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COVID-19 burden and influencing factors in Swiss long-term-care facilities: a cross-sectional analysis of a multicentre observational cohort

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Summary

OBJECTIVES: To describe the burden of COVID-19 in Swiss long-term care facilities in 2020, to identify its influencing factors, and to assess vaccination rates among residents and healthcare workers at the end of the vaccine campaign in Switzerland in May 2021.

DESIGN: Cross-sectional survey.

SETTING AND PARTICIPANTS: Long-term care facilities from two Swiss cantons (St. Gallen / Eastern Switzerland and Vaud / Western Switzerland).

METHODS: We collected numbers of COVID-19 cases and related deaths and all-cause mortality for 2020, potential risk factors at the institutional level (e.g. size, infection prevention and control measures, and resident characteristics), and vaccination rates among residents and healthcare workers. Univariate and multivariate analyses were used to identify factors associated with resident mortality in 2020.

RESULTS: We enrolled 59 long-term care facilities with a median of 46 (interquartile range [IQR]: 33–69) occupied beds. In 2020, the median COVID-19 incidence was 40.2 (IQR: 0–108.6) per 100 occupied beds, with higher rates in VD (49.9%) than in SG (32.5%; p = 0.037). Overall, 22.7% of COVID-19 cases died, of which 24.8% were COVID-19-related deaths. In the univariate analysis, higher resident mortality was associated with COVID-19 rates among residents (p < 0.001) and healthcare workers (p = 0.002) and age (p = 0.013). Lower resident mortality was associated with the proportion of single rooms (p = 0.012), isolation of residents with COVID-19 in single rooms (p = 0.003), symptom screening of healthcare workers (p = 0.031), limiting the number of visits per day (p = 0.004), and pre-scheduling visits (p = 0.037). In the multivariate analysis, higher resident mortality was only associated with age (p = 0.03) and the COVID-19 rate among residents (p = 0.013). Among 2936 residents, 2042 (69.9%) received ≥1 dose of the COVID-19 vaccine before 31 May 2021. Vaccine uptake among healthcare workers was 33.8%.

CONCLUSION AND IMPLICATIONS: COVID-19 burden was high but also highly variable in Swiss long-term care facilities. severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection among healthcare workers was a modifiable factor associated with increased resident mortality. Symptom screening of healthcare workers appeared to be an effective preventive strategy and should be included in routine infection prevention and control measures. Promoting COVID-19 vaccine uptake among healthcare workers should be a priority in Swiss long-term care facilities.

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Introduction

Long-term care facilities were disproportionally affected early in the coronavirus disease 2019 (COVID-19) pandemic [1], with high morbidity and mortality among residents [2] and several reported outbreaks [3]. Long-term care residents accounted for most COVID-19-related deaths in many countries. In Europe, long-term care facilities were the most common setting of COVID-19 outbreaks [3]. In Switzerland, long-term care residents accounted for almost half of all COVID-19-related deaths [4]. However, there is little systematic data about the COVID-19 burden in long-term care facilities, and information is mostly limited to outbreak reports [5].

Several factors contributing to the rapid spread of SARS-CoV-2 in long-term care facilities have been identified. They include resident-related factors, such as older age and comorbidities; institution-related factors, such as increased facility size and numbers of staff and residents; and community-related risk factors, such as compliance with infection prevention and control measures. Some of these factors are modifiable, and some are not [6]. However, why some institutions were so heavily affected while others were almost entirely spared is not fully understood.

While authorities imposed restrictive measures to mitigate the spread of SARS-CoV-2, such as restrictions on visits and social activities, evidence of their effectiveness remains limited. In most countries, including Switzerland, the vaccination of long-term care residents and their caring

staff was among the COVID-19 vaccination campaign's top priorities. However, in Switzerland, no systematic data on vaccination rates among residents or healthcare workers are available at an institutional or cantonal level.

This study aimed to estimate the COVID-19 burden in long-term care facilities of two Swiss Cantons in 2020 and to identify factors associated with COVID-19 burden and all-cause mortality among long-term care residents. Furthermore, it aimed to assess COVID-19 vaccination rates among residents and healthcare workers in long-term care facilities at the end of the COVID-19 vaccine campaign in Switzerland in May 2021.

Methods

Study design

This study involves a cross-sectional analysis of data retrieved from a multicentre observational cohort of long-term care facilities providing care to the elderly and/or individuals with dementia in two cantons in Eastern (St. Gallen) and Western (Vaud) Switzerland. This long-term care facility cohort was created at the end of May 2021 after the COVID-19 vaccination campaign in long-term care facilities (enrolment: 15 April to 31 May 2021). All long-term care facilities in these two cantons were invited to participate by email. The data included in this analysis retrospectively covers the period from February 2020 to May 2021.

