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FACTORS ASSOCIATED WITH READMISSION OF PATIENTS WITH CONGENITAL HEART DISEASE IN A SWISS UNIVERSITY HOSPITAL

Running title: Readmission of patients with congenital heart disease

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ABSTRACT

Background: Congenital heart defects (CHD) lead to extensive use of healthcare resources. Still, there is little information available regarding readmission rates or associated factors. We sought to evaluate readmission rates and their determinants among patients with CHD hospitalized in a Swiss university hospital.

Methods: Retrospective study using data from all non-adult (<18 years) patients hospitalised between 2002 and 2014 at the University Hospital of Lausanne with an International Classification of Diseases (ICD) version 10 code Q20 to Q25.

Results: 996 patients (460 girls, 332 undergoing surgery, mean age 2.7 years) were assessed, 96 of whom (9.6%) were readmitted within 30 days after discharge. Among the 96 readmissions, 83 (86.5%) were related to the CHD. Median time to readmission was 10 days (interquartile range: 6 - 20) and median length of readmission was 12 days (interquartile range: 6 - 20). After multivariate adjustment, foreign nationality, greater distance to hospital and length of index hospitalisation <14 days predisposed to readmission. Patients who underwent surgery were less likely to be readmitted (8.7%).

Conclusion: Readmissions were frequent, almost 1 in 10 patients, and associated with several socio-clinical factors. Providing patients who live far from hospital with specialized care closer to home may help reduce the rate of readmission.

Keywords: Congenital heart disease; readmission; Switzerland.

INTRODUCTION

Congenital heart disease (CHD) is the most common form of congenital anomaly, with a live birth prevalence ranging from 5 [1,2] to over 50 per 1,000 live births [2,3]. Patients with CHD consume considerable medical resources [4,5], leading to high healthcare costs. Hospital readmission rates are now widely cited as a surrogate measure of quality of care and of healthcare costs [6]. Indeed, several studies have shown that almost 7% of children are readmitted to hospital within 30 days of discharge [7], but only a few studies conducted in North America assessed readmission rates and determinants among CHD patients [8-11]. Assessing the factors associated with readmission rates is important in order to act upon them and to reduce unnecessary hospitalisations and health costs. Importantly, none of the studies took place in Europe.

Thus, our objectives were 1) to evaluate the rate of readmission among patients with CHD and 2) to analyse the factors associated with readmission.

MATERIALS AND METHODS

Data sources and collection

The Lausanne university hospital (Centre Hospitalier Universitaire Vaudois, CHUV) is large university hospital with over 1,200 beds dedicated to the care of patients living in the canton of Vaud and neighbour cantons. The CHUV has a unit specialized in paediatric CHD, and performs approximately 200 surgeries per year on CHDs. Data were extracted from the hospital records and included gender, age at examination, country of birth, canton of residence, length of stay (LOS) and all other disease codes. Readmissions were considered if the patient was readmitted ≤30 days after his/her previous hospitalization; if a patient had multiple readmissions, only the first one was considered. Due to logistic constraints (no national database on hospital stays and lack of harmonization of data between hospitals), the analysis had to be restricted to a single hospital, a procedure also performed in other studies [9,10].

All hospitalizations with an International Classification of Diseases (ICD-10) code ranging from Q20 to Q25 recorded between the 1st of January 2002 and 30th of March 2014 at the CHUV were considered. The exact list of the ICD-10 codes included is provided in **Supplementary Table 1.**

Inclusion and exclusion criteria

Inclusion criteria were age at admission <18 years, living in Switzerland and CHD as the main cause for hospitalization. As the CHUV participates in humanitarian actions aimed at children with CHD, patients coming from other countries to benefit from CHD surgery at the CHUV were excluded. Finally, all adult (aged ≥18 years) patients were also excluded.

