Bericht zum spitalbasierten COVID-19-Sentinel-Überwachungssystem

Datenstand: 24. Oktober 2022

1. Einleitende Zusammenfassung

Das spitalbasierte COVID-19-Sentinel-Überwachungssystem (CH-SUR) wurde im Jahr 2018 gegründet, um grippebedingte Hospitalisationen zu erfassen. Bereits am 1. März 2020, vier Tage nach der Meldung des ersten bestätigten COVID-19 Falls in der Schweiz, stand das angepasste Programm bereit, um auch Hospitalisationen im Zusammenhang mit einer laborbestätigten SARS-CoV-2-Infektion zu registrieren.

Zurzeit nehmen 20 Spitäler aktiv teil, darunter die meisten Kantons- und Universitätsspitäler, welche einen grossen Teil der hospitalisierten pädiatrischen und erwachsenen Patientinnen und Patienten in der ganzen Schweiz abdecken. Die CH-SUR-Statistik gibt unter anderem die Anzahl und Dauer der Hospitalisationen sowie die Aufenthalte auf der Intensivpflegestation an. Eine Patientin oder ein Patient kann während einer Hospitalisationsepisode mehrfach hospitalisiert werden bzw. mehrere Aufnahmen in eine Intensivpflegestation (IPS) benötigen. Ersichtlich ist in CH-SUR ebenfalls, ob die Patientin oder der Patient während der Hospitalisation an oder mit COVID-19 verstorben ist.

Einschlusskriterien: CH-SUR erfasst Daten von Patientinnen und Patienten, welche mit einer dokumentierten Infektion mit SARS-CoV-2 hospitalisiert wurden und deren Spitalaufenthalt länger als 24 Stunden andauert. Nosokomiale SARS-CoV-2-Infektionen werden in der Datenbank ebenfalls erfasst und in einem separaten Kapitel am Schluss dieses Berichts aufgeführt. Als Bestätigung für eine Infektion gilt ein positiver PCR-Test (Polymerase Chain Reaction) oder ein positiver Antigen-Schnelltest, wie auch ein klinischer Befund für COVID-19.

Seit Beginn der Epidemie bis zum 23. Oktober 2022 wurden Daten von 39 498 Hospitalisationsepisoden erhoben. Im gleichen Zeitraum wurden dem BAG im Rahmen der Meldepflicht für die gesamte Schweiz 58 869 Episoden von Hospitalisationen mit einer laborbestätigten SARS-CoV-2-Infektion gemeldet. Das CH-SUR-System deckte somit ca. 67,1% aller gemeldeten Hospitalisationen im Zusammenhang mit SARS-CoV-2 in der Schweiz ab.

Seit März 2022 konzentriert sich dieser Bericht auf Episoden, bei welchen die Infektion ausserhalb des Spitals stattgefunden hat (ambulant erworbene Infektionen, beschrieben in Kapitel 2 bis 6). Ein separates Kapitel befasst sich mit den nosokomialen Infektionen (Kapitel 7). Der Gesamtanteil der nosokomialen Infektionen unter allen dokumentierten Episoden lag bei 15,2% (5 994 von 39 498), während der Anteil der Episoden im Zusammenhang mit ambulant erworbenen Infektionen 82,0% (32 393 von 39 498) betrug (Abbildung **1**). 2,8% der Episoden konnten weder den nosokomialen noch den ambulant erworbenen Infektionen zugeordnet werden.

Von allen Episoden im Zusammenhang mit einer ambulant erworbenen Infektion, für welche vollständige relevante Daten vorliegen, erforderten 13,8% einen Aufenthalt in einer IPS (4 317 von 31 218 Episoden, 26. Februar 2020 bis August 31, 2022) und 8,8% führten zum Tod an COVID-19 (2 627 von 29 893 Episoden, 26. Februar 2020 bis October 23, 2022).

Während des letzten Zeitraums, für den genügend Daten vorliegen (Jul 01, 2022 bis Aug 31, 2022), wurden 1 890 Episoden im Zusammenhang mit ambulant erworbenen Infektionen verzeichnet. Davon betrafen 391 (20,7%) nicht immunisierte Patientinnen und Patienten, 625 (33,1%) vollständig immunisierte Patientinnen und Patienten mit

einer Auffrischimpfung und 64 (3,4%) vollständig immunisierte Patientinnen und Patienten mit zusätzlichen Auffrischimpfungen (Abbildung **2**).

Im gleichen Zeitraum waren 127 Episoden mit einem Aufenthalt auf einer Intensivpflegestation verbunden. Von diesen betrafen 24 (18,9%) nicht immunisierte und 43 (33,9%) vollständig immunisierte Patientinnen und Patienten mit einer Auffrischimpfung, und 6 (4,7%) vollständig immunisierte Patienten und Patientinnen mit zusätzlichen Auffrischimpfungen. In 47 Episoden starben die Patientinnen und Patienten an COVID-19 (2,5% aller registrierten Episoden mit bekanntem Outcome). Davon ereigneten sich 10 bei nicht immunisierten, 15 bei vollständig immunisierten und 1 bei vollständig immunisierten Patientinnen und Patienten mit zusätzlichen Auffrischimpfungen.

Am 1. April 2022 kehrte die Schweiz in die normale Lage zurück. Seither wurde das Testen aller Patienten und Patientinnen bei Spitaleintritt durch gezieltere Strategien ersetzt (siehe Empfehlungen von Swissnoso). Diese Änderung der Teststrategie führte womöglich zu einer Verringerung der Zahl der registrierten Fälle, da überwiegend Patientinnen und Patienten mit typischen COVID-19-Symptomen identifiziert werden. Definitionen und weitere Informationen zu den Daten finden Sie im Kapitel Glossar und ergänzende Informationen am Schluss dieses Berichts.

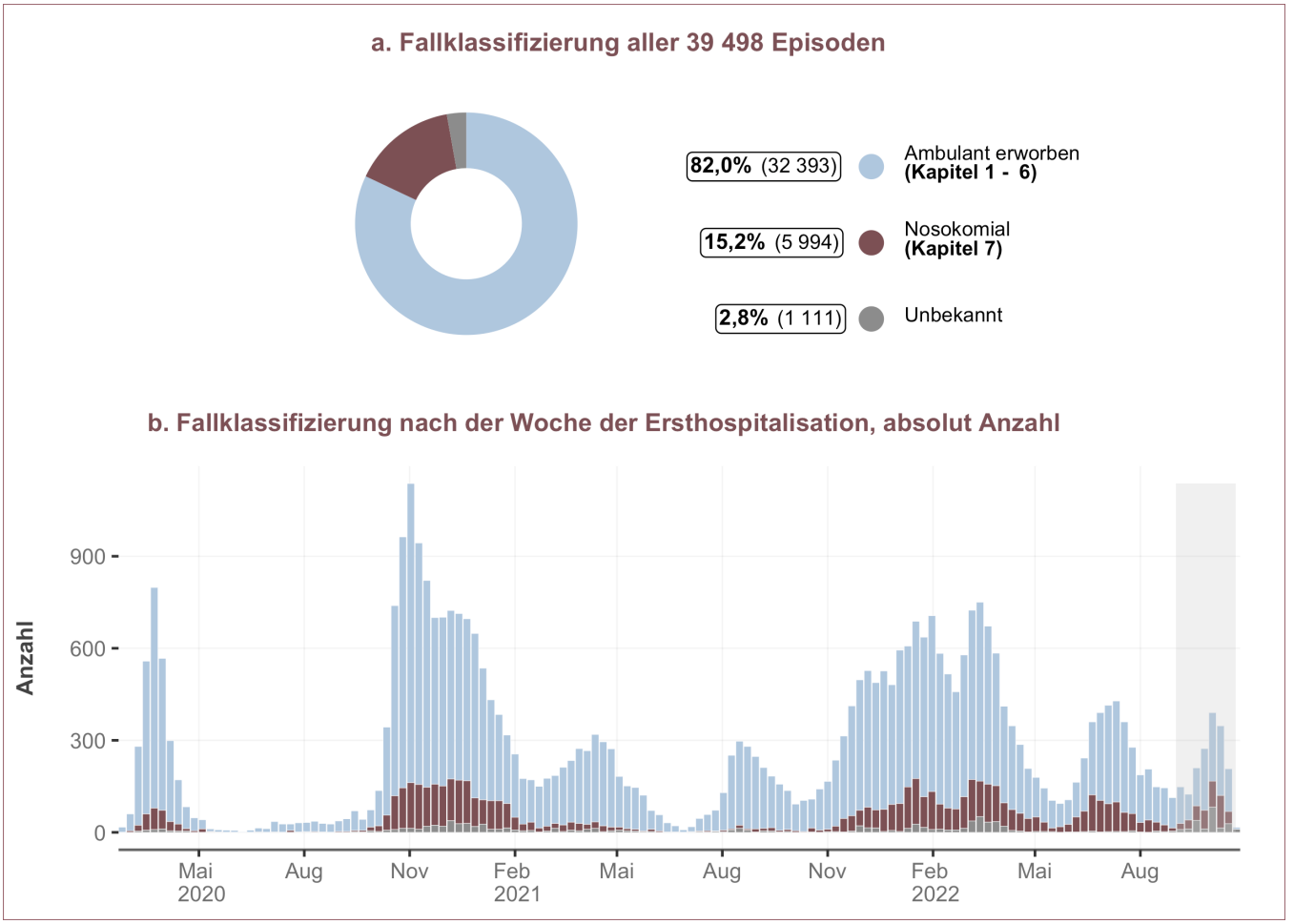


***Abbildung 1**: Episoden nach Fallklassifizierung (Infektionsquelle). Anteil (normalisiert in %) der Episoden nach Infektionsquelle (Diagramm a) und absolute Anzahl Episoden über die Zeit (Diagramm b). Bei Episoden mit Mehrfachhospitalisation wurde die Fallklassifizierung der Ersthospitalisation berücksichtigt. Aufgrund von Verzögerungen bei der Datenerfassung werden die Daten der letzten beiden Monate (grau markiert) als provisorisch betrachtet.*

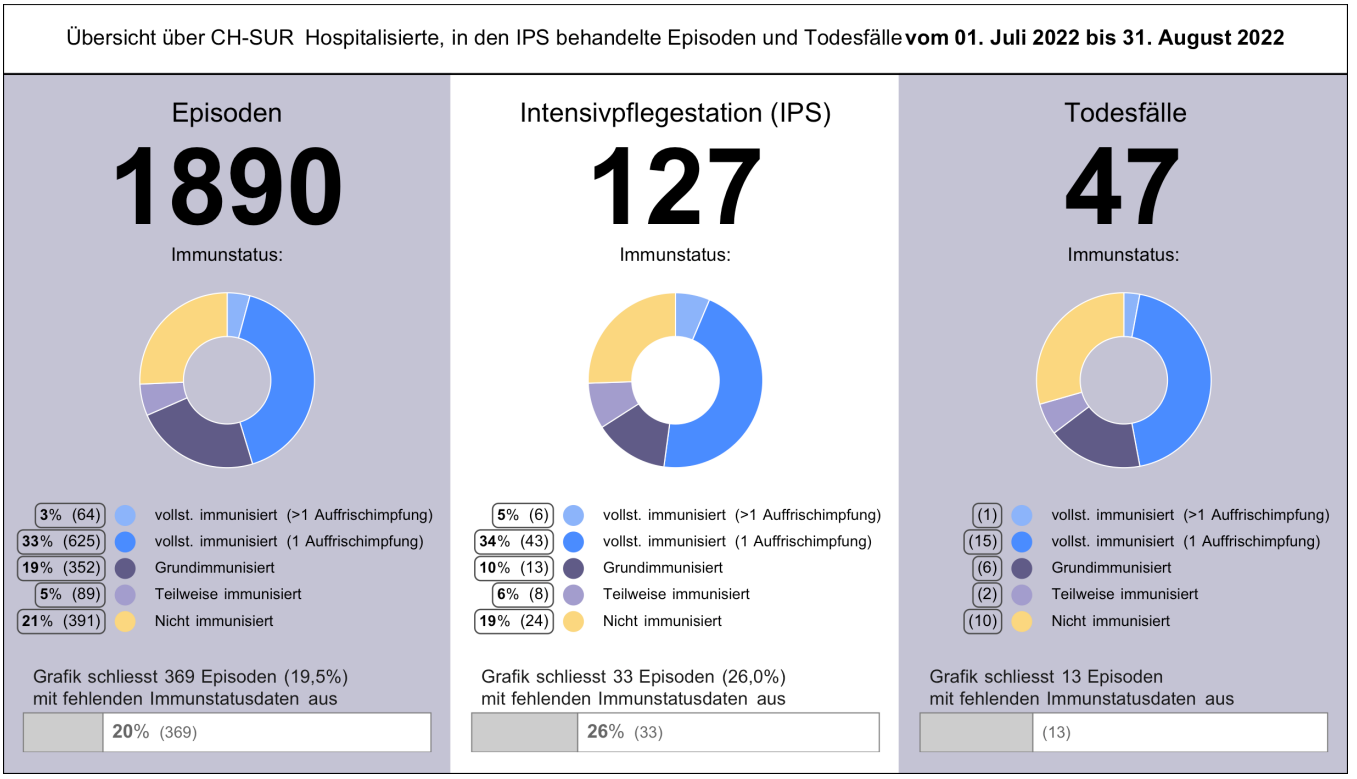


***Abbildung 2**: Übersicht über die neuesten Daten. Die Daten der letzten beiden Monate werden aufgrund von Verzögerungen bei der Dateneingabe als vorläufig betrachtet und wurden daher nicht berücksichtigt.*

2. Hospitalizations and demographic characteristics

Between the start of the epidemic in Switzerland and October 23, 2022 and among the 19 hospitals actively participating in CH-SUR, 32,393 episodes linked to community acquired infections were registered, accounting for a total of 33,596 hospitalizations. There were more hospitalizations than episodes because some episodes include multiple hospitalizations (for more details see section glossary and supplemental information). An overview of these rehospitalizations is shown in Figure **3**.

