COVID-19 Hospital Based Sentinel Surveillance Report

Data status: 13.12.2021

Introduction

The CH-SUR surveillance system was established in 2018 to capture influenza-related hospitalizations. By March 1, 2020, four days after the first confirmed COVID-19 case was reported in Switzerland, the adapted program was ready to also register hospitalizations related to laboratory-confirmed SARS-CoV-2 infection.

Currently, 20 hospitals are actively participating, including most cantonal and university hospitals, which cover a large proportion of hospitalized paediatric and adult patients throughout Switzerland. The CH-SUR statistics register the number and duration of hospitalizations as well as intensive care unit stays. A patient may be hospitalized multiple times or require multiple intensive care unit (IPS) treatments during the same hospitalization episode.

CH-SUR collects data on patients hospitalized with SARS-CoV-2 infection with hospital stays longer than 24 hours, as well as nosocomial SARS-CoV-2 infections. Confirmation of infection is a positive PCR (polymerase chain reaction) test or a positive rapid antigen test, as well as a clinical finding for COVID-19. CH-SUR also registers whether the patient died during hospitalization due to COVID-19 infection.

From the beginning of the epidemic until **December 13, 2021**, data were collected from 22 078 hospitalized patients. Because certain individuals were hospitalized more than once, the CH-SUR system recorded 22 950 hospitalizations and their course. Detailed discharge data are available for 20 377 hospitalized patients. Of these, 3205 patients were cared for in an ICU (ICU time window: Feb. 26, 2020 to Oct. 31, 2021) and 2484 individuals (12.2%) died of COVID-19 during their hospitalization. During the same period, 37 710 hospitalizations with laboratory-confirmed SARS-CoV-2 infection were reported to the FOPH under the mandatory reporting system for all of Switzerland. The CH-SUR system thus covered approximately 61% of all reported hospitalizations related to SARS-CoV-2 in Switzerland.

1. Hospitalizations and demographic characteristics

Between the start of the epidemic in Switzerland and Dec 13, 2021 and among the 20 hospitals actively participating in the COVID-19 Hospital Based Surveillance project (CH-SUR), 22,078 patients were hospitalized, for a total of 22,950 hospitalizations. There were more hospitalizations than patients because some patients were hospitalized multiple times. An overview of these rehospitalized patients is shown in Figure 1.

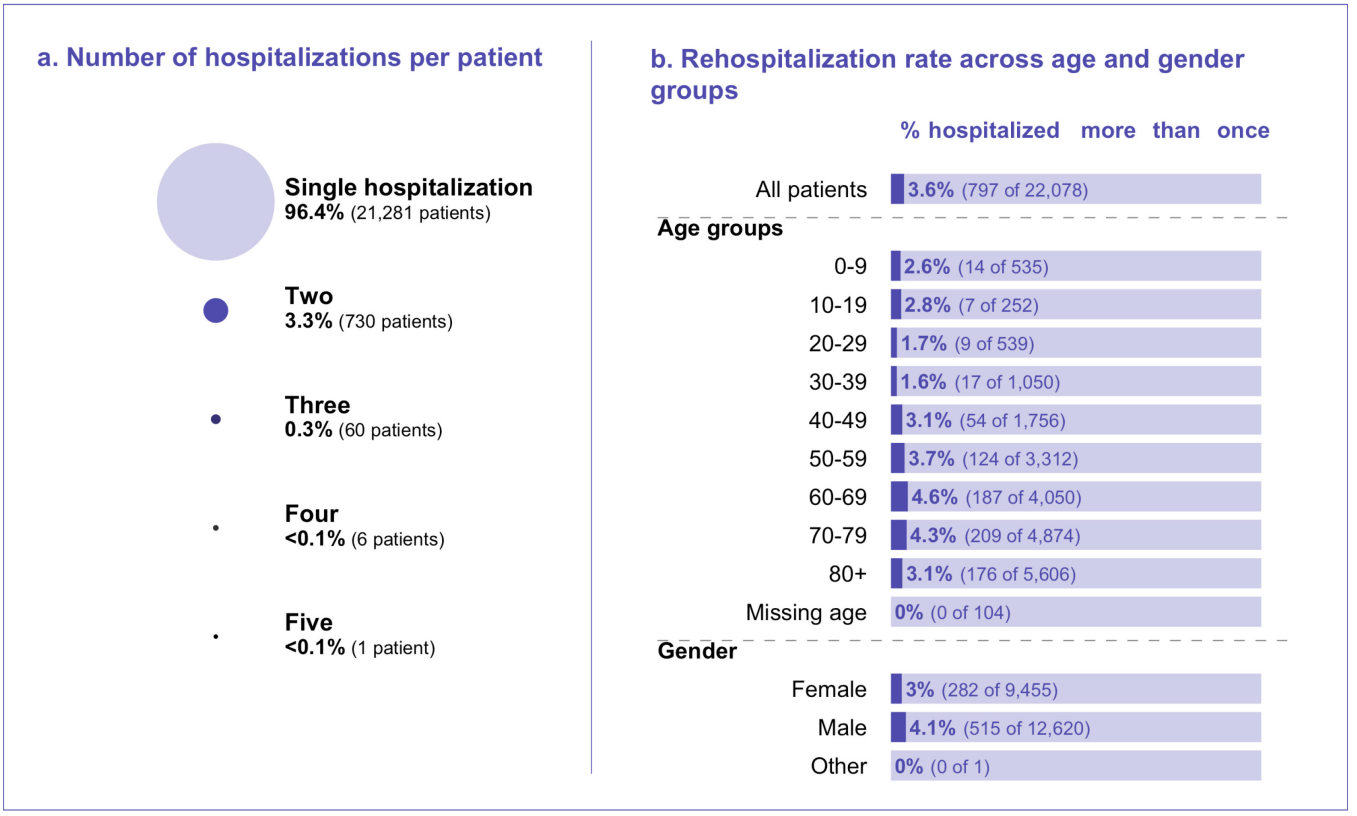

***Figure 1**: Hospitalizations per patient and rehospitalization rate across demographic groups. Includes records up to December 13, 2021.*

Most patients (96.4% [21,281 of 22,078]) were hospitalized only once, but 4% of patients (796 of 22,078) were hospitalized two to four times, and one patient was hospitalized five times (Figure **1**a).

The overall rate of rehospitalization was 3.6% (797 of 22,078) (Figure **1**b). The 60-69 age group and the 70-79 age group had the highest rate of rehospitalization at respectively 4.6% (187 of 4,050) and 4.3% (209 of 4,874). Men had a higher rehospitalization rate than women, 4.1% (515 of 12,620) vs 3% (282 of 9,455) respectively.

Overall, the majority (57.2% [12,620 of 22,078]) of patients were men (Figure **2**a), and the age distribution skewed older (Figure **2**b). The largest age category of patients were those aged 80 and above (25% [5,606]).

Figures **2**c and **2**d show the gender and age ratio over time, respectively. More men than women were admitted in each month for the entire period of observation. The proportion of patients aged 50 and above was notably high between October 2020 and January 2021, with a peak in November 2020: 88.9% (3,400 of 3,825) of patients first admitted in this month were 50 and above (Figure **2**d). This peak in older age admissions mirrors a similarly-timed peak in admission severity and case fatality ratios described later.