Statistical analysis

Statistical analyses were performed using Stata version 14.0 for Windows (Stata Corp, College Station, Texas, USA). Descriptive results were expressed as number of participants (percentage), as mean ± standard deviation or as median and [interquartile range - IQR] as appropriate. Bivariate analyses were performed using chi-square or Fisher's exact test for qualitative variables and Student's t-test or Kruskall-Wallis test for continuous variables. Multivariate analysis for readmission was performed using logistic regression and the results were expressed as Odds ratio (OR) and 95% confidence interval (CI). Tests were two-tailed and statistical significance was assessed for $p<0.05$.

Ethical statement

The study was approved by the *Commision cantonale d'éthique de la recherche sur l'être humain* (protocol number 32/14; decision issued January 30th, 2014). No informed individual consent was necessary as the study used only available administrative data.

RESULTS

Comparison between excluded and included patients

Overall, data from 1919 patients with CHD were extracted, of whom 645 (33.6%) were aged ≥18 years and 278 (14.5%) were from humanitarian actions. Thus, the final sample included 996 patients (51.9% of the initial extracted sample), of whom 332 (33.3%) were hospitalized for surgery. The characteristics of the final sample overall and according to surgery are summarized in **table 1**. Over two-thirds of hospitalizations for non-surgical reasons included children aged less than one year; similarly, over half of hospitalizations for non-surgical reasons included children with congenital malformations of cardiac septa (**Table 1**). A multivariate analysis showed age less than one year, congenital malformations of cardiac septa, of aortic and mitral valves and other congenital malformations of heart to be significantly and positively associated, while living far from hospital to be inversely associated with hospitalization for non-surgical reasons (**Supplementary Table 2**).

Factors associated with readmission

Of the 996 patients, 96 (9.6%) were readmitted within 30 days, 83 of which (86.5% of readmissions, 8.3% of all patients) with CHD as main diagnosis. Median [IQR] time to readmission was 10 [6 – 20] days and median [IQR] LOS for the readmission was 12 [6 – 20] days.

The bivariate association between readmission for CHD or for any cause and different socio-clinical factors is summarized in **table 2**. Patients of non-Swiss nationality or living in a canton far from Vaud had a higher readmission rate, as well as being discharged in the beginning of the week (Monday or Tuesday); conversely, index hospitalizations with a LOS>14 days had a lower readmission rate (**Table 2**). These findings were partly confirmed by multivariate analysis, where benefiting from surgery and LOS>14 days were significantly associated with a lower odds of readmission for CHD, while living in a canton far from Vaud was associated with a higher odds of readmission for CHD or any other cause (**table 3**).

Restricting the analysis to surgical patients showed day of discharge to be significantly associated with readmission on bivariate analysis (**supplementary table 3**), while no associations were found on multivariate analysis (**supplementary table 4**).

DISCUSSION

Our results indicate that almost one out of ten children with CHD are readmitted 30 days after a hospitalization; longer LOS of the index hospitalization and being hospitalized for surgery are associated with a lower odds of readmission, while living far from the hospital was associated with a higher likelihood of readmission.

Most hospitalizations for non-surgical reasons regarded very young children (<1 year) with mild forms of CHD. Hence, it is likely these hospitalizations regarded mainly newly diagnosed CHD in hospitalized newborns that do not need (neonatal) surgery. Unfortunately it was not possible to confirm this hypothesis, as the data was anonymized prior to extraction and no access to the individual medical files could be obtained.

Readmission rates

Of the 996 patients, 96 (9.6%) were readmitted within 30 days, 83 of which (8.3% of all patients) with CHD as main diagnosis . These values are slightly lower than in reported by studies conducted in North America, where readmission rates ranged from 10.5% [8] to 14.1% [11]. Among surgical patients, the readmission rate was 8.7%, again lower than reported by studies that excluded all non-surgical patients (i.e. Kogon et al with 10.8% [10], Saharan et al [9] with 11.3%, and Smith et al [8] with 10.5%).