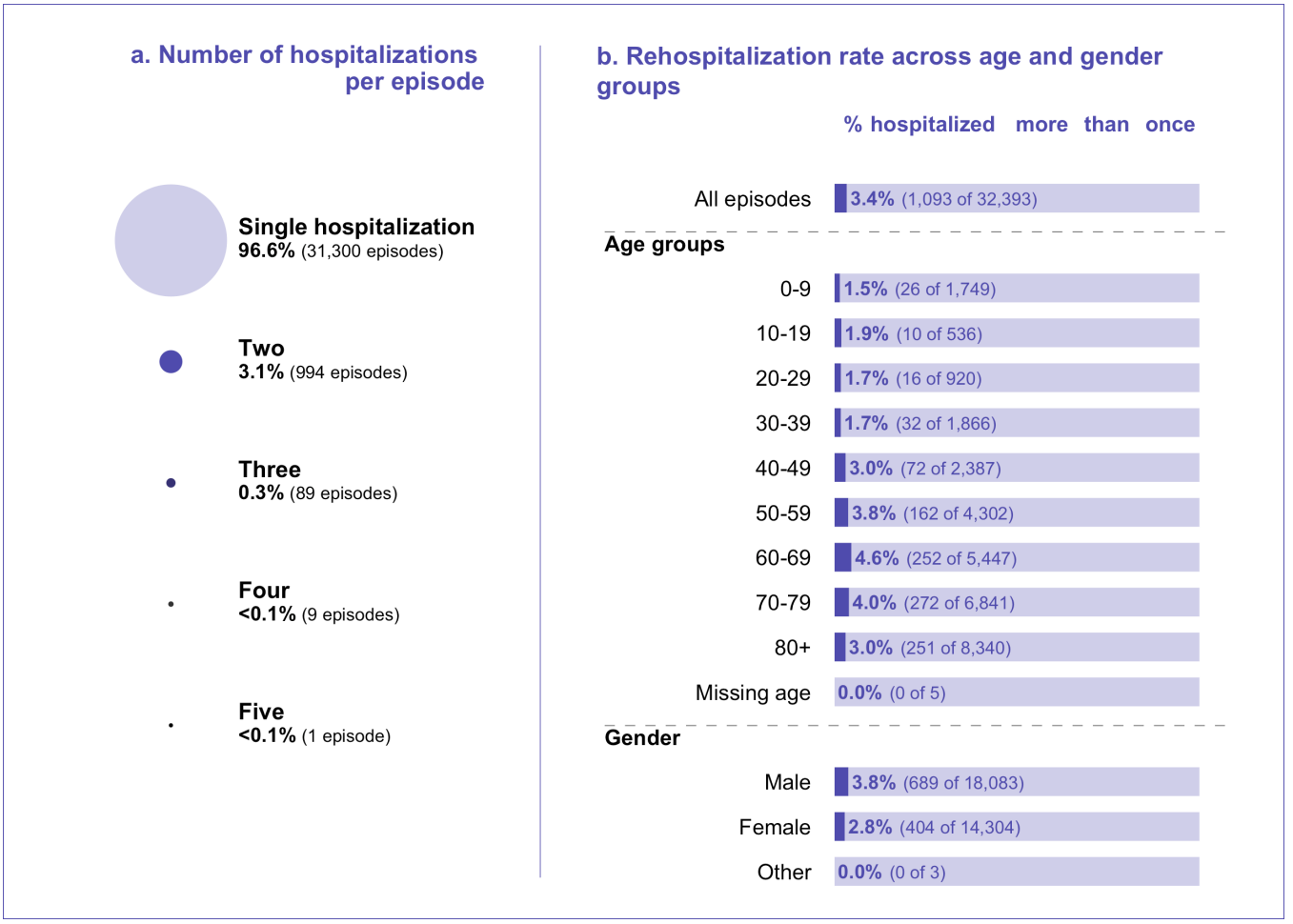


***Figure 3**: Hospitalizations per episode of hospitalization and rehospitalization rate across demographic groups. Includes records between March 2020 and October 23, 2022.*

Most patients (96.6% [31,300 of 32,393]) were hospitalized only once during an episode, while 3% of the registered episodes (1,092 of 32,393) included two to four hospitalizations. Only one episode included five hospitalizations (Figure **3**b).

The overall rate of rehospitalization within the same episode was 3.4% (1093 of 32,393) (Figure **3**b). The 60-69 age group and the 70-79 age group had the highest rate of rehospitalization at respectively 4.6% (252 of 5,447) and 4.0% (272 of 6,841). Men had a higher rehospitalization rate than women, 3.8% (689 of 18,083) vs 2.8% (404 of 14,304) respectively.

Among all episodes, the majority (55.8% [18,083 of 32,393]) of the episodes concerned male patients (Figure **4**a), and the age distribution was skewed towards older persons (Figure **4**b). The largest age category corresponded to patients aged 80 and above (26.0% [8,340]).

Figures **4**c and **4**d show the gender and age distribution ratio over time. Except for January 2022, more men than women were admitted in each month for the entire period of observation. The proportion of episodes concerning patients aged 50 and above was notably high between October 2020 and January 2021, with a peak in November 2020: 88.3% (2,823 of 3,197) of the episodes of patients admitted in this month concerned patients 50 years old and above (Figure **4**d). This peak in older age admissions mirrors a similarly-timed peak in admission severity and case fatality ratios described later. An increase in the percentage of episodes of patients aged 50 and above was

observed again from September 2021 to November 2021, reaching a local peak of 75.2% (840 of 1,117) in November 2021. Since April 2022 the percentage of episodes concerning patients aged 50 years old and above has surpassed the level of November 2021 again. Over the month of August 2022, 81.3% (361 of 444) of episodes concerned patients aged 50 and above. Notably, in this last period, we are seeing an increase in the oldest age groups being admitted with 27.5% [122 of 444] of episodes pertaining to patients aged between 70 and 80 years old and 37.1% [408 of 1,101] of episodes pertaining to patients over 80 years old in the month of August 2022.

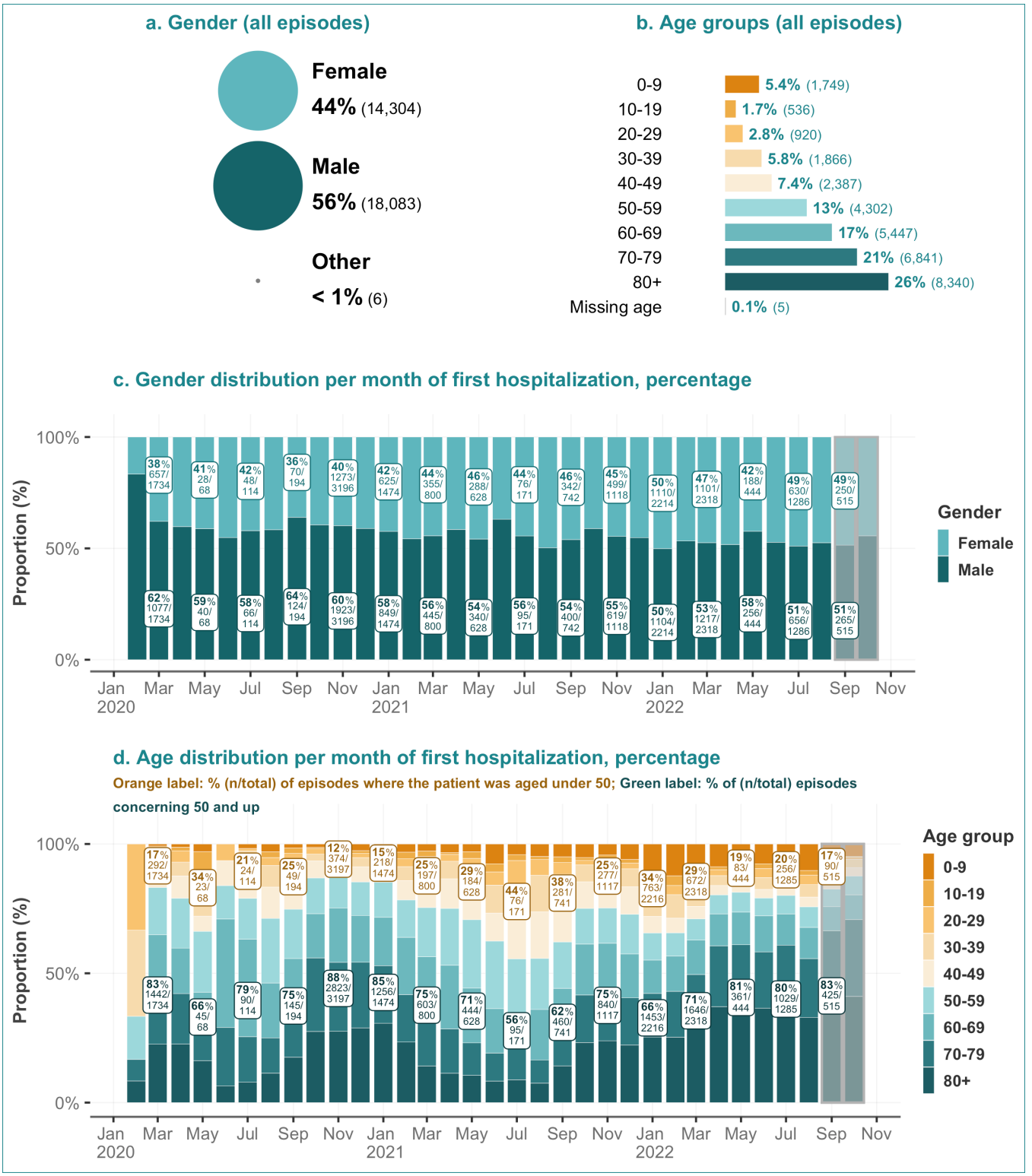


***Figure 4**: Demographic characteristics: gender and age distribution of admitted hospitalized patients, overall and per month. For episodes with multiple hospitalizations, the admission date of the first hospitalization was used. Data from the last two months (highlighted gray) is considered provisional due to entry delays. The 'other' gender category was removed from panel c, and the missing age group was removed from panel d.*

3. Outcomes

3.1. Outcomes overview

Figure **5** shows the final outcomes of CH-SUR episodes over three time intervals. Episodes resulting in death, for which COVID-19 was the cause of death (died *of* COVID-19) are shown separately from those with an alternative cause of death (died *with* COVID-19, but not *of* COVID-19). A medical doctor at the hospital for each CH-SUR-participating center determined of whether a patient died of COVID or another cause. Episodes where the cause of death was not certain, but there was a COVID-19 diagnosis (in conformity for complete inclusion criteria for CH-SUR) were counted as died of COVID or suspected death of COVID. The outcome "discharged" includes patients who were transferred out of the CH-SUR system. Episodes with "pending or missing outcomes" correspond to either patients who were still hospitalized or whose outcomes were not yet recorded in the database at the date of data extraction. Because of the higher proportion of incomplete data during the most recent months, case fatality rates from these months should be interpreted with caution.

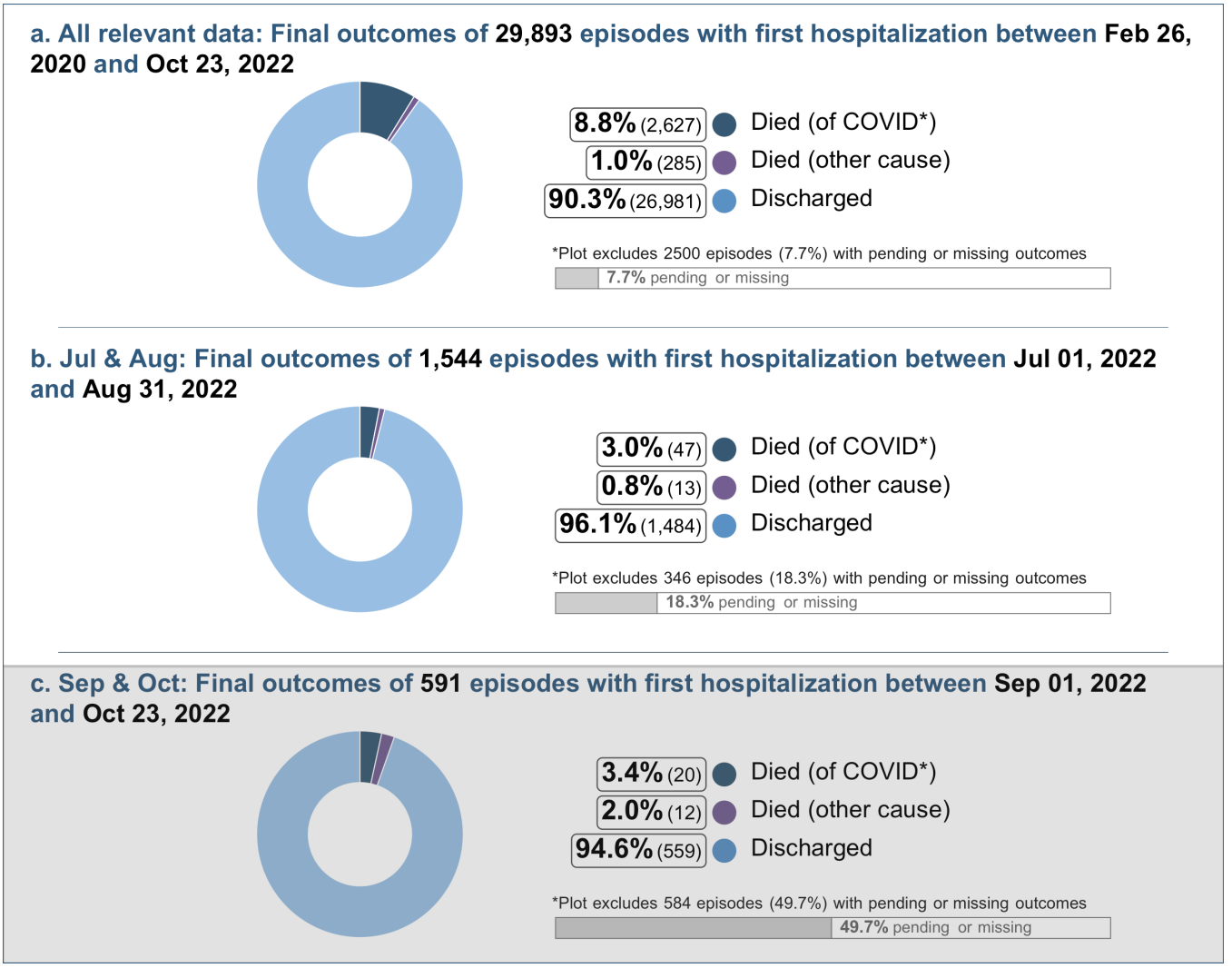


***Figure 5**: Outcomes for COVID-19 related episodes of hospitalization in CH-SUR hospitals. Includes records up to October 23, 2022. For episodes with multiple hospitalizations, only the final outcome is considered. Patients where the cause of death was not certain, but there was a COVID-19 diagnosis (in conformity for complete inclusion criteria for CH SUR) were counted as Died of COVID or suspected death of COVID. Data from the last two months (highlighted gray) is considered provisional due to entry delays. (* Died of COVID as a confirmed or suspected cause of death)*

3.2. Outcomes over time

Figure **6** shows the final outcomes of episodes over time (Figure **6**a & **6**b) and the disease severity score at admission as a function of time (Figure **6**c).