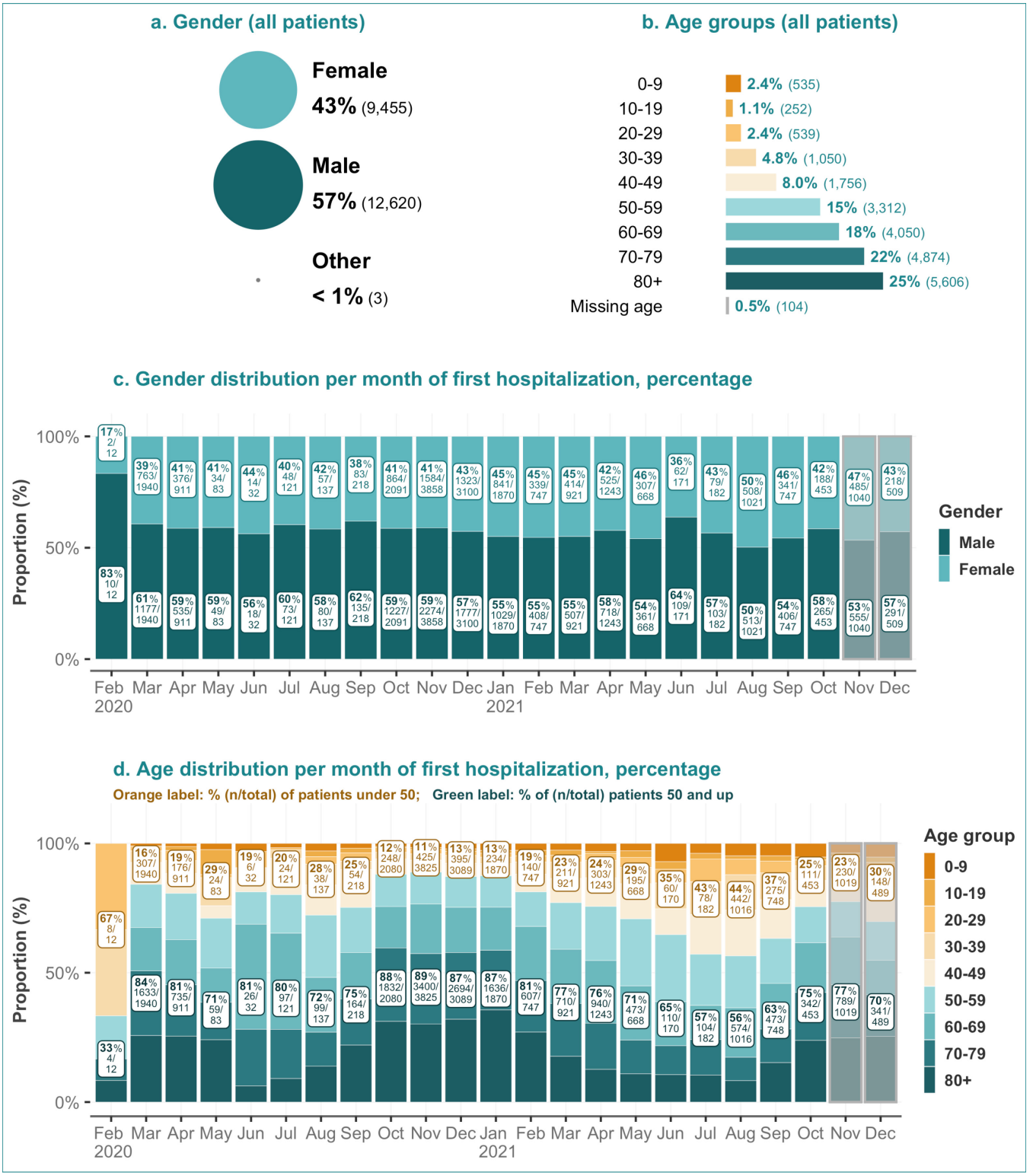

***Figure 2**: Demographic characteristics: gender and age distribution of admitted patients, overall and per month. For patients with multiple hospitalizations, the admission date of the first hospitalization was used. Data from the last two months (highlighted gray) is considered provisional due to entry delays. The 'other' gender category was removed from panel c, and the missing age group was removed from panel d.*

2. Patient outcomes

2.1. Outcomes overview

Figure **3** shows the final outcomes of CH-SUR patients over three time intervals. Patients for whom COVID-19 was the cause of death (died *of* COVID-19) are shown separately from COVID-19 patients who died of other causes (died *with* COVID-19, but not *of* COVID-19). This determination of whether a COVID patient died of COVID or another cause was done by a medical doctor at the hospital level for each CH-SUR-participating center.

Patients "discharged" include patients that were transferred out of the CH-SUR system. Patients with "pending or missing outcomes" are either patients who were still hospitalized or patients who were no longer hospitalized but whose outcomes were yet to be recorded in the database. Because of the higher proportion of incomplete data registries during the most recent months, case fatality rates from these months should be interpreted with caution.

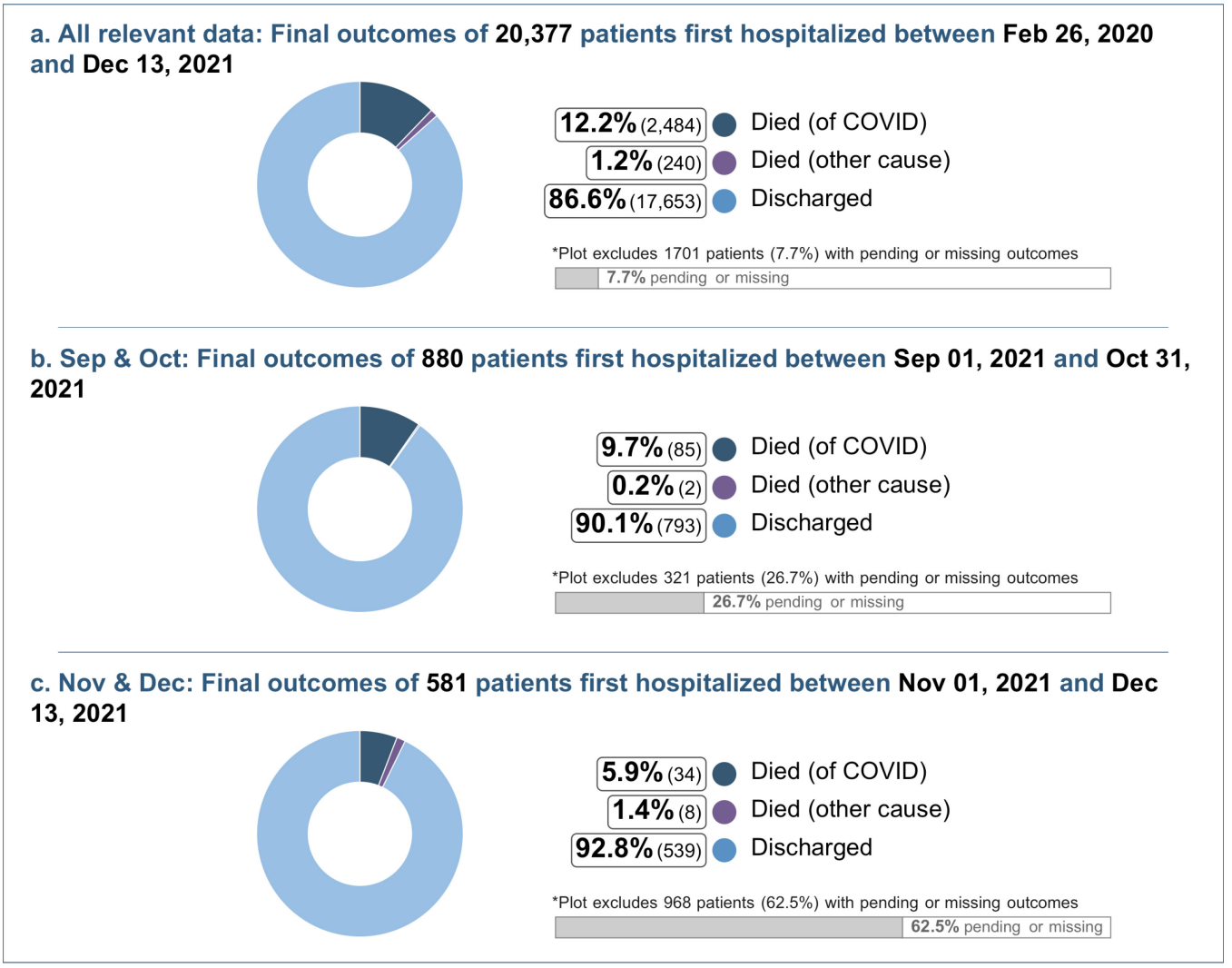

***Figure 3**: Outcomes for COVID-19 patients hospitalized in CH-SUR hospitals. Includes records up to December 13, 2021. For patients with multiple hospitalizations, only the final outcome is considered. Patients with uncertain cause of death (registered as "unknown" cause of death in the database) but with a proof of SARS-CoV-2 infection were classed as having died because of COVID.*

2.2. Outcomes over time

Figure **4** shows the final outcomes of hospitalized patients over time (Figure **4**a & **4**b), alongside the epidemic curve (Figure **4**a) and the initial disease severity of those admitted over time (Figure **4**c).