The vast majority of the patients of our study (86.5%) were readmitted on basis of a cardiac diagnosis, which is higher than reported in the literature, where values range from 14.9% [10] to 58.7% [11]. Among surgical patients, 75.9% of the readmissions were caused by a cardiac diagnosis, again higher than in studies including only surgical patients [9,10,8] (14.9% for Kogon et al [10],

24.8% for Smith et al [8], and 39.1% for Saharan et al [9]). A possible explanation is that issues unrelated to the underlying CHD are managed close to the patient's home, hospitalizations in the CHUV being conducted only if related to the CHD. As there is no centralized database with medical records in canton Vaud, it is not possible to control if patients were hospitalized elsewhere. Further, it was not possible to individually interview each patient after hospitalization. Thus, future studies should try to prospectively assess status at 30 days after hospitalization among children with CHD so to include all hospitalizations occurring outside the university hospital.

Factors associated with readmission

Median time to readmission was 10 days, comparable to other studies, where median time to readmission ranged from 7 [9] to 12 days [11].

Patients hospitalized for surgery had lower readmission rates, a finding consistent with the literature [10,11]. A likely explanation is that paediatric surgical wards prepare more intensively the patients and their families to manage the disease than other wards, thus preventing readmissions. Other explanations include the corrective nature of surgical procedure for CHD, reducing the hemodynamic anomalies that lead to complications and therefore readmission to hospital.

There is no consensus in the literature regarding day of discharge and risk of readmission: some studies reported a higher risk for end-of-week discharges [11], other studies reported a higher risk for weekday discharges [8], and other studies found no association at all [12]. In our study, discharges occurring in the beginning of the week were associated with a higher risk of readmission on bivariate analysis, although this was no longer statistically significant after multivariate analysis. Thus, our results suggest that readmission rates are not related to day of discharge.

Contrary to the literature, a longer LOS was associated with a lower risk of readmission. This finding was surprising, as all studies conducted so far reported that an initial hospital LOS over 10 days was associated with a higher risk of readmission [9,10,8,11]. A possible explanation is certain

reluctance among paediatricians to discharge children at the end of a week after an index hospitalisation for CHD, which would artificially lengthen the index stay. A longer LOS could also be related to a better preparation of the patient and the family to manage the disease, thus leading to a lower readmission rate. Still, it would be of interest to assess the reasons for a longer LOS and if it is related with a better preparation of the patient and the family. Another explanation is the natural timeline of complications after CHD surgery, namely the fact that pleural [13] and pericardial [14] [15] effusions usually occur within two weeks of surgery. Thus, patients who remain in hospital for 14 days can have their complications treated within the same hospital stay, whereas patients discharged earlier need to be readmitted for the management of their post-operative complication.

Patients living far from the hospital had a higher readmission risk than patients who live in the canton of Vaud. This could in part be explained by the fact that patients living far from the CHUV being sent because they present with more severe or complex disease or with more comorbidities, while patients presenting with a milder disease can be managed in their local hospital. Indeed, patients living far from the hospital had a higher prevalence of congenital malformations of cardiac septa (including tetralogy of Fallot) and congenital malformations of aortic and mitral valves (**Supplementary table 5**). Still, this higher risk persisted even after adjustment for type of disease, suggesting that other factors not accounted for might intervene. A first possible explanation is that, because of the disease, patients and their families prefer to come (or are even sent by their local caregivers) to a tertiary, university hospital in case of any complication. Another possible explanation is that patients who live far from the CHUV have had less follow-up due to lack of specialized care in their area. Interestingly, the CHUV has developed specialized consultations in other hospitals outside the Vaud canton, and it will be interesting to assess their impact on readmission rates among patients living far from the CHUV.