The first mortality peak was observed for patients admitted around the beginning of the epidemic: 15.1% (262 of 1,732) of episodes of patients first admitted in March 2020 resulted in death of COVID-19. Mortality decreased after March 2020, but rose again between October 2020 and January 2021, with a peak in December 2020: 13.9% (330 of 2,374) of episodes of patients first admitted in December 2020 resulted in death. An additional peak of mortality was observed during the month of October 2021, when 12.2% (53 of 433) of episodes resulted in death of COVID-19. Since the month of February 2022, mortality has remained at low levels: less than 5% of episodes resulted in death each month.

The high case fatality rates of patients with episodes of hospitalization in March 2020, between October 2020 and January 2021 and during October 2021, are mirrored by the higher admission severity scores (Figure **6**c) and older patients' ages (Figure **4**c) during these periods. Overall, in 31.7% (550 of 1,734) of the episodes with admission date in March 2020, the severity score was above 2. Over the months of October 2020 to January 2021, the proportion of episodes with severity scores of 2 and above was higher as over the rest of the epidemic, representing more than 40% (958 of 2,394) of the admissions in that period. Most recently, during August 2022, 33.3% (201 of 604) of the episodes had a severity score above 2, but this is not mirrored by higher case fatality rates (Figure **5**)

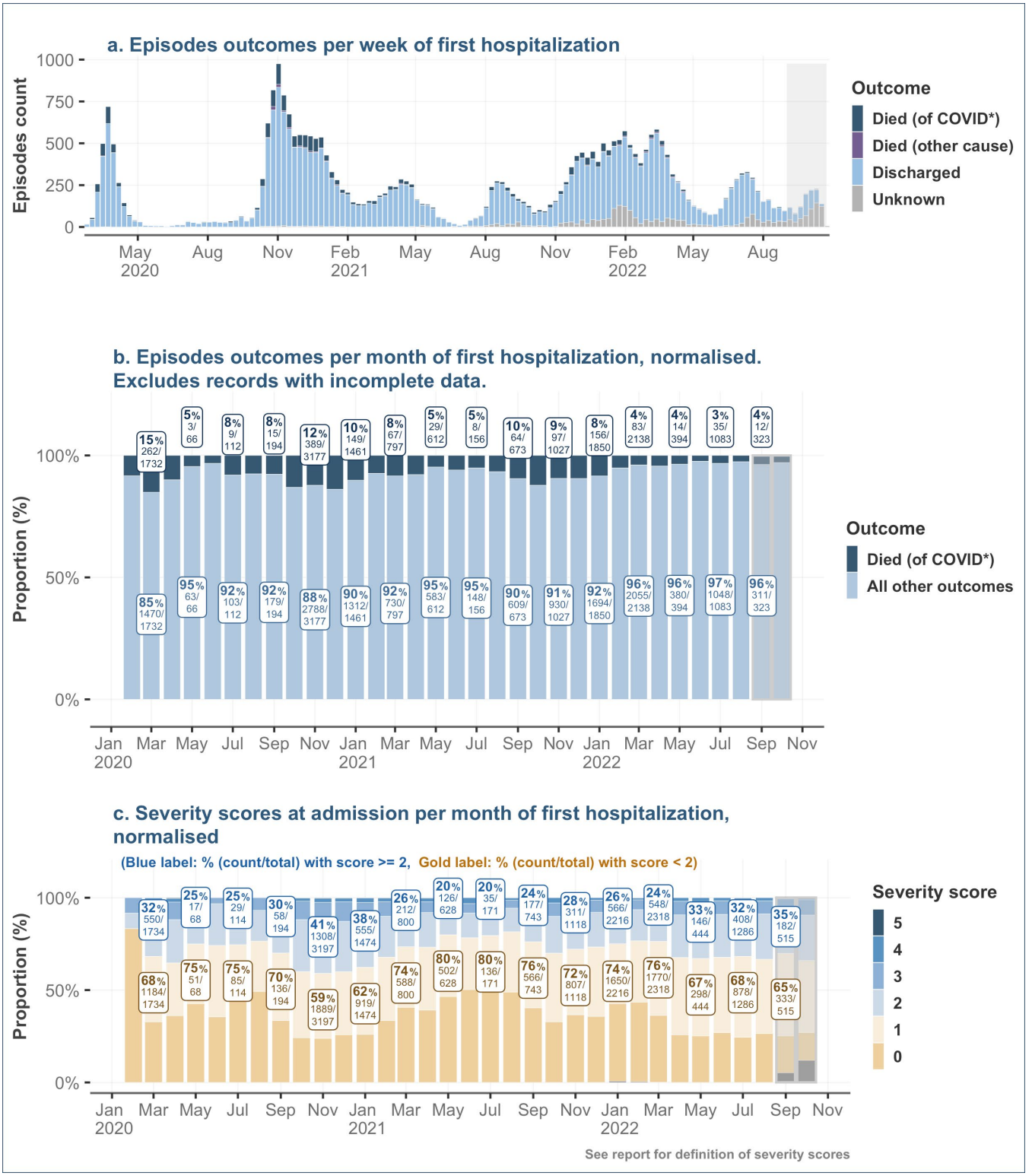


***Figure 6**: Epidemic curve, episodes' outcomes and severity scores at admission for COVID-19 hospitalizations over time. Includes records up to October 23, 2022. Data from the two last months (highlighted in gray) are considered provisional due to data entry delays. Episodes where the cause of death was not certain, but there was a COVID 19 diagnosis (in conformity for complete inclusion criteria for CH SUR) were counted as Died of COVID or suspected death of COVID. (* Died of COVID as a confirmed or suspected cause of death)*

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

Since the beginning of the epidemic and until August 31, 2022, the case fatality rate (CFR) increases with increasing age, from 0% (0 of 1,601) in episodes of patients aged 0-9, to 3.1% (125 of 4,010) in episodes of patients aged 50-59, and to 18.7% (1,363 of 7,277) in episodes of patients aged 80+. CFR% was greater in men than in women: 10.3% (1,706 of 16,498) vs 7% (901 of 12,799) respectively. In addition, the CFR% was greater for episodes with higher severity scores at admission: 1% (97 of 9,826) of the episodes with severity score 0 resulted in death of COVID-19, while 48% (24 of 50) of the episodes with severity score 5 resulted in death of COVID-19 (Figure **7**a).

The overall CFR% of the most recent period for which enough data is available (months July and August 2022, Figure **7**b) was lower than the CFR% of the whole epidemic period (3.0% vs. 8.9%). The CFR% of the age groups 70-79 and 80+ were also lower than over the whole epidemic (Figure **7**).

Of note, there was no clear mortality difference across different BMI groups. Data regarding vaccination status can be found in section 4.

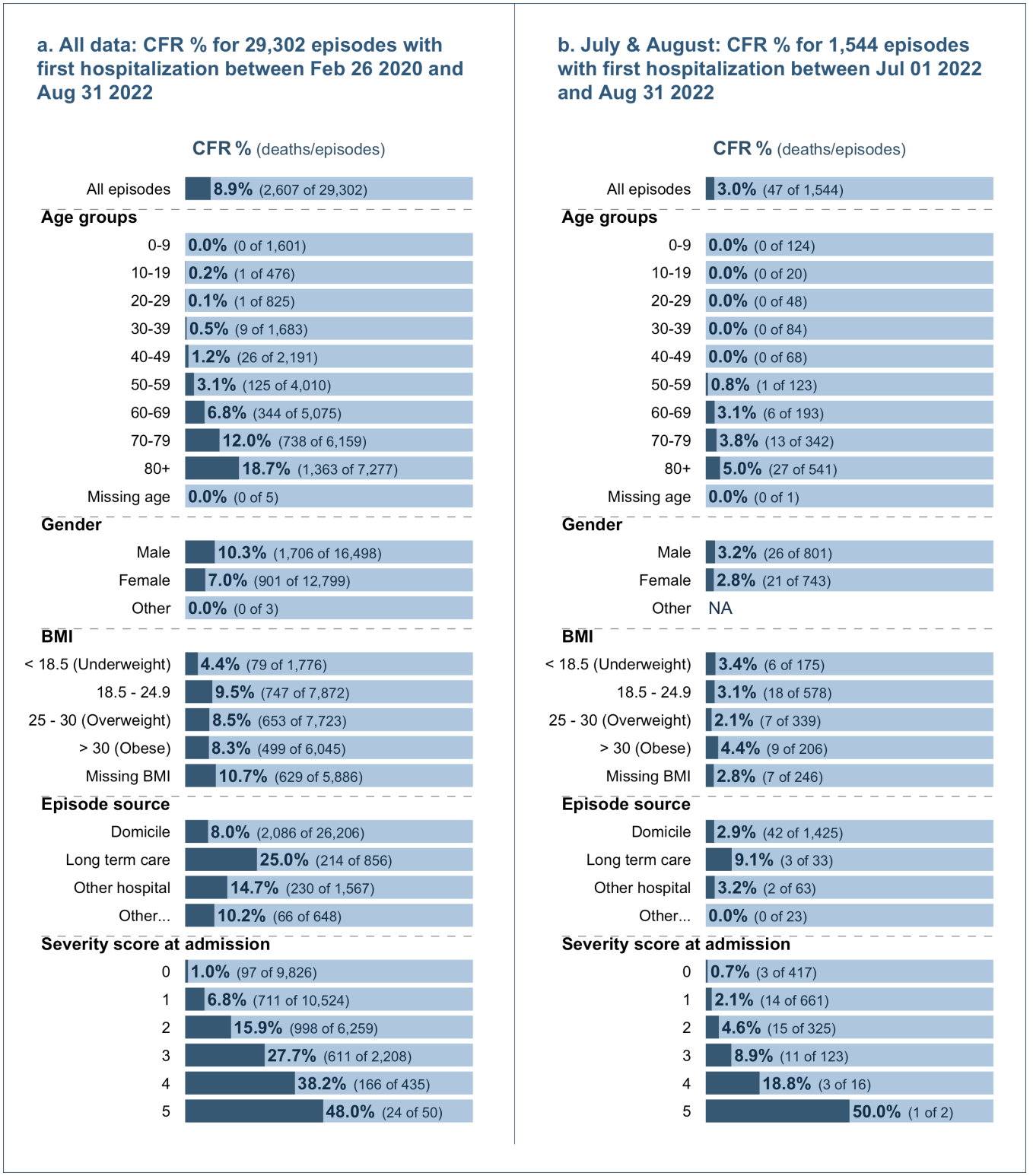


***Figure 7**: Case fatality rate (CFR) % among demographic and risk groups: percentage of hospitalization episodes in different demographic groups, which ended in the death of the patient of COVID-19 in hospital. Both figures include records up to Aug 31 2022 but records with incomplete data (ongoing hospitalization episodes or with a pending outcome in the database) were not included. Blank rows indicate a count of zero.*

4. Immune/vaccination status

4.1. Immune status over time

For these analyses, the immune status of a patient considers the previous COVID-19 infections and the 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.

The proportion of fully immunized patients (with one booster) rose gradually after January 2021 (Figure **8**b). This is expected, given the rise in the proportion of the fully vaccinated Swiss population (see FOPH Dashboard).

As of October 25, 2022, 69.7% of the Swiss population was vaccinated (Figure **8**c). It is important to note that we can know the percentage of the population which is vaccinated (through administrative records), but only approximate the proportion of the population which is immunized. Recent studies from Corona Immunitas are indicating that the population immunization (by vaccination and/or previous infection) is nearing the 100%. The higher percentage of base immunized, fully immunized (with one booster), and fully immunized (with additional boosters) of recent months (23.1%, 41.1% and 4.2% respectively) within the episodes recorded in CH-SUR (Figure **8**b), may therefore be partly linked to the decreasing number of non-immunized persons in the population.

