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COVID-19 Hospital Based Surveillance CH-SUR
Federal Department of Home Affairs FDHA
Federal Office of Public Health FOPH
University of Geneva Institute of Global Health UNIGE (IGH)

Bericht zum spitalbasierten COVID-19-Sentinel-Überwachungssystem

Datenstand: 24.01.2022

1. Einleitende Zusammenfassung

Das CH-SUR-Überwachungssystem wurde im Jahr 2018 eingerichtet, 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 die Anzahl und Dauer der Hospitalisationen sowie die Aufenthalte auf der Intensivpflegestation an. Eine Patientin oder ein Patient kann mehrfach hospitalisiert werden bzw. Behandlungen in einer Intensivpflegestation (IPS) benötigen.

Einschlusskriterien: CH-SUR erfasst Daten von Patientinnen und Patienten, welche mit einer Infektion mit SARS-CoV-2 hospitalisiert wurden, und deren Spitalaufenthalt länger als 24 Stunden andauert, sowie nosokomiale SARS-CoV-2 Infektionen. 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. Ersichtlich ist in CH-SUR ebenfalls, ob der Patient oder die Patientin während der Hospitalisation aufgrund der COVID-19-Infektion verstorben ist.

Seit Beginn der Epidemie bis zum 24. Januar 2022 wurden Daten von 25 048 hospitalisierten Patienten und Patientinnen erhoben. Da gewisse Personen mehrfach hospitalisiert wurden, hat das CH-SUR-System 25 995 Hospitalisierungen und deren Verlauf registriert. 3 375 Patientinnen und Patienten (16,3 %) wurden in einer IPS gepflegt (Zeitfenster IPS: 26.02.20 bis 30.11.2021) und 2 640 Personen (11,9 %) sind während ihres Spitalaufenthaltes an COVID-19 verstorben (Zeitfenster: 26.02.20 bis 24.01.2022). Im gleichen Zeitraum wurden dem BAG im Rahmen der Meldepflicht für die gesamte Schweiz 42 098 Hospitalisationen mit einer laborbestätigten SARS-CoV-2-Infektion gemeldet. Das CH-SUR-System deckte somit ca. 61,7 % aller gemeldeten Hospitalisationen im Zusammenhang mit SARS-CoV-2 in der Schweiz ab.

Während des letzten Zeitraums, für den genügend Daten vorliegen (1. Oktober bis 30. November 2021), waren von 1673 hospitalisierten Patientinnen und Patienten mit bekanntem Immunstatus 760 (45,4 %) nicht immunisiert und 513 (30,7 %) vollständig immunisiert (grundimmunisiert mit oder ohne Auffrischimpfung) (Abb. 1). Im gleichen Zeitraum wurden 213 Patientinnen und Patienten auf einer Intensivstation betreut, von denen 148 (69,5 %) nicht immunisiert und 50 (23,5 %) vollständig immunisiert waren. 99 Patientinnen und Patienten starben an Covid-19 (5,9 % der hospitalisierten Patient/innen), wobei 47 Todesfälle nicht immunisierte Patientinnen und Patienten und 44 vollständig immunisierte Patientinnen und Patienten betrafen.

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Übersicht über CH−SUR Hospitalisierte, in den IPS behandelte Personen und Todesfälle **vom 01. Oktober 2021 bis 30. November 2021**

hospitalisierte Personen	Intensivpflegestation (IPS)	Todesfälle
1673	**213**	**99**

Immunstatus der Personen (hospitalisierte Personen):
- 31% (513) Vollständig immunisiert *
- 45% (760) Nicht immunisiert
- 2% (40) Andere *

Grafik schliesst 360 Personen (21,5%) mit fehlenden Immunstatusdaten aus
22% (360)

Immunstatus der Personen (IPS):
- 23% (50) Vollständig immunisiert *
- 69% (148) Nicht immunisiert
- 2% (5) Andere *

Grafik schliesst 10 Personen (4,7%) mit fehlenden Immunstatusdaten aus
5% (10)

Immunstatus der Personen (Todesfälle):
- (44) Vollständig immunisiert *
- (47) Nicht immunisiert
- (5) Andere *