Setting

In Switzerland, as a federal state, jurisdictions on infection control are shared between national and cantonal authorities, which have considerable autonomy in deciding which public health measures are mandatory and which are not. Throughout the COVID-19 pandemic, this led to considerable heterogeneity among cantons in recommendations on visitor regulation and infection prevention and control measures for long-term care facilities. For example, the canton of St. Gallen imposed a visit ban in long-term care facilities from 16 March to 11 May 2020, while the canton of Vaud never banned visits to long-term care facilities. Different measures were also imposed based on the different local epidemiology. COVID-19 incidence in the general population was higher in the canton of Vaud than in the canton of St. Gallen (6878 vs 4968 cases per 100,000 inhabitants) in 2020 [7]. In January 2021, a national vaccination campaign was started based on the mRNA vaccines Comirnaty and Spikevax. From January to March 2021, mobile medical teams provided on-site vaccination of long-term care residents and healthcare workers.

Data collection

At enrollment, participating institutions received an electronic link to a questionnaire implemented in the research electronic data capture (REDCap) web-based application for designing and managing online clinical research surveys and databases [8]. Data were collected from long-term care facilities managers or designated individuals. The survey included information on institutional characteristics, infection prevention and control practices, resident and staff characteristics, COVID-19 case numbers, and all-cause and COVID-19-related hospitalisations and deaths among residents in 2020 (see questionnaire available for download at https://doi.org/10.57187/smw.2023.40052). To compare all-cause mortality in 2020 with the previous year (see below), all-cause deaths in 2019 were obtained, and the number of occupied beds per facility in 2019 was retrieved from the Federal Office of Public Health (FOPH) website [9]. Institutions also reported the age, sex, care level needed, COVID-19 vaccination status, and infection history of each resident, and the COVID-19 vaccination status of healthcare workers as of 31 May 2021. The care level was optionally assessed according to the Swiss Health Care Services Regulations on a scale of 1 to 12, where 12 corresponded to the greatest assistance required in terms of time in daily living activities. All data were double-checked for plausibility by the study team and discussed with the institution when necessary.

Data analysis

To describe the COVID-19 burden, we calculated cumulative COVID-19, COVID-19-related hospitalisation, and COVID-19-related death rates and all-cause mortality among residents of the participating institutions in 2020. All rates were calculated as numbers per 100 occupied beds (as of 31 December 2020). The number of occupied beds was estimated by multiplying the total bed number by the average occupancy rate in 2020. Furthermore, all-cause mortality in 2020 was compared to that in 2019, which was calculated based on all-cause deaths in 2019 entered by the institutions and the number of occupied beds per facility in 2019 retrieved from the Swiss FOPH website.

COVID-19 rates among healthcare workersin 2020 were calculated as the number of COVID-19 cases per 100 healthcare workers. The number of healthcare workers was considered the number of healthcare workers employed at the time of the survey and therefore represents an estimate that does not account for staff fluctuations in 2020.

To identify possible risk factors for a higher COVID-19 burden, we investigated associations of facility characteristics, infection prevention and control measures, and resident characteristics with all-cause mortality among residents in 2020 in a univariate analysis. Questions 17, 18, 21, 22, and 23 (see questionnaire available as PDF for download) were merged into a single variable to classify the level of infection prevention and control practice development. Long-term care facilities with ≥4 'yes' answers were classified as having 'well-developed' hygiene guidelines and staff training on infection prevention and control. Based on a conceptual framework describing the relationships among predictor variables and between them and the 'all-cause resident mortality' outcome, we included relevant predictor variables in a multivariate model (see figure S1 for details).

We used all-cause mortality and not COVID-19 rates as the main outcome for this analysis to account for possible underdetection of COVID-19 cases due to different testing policies or capacities among long-term care facilities and their underreporting.

Finally, we assessed the COVID-19 vaccination rates of residents and healthcare workers as of 31 May 2021, as reported by the individual institutions.

Statistical analysis

Quantitative variables are presented as their median (interquartile range [IQR]). Categorical variables are summarised as absolute and relative (of the non-missing total) frequencies (range). COVID-19 case incidence, death, and vaccination rates were estimated by dividing the number of COVID-19 cases, deaths, or vaccinated residents by the number of occupied beds. The number of occupied beds was estimated by multiplying the number of beds by the average occupancy. Missing data were not replaced, and a complete case analysis was performed.

Descriptive statistics and incidence rates are presented separately for the entire sample and the two cantons. However, comparing the two cantons did not fall among the study's primary aims. Analysis of factors associated with all-cause mortality in 2020 (see below) was performed on the entire cohort.

We used univariable and multivariable quasi-Poisson regression analyses. The univariable analyses helped to identify factors associated with all-cause mortality in 2020. The multivariable model included factors that we believed had a possible causal impact on mortality: age, sex, care level, canton, and COVID-19 incidence in residents and healthcare workers. Canton served as a proxy for factors such as different healthcare-worker-to-resident ratios and recommendations at the cantonal level. COVID-19 incidence in healthcare workers was used as a proxy for undetected/asymptomatic additional COVID-19 incidence in residents (figure S1).