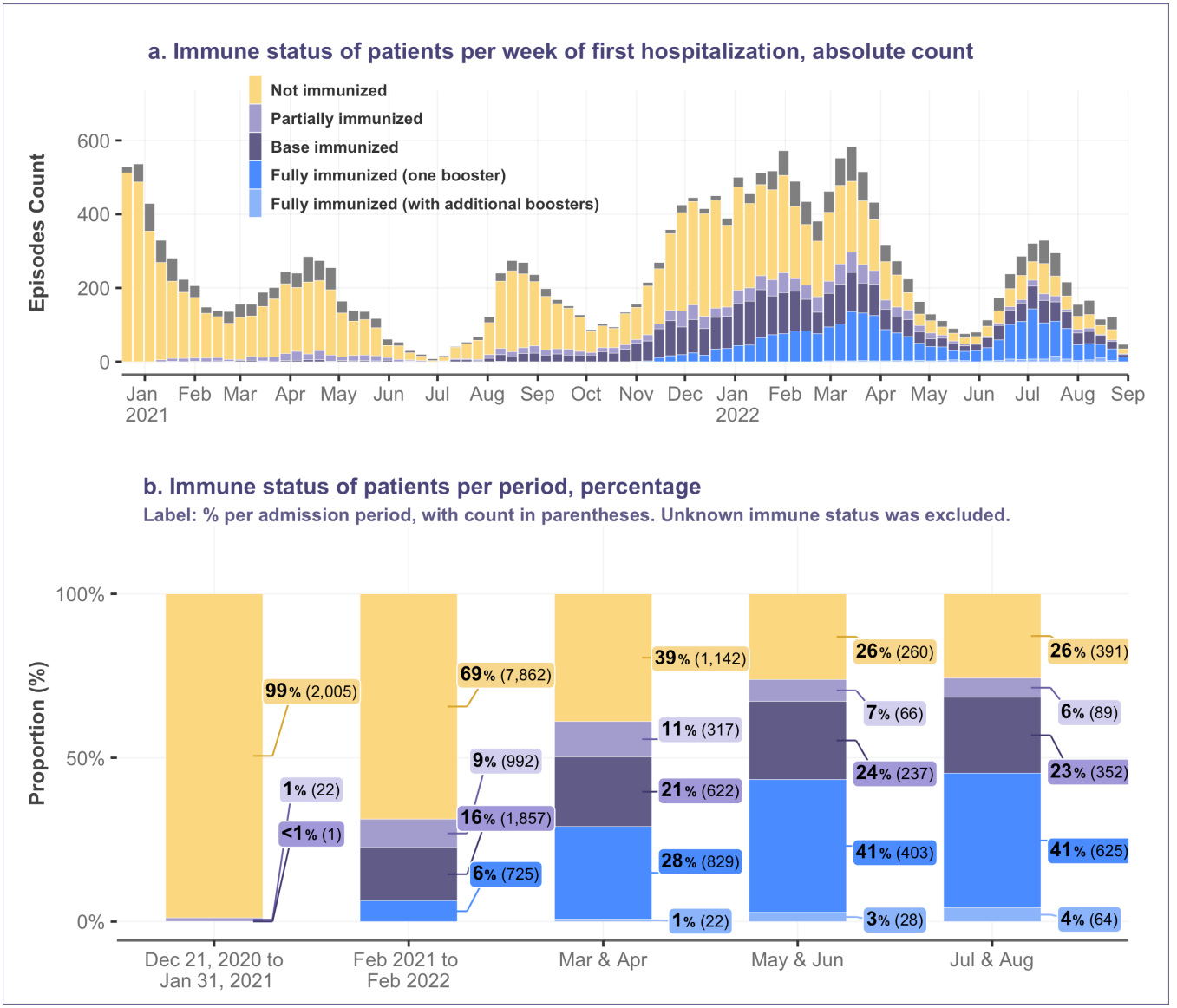


***Figure 8**: Immune status of patients over time. See glossary for definitions of immune status categories. For episodes with multiple hospitalizations, the immune status for the first hospitalization was considered. Episodes are included since the week vaccination began, Dec 21, 2020. (Vaccination began on Dec 23, 2020, but we include*

Dec 22 and 21 to cover a full week.) Episodes with first admission date afterAug 31, 2022were excluded, as a large proportion of these records have not been completely filled in the database.

4.2. Demographic characteristics by immune status

Fully immunized and fully immunized (with additional boosters) hospitalized patients were disproportionately older. Since vaccination initiation, respectively 47% and 47% of the episodes of fully immunized patients (one/additional boosters) corresponded to patients aged 80 and above (Figure **9**a, right panels). In contrast, only 18% (2,078 of 11,492) of the episodes of non-immunized patients corresponded to patients aged 80 and above (Figure **9**a, left panel).

However, in more recent data, we observe an increase in the proportion of older (aged 80+) as well as younger patients (0 to 9 years old) among the non-immunized episodes. From May 2022 to June 2022, among the episodes of non-immunized patients, 32% (82 of 260) concerned patients aged 0 to 9 years old and 27% (69 of 260) concerned patients aged 80 and above. In the most recent data, from July 2022 to August 2022, 34% (132 of 391) of non-immunized episodes involved patients aged 0 to 9 years and 25% (98 of 391) involved patients aged 80 years and above.

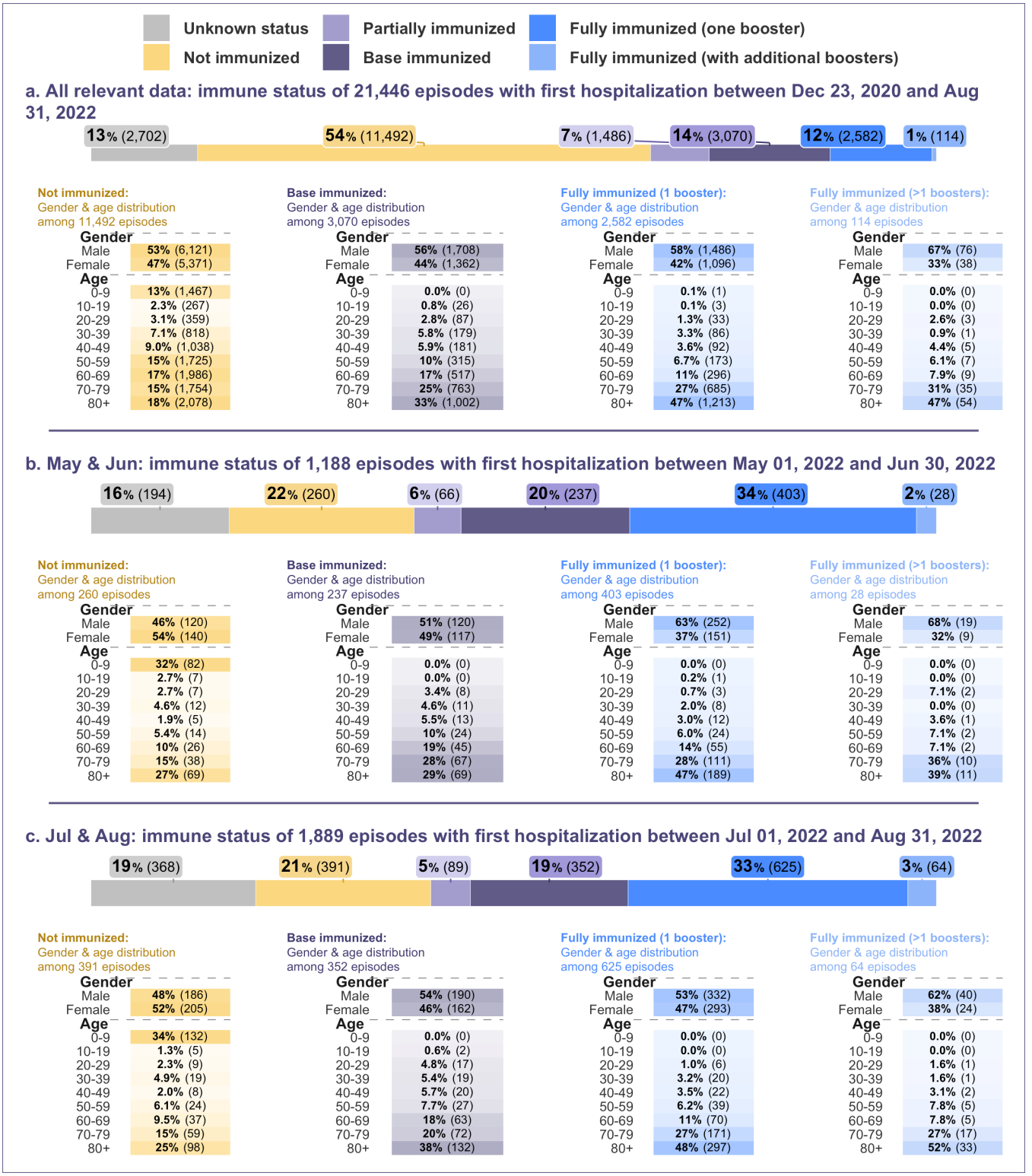


***Figure 9**: Demographic characteristics of hospitalized patients by immune status, over three different periods. Some patients may be counted more than once, as a single patient can have several episodes. Episodes with first admission date after Aug 31 2022 were excluded, as a large proportion of these records have not been completely filled in the database. Episodes with missing ages or gender are not included in the analysis.*

4.3. Outcomes by immune status

Since the date vaccinations began, December 23, 2020, among the 2,208 episodes of fully immunized patients (with one booster), CH SUR registered 91 deaths because of COVID-19 (Figure **10**a, right panels: fully immunized). 59 of them corresponded to patients aged 80 years old and above. Within the episode of fully immunized patients with additional boosters episodes, 4 deaths occurred because of COVID as an outcome, all concerned patients over 80 years old. Since vaccination start, 820 episodes ended in COVID-caused deaths among non-immunized patients (Figure **10**a, left panel).

During the months of July and August, CH-SUR registered 34 deaths because of COVID-19 of which the immune status was known. Of these, 10 (29.4%) happened among non-immunized patients, 2 deaths (5.9%) among partially immunized patients, 6 deaths (17.6%) among base immunized patients, and 15 deaths (44.1%) among fully immunized patients (with one booster) (Figure **10**). The relatively high proportion of fully immunized patients among the deaths compared to non-immunized patients, may be linked to the increasingly low number of non-immunized persons in the population (see section 4.1.)

However, the CFR values by age show that the risk of death for the limited number of people who are hospitalized despite full immunization (with one booster) is generally lower than that of unvaccinated hospitalized people across all age groups. This is specifically true for episodes concerning patients aged over 80 years and above (9.6% CFR for non-immunized episodes compared to 3.9% for fully immunized episodes and 4.3% for fully immunized (with additional boosters) episodes) (Figure **10**c, left and right panel). This reflects the protective effect of vaccination on the risk of death.

Unknown status | Partially immunized | Fully immunized (one booster)
Not immunized | Base immunized | Fully immunized (with additional boosters)

a. All relevant data: 1,214 deaths among 17,009 episodes with first hospitalization between Dec 23, 2020 and Aug 31, 2022

Not immunized:
Age distribution of **820** deaths
in **10,677** episodes

Age	Cases	Deaths	CFR %
0-9	1381	0	0%
10-19	237	1	0.4%
20-29	322	1	0.3%
30-39	746	5	0.7%
40-49	964	13	1.3%
50-59	1618	53	3.3%
60-69	1873	137	7.3%
70-79	1631	214	13.1%
80+	1905	396	20.8%

Base immunized:
Age distribution of **181** deaths
in **2,637** episodes

Age	Cases	Deaths	CFR %
0-9	0	0	-
10-19	20	0	0%
20-29	66	0	0%
30-39	143	0	0%
40-49	154	2	1.3%
50-59	272	9	3.3%
60-69	449	21	4.7%
70-79	682	43	6.3%
80+	851	106	12.5%

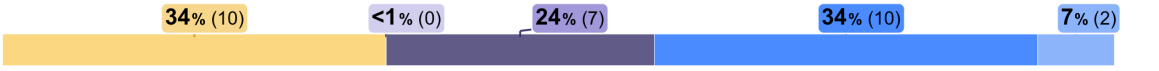
Fully immunized (1 booster):
Age distribution of **91** deaths
in **2,208** episodes

Age	Cases	Deaths	CFR %
0-9	1	0	0%
10-19	2	0	0%
20-29	30	0	0%
30-39	67	0	0%
40-49	76	0	0%
50-59	153	0	0%
60-69	258	5	1.9%
70-79	585	27	4.6%
80+	1036	59	5.7%

Fully immunized (>1 boosters):
Age distribution of **4** deaths
in **101** episodes

Age	Cases	Deaths	CFR %
0-9	0	0	-
10-19	0	0	-
20-29	2	0	0%
30-39	1	0	0%
40-49	5	0	0%
50-59	6	0	0%
60-69	9	0	0%
70-79	34	0	0%
80+	44	4	9.1%

b. May & Jun: 29 deaths among 929 episodes with first hospitalization between May 01, 2022 and Jun 30, 2022



Not immunized:
Age distribution of **10** deaths
in **238** episodes

Age	Cases	Deaths	CFR %
0-9	79	0	0%
10-19	5	0	0%
20-29	7	0	0%
30-39	12	0	0%
40-49	4	0	0%
50-59	14	0	0%
60-69	25	2	8.0%
70-79	34	2	5.9%
80+	58	6	10.3%

Base immunized:
Age distribution of **7** deaths
in **227** episodes

Age	Cases	Deaths	CFR %
0-9	0	0	-
10-19	0	0	-
20-29	8	0	0%
30-39	11	0	0%
40-49	13	0	0%
50-59	24	0	0%
60-69	43	2	4.7%
70-79	63	1	1.6%
80+	65	4	6.2%

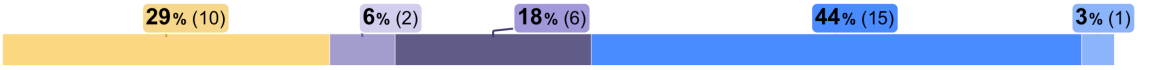
Fully immunized (1 booster):
Age distribution of **10** deaths
in **378** episodes

Age	Cases	Deaths	CFR %
0-9	0	0	-
10-19	0	0	-
20-29	3	0	0%
30-39	6	0	0%
40-49	11	0	0%
50-59	23	0	0%
60-69	53	0	0%
70-79	105	4	3.8%
80+	177	6	3.4%

Fully immunized (>1 boosters):
Age distribution of **2** deaths
in **27** episodes

Age	Cases	Deaths	CFR %
0-9	0	0	-
10-19	0	0	-
20-29	2	0	0%
30-39	0	0	-
40-49	1	0	0%
50-59	1	0	0%
60-69	2	0	0%
70-79	10	0	0%
80+	11	2	18.2%

c. Jul & Aug: 34 deaths among 1,209 episodes with first hospitalization between Jul 01, 2022 and Aug 31, 2022



Not immunized:
Age distribution of **10** deaths
in **318** episodes

Age	Cases	Deaths	CFR %
0-9	116	0	0%
10-19	5	0	0%
20-29	8	0	0%
30-39	13	0	0%
40-49	6	0	0%
50-59	21	0	0%
60-69	33	2	6.1%
70-79	43	1	2.3%
80+	73	7	9.6%

Base immunized:
Age distribution of **6** deaths
in **264** episodes

Age	Cases	Deaths	CFR %
0-9	0	0	-
10-19	1	0	0%
20-29	11	0	0%
30-39	16	0	0%
40-49	16	0	0%
50-59	22	1	4.5%
60-69	45	1	2.2%
70-79	55	1	1.8%
80+	98	3	3.1%

Fully immunized (1 booster):
Age distribution of **15** deaths
in **501** episodes

Age	Cases	Deaths	CFR %
0-9	0	0	-
10-19	0	0	-
20-29	4	0	0%
30-39	15	0	0%
40-49	19	0	0%
50-59	34	0	0%
60-69	61	2	3.3%
70-79	139	4	2.9%
80+	229	9	3.9%

Fully immunized (>1 boosters):
Age distribution of **1** death
in **52** episodes

Age	Cases	Deaths	CFR %
0-9	0	0	-
10-19	0	0	-
20-29	0	0	-
30-39	1	0	0%
40-49	2	0	0%
50-59	5	0	0%
60-69	5	0	0%
70-79	16	0	0%
80+	23	1	4.3%

***Figure 10**: Mortality of CH-SUR hospitalized patients by immune status, age group and hospitalization episode, over three different periods. For partially immunized patients, only number of deaths is shown in the horizontal bar but not the detailed table showing CFR% by age group. The total counts of episodes include episodes with a final patient outcome known (discharged, died of any cause, or transferred out of CH-SUR), and where the patient's immune status was known. Episodes with missing age, missing gender, or missing immune status were not included in the analysis. Counts of deaths only include episodes resulting in death because of COVID-19 (including those with COVID as suspected cause of death). Case-fatality rate (CFR), especially for the fully immunized (with additional booster) category, should be interpreted with caution due to small sample sizes.*

5. Intensive care unit (ICU) admission

5.1. ICU admission over time

Figure **11** shows the proportion (in %) of ICU admission over time. The proportion of episodes with ICU admissions peaked between May and July 2020. Notably, this was during a period of low overall hospitalizations. In contrast, the lowest proportion was observed in most recent months since January 2022.