The first mortality peak is seen for patients admitted around the beginning of the epidemic: 16.8% (325 of 1,938) of patients first admitted in March 2020 did not survive. Mortality fell after March 2020, but rose again between October 2020 and January 2021, with a peak in December 2020: 15.1% (463 of 3,060) of patients first admitted in December 2020 did not survive.

The high case fatality rates for those first admitted at the start of the epidemic and at the height of period between Oct 2021 and Jan 2021 are mirrored by the higher admission severity scores at these times (Figure **4**c) and older patient's ages (Figure **2**c) registered for these periods. 34.2% (664 of 1,940) of patients first admitted in March 2020 had a severity score above 2.[1] Over the months of Oct 2020 to Jan 2021, the proportion with severity scores of 2 and above was similarly high: 40.8% (1,266 of 3,100) in December 2020.

[1] For adults, the severity score used was the CURB-65 score. One point was given for each of the following symptoms: confusion (abbreviated Mental Test Score < 9), blood urea nitrogen > 19 mg/dL, respiratory rate > 30 per minute, low blood pressure (diastolic < 60 or systolic < 90 mmHg), age > 65 years. For children, one point was given for each of the following: respiratory distress, oxygen saturation < 92%, evidence of severe clinical dehydration or clinical shock and an altered consciousness level.

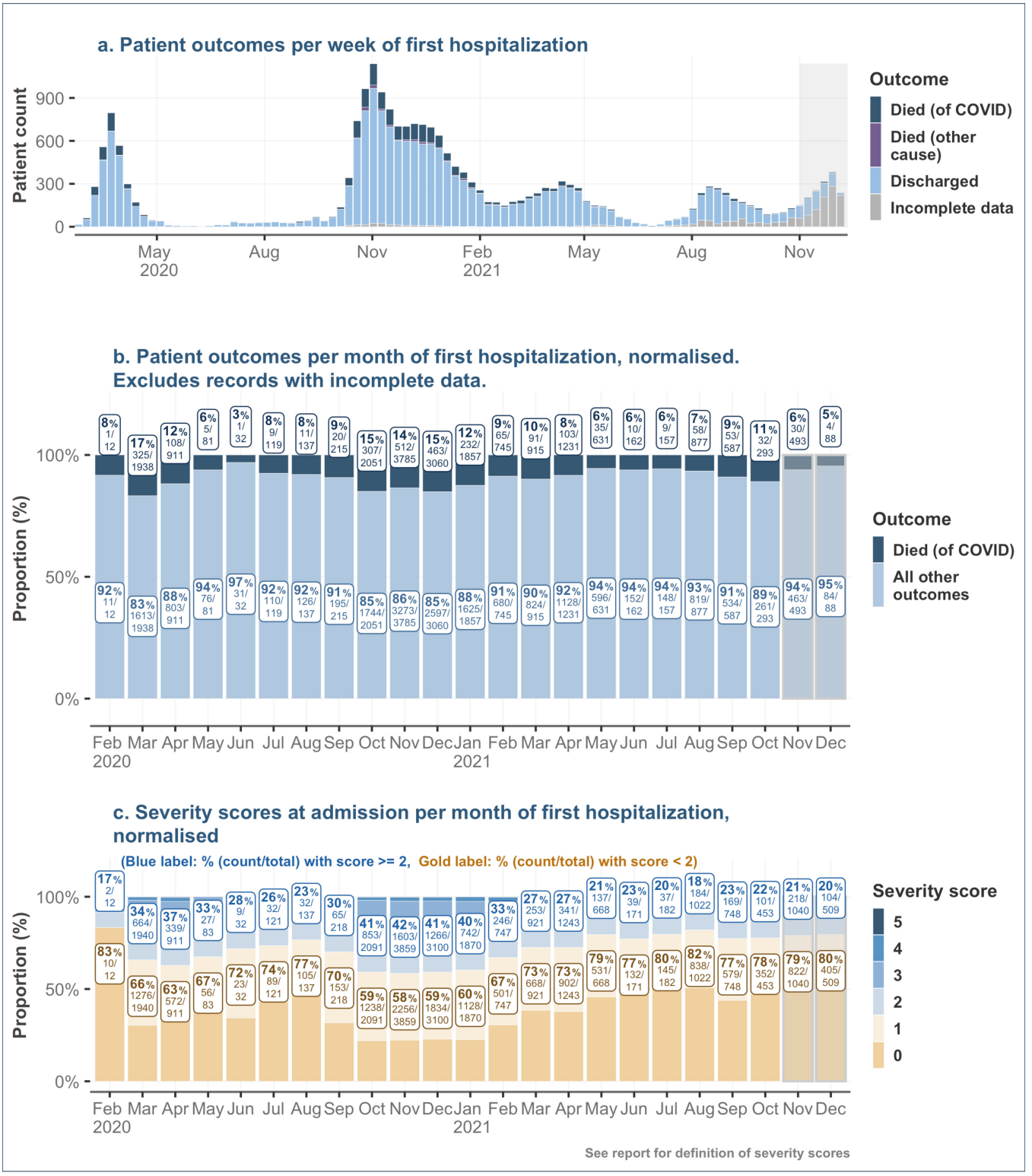

***Figure 4**: Epidemic curve, patient outcomes and severity scores at admission for COVID-19 patients over time. Includes records up to December 13, 2021. Data from the two last months (highlighted in gray) are considered provisional due to data entry delays. Patients with uncertain cause of death (registered as "unknown" cause of death in the database) but with a proof of SARS-CoV-2 infection were classed as having died because of COVID.*

2.3. Case fatality rate (CFR) across demographic and risk groups

Since the beginning of the epidemic and until October the 31st, the case fatality rate (CFR) increased exponentially with increasing age, from 0% (0 of 460) in patients aged 0-9, to 3.5% (103 of 2,985) in patients aged 50-59, and to 25.4% (1,293 of 5,099) in patients aged 80+. CFR% was greater in men than in women: 14.1% (1,604 of 11,365) vs 10% (846 of 8,428) respectively. In addition, the CFR% was greater for patients with higher severity scores at admission: 1.4% (82 of 5,819) of patients with severity score 0 died of COVID-19, while 51.1% (24 of 47) of patients with severity score 5 died of COVID-19.

When considering the most recent evolution for which enough data is available (months September and October 2021 in Figure **5**b) an overall similar CFR % as for the whole epidemic is observed for the BMI and patient source. As over the whole epidemic, the fatality rate increases with age, but for the most recent months a slight raise of the CFR % among the patients aged 60 to 69 years old is observed. Also exceptionally for the months September and October 2021, the CFR % was higher for females than for males (not significant difference).

Of note, there was no clear mortality difference across different BMI groups. Data regarding vaccination status can be found in section 3.