Residents' age, sex, and care level were aggregated using the median per institution (for age and care level) or the percentage of males (for sex). We did not correct *p*-values for multiple testing. Rate ratios (RR) were interpreted as follows. The RR for continuous predictors represents the change in the outcome for a one-unit increase in the independent variable. The RR for factor variables represents the change in the outcome compared to the reference category (i.e. a RR of 2 means that the incidence rate of the respective group is twice the incidence rate of the reference group). All analyses were performed with the R statistical software (version 4.0.2).

Ethics

Since resident data was collected anonymously or in aggregate form, this study did not fall within the scope of the Swiss Human Research Act. Therefore, no ethical approval was required, as confirmed by the local ethics committee (EKOS).

Results

Baseline characteristics

Of 212 eligible institutions of the cantons of St. Gallen and Vaud, 59 (33 in St. Gallen, 26 in Vaud) comprising 3372 beds (1887 in St. Gallen, 1485 in Vaud) participated in the study. In 2020, the overall occupancy rate was 96.0% (93.0–98.3), and the median number of occupied beds per long-term care facility was 46 (IQR: 33–69).

Baseline characteristics are shown in table 1. Baseline characteristics of the institutions, residents and staff members with missing data are shown in table S1 in the appendix. Among the 2936 residents living in the long-term care facilities on 31 May 2021, 2083 (70.2%) were women, and their median age was 87 years (IQR: 79–91). Their median care level was 7.0 (IQR: 4.0–9.0). Regarding infection prevention and control measures, few long-term care facilities reported regular testing of asymptomatic residents (6/59; 10.2%) or healthcare workers (14/59; 23.7%). Screening for COVID-19 symptoms was performed daily for residents in 25.4% (15/59) and healthcare workers in 33.9% (20/59) of institutions. Nearly half of the long-term care facilities (27/59; 45.8%) never banned visits or did so only during outbreaks. Regarding COVID-19 protective measures during patient care activities, 54/59 institutions (91.5%) reported that staff always wore gowns, while using other personal protective equipment (PPE; i.e. FFP2 masks, gloves, and goggles) was more variable.

COVID-19 cases and COVID-19-related and all-cause deaths among residents in 2020

In 2020, the overall COVID-19 incidence rate was 40.2 cases per 100 occupied beds, with significantly higher rates in Vaud than in St. Gallen (49.9% vs 32.5%; p = 0.037; figure 1). Rates varied widely among long-term care facilities, with 8/59 institutions (one in Vaud and seven in St. Gallen) reporting no COVID-19 cases.

All-cause deaths were 36.9 per 100 occupied beds in 2020 and 28.7 in 2019 (p = 0.014). The overall incidence of COVID-19-related deaths was 9.1 per 100 occupied beds. Overall, 22.7% of COVID-19 cases died, of which 24.8% were COVID-19-related deaths (Figure 2). In 2020, all-cause mortality was marginally higher in Vaud than in St. Gallen (39.0 vs 35.2; p = 0.48), whilst in 2019, it was higher in St. Gallen than in Vaud (30.4 vs 26.5 per 100 occupied beds; p = 0.23).

Factors associated with all-cause mortality 2020

The univariable associations between selected variables and all-cause mortality are shown in figure 3. Among resident characteristics, higher all-cause mortality was associated with older age (RR = 1.05, 95% confidence interval [CI]: 1.01–1.08; p = 0.013) but not sex or higher care level. In the univariate analysis, higher COVID-19 rates both among residents (RR = 1.009, 95% CI: 1.004–1.013; p < 0.001) and healthcare workers (RR = 1.013, 95% CI: 1.005–1.021; p = 0.002) correlated with increased resident mortality. The proportion of single rooms was associated with lower mortality (RR = 0.991 per 1% increase, 95% CI: 0.984–0.998; p = 0.012) as were the following infection prevention and control practices: isolation of residents with COVID-19 in single rooms (RR = 0.65, 95% CI: 0.49–0.85; p = 0.003), screening of staff for COVID-19 symptoms (RR = 0.69, 95% CI: 0.50–0.95; p = 0.031), and regulation of visits such as limiting the number per day (RR = 0.65, 95% CI: 0.49–0.87; p = 0.004) or scheduling visits in advance (RR = 0.74, 95% CI: 0.56–0.97; p = 0.037).

In the multivariate analysis, age (adjusted RR = 1.04) and COVID-19 rates among residents (adjusted RR = 1.008)

remained significantly associated with all-cause resident mortality (figure 4).

COVID-19 vaccination rates

Of the 2936 residents, 2042 (69.6%) received ≥1 dose of a COVID-19 vaccine as of 31 May 2021 (figure 4). Overall, 1747 (59.5%) were fully vaccinated, and 543 (18.7%) had a COVID-19 history and had received one vaccine dose. Additionally, 386 (13.8%) residents had a COVID-19 history but had not been vaccinated. COVID-19 vaccine uptake among healthcare workers was 33.8% (30.8% in St. Gallen and 36.9% in Vaud).