Study limitations

The main limitation to our study is the small sample size, with few patients undergoing surgery, leading to a relatively low statistical power. Still, our study is the first one performed in Europe and the sample size is bigger than other studies on the same topic [9,10]. The fact that it was conducted in a single institution might reduce its generalizability; still, most studies on the same topic were also conducted within a single institution [9,10] or a single region [11]. Other limitations are the lack of readmission data in other hospitals, thus precluding comparisons; also, the retrospective character does not allow studying the reasons for readmission. Finally, a possible referral bias cannot be ruled out, as our institution is a referring centre for management of children with congenital heart disease; hence, it is possible that only children with the most severe forms of disease are overrepresented. Further studies are needed to increase sample size, for example by joining all data from Switzerland.

Conclusion

In a Swiss university hospital, slightly less than one out of ten children with CHD is readmitted within 30 days after the index hospitalization. Distance from hospital and shorter LOS significantly increase the risk of readmission.

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TABLES

Table 1: characteristics of the sample, overall and according to surgery.

	All	No surgery	Surgery	P-value
N (%)	996 (100)	664 (66.7)	332 (33.3)	
Gender (%)				0.472
Boys	536 (53.8)	352 (65.8)	184 (34.2)	
Girls	460 (46.2)	312 (67.8)	148 (32.2)	
Swiss nationality (%)				0.416
No	438 (44.0)	286 (65.3)	152 (34.7)	
Yes	558 (56.0)	378 (67.7)	180 (32.3)	
Age (years)	2.7 ± 4.4	2.2 ± 3.9	3.8 ± 5.0	<0.001
Age groups (%)				<0.001
[0-1[	615 (61.8)	454 (73.8)	161 (26.2)	
[1-18[	381 (38.3)	210 (55.1)	171 (44.9)	
Type of disease §				<0.001
Q20	97 (9.7)	56 (57.7)	41 (42.3)	
Q21	531 (53.3)	380 (71.6)	151 (28.4)	
Q22	55 (5.5)	38 (69.1)	17 (30.9)	
Q23	66 (6.6)	26 (39.4)	40 (60.6)	
Q24	42 (4.2)	33 (78.6)	9 (21.4)	
Q25	205 (20.6)	131 (63.9)	74 (36.1)	
Length of stay (days)	6 [2 - 14]	4 [1 - 9]	10 [5.5 - 24.5]	<0.001 †

Results are expressed as number of participants (percentage), mean ± SD or median [interquartile range]. Percentage are expressed per column for all participants, and by row for surgery / non-surgery groups. Comparisons between surgery groups performed by chi-square for categorical values and Student's t-test or Kruskal-Wallis (†) test; p-values are for a two-sided test. § ICD-10 codes: Q20, congenital malformations of cardiac chambers and connections; Q21, congenital malformations of cardiac septa; Q22, congenital malformations of pulmonary and tricuspid valves; Q23, congenital malformations of aortic and mitral valves; Q24, other congenital malformations of heart; Q25, congenital malformations of great arteries.

263 **Table 2**: bivariate analysis of the factors associated with readmission at 30 days for congenital heart
264 disease or for any cause, non-adult patients with congenital heart disease hospitalized at the
265 Lausanne university hospital between 1st of January 2002 and 30th of March 2014.