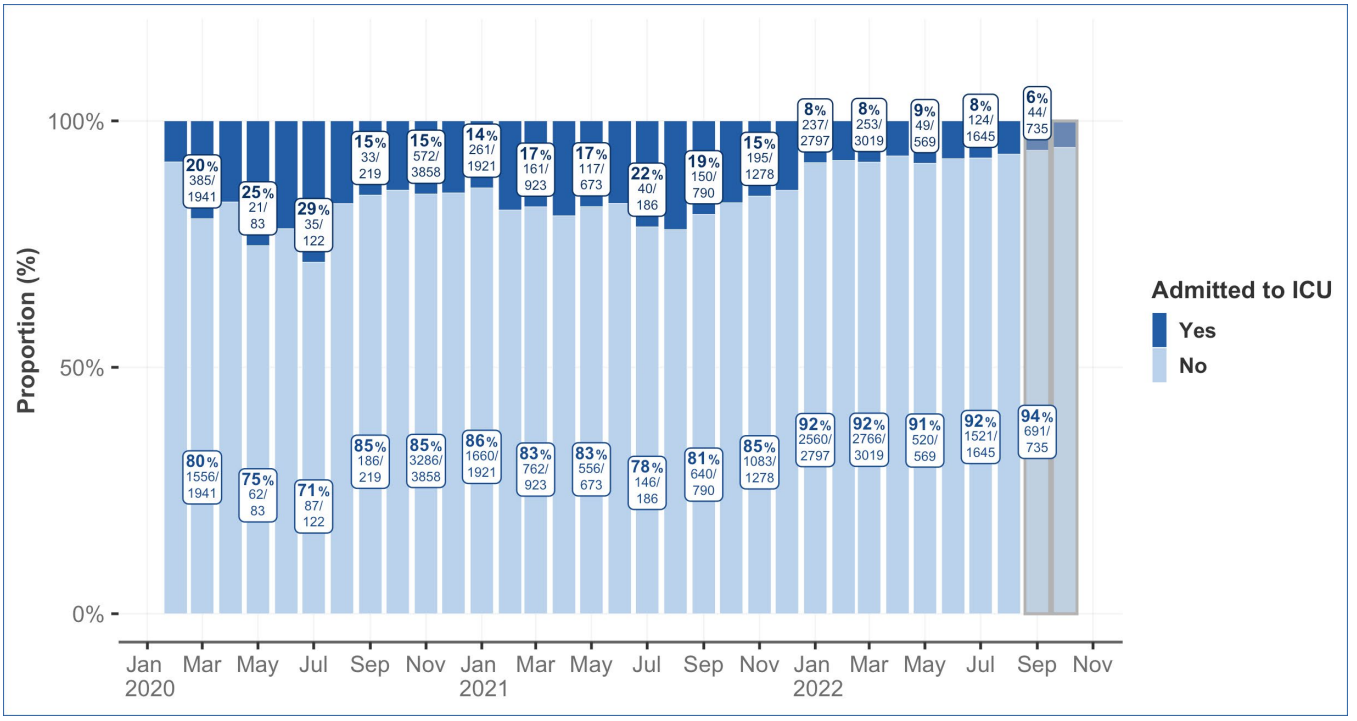


***Figure 11**: Percentage and proportion of episodes with at least one ICU admission over time. Records with incomplete data (ongoing episodes or with a pending outcome in the database) were not included. Data from the last two months (highlighted gray) are considered provisional due to data entry delays.*

5.2. 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 **12**a). The 60-69 age group had the highest probability of admission to the ICU, with 23.1% (1,230 of 5,336) of the episodes including at least one ICU admission. Notably, individuals aged 80 and above were least likely to be admitted to the ICU, with 5.2% (408 of 7,861) of the episodes including at least one ICU admission.

Males were more likely to be admitted to the ICU than females. Overall, admissions to the ICU were registered for 16.8% of the episodes concerning males, compared to 10.1% of the episodes concerning females.

Episodes of patients transferred from other hospitals had a high probability of ICU admission: 49.4% of such episodes (826 of 1,673) required at least one ICU admission (Figure **12**a), compared to an overall admission rate of 13.8%.

ICU admission probability also increased slightly with increasing BMI and steeply with increasing admission severity scores (Figure **12**a).

Figure **12**b shows the ICU admissions for the most recent period with available data (July 2022 and August 2022). The distribution of ICU admissions across different population groups during the latest period was roughly similar to the frequencies observed for the whole observation period. However, differences across BMI groups seem to have largely disappeared. Moreover, the relation between ICU admission and increasing severity at admission only shows for patients with severity scores of 3 and above. Given the smaller sample size of this period of observation, larger oscillations in the percentages are expected, making the real trends difficult to identify. For the overall frequency of admission to ICU and all population groups observed, the frequency of admission to ICU was smaller for the months of July and August than for the full epidemic period (Figure **12**).

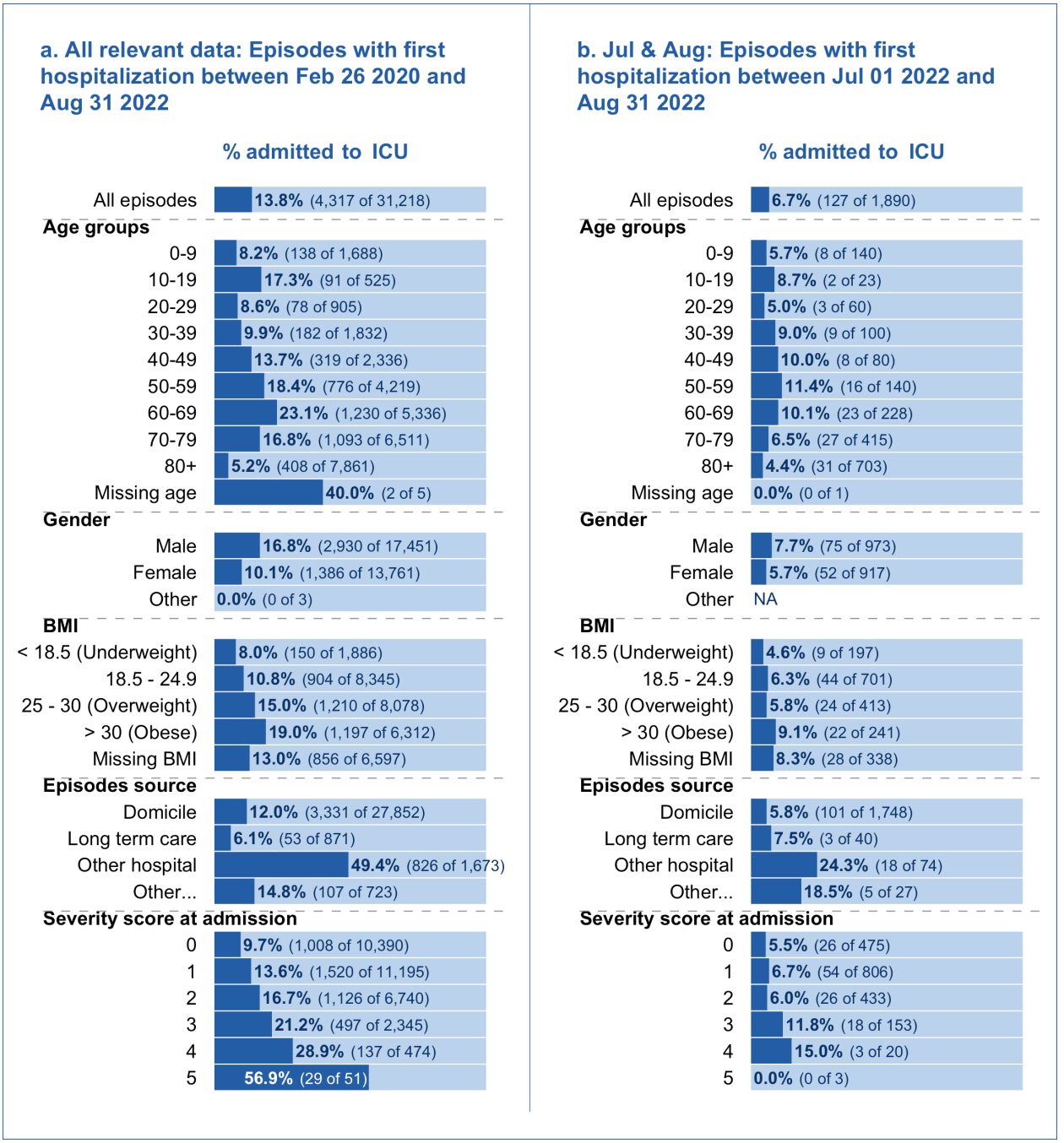
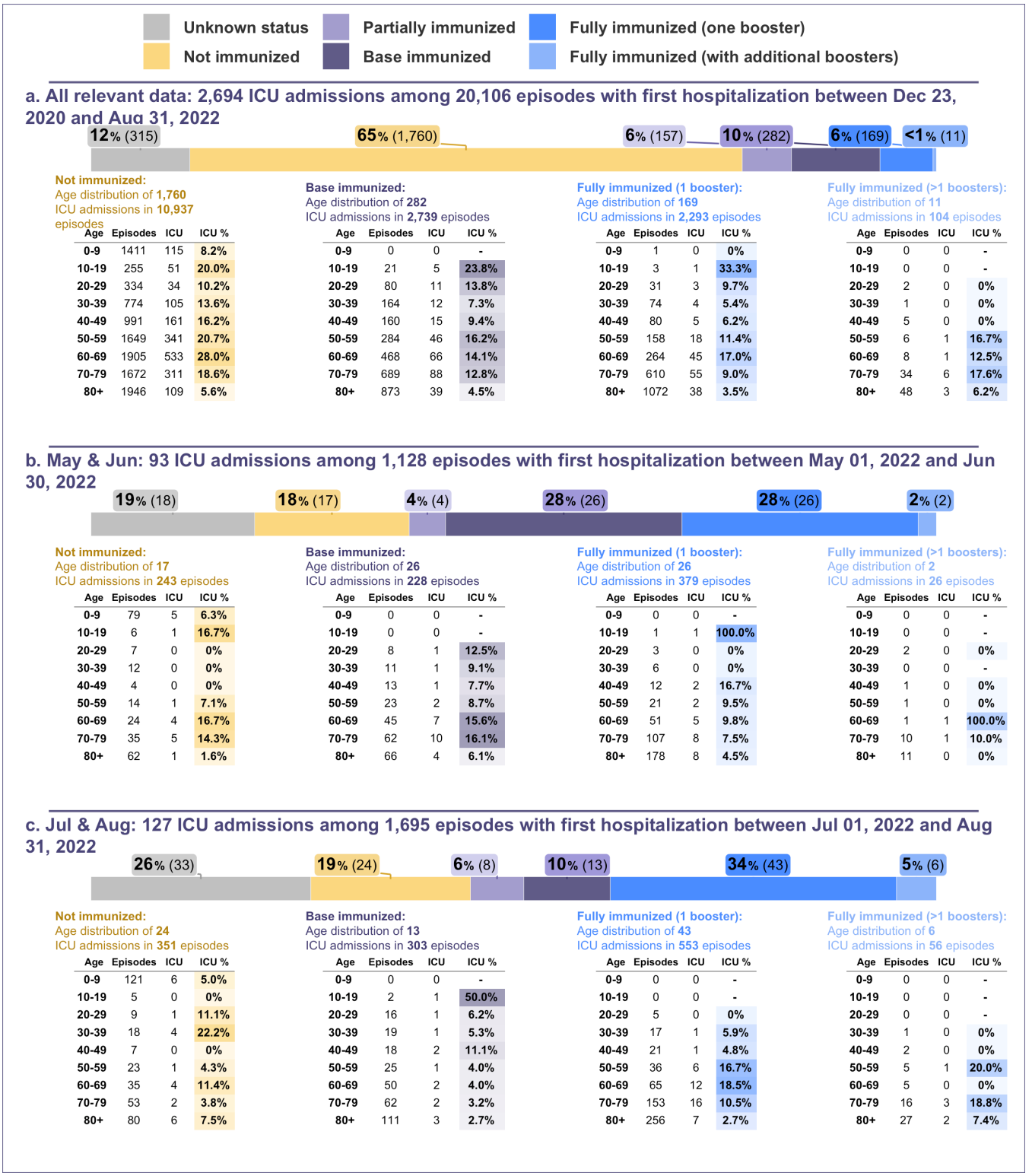


***Figure 12**: Percentage of hospitalization episodes with at least one ICU admission, grouped by demographic and risk factors, over two time intervals. For episodes with multiple hospitalizations, we considered whether they were admitted to the ICU during any of their hospitalizations. Both panels include records up to Aug 31, 2022 due to data completeness considerations. Records with incomplete data (ongoing episodes or with a pending outcome in the database) were not included. A blank row indicates a count of zero.*

5.3. ICU admission rate by immune status

Figure **13** shows the ICU admission rate (number of episodes requiring an admission to the ICU over all episodes registered), stratified by age.