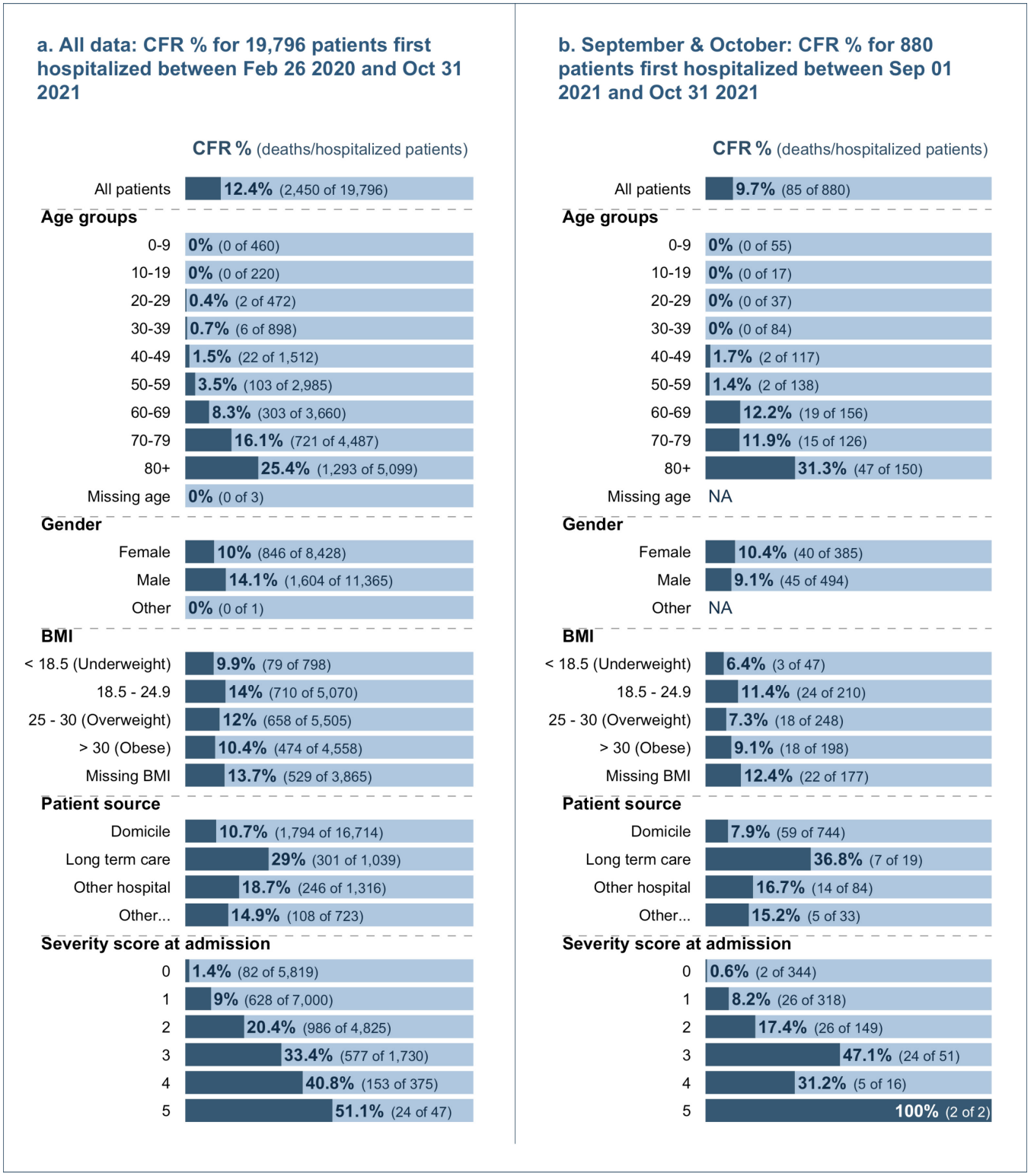

***Figure 5**: Case fatality rate (CFR) % among demographic and risk groups: percentage of patients in different demographic groups who were recorded as having died in hospital of COVID-19. Both figures include records up to Oct 31 2021 but records with incomplete data (patients still hospitalized or with a pending outcome in the database) were not included. Blank rows indicate a patient count of zero.*

3. Immune/vaccination status

3.1. Immune status over time

For these analyses, a patient's immune status considers the patient's previous COVID-19 infections and their vaccine doses received up to the time of a positive COVID-19 test, specifically up to the time when the sample for the test was collected.[2]

The proportion of hospitalized patients who were fully immunized rose gradually after January 2021 (Figure **6** b). This is expected, given the rise in the proportion of the whole Swiss population that is fully vaccinated (Figure**6**c, source: BAG Dashboard).

During the months of Sep & Oct, when between 55.15% and 64.26% of the Swiss population was fully vaccinated (Figure **6**c), the fully immunized made up only a minority (19%) of hospitalizations recorded in CH-SUR (Figure **6**b), suggesting protection against hospitalization (and, consequently, death) due to COVID-19.

[2] Immune status categories were defined as follows:

a) Not immunized: Patients who had not received a single dose of any vaccine by the time of the positive SARS CoV 2 test and had no proof of previous infection with this virus before this hospitalisation.

b) Incompletely immunized: Patients who received one vaccine dose of Moderna or Comirnaty before the positive test and have no previous SARS-CoV-2 infection. Patients who received two doses of the vaccines Moderna or Comirnaty but tested positive within 13 days of this second dose and had no previous SARS-CoV-2 infection before this hospitalisation. Patients who received one dose with the Janssen vaccine and were tested positive for SARS CoV 2 within 21 days after vaccine application date and have no previous SARS-CoV-2 infection.*

c) Fully immunized: Patients who received two or more doses of the vaccines Moderna or Comirnaty and tested positive 14 days or more after the second dose. Patients who received one dose of the Janssen vaccine and were tested positive for SARS CoV-2 22 or more days after vaccination date. Patients with a prior infection (requiring hospitalisation or not) who received at least one vaccine dose, independent of the time between disease recovery, date and brand of vaccine and positive test or hospitalization.

d) Recovered from a SARS-CoV-2 infection: Patients with confirmed previous SARS CoV 2 infection, which required or not hospitalisation in the past and are not vaccinated with any dose; independent of the time since previous infection. CAVEAT: Many recovered patients are not identified as such in the database (information collected only since June 2021, undiagnosed infection, information missing from the medical record).

e) Unknown immune status: Patients for whom vaccination and immune information was not available and patients with previous infection status known but unknown vaccination status.

*The definition of the incompletely- and fully- immunized patients is different for the CH SUR reports as from the BAG dashboard. This is due to the different data sources that each of the reporting systems is using. While CH SUR considers a time window of 14 days from last vaccine application to consider the patient fully immunized, the definition of the immune status showed in the BAG-dashboard does not consider this time window.