	Congenital heart disease			Any cause		
	No	**Yes**	**P-value**	**No**	**Yes**	**P-value**
N	913	83		900	96	
Gender (%)			0.592			0.773
Girl	424 (46.4)	36 (43.4)		417 (46.3)	43 (44.8)	
Boy	489 (53.6)	47 (56.6)		483 (53.7)	53 (55.2)	
Surgery (%)			0.168			0.494
No	603 (66.1)	61 (73.5)		597 (66.3)	67 (69.8)	
Yes	310 (34.0)	22 (26.5)		303 (33.7)	29 (30.2)	
Age groups (%)			0.087			0.345
[0-1[	571 (62.5)	44 (53.0)		560 (62.2)	55 (57.3)	
[1-18[	342 (37.5)	39 (47.0)		340 (37.8)	41 (42.7)	
Nationality (%)			0.008			0.057
Not Swiss	390 (42.7)	48 (57.8)		387 (43.0)	51 (53.1)	
Swiss	523 (57.3)	35 (42.2)		513 (57.0)	45 (46.9)	
Type of disease §			0.235 †			0.521 †
Q20	90 (9.9)	7 (8.4)		89 (9.9)	8 (8.3)	
Q21	475 (52.0)	56 (67.5)		471 (52.3)	60 (62.5)	
Q22	52 (5.7)	3 (3.6)		51 (5.7)	4 (4.2)	
Q23	62 (6.8)	4 (4.8)		59 (6.6)	7 (7.3)	
Q24	40 (4.4)	2 (2.4)		40 (4.4)	2 (2.1)	
Q25	194 (21.3)	11 (13.3)		190 (21.1)	15 (15.6)	
Canton of origin			0.004			0.034
Vaud	546 (59.8)	42 (50.6)		540 (60.0)	48 (50.0)	
Neighbour ‡	238 (26.1)	18 (21.7)		231 (25.7)	25 (26.0)	
Other	129 (14.1)	23 (27.7)		129 (14.3)	23 (24.0)	
LOS>14 days (%)			0.005			0.055
No	677 (74.2)	73 (88.0)		670 (74.4)	80 (83.3)	
Yes	236 (25.9)	10 (12.0)		230 (25.6)	16 (16.7)	
Day of discharge			0.009 †			0.039 †
Sunday	51 (5.6)	3 (3.6)		50 (5.6)	4 (4.2)	

Monday	184 (20.2)	27 (32.5)	182 (20.2)	29 (30.2)
Tuesday	217 (23.8)	27 (32.5)	214 (23.8)	30 (31.3)
Wednesday	150 (16.4)	7 (8.4)	147 (16.3)	10 (10.4)
Thursday	111 (12.2)	11 (13.3)	110 (12.2)	12 (12.5)
Friday	136 (14.9)	6 (7.2)	133 (14.8)	9 (9.4)
Saturday	64 (7)	2 (2.4)	64 (7.1)	2 (2.1)

Results are expressed as number of participants and (column percentage). Statistical analysis by chi-square or Fisher's exact test (†); p-values are for a two-sided test. § ICD-10 codes: Q20, congenital malformations of cardiac chambers and connections; Q21, congenital malformations of cardiac septa; Q22, congenital malformations of pulmonary and tricuspid valves; Q23, congenital malformations of aortic and mitral valves; Q24, other congenital malformations of heart; Q25, congenital malformations of great arteries. ‡, Fribourg, Geneva, Neuchâtel and Valais.

Table 3: multivariate analysis of the factors associated with readmission at 30 days for congenital heart disease or for any cause, non-adult patients with congenital heart disease hospitalized at the Lausanne university hospital between 1st of January 2002 and 30th of March 2014.