In recent data, from July and August, although episodes include 36.1% of people aged over 80 years old (see section 2 for more information on age distribution), these episodes did not have a high ICU rate (i.e. not many included an ICU stay).



Age	Episodes	ICU	ICU %
0-9	1411	115	8.2%
10-19	255	51	20.0%
20-29	334	34	10.2%
30-39	774	105	13.6%
40-49	991	161	16.2%
50-59	1649	341	20.7%
60-69	1905	533	28.0%
70-79	1672	311	18.6%
80+	1946	109	5.6%

Age	Episodes	ICU	ICU %
0-9	0	0	-
10-19	21	5	23.8%
20-29	80	11	13.8%
30-39	164	12	7.3%
40-49	160	15	9.4%
50-59	284	46	16.2%
60-69	468	66	14.1%
70-79	689	88	12.8%
80+	873	39	4.5%

Age	Episodes	ICU	ICU %
0-9	1	0	0%
10-19	3	1	33.3%
20-29	31	3	9.7%
30-39	74	4	5.4%
40-49	80	5	6.2%
50-59	158	18	11.4%
60-69	264	45	17.0%
70-79	610	55	9.0%
80+	1072	38	3.5%

Age	Episodes	ICU	ICU %
0-9	0	0	-
10-19	0	0	-
20-29	2	0	0%
30-39	1	0	0%
40-49	5	0	0%
50-59	6	1	16.7%
60-69	8	1	12.5%
70-79	34	6	17.6%
80+	48	3	6.2%

Age	Episodes	ICU	ICU %
0-9	79	5	6.3%
10-19	6	1	16.7%
20-29	7	0	0%
30-39	12	0	0%
40-49	4	0	0%
50-59	14	1	7.1%
60-69	24	4	16.7%
70-79	35	5	14.3%
80+	62	1	1.6%

Age	Episodes	ICU	ICU %
0-9	0	0	-
10-19	0	0	-
20-29	8	1	12.5%
30-39	11	1	9.1%
40-49	13	1	7.7%
50-59	23	2	8.7%
60-69	45	7	15.6%
70-79	62	10	16.1%
80+	66	4	6.1%

Age	Episodes	ICU	ICU %
0-9	0	0	-
10-19	1	1	100.0%
20-29	3	0	0%
30-39	6	0	0%
40-49	12	2	16.7%
50-59	21	2	9.5%
60-69	51	5	9.8%
70-79	107	8	7.5%
80+	178	8	4.5%

Age	Episodes	ICU	ICU %
0-9	0	0	-
10-19	0	0	-
20-29	2	0	0%
30-39	0	0	-
40-49	1	0	0%
50-59	1	0	0%
60-69	1	1	100.0%
70-79	10	1	10.0%
80+	11	0	0%

Age	Episodes	ICU	ICU %
0-9	121	6	5.0%
10-19	5	0	0%
20-29	9	1	11.1%
30-39	18	4	22.2%
40-49	7	0	0%
50-59	23	1	4.3%
60-69	35	4	11.4%
70-79	53	2	3.8%
80+	80	6	7.5%

Age	Episodes	ICU	ICU %
0-9	0	0	-
10-19	2	1	50.0%
20-29	16	1	6.2%
30-39	19	1	5.3%
40-49	18	2	11.1%
50-59	25	1	4.0%
60-69	50	2	4.0%
70-79	62	2	3.2%
80+	111	3	2.7%

Age	Episodes	ICU	ICU %
0-9	0	0	-
10-19	0	0	-
20-29	5	0	0%
30-39	17	1	5.9%
40-49	21	1	4.8%
50-59	36	6	16.7%
60-69	65	12	18.5%
70-79	153	16	10.5%
80+	256	7	2.7%

Age	Episodes	ICU	ICU %
0-9	0	0	-
10-19	0	0	-
20-29	0	0	-
30-39	1	0	0%
40-49	2	0	0%
50-59	5	1	20.0%
60-69	5	0	0%
70-79	16	3	18.8%
80+	27	2	7.4%

***Figure 13**: ICU admission over all episodes of CH-SUR hospitalized patients by immune status and age group over three different periods. For partially immunized patients, only number of ICU admissions is shown in the horizontal*

bar but not the detailed table showing ICU% by age group. Episodes with missing age, or missing ICU stay were not included in the analysis. ICU admission rates (ICU%), especially for the fully immunized (with additional boosters) category, should be interpreted with caution due to small sample sizes.

5.4. ICU admissions contrasted by immune status

Due to a variance in vaccine coverage, only the recent evolution is represented. Data for September and October 2022 are not meaningful due to their incompleteness and are therefore not yet shown.

In both periods considered, the largest group of episodes with an ICU admission concerned fully immunized patients (with one booster) (28% and 34% of all episodes with ICU admissions in each of the described periods respectively). For most immune status categories shown and in both periods considered, there were more men than women admitted to the ICU (Figure **14**).

For episodes of fully immunized patients (with one or more boosters), there is a skew towards older age groups being admitted to the ICU (between May 2022 and Aug 2022 around 93% of these episodes concerned patients aged 50+). In the two time periods, 89.3% (May, Jun) and 95.9% (Jul, Aug) of these episodes concerned patients aged 50+.

In comparison, episodes of non-immunized patients admitted to the ICU included proportionally more patients from younger age groups, as only 64.8% (May, Jun) and 54.5% (Jul, Aug) of the episodes corresponded to patients aged 50 years and above.

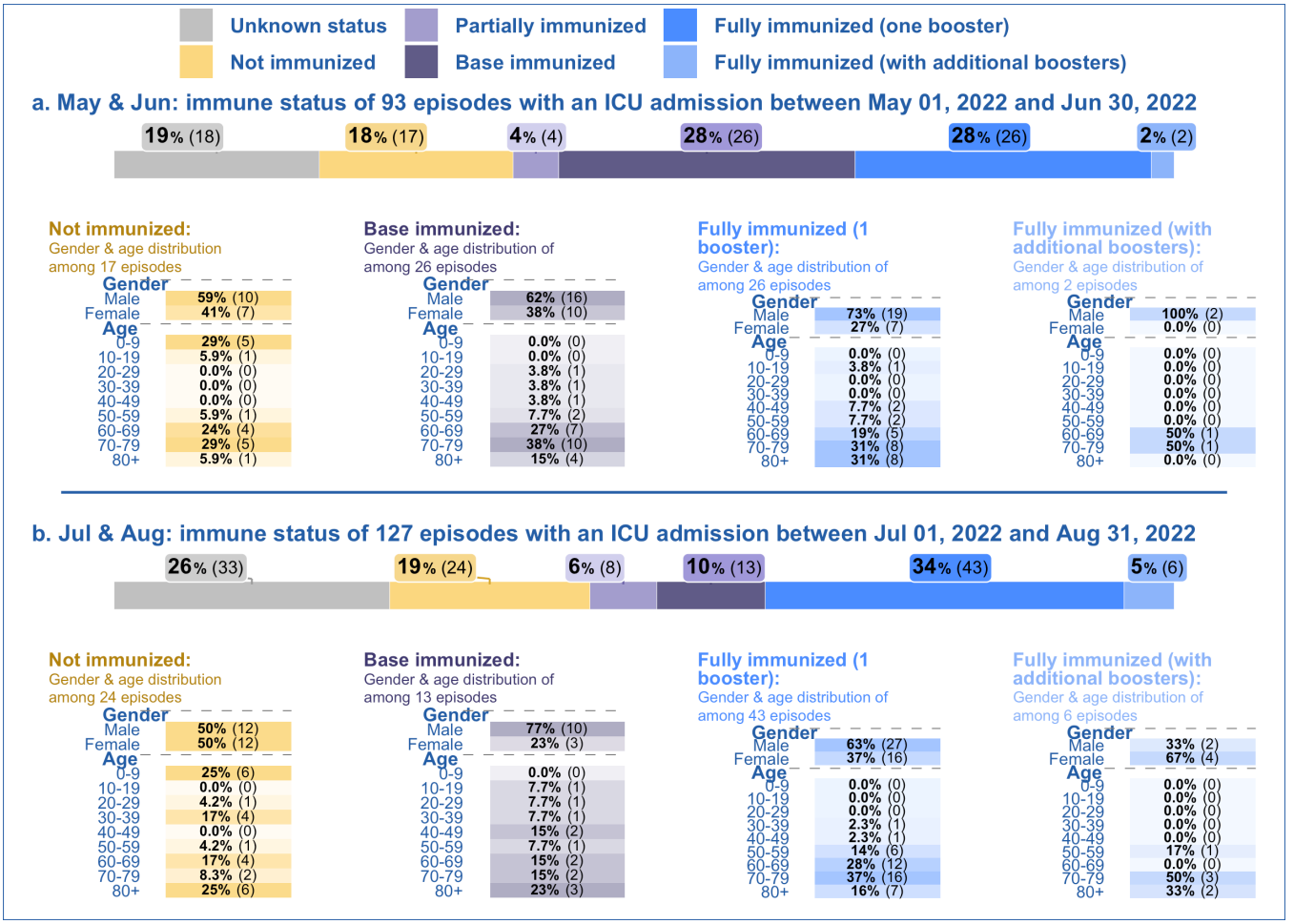


***Figure 14**: Demographic characteristics of patients in ICU by immune status and episode, over two different periods. Episodes with a first admission date after Aug 31, 2022 were excluded, as a large proportion of these records have not been completely filled in the database. Episodes with missing ages or gender marked as 'Other' are not shown. Data on ICU admissions for the fully immunized (with additional boosters) should be interpreted with caution due to small sample sizes.*

6. Treatments

Several treatments have been used since the beginning of the pandemic and guidelines for COVID-19 treatment evolve according to the current state of knowledge. Therapeutic strategies may vary across centers, contributing to the heterogeneity of data. For clarity purpose, the treatments were classified into three categories: antivirals [1], monoclonal antibodies [2] and immune-modulating strategies [3].Combinations of treatments were explored: combinations are defined as the co-administration or the sequential administration of treatments during the same episode.

Figure **15** represents the categories of treatments (including combinations) over time, starting February 2020. This figure illustrates the changes in the overall treatment strategy as well as the increasing proportion of episodes during which no anti-COVID treatment was administered. This may be in line with the increasing proportion of non-severe cases over time.

In the Figure **16**, treatments are analysed at the drug-level. The most commonly used drugs and their different combinations are presented.

Figure **17** represents the use of treatments across different patient groups. The global period from December 2020 to November 2021 is compared to the more recent period from December 2021 to October 2022 when the Omicron variant was predominant. In the more recent period, the proportion of patients who did not receive any anti-COVID treatment increased across all groups.

[1] Antivirals comprise: nirmatrevir/ritonavir, remdesivir and other antivirals (chloroquine, lopinavir/ritonavir, ribavirin, tenofovir, etc.).

[2] Monoclonal antibodies comprise: tixagevimab/cilgavimab, sotrovimab, casirivimab/imdevimab, bamlanivimab/etesevimab, and others (convalescent plasma, etc.).

[3] Immune-modulating strategies comprise: corticoids (dexamethasone, prednisone), inhaled corticoids (budesonide), tocilizumab, baricitinib, and others (interferon, etc.).

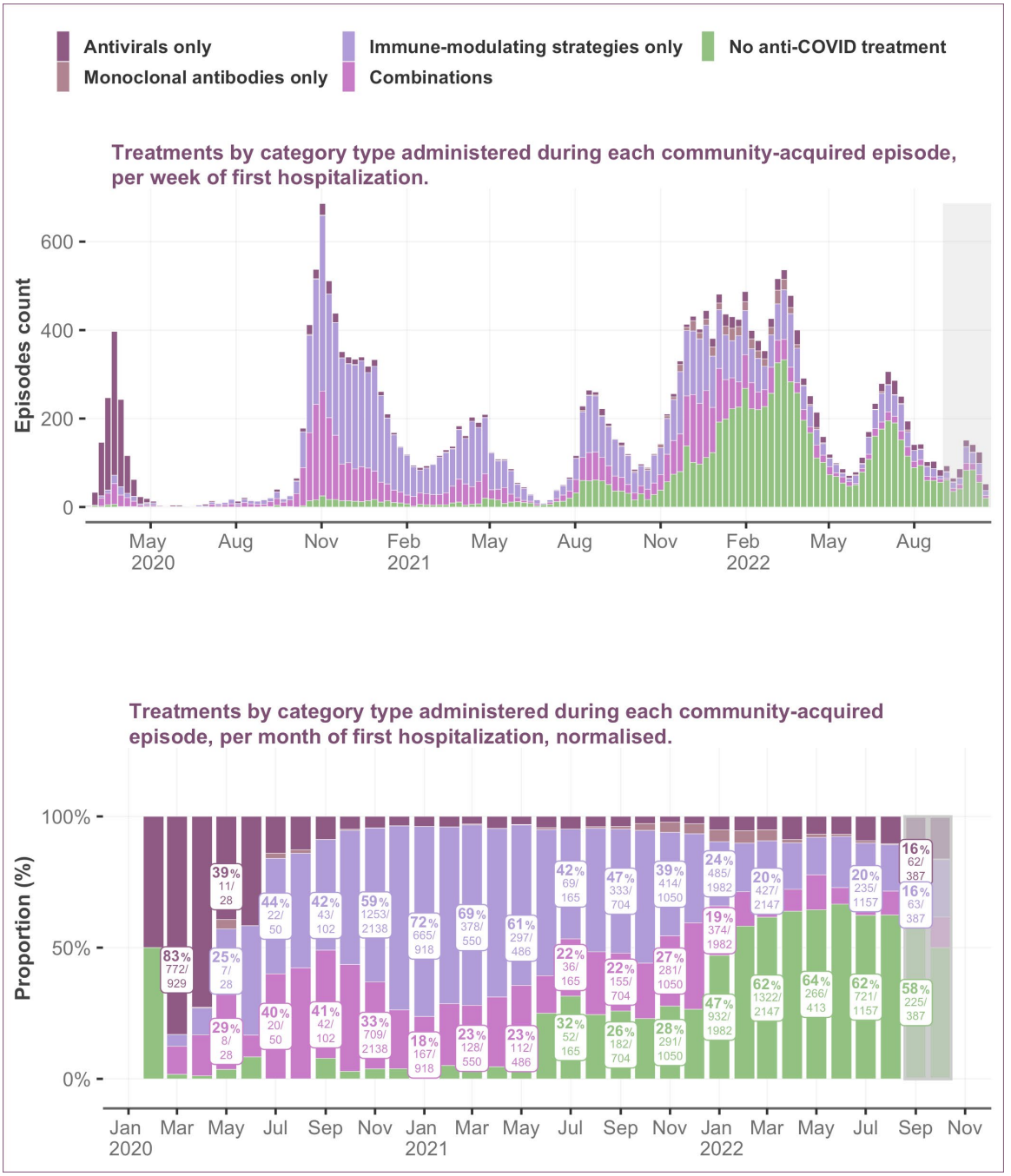


***Figure 15**: Anti-COVID treatments administered over time. Absolute counts are displayed per week of first hospitalization. Relative counts are presented by month of first hospitalization. Incomplete records were excluded.*

