |

**TABLE 2** Patient characteristics, in-hospital interventional treatments, and mortality in % (n) unless otherwise specified

Abbreviation: CCI, Charlson comorbidity index.

<sup>a</sup>transcatheter ablation of septal hypertrophy in patients with hypertrophic obstructive cardiomyopathy (ICD code 42.1).

with the observed, non-significant decrease in admissions but overall this seemed not to affect the care of those cohorts. The increase in HCM cases supports a previous study from our group that has shown prevalence of clinically diagnosed HCM in Germany to be lower than in systematic population studies with a parallel prevalence increase between 2011 and 2015 (Husser et al., 2018). In addition, changes in workup of patients with cardiac conditions may have occurred during the pandemic but are not accounted for in this study. Both factors may have increased the diagnostic awareness and yield. Finally, (post-Covid-19) myocarditis mimicking HCM cannot be ruled out in selected cases (Giagfaglione et al., 2020).

This is also in stark contrast to the very few studies focusing on diagnosis and management of patients with genetic disorders that are, moreover, limited to short observation periods. For instance, a survey conducted in 11 countries in Europe, Asia, and Africa found a 60%–80% decline of reported inborn errors of metabolism and a profound impact on patient management between March 1 and May 31, 2020 (Elmonem et al., 2020). In another report from New York City, outpatient genetics services were sustained by changes in workflow, e.g. change to teleconsultation, that was offered to 156 clinical genetics/cancer patients in 1 month, similar as compared with regular visits (Pereira et al., 2020).

As claims data are primarily used for administrative, financial, and reimbursement purposes it lacks important detail information such as admission cause (aside from primary and secondary diagnoses) or potential disease causing mutations. Although HCM and ARVC diagnoses are usually made according to current diagnostic criteria, misdiagnosis/misreading cannot be ruled out. However, since this would probably equally affect study and control cohorts, overall results and conclusions would therefore remain the same. Moreover, there are no specific ICD codes for certain inherited cardiomyopathies such as dilatative or restrictive cardiomyopathy of left ventricular non-compaction that could therefore not be studied.

In summary, this correspondence adds to the evolving knowledge of management of genetic disorders by providing real-world data on the hospital care of inherited cardiomyopathies in Germany during the Covid-19 pandemic and complements the previous call for more data published here (Hamad et al., 2020).

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#### CONFLICT OF INTEREST

None declared.

#### AUTHOR CONTRIBUTION

Study conception and design: Daniela Husser, Ralf Kuhlen, Andreas Bollmann; data collection: Andreas Meier-Hellmann, Ralf Kuhlen; data analysis: Vincent Pellissier, Sven Hohenstein; draft manuscript preparation: Daniela Husser, Andreas Bollmann; all authors reviewed the results, made critical revisions and approved the final version of the manuscript.

#### DATA AVAILABILITY STATEMENT

Helios Health and Helios Hospitals have strict rules regarding data sharing because of the fact that health claims data are a sensible data source and have ethical restrictions imposed due to concerns regarding privacy. Access to anonymized data that support the findings of this study are available on request from the Leipzig Heart Institute ([www.leipzig-heart.de](http://www.leipzig-heart.de)).

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