	CHO	p-value	Any cause	p-value
Gender				
Girl	1 (ref.)		1 (ref.)	
Boy	1.1 (0.68 - 1.77)	0.693	1.05 (0.67 - 1.62)	0.844
Surgery				
No	1 (ref.)		1 (ref.)	
Yes	0.49 (0.25 - 0.97)	0.042	0.63 (0.34 - 1.18)	0.153
Age groups				
[0-1[	1 (ref.)		1 (ref.)	
[1-18[	0.97 (0.56 - 1.69)	0.916	0.83 (0.49 - 1.40)	0.491
Nationality				
Not Swiss	1 (ref.)		1 (ref.)	
Swiss	0.62 (0.38 - 1.02)	0.062	0.70 (0.44 - 1.10)	0.124
Type of disease §				
Q20	1 (ref.)		1 (ref.)	
Q21	1.08 (0.45 - 2.62)	0.861	1.19 (0.52 - 2.73)	0.680
Q22	0.55 (0.13 - 2.33)	0.418	0.75 (0.21 - 2.71)	0.661
Q23	0.74 (0.19 - 2.82)	0.655	1.36 (0.44 - 4.22)	0.589
Q24	0.60 (0.11 - 3.16)	0.545	0.55 (0.11 - 2.82)	0.477
Q25	0.62 (0.22 - 1.72)	0.357	0.81 (0.32 - 2.04)	0.659
Canton of origin				
Vaud	1 (ref.)		1 (ref.)	
Neighbour ‡	1.31 (0.70 - 2.44)	0.401	1.50 (0.86 - 2.60)	0.152
Other	2.96 (1.56 - 5.61)	0.001	2.34 (1.27 - 4.31)	0.006
LOS>14 days				
No	1 (ref.)		1 (ref.)	
Yes	0.42 (0.20 - 0.91)	0.028	0.63 (0.33 - 1.19)	0.156
Day of discharge				
Sunday	1 (ref.)		1 (ref.)	
Monday	3.06 (0.85 - 10.9)	0.086	2.35 (0.76 - 7.26)	0.138
Tuesday	2.72 (0.77 - 9.62)	0.121	2.07 (0.68 - 6.30)	0.202

Wednesday	0.94 (0.23 - 3.89)	0.936	0.96 (0.28 - 3.26)	0.945
Thursday	2.22 (0.58 - 8.52)	0.247	1.60 (0.48 - 5.34)	0.441
Friday	0.99 (0.23 - 4.20)	0.991	1.00 (0.29 - 3.44)	0.996
Saturday	0.74 (0.12 - 4.72)	0.754	0.47 (0.08 - 2.71)	0.398

CHO, congenital heart disease. Results are expressed as odds ratio and [95% confidence interval]. § ICD-10 codes: Q20, congenital malformations of cardiac chambers and connections; Q21, congenital malformations of cardiac septa; Q22, congenital malformations of pulmonary and tricuspid valves; Q23, congenital malformations of aortic and mitral valves; Q24, other congenital malformations of heart; Q25, congenital malformations of great arteries. ‡, Fribourg, Geneva, Neuchâtel and Valais.

SUPPLEMENTARY DATA

Supplementary table 1: international classification of diseases (ICD-10) codes used to define congenital heart disease.

ICD-10 code	Designation
Q20	Congenital malformations of cardiac chambers and connections
Q21	Congenital malformations of cardiac septa
Q22	Congenital malformations of pulmonary and tricuspid valves
Q23	Congenital malformations of aortic and mitral valves
Q24	Other congenital malformations of heart
Q25	Congenital malformations of great arteries

Supplementary table 2: factors associated with hospitalization for non-surgical reasons

	Odds ratio and (95% CI)	P-value
Gender		
Girl	1 (ref)	
Boy	0.96 (0.73 - 1.27)	0.790
Swiss national		
No	1 (ref)	
Yes	1.06 (0.79 - 1.43)	0.684
Canton		
Vaud	1 (ref)	
Neighbour	0.51 (0.37 - 0.71)	<0.001
Distant	0.62 (0.41 - 0.92)	0.019
Age group		
1+ year	1 (ref)	
<1 year	2.16 (1.61 - 2.91)	<0.001
Type of disease §		
Q20	1 (ref)	
Q21	1.84 (1.16 - 2.93)	0.010
Q22	1.60 (0.78 - 3.29)	0.198
Q23	0.52 (0.27 - 1.00)	0.049
Q24	2.75 (1.16 - 6.51)	0.021
Q25	1.34 (0.81 - 2.23)	0.258

Results are expressed as odds ratio and (95% confidence interval). Statistical analysis by logistic regression. § ICD-10 codes: Q20, congenital malformations of cardiac chambers and connections; Q21, congenital malformations of cardiac septa; Q22, congenital malformations of pulmonary and tricuspid valves; Q23, congenital malformations of aortic and mitral valves; Q24, other congenital malformations of heart; Q25, congenital malformations of great arteries.