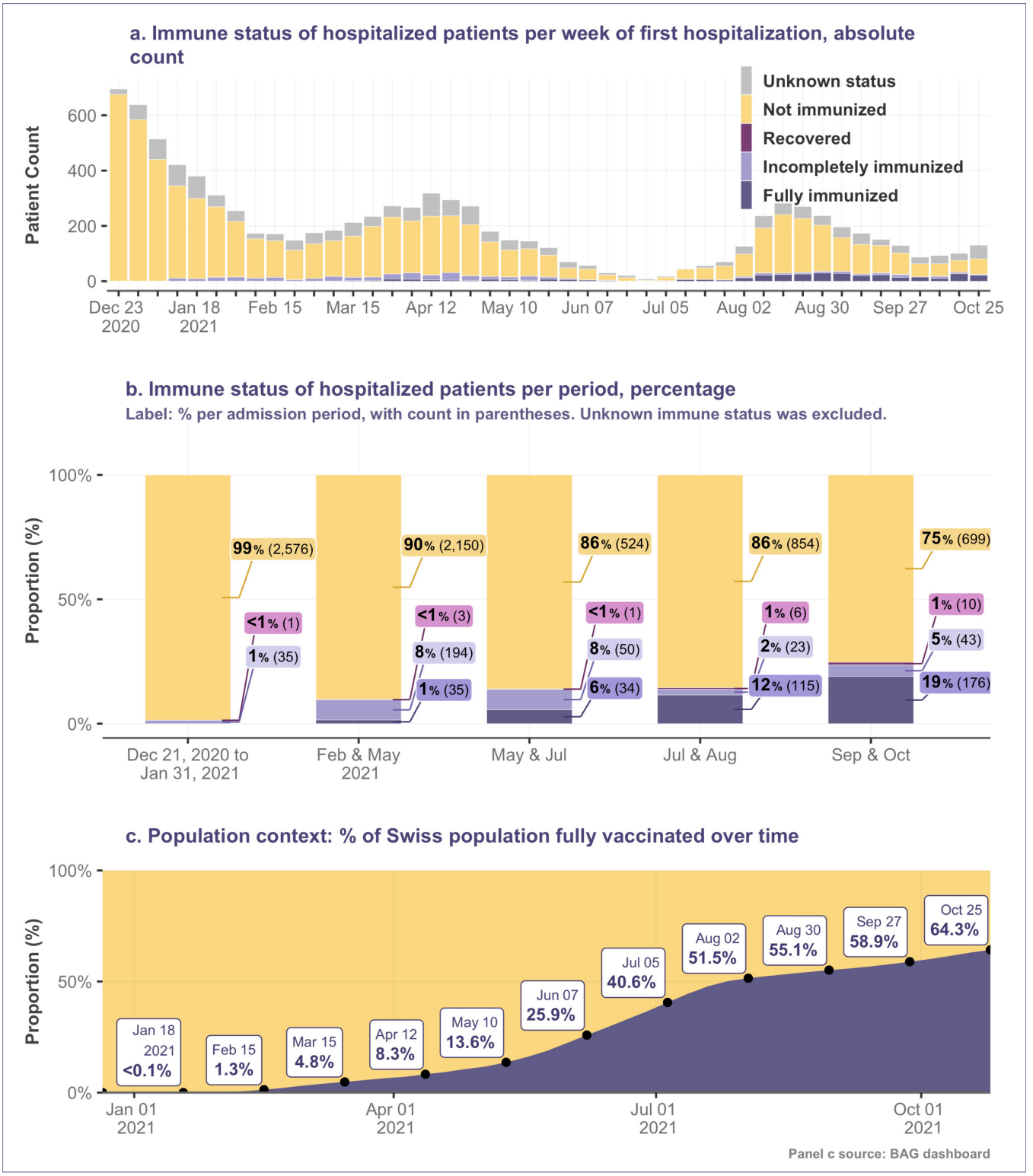

***Figure 6**: Immune status of hospitalized patients and overall vaccination rate in Switzerland. See footnote for definitions of immune status categories. For patients with multiple hospitalizations, the immune status for the first hospitalization was considered. Panels a and b include patients hospitalized since the week vaccination began, Dec 21 2020. (Vaccination began on December 23 2020, but we include December 22 and 21 to cover a full week.) Patients first hospitalized after Oct 31 2021 were excluded, as a large proportion of these records have not been completely filled in the database.*

3.2. Patient characteristics by immune status

Fully immunized patients (patients with breakthrough disease) were disproportionately older: since vaccination initiation, 41% of fully immunized patients (146 of 360) admitted to CH-SUR hospitals were aged 80 and above (Figure **7**a, right panel). In contrast, only 19% of non-immunized patients (1,235 of 6,575) were aged 80 and above (Figure **7**a, left panel).

This older-skewed age distribution for breakthrough hospitalizations may be related to the vaccination strategy applied in Switzerland, where the elderly population was vaccinated as a first priority. In addition, even after the opening of vaccination to all ages, vaccination coverage remains higher among older age groups (see BAG Dashboard). Certain risk factors for hospitalization may also be more prevalent among the elderly.

It is also notable that in more recent months, younger patients make up an increasing share of non-immunized patients (Figures **7**b and c, left panels). For example, when considering all data since vaccination initiation, individuals aged 30-39 made up only 6.7% of non-immunized patients (441 of 6,575) (Figure **7**a, left panel), but in September and October, they made up a larger share, 12% of non-immunized patients (81 of 698) (Figure **7**c, left panel). This might be explained by the fact that most of those in the older age classes had been vaccinated by this time and the number of SARS-Cov-2 infections shifted to younger ages in society (see BAG Dashboard).

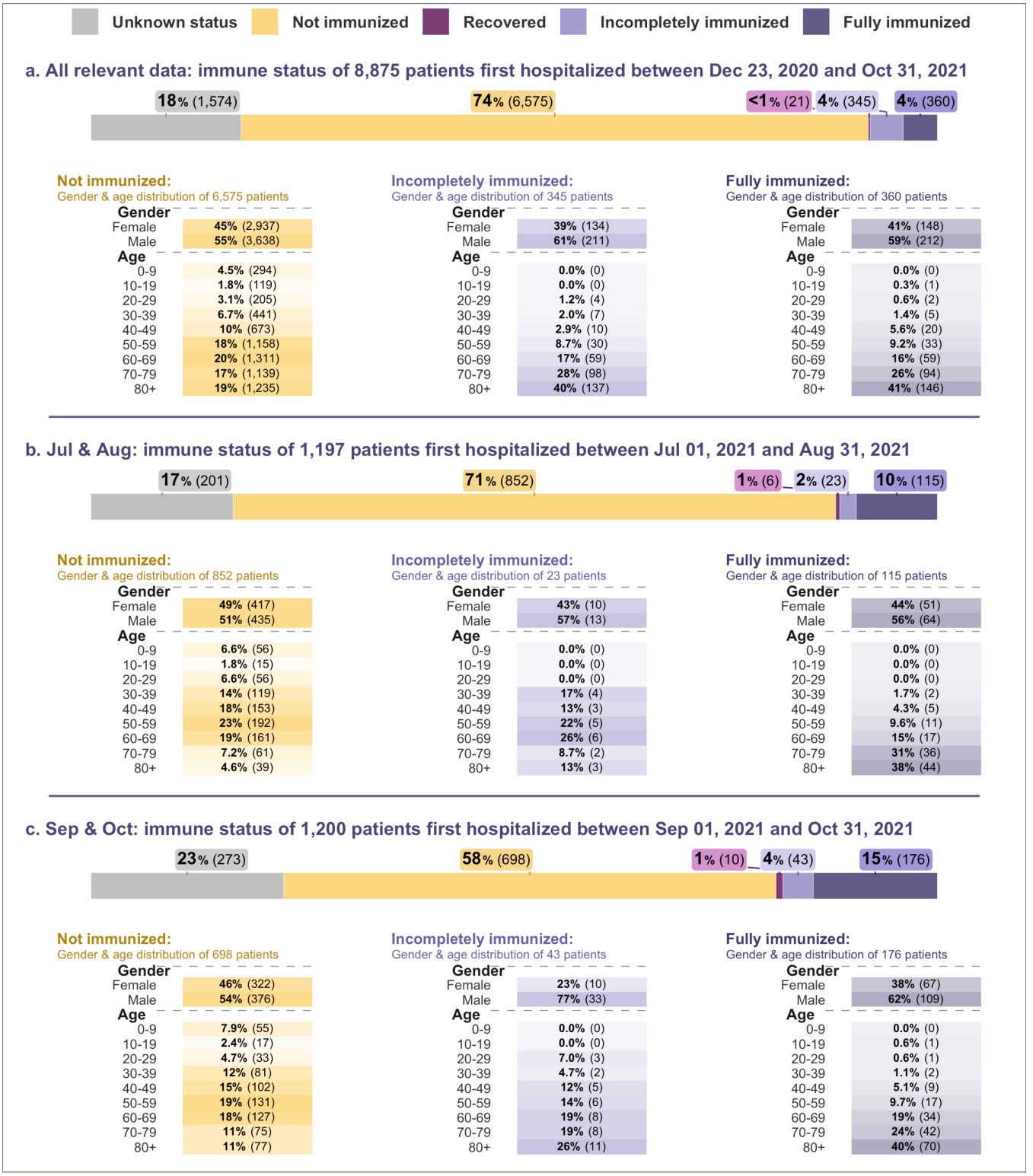

***Figure 7**: Demographic characteristics of patients hospitalized by immune status, over three different periods. Patients first hospitalized after Oct 31 2021 were excluded, as a large proportion of these records have not been completely filled in the database. Patients with missing ages and gender marked 'Other' are not shown.*

3.3. Patient outcomes by immune status

Since the date vaccinations began, Dec 23, 2020, CH-SUR registered only 43 deaths among fully immunized patients (Figure **8**a, right panel subtitle). Of these deaths, 22 were among individuals aged 80 and above. Over the same period, there were 571 COVID-caused deaths among non-immunized patients (Figure **8**a, left panel).