Discussion

This cross-sectional study of 59 Swiss long-term care facilities found their COVID-19 burden was high in 2020, with an overall incidence of all-cause deaths of 36.9 per 100 occupied beds, but also with high variability in mortality across institutions. Our main findings are the association between COVID-19 rates among residents and increased resident mortality. Factors such as routine symptom screening of healthcare workers, regulation of visits, the proportion of single rooms in the facility, and isolating COVID-19 patients in single rooms are potentially protective factors. This study's strengths include its large cohort, including institutions from two geographical regions with a large number of residents, and its consideration of a multiplicity of possible influencing factors.

Table 1:
Baseline characteristics of institutions, residents, and staff.

			Total	St. Gallen	Vaud
General institutions information					
Number of institutions			59	33 (55.9%)	26 (44.1%)
Number of beds			3372	1887 (55.9%)	1485 (44.1%)
Number of occupied beds (median [IQR])			46 (33, 69)	46.1 (32, 69.3)	47.5 (36.3, 63.6)
Percentage of single rooms (median [IQR])			96.8 (77.4, 100.0)	100.0 (89.5, 100.0)	92.4 (60.2, 100.0)
Infection control practices – number of institutions					
Hygiene guidelines and staff training on IPC		Does not exist or is underdeveloped	24 (40.7%)	22 (66.7%)	2 (7.7%)
		Well developed	35 (59.3%)	11 (33.3%)	24 (92.3%)
COVID-19 response and/or outbreak manager present in the institution			54 (91.5%)	30 (90.9%)	24 (92.3%)
Isolation of residents with COVID-19		Mostly/always	19 (32.2%)	11 (33.3%)	8 (30.8%)
		Rarely/never	40 (67.8%)	22 (66.7%)	18 (69.2%)
Personal protective Equipment – use by COVID-19 patients	FFP2 masks	Always	23 (39.0%)	18 (54.5%)	5 (19.2%)
		No or sometimes	36 (61.0%)	15 (45.5%)	21 (80.8%)
	Glows	Always	38 (64.4%)	29 (87.9%)	9 (34.6%)
		No or sometimes	21 (35.6%)	4 (12.1%)	17 (65.4%)
	Gowns	Always	54 (91.5%)	28 (84.8%)	26 (100.0%)
		No or sometimes	5 (8.5%)	5 (15.2%)	0 (0.0%)
	Goggles	Always	31 (52.5%)	21 (63.6%)	10 (38.5%)
		No or sometimes	28 (47.5%)	12 (36.4%)	16 (61.5%)
Visitor restrictions (visits not allowed)	No or only during outbreaks		27 (45.8%)	9 (27.3%)	18 (69.2%)
	Always or according to cantonal recommendations		32 (54.2%)	24 (72.7%)	8 (30.8%)
COVID-19 screening before (re-)admission			33 (55.9%)	21 (63.6%)	12 (46.2%)
Regular COVID-19 screening/testing (outside of outbreaks) of asymptomatic:	Residents		6 (10.2%)	5 (15.2%)	1 (3.8%)
	Staff members		14 (23.7%)	12 (36.4%)	2 (7.7%)
Residents, n			2862	1570	1292
Age (median [IQR])			87.0 (79.0, 91.0)	86.0 (80.0, 91.0)	87.0 (78.0, 92.0)
Male sex			854 (29.8%)	470 (29.9%)	384 (29.7%)
Care level according to the Swiss Health Care Services Regulations (Krankenpflege-Leistungsverordnung [KLV]) (median [IQR])			7.0 (4.0, 9.0)	4.0 (2.0, 7.0)	9.0 (7.0, 12.0)
Influenza vaccination, n	Season 2019/20		1228 (59.0%)	522 (44.1%)	706 (78.8%)
	Season 2020/21		1501 (63.0%)	643 (49.6%)	858 (79.2%)
Staff members					
Influenza vaccination (%, median [IQR])	Season 2019/20		17.2 (6.1, 44.4)	6.9 (0.8, 9.3)	46.2 (30.5, 67.6)
	Season 2020/21		13.8 (6.7, 34.0)	7.4 (0.0, 11.5)	34.2 (24.2, 44.0)
COVID-19 rates in 2020 (No. per 100 HCW), median (IQR)			21.04 (11.3, 33.9)	13.0 (5.2, 24.0)	24.0 (15.4, 38.9)
Work days lost due to COVID-19 due to COVID-19 or COVID-19-related isolation/quarantine per employee in 2020(median [IQR])			1.5 (0.7, 3.2)	2.7 (1.6, 4.2)	0.7 (0.3, 0.9)

IQR: interquartile range; HCW: healthcare workers; IPC: infection prevention and control

Figure 1: COVID-19 incidence, total deaths, and COVID-19-related mortality in 2020. Surviving COVID-19 cases (yellow bars), COVID-19-related deaths (blue bars), and total deaths (blank bars) per occupied bed are shown for each institution. Horizontal lines represent the medians of total COVID-19 cases (red line), COVID-19-related deaths (blue line), and total deaths (black line).COVID-19 rates >100% indicate high turnover rates of COVID-19-affected residents.