***Figure 16**: Anti-COVID treatments administered over three periods. Horizontal bars to the left represent the % of episodes who received a specific drug. Vertical bars show the % of episodes who received the combination of drugs indicated with the black dot(s) directly below the bar. Only the top 12 combinations are shown for each time period.*

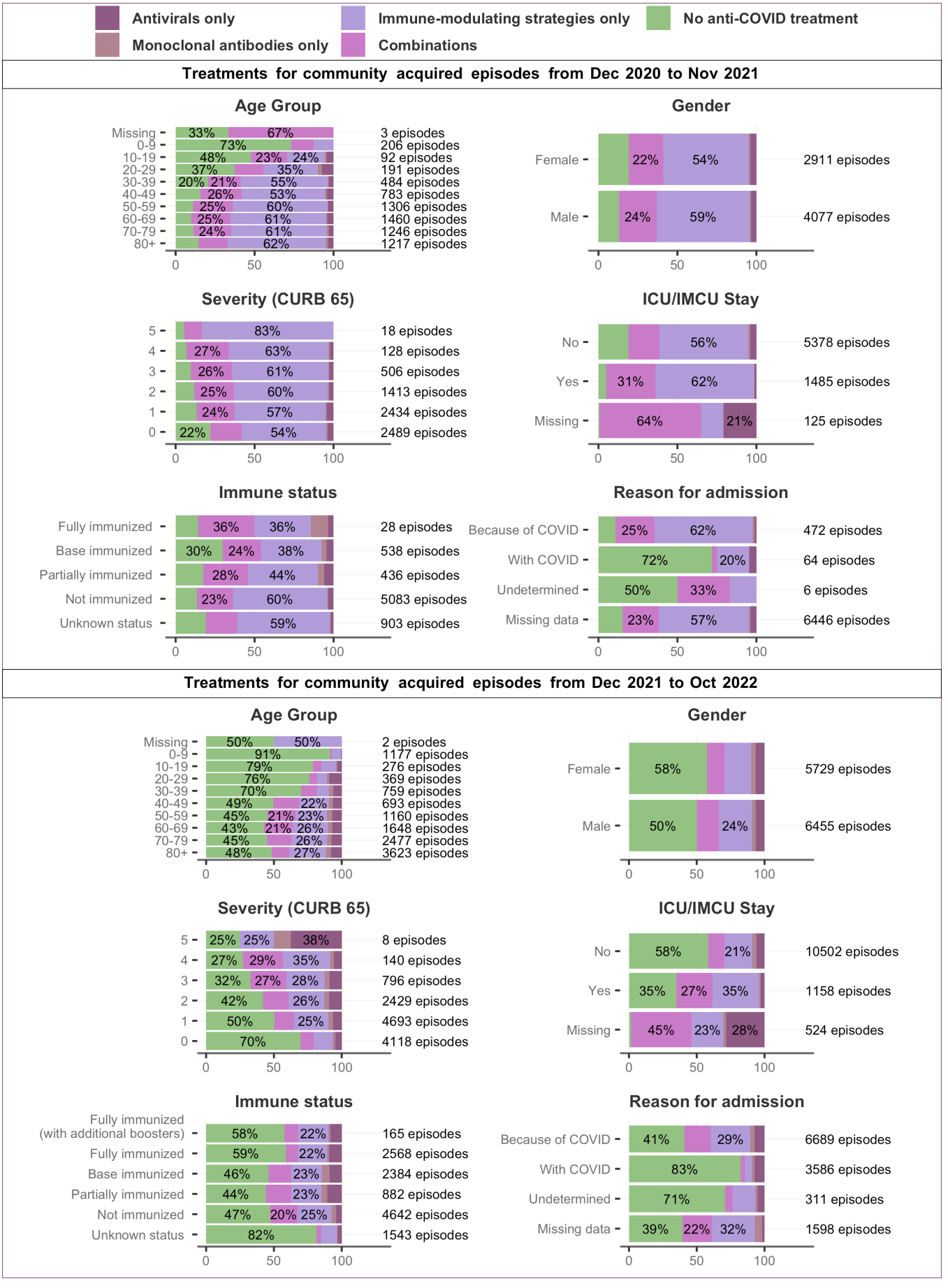

Antivirals only
Immune-modulating strategies only
No anti-COVID treatment
Monoclonal antibodies only
Combinations
Treatments for community acquired episodes from Dec 2020 to Nov 2021
Age Group
Missing 33% 67% 3 episodes
0-9 73% 206 episodes
10-19 48% 23% 24% 92 episodes
20-29 37% 35% 191 episodes
30-39 20% 21% 55% 484 episodes
40-49 26% 53% 783 episodes
50-59 25% 60% 1306 episodes
60-69 25% 61% 1460 episodes
70-79 24% 61% 1246 episodes
80+ 62% 1217 episodes
0 50 100
Gender
Female 22% 54% 2911 episodes
Male 24% 59% 4077 episodes
0 50 100
Severity (CURB 65)
5 83% 18 episodes
4 27% 63% 128 episodes
3 26% 61% 506 episodes
2 25% 60% 1413 episodes
1 24% 57% 2434 episodes
0 22% 54% 2489 episodes
0 50 100
ICU/IMCU Stay
No 56% 5378 episodes
Yes 31% 62% 1485 episodes
Missing 64% 21% 125 episodes
0 50 100
Immune status
Fully immunized 36% 36% 28 episodes
Base immunized 30% 24% 38% 538 episodes
Partially immunized 28% 44% 436 episodes
Not immunized 23% 60% 5083 episodes
Unknown status 59% 903 episodes
0 50 100
Reason for admission
Because of COVID 25% 62% 472 episodes
With COVID 72% 20% 64 episodes
Undetermined 50% 33% 6 episodes
Missing data 23% 57% 6446 episodes
0 50 100
Treatments for community acquired episodes from Dec 2021 to Oct 2022
Age Group
Missing 50% 50% 2 episodes
0-9 91% 1177 episodes
10-19 79% 276 episodes
20-29 76% 369 episodes
30-39 70% 759 episodes
40-49 49% 22% 693 episodes
50-59 45% 21% 23% 1160 episodes
60-69 43% 21% 26% 1648 episodes
70-79 45% 26% 2477 episodes
80+ 48% 27% 3623 episodes
0 50 100
Gender
Female 58% 5729 episodes
Male 50% 24% 6455 episodes
0 50 100
Severity (CURB 65)
5 25% 25% 38% 8 episodes
4 27% 29% 35% 140 episodes
3 32% 27% 28% 796 episodes
2 42% 26% 2429 episodes
1 50% 25% 4693 episodes
0 70% 4118 episodes
0 50 100
ICU/IMCU Stay
No 58% 21% 10502 episodes
Yes 35% 27% 35% 1158 episodes
Missing 45% 23% 28% 524 episodes
0 50 100
Immune status
Fully immunized (with additional boosters) 58% 22% 165 episodes
Fully immunized 59% 22% 2568 episodes
Base immunized 46% 23% 2384 episodes
Partially immunized 44% 23% 882 episodes
Not immunized 47% 20% 25% 4642 episodes
Unknown status 82% 1543 episodes
0 50 100
Reason for admission
Because of COVID 41% 29% 6689 episodes
With COVID 83% 3586 episodes
Undetermined 71% 311 episodes
Missing data 39% 22% 32% 1598 episodes
0 50 100

***Figure 17**: Anti-COVID treatments administered stratified across different demographic groups. Two time periods are represented: a time period since vaccination began until November 2021, and a recent timeframe since the Omicron variant became dominant (Dec 2021) until the most recent data.*

7. Nosocomial cases

The proportion of episodes with nosocomial infections peaked in January 2021 and again in July 2022 with 30% or more of the episodes in this latter period linked to infections of nosocomial origin (Figure **18**c). In recent months, this proportion rose since September 2022, accounting for 22.4% of the episodes registered in CH-SUR over the month of September 2022 and 27.2% in October 2022. The peaks in 2022 might be partially explained by periods of higher virus circulation and temporary increases in nosocomial systematic testing in some hospitals. As testing strategies vary across hospitals and over time, these data should be interpreted with caution.

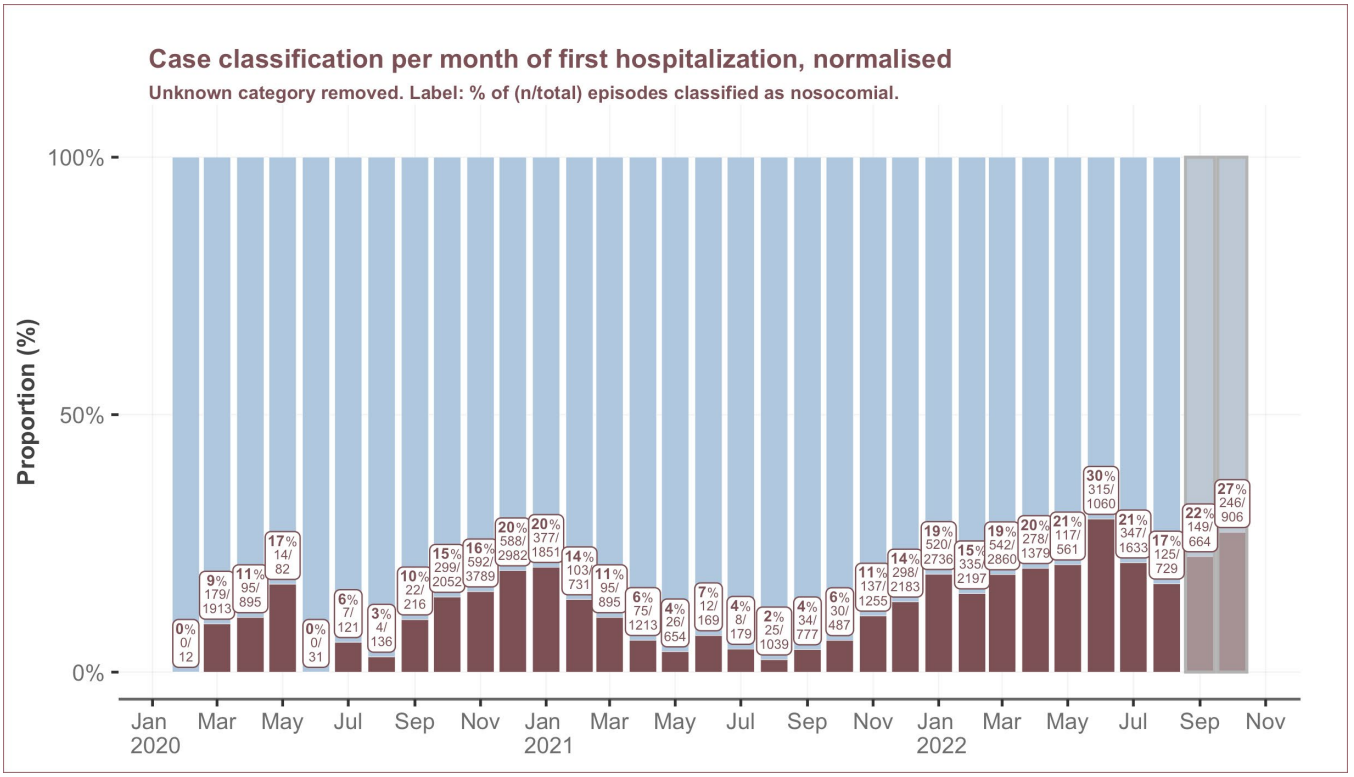


***Figure 18**: Classification (infection source) of hospitalization episodes over time. Data from the last two months (highlighted gray) are considered provisional due to data entry delays.*

Over the full course of the epidemic, the nosocomial infections affected principally an elderly population, with patients aged 80 years and above, accounting for 2,826 (47%) of the nosocomial episodes. In comparison, 8,298 (26%) of episodes with community-acquired infections corresponded to patients aged 80 years and above.