During the months of September and October, there were 50 deaths (64.9%) among non-immunized patients, 5 deaths (6.5%) among partially immunized patients, and 22 deaths (28.6%) among fully immunized patients (Figure **8**). Despite representing a smaller share of the population (45% of non immunized people at the time of data analysis, see Figure **6**c), the non-immunized population's death toll represents a larger portion of overall deaths (Figure **8**c).

CH-SUR data highlights the protective effect of vaccination against hospitalization, and consequently death, due to COVID-19. Nevertheless, the CFR values by age show that the risk of death for the limited number of people who are hospitalized despite full vaccination is in most cases lower but not substantially different to that of unvaccinated hospitalized people (Figure **8**c, left and right panel). This must be balanced by the very positive effect of vaccination on the risk of hospitalization and therefore on the risk of death.

a. All relevant data: 668 deaths among 6,993 patients first hospitalized between Dec 23, 2020 and Oct 31, 2021

Not immunized: Age distribution of **571** deaths in **6,345** patients

Age	Patients	Deaths	CFR %
0-9	284	0	0%
10-19	115	0	0%
20-29	193	2	1.0%
30-39	418	2	0.5%
40-49	638	8	1.3%
50-59	1108	31	2.8%
60-69	1255	95	7.6%
70-79	1119	159	14.2%
80+	1215	274	22.6%

Incompletely immunized: Age distribution of **54** deaths in **332** patients

Age	Patients	Deaths	CFR %
0-9	0	0	-
10-19	0	0	-
20-29	4	0	0%
30-39	6	0	0%
40-49	10	0	0%
50-59	28	3	10.7%
60-69	53	7	13.2%
70-79	98	15	15.3%
80+	133	29	21.8%

Fully immunized: Age distribution of **43** deaths in **316** patients

Age	Patients	Deaths	CFR %
0-9	0	0	-
10-19	1	0	0%
20-29	2	0	0%
30-39	5	0	0%
40-49	17	0	0%
50-59	30	2	6.7%
60-69	54	9	16.7%
70-79	82	10	12.2%
80+	125	22	17.6%

b. Jul & Aug: 57 deaths among 884 patients first hospitalized between Jul 01, 2021 and Aug 31, 2021

Not immunized: Age distribution of **45** deaths in **763** patients

Age	Patients	Deaths	CFR %
0-9	53	0	0%
10-19	14	0	0%
20-29	47	0	0%
30-39	105	1	1.0%
40-49	140	3	2.1%
50-59	171	8	4.7%
60-69	141	12	8.5%
70-79	56	10	17.9%
80+	36	11	30.6%

Incompletely immunized: Age distribution of **1** death in **18** patients

Age	Patients	Deaths	CFR %
0-9	0	0	-
10-19	0	0	-
20-29	0	0	-
30-39	4	0	0%
40-49	3	0	0%
50-59	3	1	33.3%
60-69	3	0	0%
70-79	2	0	0%
80+	3	0	0%

Fully immunized: Age distribution of **11** deaths in **103** patients

Age	Patients	Deaths	CFR %
0-9	0	0	-
10-19	0	0	-
20-29	0	0	-
30-39	2	0	0%
40-49	5	0	0%
50-59	11	1	9.1%
60-69	16	2	12.5%
70-79	34	5	14.7%
80+	35	3	8.6%

c. Sep & Oct: 77 deaths among 796 patients first hospitalized between Sep 01, 2021 and Oct 31, 2021

Not immunized: Age distribution of **50** deaths in **611** patients

Age	Patients	Deaths	CFR %
0-9	50	0	0%
10-19	14	0	0%
20-29	31	0	0%
30-39	75	0	0%
40-49	88	2	2.3%
50-59	113	1	0.9%
60-69	105	14	13.3%
70-79	68	10	14.7%
80+	67	23	34.3%

Incompletely immunized: Age distribution of **5** deaths in **38** patients

Age	Patients	Deaths	CFR %
0-9	0	0	-
10-19	0	0	-
20-29	3	0	0%
30-39	1	0	0%
40-49	5	0	0%
50-59	6	0	0%
60-69	6	1	16.7%
70-79	8	0	0%
80+	9	4	44.4%

Fully immunized: Age distribution of **22** deaths in **147** patients

Age	Patients	Deaths	CFR %
0-9	0	0	-
10-19	1	0	0%
20-29	1	0	0%
30-39	2	0	0%
40-49	7	0	0%
50-59	14	1	7.1%
60-69	30	4	13.3%
70-79	34	4	11.8%
80+	58	13	22.4%

***Figure 8**: Mortality of CH-SUR patients by immune status and age group, over three different periods. The total counts of patients in the subtitles include patients with a final outcome (discharged, died of any cause, or transferred out of CH-SUR), and whose immune status was fully immunized, incompletely immunized or not immunized. Missing age and partially immunized patients' records were removed. Counts of deaths only include patients who died because of COVID-19. Case-fatality rate (CFR), especially for the incompletely immunized and fully immunized categories, should be interpreted with caution due to small sample sizes.*

4. Intensive care unit (ICU) admission

4.1. ICU admission across demographic and risk groups

Over the whole period of observation ICU admission probability across ages was roughly bimodal with a peak for the 10-19 year age group and for the 60-69 age group (Figure **9**a). The 60-69 age group had the highest probability of admission to the ICU, with 25.6% admitted (936 of 3,660). Notably, individuals aged 80 and above were least likely to be admitted to the ICU, with only 6% admitted (308 of 5,099).

Males were more likely to be admitted in an ICU ward than females. 19.5% of the hospitalized males were admitted in an ICU ward, compared to 11.7% of the hospitalized females.

Patients transferred in from other hospitals had a high probability of ICU admission: 47.6% of such patients (627 of 1,316) were admitted to the ICU (Figure **9**a).

ICU admission probability also increased slightly with increasing BMI, and increased steeply with increasing admission severity scores (Figure **9**a).

Figure **9**b shows the same information but for a recently hospitalized subset of patients. The trends across groups are roughly similar to what is observed across all hospitalized patients. Given the smaller sample size, the trends are not so clearly distinguishable.