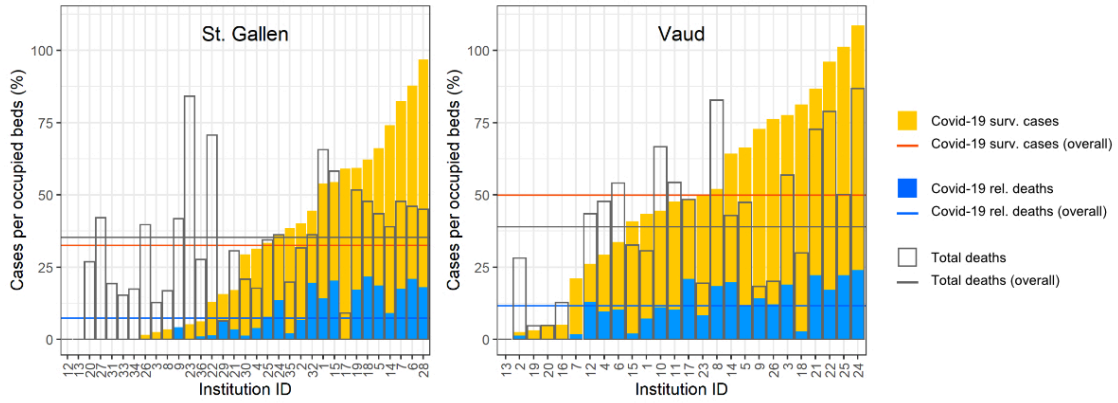


Figure 2: Total deaths per occupied bed in 2020 (yellow bars) and 2019 (blank bars) for (a) St. Gallen and (b) Vaud. Missing data: no bars indicate missing data in 2019 but no deaths in 2020.

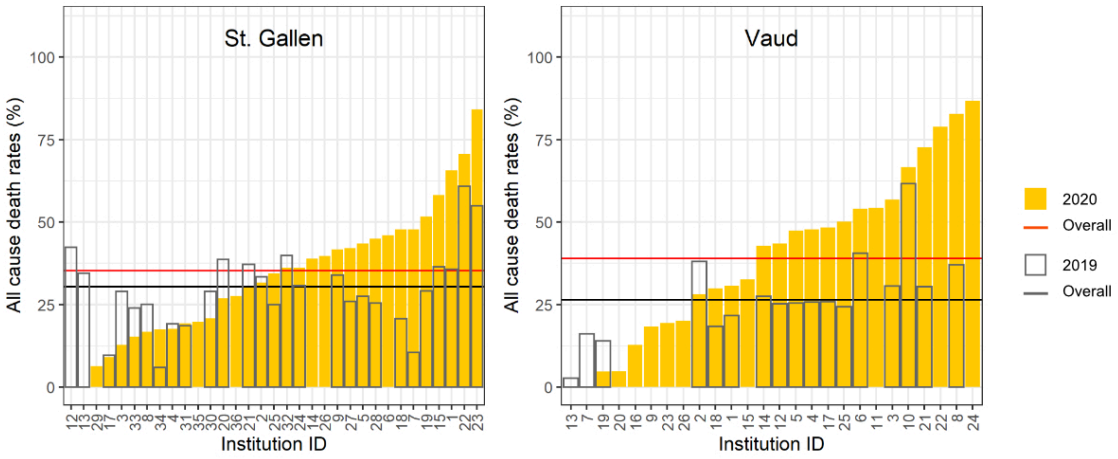
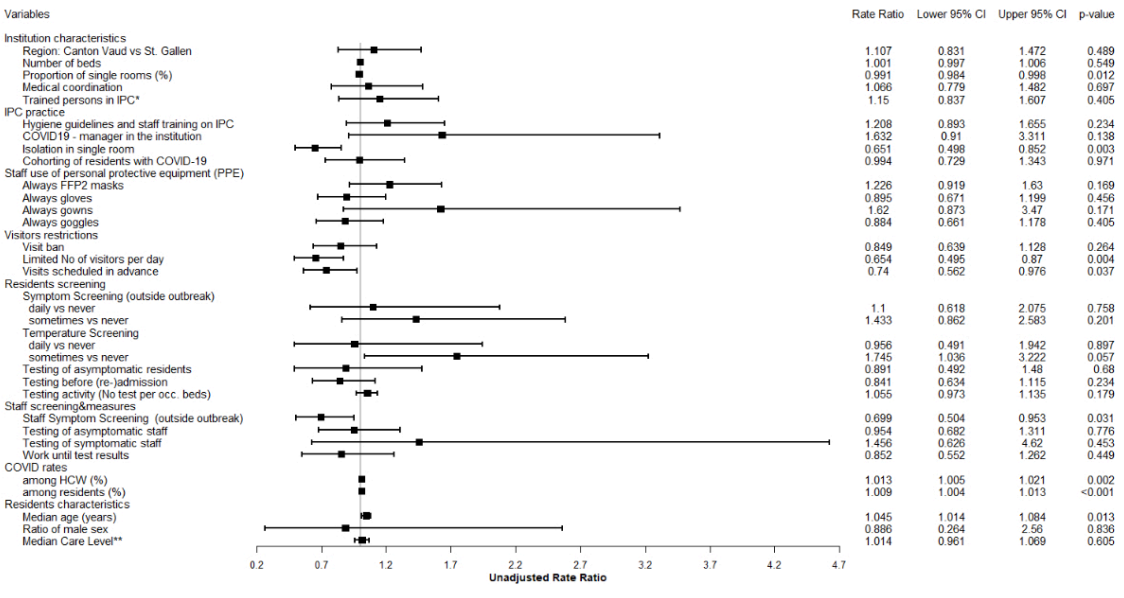