Supplementary table 3: bivariate analysis of the factors associated with readmission at 30 days for congenital heart disease or for any cause, surgical patients with congenital heart disease hospitalized at the Lausanne university hospital between 1st of January 2002 and 30th of March 2014.

	Congenital heart disease			Any cause		
	No	**Yes**	**P-value**	**No**	**Yes**	**P-value**
N	310	22		303	29	
Gender (%)			0.932			0.977
Girl	138 (44.5)	10 (45.5)		135 (44.6)	13 (44.8)	
Boy	172 (55.5)	12 (54.6)		168 (55.5)	16 (55.2)	
Age groups (%)			0.768			0.716
[0-1[	151 (48.7)	10 (45.5)		146 (48.2)	15 (51.7)	
[1-18[	159 (51.3)	12 (54.6)		157 (51.8)	14 (48.3)	
Nationality (%)			0.393			0.914
Not Swiss	140 (45.2)	12 (54.6)		139 (45.9)	13 (44.8)	
Swiss	170 (54.8)	10 (45.5)		164 (54.1)	16 (55.2)	
Type of disease §			0.279 †			0.715 †
Q20	40 (12.9)	1 (4.6)		39 (12.9)	2 (6.9)	
Q21	135 (43.6)	16 (72.7)		133 (43.9)	18 (62.1)	
Q22	16 (5.2)	1 (4.6)		16 (5.3)	1 (3.5)	
Q23	39 (12.6)	1 (4.6)		37 (12.2)	3 (10.3)	
Q24	9 (2.9)	0 (0)		9 (3.0)	0 (0)	
Q25	71 (22.9)	3 (13.6)		69 (22.8)	5 (17.2)	
Canton of origin			0.746			0.939
Vaud	147 (47.4)	10 (45.5)		144 (47.5)	13 (44.8)	
Neighbour ‡	99 (31.9)	6 (27.3)		95 (31.4)	10 (34.5)	
Other	64 (20.7)	6 (27.3)		64 (21.1)	6 (20.7)	
LOS>14 days (%)			0.150			0.483
No	192 (61.9)	17 (77.3)		189 (62.4)	20 (69.0)	
Yes	118 (38.1)	5 (22.7)		114 (37.6)	9 (31.0)	
Day of discharge			0.019 †			0.058 †
Sunday	11 (3.6)	0 (0)		11 (3.6)	0 (0)	
Monday	52 (16.8)	8 (36.4)		50 (16.5)	10 (34.5)	
Tuesday	87 (28.1)	10 (45.5)		85 (28.1)	12 (41.4)	

Wednesday	50 (16.1)	3 (13.6)	49 (16.2)	4 (13.8)
Thursday	45 (14.5)	0 (0)	44 (14.5)	1 (3.5)
Friday	48 (15.5)	0 (0)	47 (15.5)	1 (3.5)
Saturday	17 (5.5)	1 (4.6)	17 (5.6)	1 (3.5)

Results are expressed as number of participants and (column percentage). Statistical analysis by chi-square or Fisher's exact test (†); p-values are for a two-sided test. § ICD-10 codes: Q20, congenital malformations of cardiac chambers and connections; Q21, congenital malformations of cardiac septa; Q22, congenital malformations of pulmonary and tricuspid valves; Q23, congenital malformations of aortic and mitral valves; Q24, other congenital malformations of heart; Q25, congenital malformations of great arteries. ‡, Fribourg, Geneva, Neuchâtel and Valais.

Supplementary table 4: multivariate analysis of the factors associated with readmission at 30 days for congenital heart disease or for any cause, surgical patients with congenital heart disease hospitalized at the Lausanne university hospital between 1st of January 2002 and 30th of March 2014.