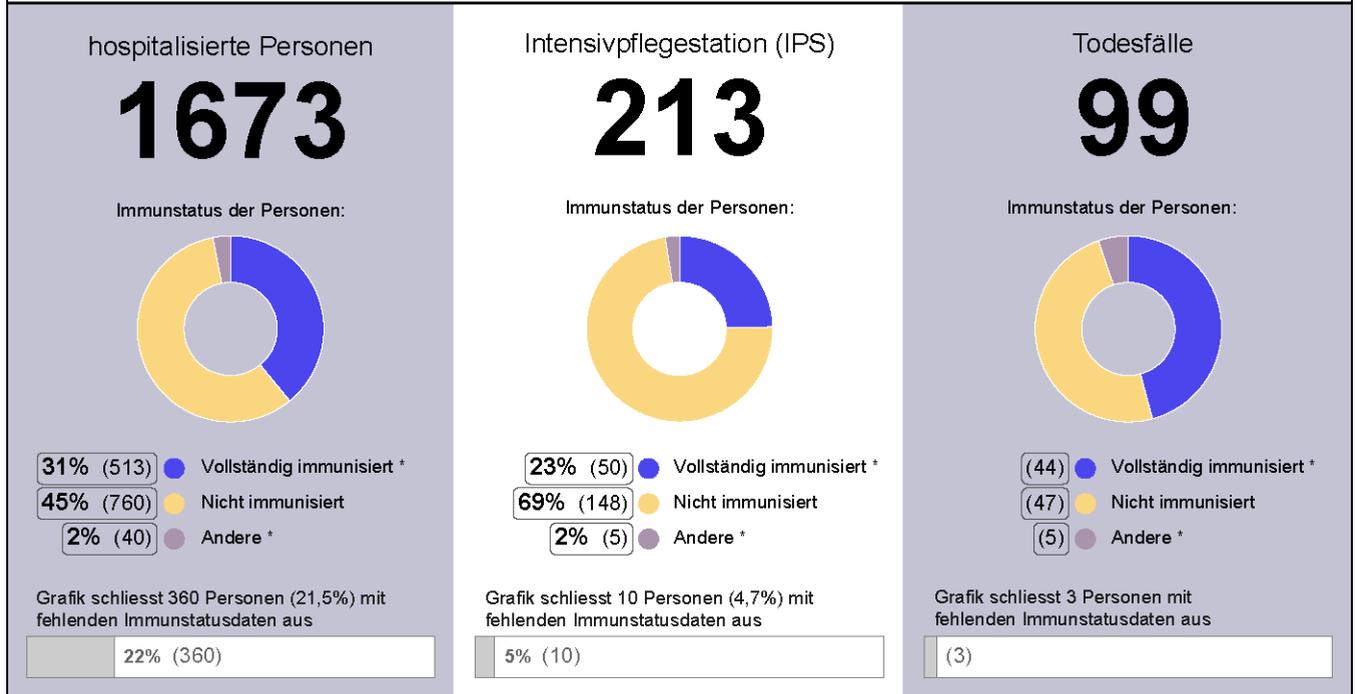Grafik schliesst 3 Personen mit fehlenden Immunstatusdaten aus
(3)

Abbildung 1: *Übersicht über die neuesten Daten (* vollständig immunisiert: Patient/innen mit einer Grundimmunisierung und Personen mit einer Auffrischimpfung. Andere: teilweise immunisierte Patient/innen und Personen, die von einer früheren SARS-CoV-2-Infektion genesen sind)*

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2. Hospitalizations and demographic characteristics