Figure 3: Forest plot showing the univariable, unadjusted associations between selected variables and total deaths per occupied bed (%).



In Swiss long-term care facilities, we found excess mortality in 2020 driven by COVID-19, which accounted for 24.8% of all deaths. These findings are consistent with those in other countries [2] and the excess mortality seen in Switzerland for older age groups (up to 16% for men aged >70 years and 12% for women aged >75 years) [10]. Current data indicates that the level of community transmission is one of the strongest predictors of COVID-19 rates in long-term care facilities [11]. Consistent with this, the difference in COVID-19 incidence between long-term care facilities in St. Gallen and Vaud mirrors that of the surrounding population for the same period. As reported in previous studies [6, 12],we also found appreciable variability in COVID-19 incidence across facilities. Notably, several institutions in St. Gallen reported no COVID-19 cases but had mortality rates comparable to other institutions. We believe a lack of COVID-19 case detection during the first wave might explain this discrepancy.

Our study adds to the literature associating COVID-19 rates among healthcare workers with increased all-cause resident mortality [13–15]. Another Swiss study showed that severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) seroprevalence among nursing home staff was associated with COVID-19 cases and COVID-19-related hospitalisations and deaths among residents [15]. The role of healthcare workers in COVID-19 transmission is complex. They are at increased risk of acquiring SARS-CoV2 and can be a source of infection for residents and other healthcare workers at the same time [16]. One study reported that infection among healthcare workers was associated with death among long-term care residents and tried to assess transmission dynamics [13]. Given a six-day lag between infection in healthcare workers and deaths in long-term care residents, the authors concluded that residents were most likely infected by staff and not the reverse. While we did not assess transmission dynamics, our finding of an association between infection in healthcare workers and resident mortality highlights the importance of interventions targeting healthcare workers to reduce COVID-19 risk in long-term care facilities.

Therefore, screening healthcare workers for COVID-19 symptoms appeared to be an effective preventive strategy

Figure 4: Forest plot showing the multivariate associations between selected variables and total death per occupied bed (%).

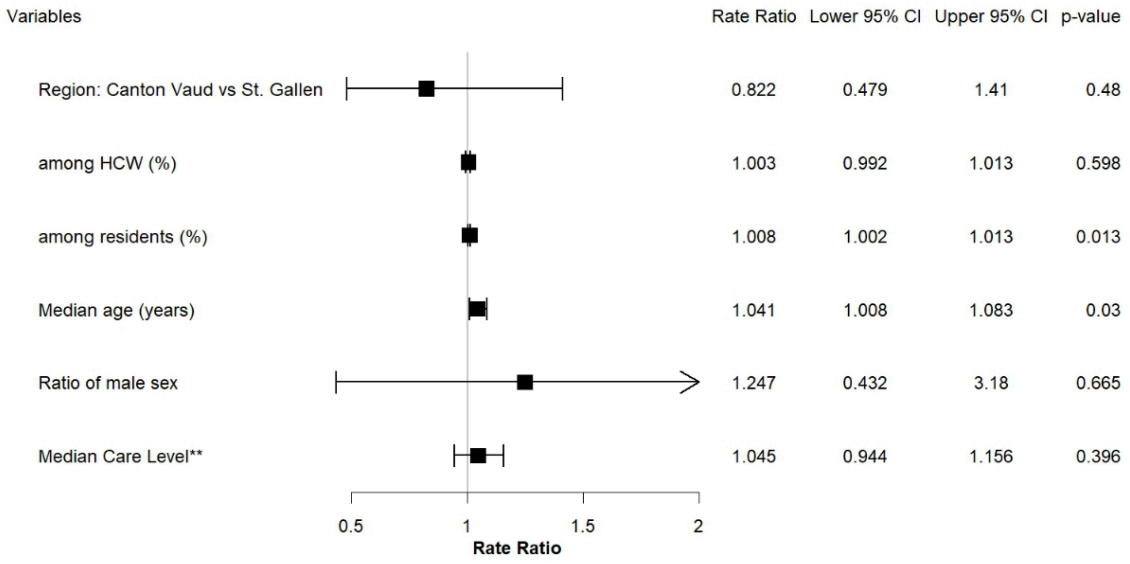
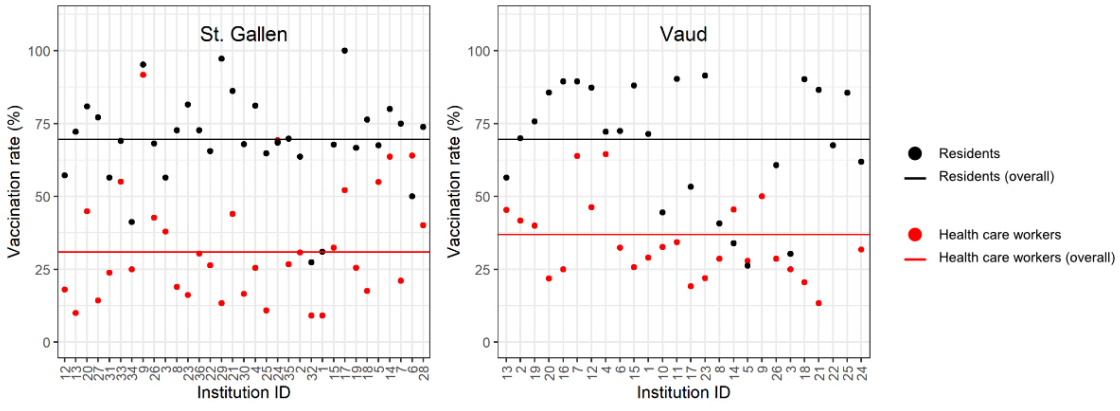