	CHO	**p-value**	**Any cause**	**p-value**
Gender				
Girl	1 (ref.)		1 (ref.)	
Boy	1.21 (0.46 - 3.16)	0.700	1.08 (0.46 - 2.50)	0.866
Age groups				
[0-1[	1 (ref.)		1 (ref.)	
[1-18[	0.32 (0.10 - 1.07)	0.064	0.41 (0.14 - 1.17)	0.094
Nationality				
Not Swiss	1 (ref.)		1 (ref.)	
Swiss	0.63 (0.22 - 1.84)	0.401	0.91 (0.37 - 2.23)	0.839
Type of disease §				
Q20	1 (ref.)		1 (ref.)	
Q21	4.35 (0.48 - 39.8)	0.193	3.08 (0.58 - 16.5)	0.189
Q22	2.28 (0.11 - 46.0)	0.590	1.14 (0.08 - 15.6)	0.921
Q23	1.01 (0.05 - 18.8)	0.995	2.08 (0.29 - 15.0)	0.469
Q24	NA		NA	
Q25	1.26 (0.12 - 13.7)	0.850	1.23 (0.21 - 7.16)	0.818
Canton of origin				
Vaud	1 (ref.)		1 (ref.)	
Neighbour ‡	0.70 (0.22 - 2.26)	0.556	0.91 (0.35 - 2.33)	0.837
Other	1.28 (0.39 - 4.18)	0.679	0.97 (0.32 - 2.90)	0.952
LOS>14 days				
No	1 (ref.)		1 (ref.)	
Yes	0.52 (0.14 - 1.90)	0.323	0.88 (0.30 - 2.60)	0.822
Day of discharge				
Sunday	1 (ref.)		1 (ref.)	
Monday	3.34 (0.31 - 35.9)	0.320	4.53 (0.47 - 43.2)	0.190
Tuesday	2.16 (0.23 - 20.1)	0.497	2.85 (0.33 - 24.6)	0.340
Wednesday	1.27 (0.11 - 14.9)	0.849	1.84 (0.18 - 18.9)	0.607
Thursday	NA		0.43 (0.02 - 7.44)	0.561

Friday	NA	0.44 (0.03 - 7.65)	0.572
Saturday	NA	NA	

CHO, congenital heart disease. Results are expressed as odds ratio and (95% confidence interval). Statistical analysis by logistic regression . § ICD-10 codes: Q20, congenital malformations of cardiac chambers and connections; Q21, congenital malformations of cardiac septa; Q22, congenital malformations of pulmonary and tricuspid valves; Q23, congenital malformations of aortic and mitral valves; Q24, other congenital malformations of heart; Q25, congenital malformations of great arteries. ‡, Fribourg, Geneva, Neuchâtel and Valais. NA, not assessable.

Supplementary table 5: type of disease according to canton of residence.

	Vaud	Neighbour ‡	Other	P-value
N (%)	588 (59.0)	256 (25.7)	152 (15.3)	
Type of disease §				<0.001
Q20	40 (6.8)	36 (14.1)	21 (13.8)	
Q21	347 (59.0)	111 (43.4)	73 (48.0)	
Q22	29 (4.9)	16 (6.3)	10 (6.6)	
Q23	38 (6.5)	13 (5.1)	15 (9.9)	
Q24	23 (3.9)	16 (6.3)	3 (2.0)	
Q25	111 (18.9)	64 (25.0)	30 (19.7)	

Results are expressed as number of participants and (column percentage). Statistical analysis by chi-square; p-values are for a two-sided test. § ICD-10 codes: Q20, congenital malformations of cardiac chambers and connections; Q21, congenital malformations of cardiac septa; Q22, congenital malformations of pulmonary and tricuspid valves; Q23, congenital malformations of aortic and mitral valves; Q24, other congenital malformations of heart; Q25, congenital malformations of great arteries. ‡, Fribourg, Geneva, Neuchâtel and Valais.