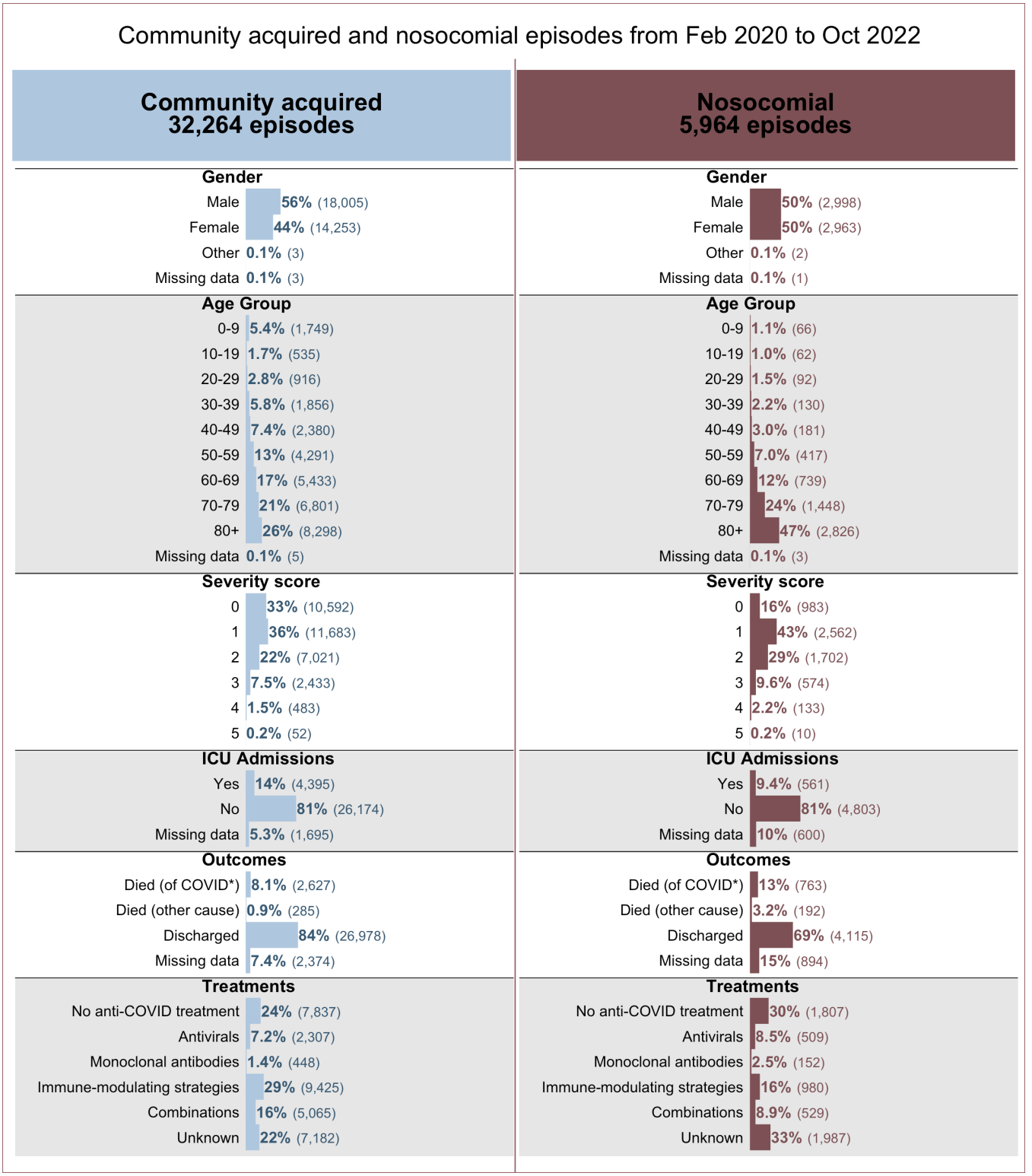


***Figure 19**: Comparison of community acquired and nosocomial cases by demographics, severity score, ICU, outcomes and treatments.*

8. Glossar und ergänzende Informationen

Hospitalization / Hospitalisation:

Bei der Hospitalisation handelt es sich um die kleinste Datenanalyseeinheit. Sie ergibt sich aus jeweils einem Ein- und Austritt in einem an CH-SUR teilnehmenden Spital, wenn der Aufenthalt länger als 24 Stunden andauert. Jede Aufnahme einer Person in ein Spital wird als neue Hospitalisation gezählt. Da es innerhalb desselben Krankheitsverlaufs (einer einzelnen Infektion) häufig zu mehreren Hospitalisationen (Wiedereintritten) kommt, erfolgt die Analyse in diesem Bericht anhand der Anzahl Episoden und nicht anhand der Anzahl Hospitalisationen.

Episode / Episode:

Bei jeder Neuaufnahme in ein Spital, die mindestens 30 Tage nach einer früheren Hospitalisation erfolgt und zu einem Aufenthalt von mehr als 24 Stunden führt, wird eine Episodennummer vergeben. Wird eine Person innerhalb von 30 Tagen nur einmal oder mehrfach hospitalisiert, wird in beiden Fällen nur eine Episode gezählt. Wird eine Person im Abstand von über 30 Tagen zweimal hospitalisiert, werden zwei unterschiedliche Episodennummern vergeben. Wird eine Person innerhalb von 30 Tagen nach der letzten Entlassung zwischen zwei an CH-SUR teilnehmenden Spitälern transferiert, werden diese Hospitalisationen zur selben Episode gezählt. Eine Episode kann deshalb mehrere Hospitalisationen und jede Hospitalisation kann mehrere IPS-Aufnahmen umfassen.

Reason for the hospitalization / Hospitalisationsgrund:

- *Hospitalization because of COVID-19 / Hospitalisation aufgrund von COVID-19*: Basierend auf den bei der Aufnahme verfügbaren Informationen wird die Person hospitalisiert, weil sie Symptome aufgrund von COVID-19 aufweist oder an einer offensichtlich durch COVID-19 verursachten Dekompensation einer chronischen Krankheit leidet.

- *Hospitalization with a SARS-CoV-2 infection / Hospitalisation mit einer SARS-CoV-2-Infektion*: Basierend auf den bei der Aufnahme verfügbaren Informationen weist die Person einen positiven SARS-CoV-2-Test auf, wird aber ohne COVID-19-Symptome aus einem nicht mit COVID-19 zusammenhängenden Grund hospitalisiert. Das Hauptproblem ist also ein Unfall oder eine Erkrankung, die nicht mit COVID-19 in Verbindung steht.

Origin of the infection / Infektionsursprung:

- *Community acquired infection: / Ambulant erworbene Infektion*: Die SARS-CoV-2 Infektion wurde vor der Aufnahme in das Spital oder innerhalb der ersten fünf Tage nach der Aufnahme festgestellt.

- *Nosocomial infection / Nosokomiale Infektion*: Eine Episode gilt als «nosokomial», wenn die SARS-CoV-2 Infektion nach fünf oder mehr Tagen nach der Aufnahme in das Spital festgestellt wird.

Severity score at admission / Schweregrad bei der Aufnahme:

Bei Erwachsenen wird zur Beurteilung des Schweregrads der CURB-65 Score angewendet. Für jedes der folgenden Kriterien wird jeweils 1 Punkt gezählt: Verwirrtheit (Abbreviated Mental Test Score < 9), Serumharnstoff > 19 mg/dl, Atemfrequenz > 30 pro Minute, tiefer Blutdruck (diastolisch < 60 oder systolisch < 90 mmHg), Alter > 65 Jahre. Bei Kindern wird je ein Punkt für folgende Kriterien gezählt: Atemnot, Sauerstoffsättigung < 92%, Anzeichen schwerer klinischer Dehydratation oder eines klinischen Schocks und ein veränderter Bewusstseinszustand. Der Schweregrad entspricht der Summe der jeweiligen gezählten Punkte.

Intermediate care unit (intermediate care or IMC) / Intermediate Care Unit (IMC): Pflegestation für Personen, die an einer Störung einer lebenswichtigen Funktion leiden oder deren Pflegelast keine Rückkehr in eine Bettenstation erlaubt. Die Intermediate Care Unit bildet das Bindeglied zwischen Intensivpflegestation und Bettenstation.

Intensive care unit (ICU) / Intensivpflegestation (IPS): Pflegestation für Personen, die eine schwerwiegende Störung einer oder mehrerer lebenswichtiger Funktionen haben oder bei denen das Risiko schwerer Komplikationen besteht.

Immune status / Immunstatus:

Für die Definition des Immunstatus werden sowohl die Impfung als auch eine frühere bestätigte SARS-CoV-2-Infektion berücksichtigt. Der Immunstatus ist wie folgt definiert:

a) *Not immunized / Nicht immunisiert*: Personen, die zum Zeitpunkt des positiven SARS-CoV-2-Tests keine Dosis irgendeines Impfstoffs erhalten hatten und bei denen kein Nachweis einer Infektion mit dem Virus vor der Hospitalisationsepisode bestand.

b) *Partially immunized / Teilweise immunisiert*:

1. Personen, die vor dem positiven Test eine Impfstoffdosis Moderna (Spikevax®), Pfizer/BioNTech (Comirnaty®), AstraZeneca (Vaxzevria®), Sinopharm®, Sinovac (CoronaVac®) oder COVAXIN® erhalten hatten und bei denen kein Nachweis einer früheren SARS-CoV-2-Infektion bestand.

2. Personen, die mit keiner Dosis geimpft wurden und bei denen eine frühere SARS-CoV-2-Infektion bestätigt wurde, die in der Vergangenheit eine Hospitalisation erfordert hatte oder nicht; unabhängig von der Zeit seit der früheren Infektion. Achtung: Viele genesene Personen werden in der Datenbank nicht als solche identifiziert (erst seit Juni 2021 erhobene Information, nicht diagnostizierte Infektionen, fehlende Informationen im Dossier).

c) *Base immunized / Grundimmunisiert*:

1. Personen, die eine Dosis des Impfstoffs Johnson & Johnson (Janssen®) oder zwei Dosen des Impfstoffs Spikevax®, Comirnaty®, Vaxzevria®, Sinopharm®, CoronaVac® oder COVAXIN® erhalten hatten (Impfempfehlung BAG / Eidgenössische Kommission für Impffragen).

2. Personen mit einer dokumentierten früheren Infektion oder einem positiven Test (die einen Spitalaufenthalt erfordert hatten oder nicht), die eine Dosis eines der oben aufgeführten Impfstoffe erhalten hatten, unabhängig von der Zeit seit der Genesung, dem Datum und der Marke des Impfstoffs, und einem positiven Test oder einer Hospitalisation.

3. Personen, die eine Kombination folgender Impfstoffe erhalten hatten: Comirnaty® und Spikevax®, Vaxzevria® und Comirnaty® oder Vaxzevria® und Spikevax®. Personen, die eine zusätzliche Auffrischimpfung erhalten hatten, werden hier nicht berücksichtigt (Kategorie Fully immunized / Vollständig immunisiert).

d) *Fully immunized / Vollständig immunisiert*: Grundimmunisierte Personen, die eine zusätzliche Impfdosis (Auffrischimpfung) erhalten haben und bei denen diese mindestens 4 Monate zurückliegt. e) *Fully immunized (with additional boosters) / Vollständig immunisiert mit zusätzlichen Auffrischimpfungen*: Grundimmunisierte Personen, die zusätzliche Impfdosen (Auffrischimpfungen) erhalten haben und bei denen diese mindestens 4 Monate zurückliegt.

f) *Unknown immune status / Unbekannter Immunstatus*: Personen, für die keine Informationen über Impfungen und zur Immunität vorlagen.

Wichtige Hinweise: Besondere Bevölkerungsgruppen:

Kinder im Alter von 5 bis 11 Jahren: Kinder im Alter von 5 bis 11 Jahren benötigen eine Dosis weniger als in den oben genannten Kategorien, um als grundimmunisiert zu gelten. Eine Auffrischimpfung wird für Kinder unter 12 Jahren nicht empfohlen. Beispiel: Eine Patientin zwischen 5 und 11 Jahren, die nur eine Dosis Comirnaty® erhalten hat, gilt als grundimmunisiert.

Immunsupprimierte Patienten und Patientinnen gelten als grundimmunisiert, wenn sie eine zusätzliche Impfdosis erhalten haben, die über die in der vorherigen Definition genannten Anzahl Dosen hinausgeht. Beispiel: Eine immunsupprimierte Person gilt als grundimmunisiert, wenn sie drei Dosen der Impfstoffe Comirnaty®, Spikevax® oder Vaxzevria® erhalten hat (anstelle von zwei Dosen bei nicht immunsupprimierten Patienten und Patientinnen) oder wenn die Person zwei Impfdosen der Impfstoffe Comirnaty® und Spikevax® oder Vaxzevria® erhalten hat und sich von einer früheren SARS-CoV-2-Infektion erholt hat. Wenn diese Anzahl Dosen nicht verabreicht wurde, gilt die Person als teilweise immunisiert.

Für eine vollständige Immunisierung (mit einer Auffrischimpfung oder mit zusätzlichen Auffrischimpfungen) gelten die gleichen Definitionen wie für nicht immunsupprimierte Patienten und Patientinnen.

Discharge / Entlassung: Ein Spitalaustritt gilt als «Entlassung», wenn die Person das Spital mit einem der folgenden Zielorte verlässt: 1. nach Hause; 2. Langzeitpflegeeinrichtung; 3. anderes Spital; 4. andere Einrichtung, die sich nicht am CH-SUR-Überwachungssystem beteiligt; 5. Rehabilitationseinrichtung; 6. unbekannter Zielort

Reason of death / Todesursache: : Personen, bei denen COVID-19 die Todesursache war (died of COVID-19 / verstorben an COVID-19), werden getrennt aufgeführt von den COVID-19-Patientinnen und -Patienten, die wegen

anderer Todesursachen verstarben (died with COVID-19, but not of COVID-19 / verstorben mit COVID-19, aber nicht an COVID-19). Ob eine Person an COVID-19 oder aus einem anderen Grund verstarb, wird auf Spitalebene im betreffenden am CH-SUR-System teilnehmenden Zentrum von einer Ärztin oder einem Arzt beurteilt. Fälle, in denen die Todesursache nicht sicher ist, aber eine COVID-19-Diagnose vorliegt (in Übereinstimmung mit den Einschlusskriterien für CH-SUR), werden als «verstorben an COVID-19» oder «vermuteter COVID-19-Todesfall» gezählt.

Dealing with missing data / Umgang mit fehlenden Daten: Wenn im Text erwähnt, werden fehlende Daten von der Analyse ausgeschlossen. Andernfalls werden Datensätze mit fehlenden Daten in der Gesamtanzahl berücksichtigt und entsprechend analysiert. Dies kann dazu führen, dass die Denominatoren der verschiedenen analysierten Kategorien nicht dieselbe Gesamtsumme ergeben. In einigen Abbildungen werden die Daten der letzten beiden Monate aufgrund von Verzögerungen bei der Datenerfassung als provisorisch betrachtet und grau markiert, wobei dies jeweils angegeben wird.

Report prepared by:

University of Geneva, Institute of Global Health (IGH): Vancauwenberghe, Laure; Nwosu, Kenechukwu; Thiabaud, Amaury; Suveges, Maria; Sobel, Jonathan; Botero Mesa, Sara; Keiser, Olivia

Infection Control Program, University of Geneva Hospitals (HUG): Zanella, Marie-Celine

Bundesamt für Gesundheit, Bern (BAG): Roder, Ursina; Resenterra-Charrière, Véronique; Fesser, Anna Vonlanthen, Jasmin;