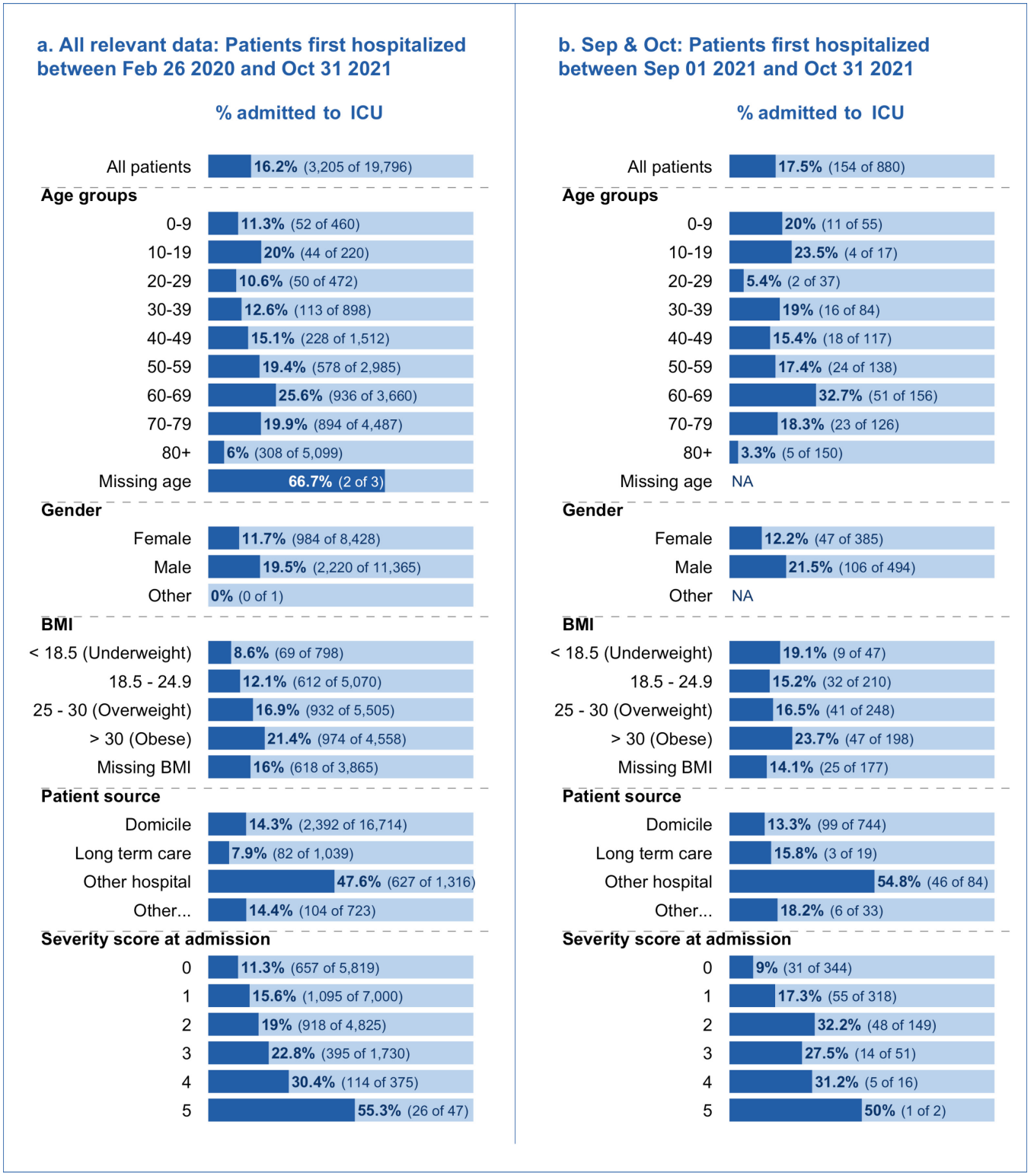

***Figure 9**: Percentage of patients admitted to ICU, grouped by demographic and risk factors, over two time intervals. For patients with multiple hospitalizations, we considered whether they were admitted to the ICU during any of their hospitalizations. Both panels include records up to Oct 31 2021 due to data completeness considerations. Records with incomplete data (patients still hospitalized or with a pending outcome in the database) were not included. A blank row indicates a patient count of zero.*

4.2. ICU admission by immune status

Due to a variance in vaccine coverage, only recent time periods were represented. Data for November and December are not meaningful due to their incompleteness and are therefore not yet released.

In both time periods, the predominant immune status [3] to be admitted to ICU were non immunized patients (80% and 75% of all ICU admissions in each of the described periods respectively). For all immune status categories shown and in both time periods, there were more men than women admitted to the ICU.

For fully immunized patients, there is a skew towards older age groups being admitted to the ICU (Jul and Aug: 90% of patients were above 50 and Sep and Oct: 95.3% of patients were above 50). In comparison, non immunized patients admitted to the ICU included proportionally more patients on younger age classes, as only 66.3% (Jul, Aug) and 62.9% (Sep, Oct) were aged above 50.

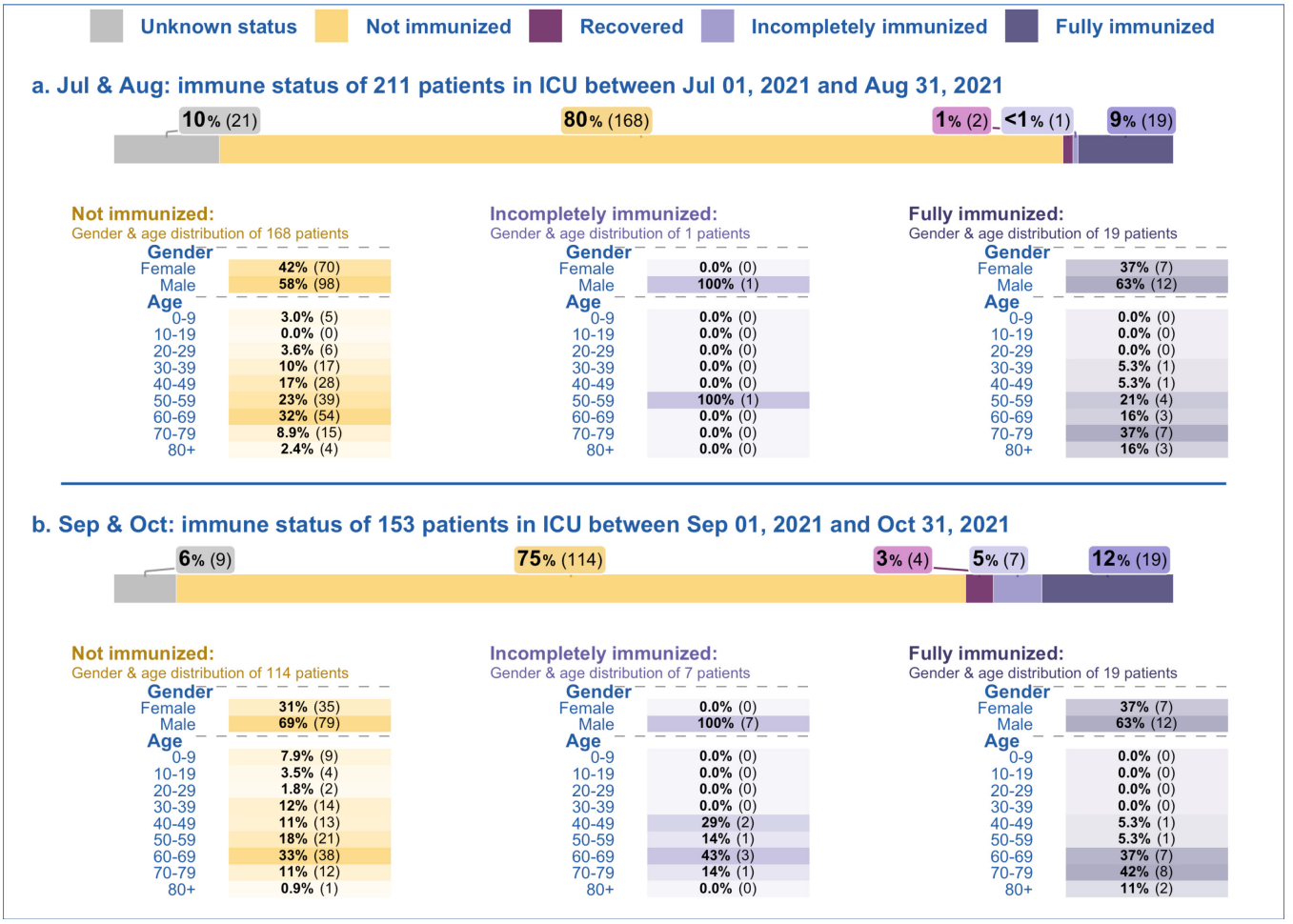

***Figure 10**: Demographic characteristics of patients in ICU by immune status, over two different periods. Patients in ICU after Oct 31 2021 were excluded, as a large proportion of these records have not been completely filled in the database. Patients with missing ages and gender marked 'Other' are not shown.*

[3] Immune status categories were defined in section 3

4.3. ICU admission over time

Figure **11** shows the trend of ICU admission over time. The proportion of patients admitted to the ICU peaked between May and July 2020. Notably, this was during a period of low overall hospitalizations.