Figure 5: COVID-19 vaccination rates among residents (black dots) and healthcare workers (red dots) per institution as of May 2021. Horizontal lines show the median vaccination rates of residents (black line) and healthcare workers (red line). Institutions are in the same order as in figure 1. Missing data: one missing for residents and two missing for healthcare workers (institutions 9, 22, and 25).



in our cohort, given its association with lower resident mortality in the univariate analysis. While a similar trend was observed for serial testing of asymptomatic residents and staff, it was not significant. In contrast with these findings, a comprehensive review by Dykgraaf et al. on preventive strategies in long-term care facilities found stronger evidence for universal serial testing than symptom-based approaches [17] due to the high proportion of asymptomatic infections [18–21]. In our cohort, the true impact of asymptomatic testing could not be appropriately assessed because only a few institutions had adopted this strategy. Regarding the effectiveness of symptom screening, at least two factors must be considered. Previous studies on the influenza pandemic [22, 23] show that healthcare workers often continue to work while experiencing mild symptoms. Furthermore, recognising mild symptoms may not always be straightforward. This issue is particularly true for breakthrough infections among fully vaccinated healthcare workers, who are often asymptomatic or paucisymptomatic [24]. Therefore, it is unsurprising that symptom screening, promoting timely and reliable recognition of symptoms, and, therefore, early detection of cases appear to be an effective strategy in our analysis. Our results suggest that symptom screening of healthcare workers should be part of routine infection prevention and control measures in long-term care facilities.

Another important finding of our study is the strong association between visitor regulation and decreased resident mortality in the univariate analysis. Several studies have reported their adverse effects on resident well-being [25]. However, to what extent different levels of restrictions protect residents remains unclear. A few studies, such as Verbeek et al., reported no new cases among residents after the relaxation of visits, provided there was strict adherence to infection prevention and control measures [26]. Our analysis showed a strong association between regulating visits and decreased mortality. In contrast, the trend for complete visit bans was nonsignificant, adding to the evidence that careful regulation of visitors within a host of infection prevention and control measures might be sufficient to prevent the introduction of COVID-19 into long-term care facilities.

We confirmed the findings of previous studies indicating that crowding was a risk factor. In a large cohort of 618 nursing homes from Ontario, Canada, COVID-19 incidence and mortality in facilities with a larger proportion of shared bedrooms and bathrooms was double that of facilities with single-occupancy rooms [27]. Similarly, a higher proportion of single bedrooms and the isolation of COVID-19 patients in single rooms were associated with lower mortality in our cohort.

Finally, our findings highlight a gap in COVID-19 vaccination coverage in Swiss long-term care facilities. Only one-third (33.8%) of healthcare workers had received their first COVID-19 vaccine dose by the end of May 2021. Vaccine coverage among healthcare workers might be underestimated given the substantial proportion of missing data and the fact that healthcare workers vaccinated outside their institutions might not report it to them.

Additionally, at the time of the survey, many healthcare workers might not yet have qualified for vaccination because of recent infection, according to the then-current FOPH recommendation. Nevertheless, our results align with another Swiss study on vaccination willingness among healthcare workers, in which barely 30% of 398 healthcare workers of long-term care facilities declared willingness to get vaccinated [28]. Vaccine uptake among long-term care residents was also suboptimal, despite the COVID-19 vaccination campaign being tailored to long-term care facilities. Indeed, it was lower than that reported in other EU countries by the end of May 2021 (69.9% in Switzerland vs 80.4% in EU countries) [29]. Vaccination of long-term care residents significantly decreased the risk of infection, severe disease, and death [2]. Breakthrough infections have also been reported among fully vaccinated residents [31] and healthcare workers [24, 32], but most are mild or asymptomatic. These findings emphasise the need for ongoing interventions to maximise vaccine uptake in Swiss long-term care facilities.

Our study had several limitations. First, selection bias may have arisen since study participation was voluntary. Assuming that particularly motivated institutions were more likely to participate in our study, underestimation of the actual COVID-19 burden in this setting is possible. Second, since long-term care facilities managers collected the data, they might be subject to self-reporting bias. Third, for some variables (e.g. mortality rates for 2019), some institutions could not be included in their calculation due to missing data. Fourth, the probability of chance significant findings was elevated by the large number of influencing factors considered.

This study was ongoing until 22 June 2022 with regular follow-up questionnaires. Its findings will allow us to understand better the impact of COVID-19 vaccination on the COVID-19 burden of long-term care facilities and to prospectively evaluate the effectiveness of different infection prevention and control measures. This outcome is particularly important in light of increased population immunity and the emergence of less virulent SARS-CoV-2 variants.

In conclusion, we identified SARS-CoV-2 infection among healthcare workers as a modifiable variable associated with increased mortality in long-term care facilities. Therefore, promoting COVID-19 vaccine uptake is pivotal among healthcare workers in Swiss long-term care facilities. Furthermore, we suggest including symptom screening of healthcare workers as part of routine infection prevention and control measures.

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Potential competing interests

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflict of interest was disclosed.

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Appendix

The questionnaire is available as a separate pdf for download.

Table S1:
Baseline characteristics of the institutions, residents and staff members with missing data.

	Variable	Rate Ratio	Lower 95% CI	Upper 95% CI	p-value	Missings
Institution characteristics	Region: Canton Vaud vs St. Gallen	1.107	0.831	1.472	0.489	0/59
	Number of beds	1.001	0.997	1.006	0.549	0/59
Proportion of single rooms (%)	Medical coordination	1.066	0.779	1.482	0.697	0/59
	Trained persons in IPC*	1.15	0.837	1.607	0.405	0/59
IPC practice	Hygiene guidelines and staff training on IPC	1.208	0.893	1.655	0.234	0/59
	COVID-19 manager in the institution	1.632	0.91	3.311	0.138	0/59
Isolation in single room	Cohorting of residents with COVID-19	0.994	0.729	1.343	0.971	0/59
Staff use of personal protective equipment (PPE)	Always FFP2 masks	1.226	0.919	1.63	0.169	0/59
	Always gloves	0.895	0.671	1.199	0.456	0/59
	Always gowns	1.62	0.873	3.47	0.171	0/59
	Always goggles	0.884	0.661	1.178	0.405	0/59
Visitors restrictions	Visit ban	0.849	0.639	1.128	0.264	0/59
	Limited No of visitors per day	**0.654**	**0.495**	**0.87**	**0.004**	0/59
	Visits scheduled in advance	**0.74**	**0.562**	**0.976**	**0.037**	0/59
Residents screening	Symptom Screening (outside outbreak)					0/59
	Daily vs never	1.1	0.618	2.075	0.758	
	Sometimes vs never	1.433	0.862	2.583	0.201	
	Temperature Screening					0/59
	Daily vs never	0.956	0.491	1.942	0.897	
	Sometimes vs never	1.745	1.036	3.222	0.057	
	Testing of asymptomatic residents	0.891	0.492	1.48	0.68	0/59
	Testing before (re-)admission	0.841	0.634	1.115	0.234	0/59
	Testing activity (No test per occ. beds)	1.055	0.973	1.135	0.179	2/59
Staff screening&measures	**Staff Symptom Screening (outside outbreak)**	**0.699**	**0.504**	**0.953**	**0.031**	0/59
	Testing of asymptomatic staff	0.954	0.682	1.311	0.776	0/59
	Testing of symptomatic staff	1.456	0.626	4.62	0.453	0/59
	Work until test results	0.852	0.552	1.262	0.449	0/59
COVID rates	Among HCW (%)	**1.013**	**1.005**	**1.021**	**0.002**	1/59
	Among residents (%)	**1.009**	**1.004**	**1.013**	**0**	0/59
Residents characteristics	**Median age (years)**	**1.045**	**1.014**	**1.084**	**0.013**	1/59
	Ratio of male sex	0.886	0.264	2.56	0.836	1/59
	Median Care Level**	1.014	0.961	1.069	0.605	1/59

Figure S1: Conceptual framework mortality residents long-term care facilities. HCW: Health care workers; IPC: infection prevention measures. *serves as proxy of non-diagnosed/asymptomatic COVID-19 cases in residents ** serves as proxy for HCW/residents ratio, different IPC-measures.