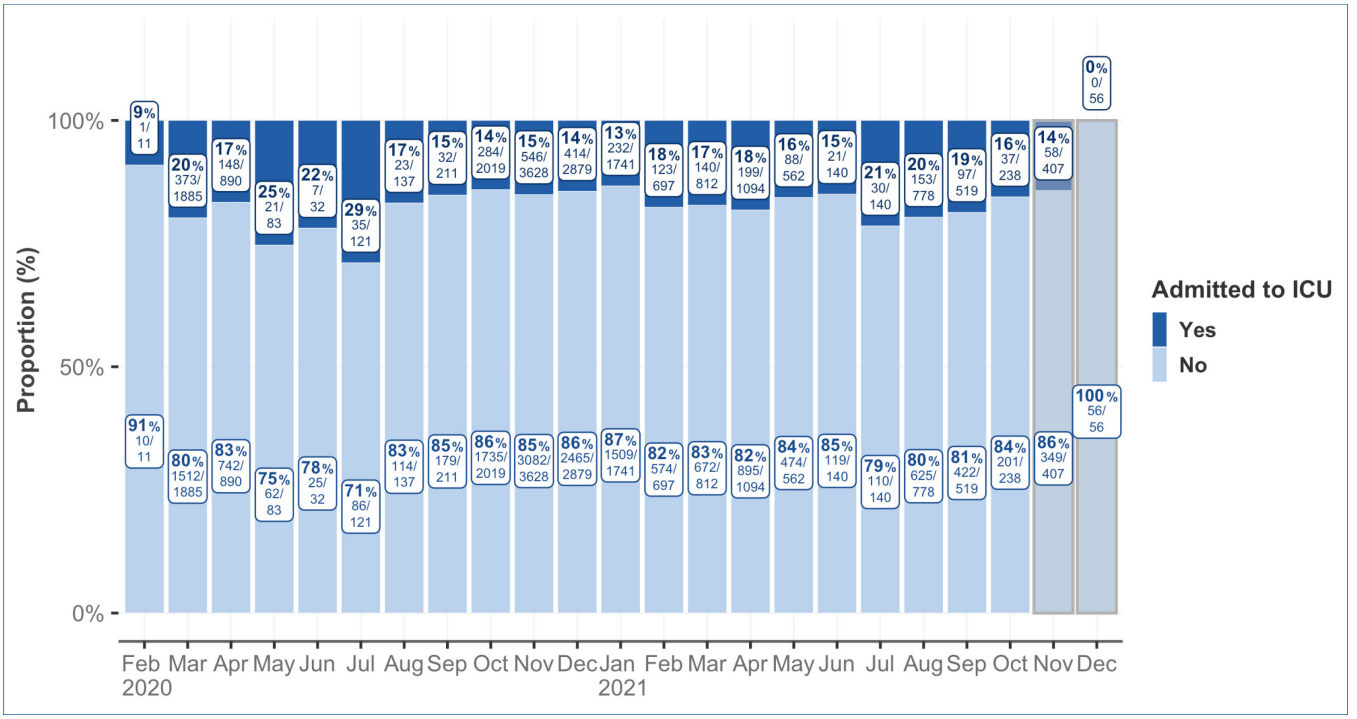

***Figure 11**: Percentage and proportion of patients admitted to the ICU over time. For patients with multiple hospitalizations, we considered whether they were admitted to the ICU during any of their hospitalizations. Records with incomplete data (patients still hospitalized or with a pending outcome in the database) were not included. Data from the last two months (highlighted gray) are considered provisional due to data entry delays.*

5. Nosocomial cases

In the CH-SUR database, a patient's infection is classified as nosocomial when the patient tests positive for SARS CoV-2 five or more days after they were admitted to the hospital for non-COVID-related reasons.

The overall percentage of nosocomial cases among patients in the database was 12.3% (2,718 of 22,078) (Figure **12**a).

The proportion of nosocomial cases peaked in January 2021: 20.6% (371 of 1,797) of patients hospitalized in that month had infections of nosocomial origin (Figure **12**c). Notably, this peak in nosocomial proportion roughly coincides with the peak of hospitalizations (Figure **12**b).

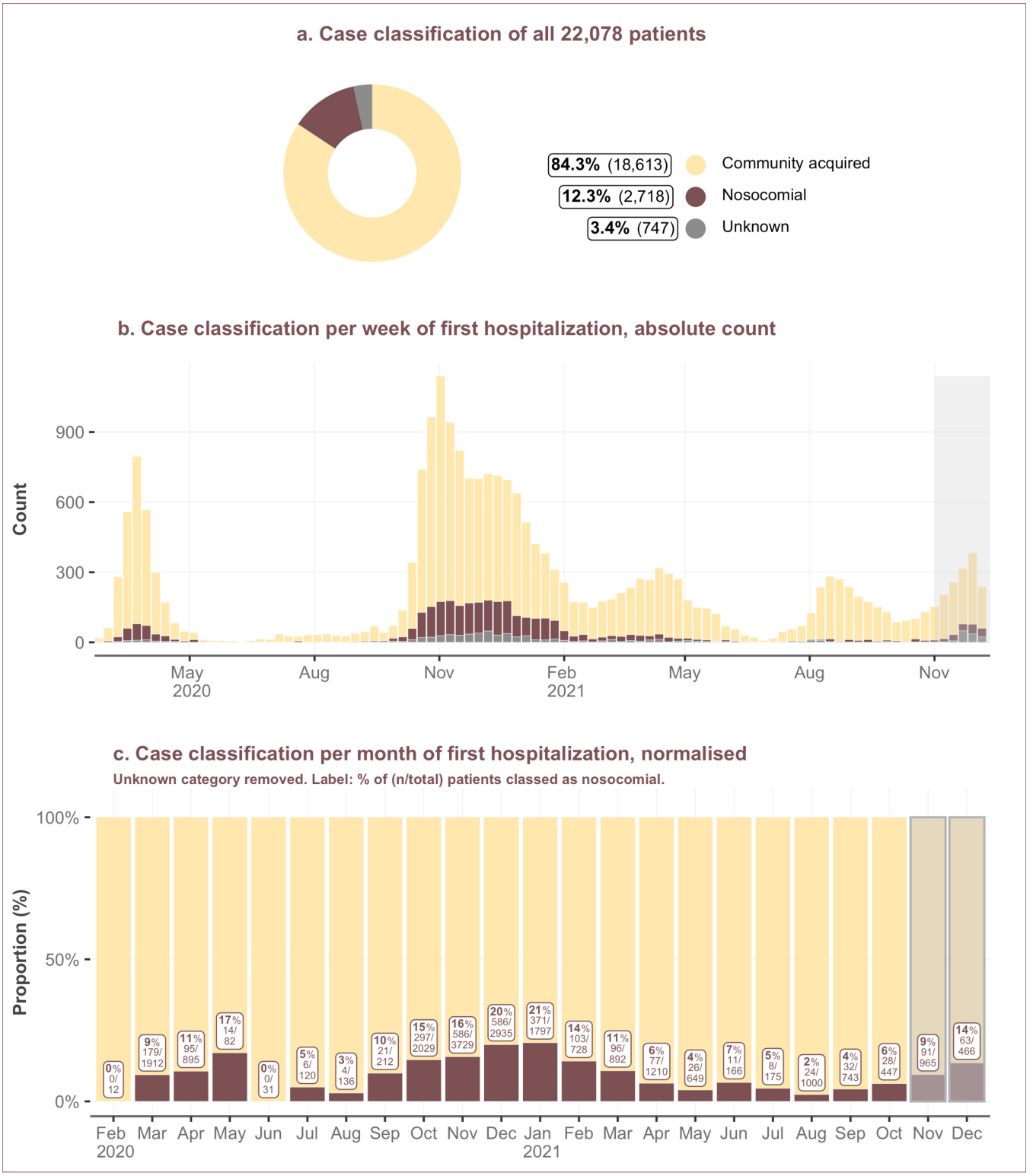

***Figure 12**: Case classification (infection source) for patients over time*

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