Between the start of the epidemic in Switzerland and Jan 24, 2022 and among the 20 hospitals actively participating in the COVID-19 Hospital Based Surveillance project (CH-SUR), 25,048 patients were hospitalized, accounting for a total of 25,995 hospitalizations. There were more hospitalizations than patients because some patients were hospitalized multiple times. An overview of these rehospitalized patients is shown in Figure **2**.
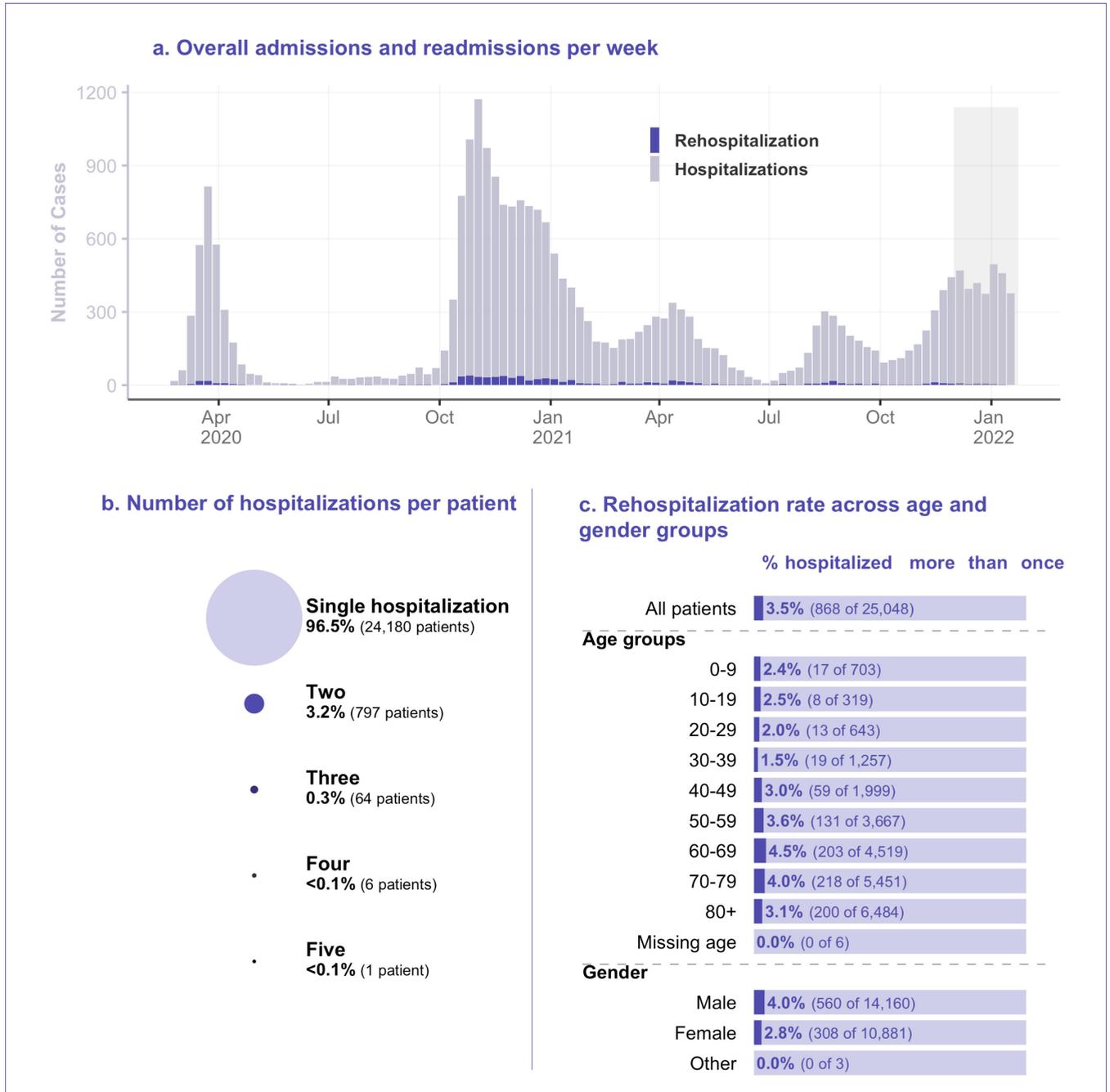

Figure 2: *Hospitalizations per patient and rehospitalization rate across demographic groups. Includes records up to January 24, 2022.*

Most patients (96.5% [24,180 of 25,048]) were hospitalized only once, but 3% of patients (867 of 25,048) were hospitalized two to four times, and one patient was hospitalized five times (Figure **2**a).

The overall rate of rehospitalization was 3.5% (868 of 25,048) (Figure **2**b). The 60-69 age group and the 70-79 age group had the highest rate of rehospitalization at respectively 4.5% (203 of 4,519) and 4% (218 of 5,451). Men had a higher rehospitalization rate than women, 2.8% (308 of 10,881) vs 4% (560 of 14,160) respectively.

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Overall, the majority (56.5% [14,160 of 25,048]) of the hospitalized patients were men (Figure **3**a), and the age distribution skewed older (Figure **3**b). The largest age category of patients were those aged 80 and above (26.0% [6,484]).

Figures **3**c and **3**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: 89% (3,437 of 3,860) of patients first admitted in this month were 50 and above (Figure **3**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 patients aged 50 and above was observed again from September 2021 onwards, reaching a local peak of 77.3% (917 of 1,187) in November 2021.

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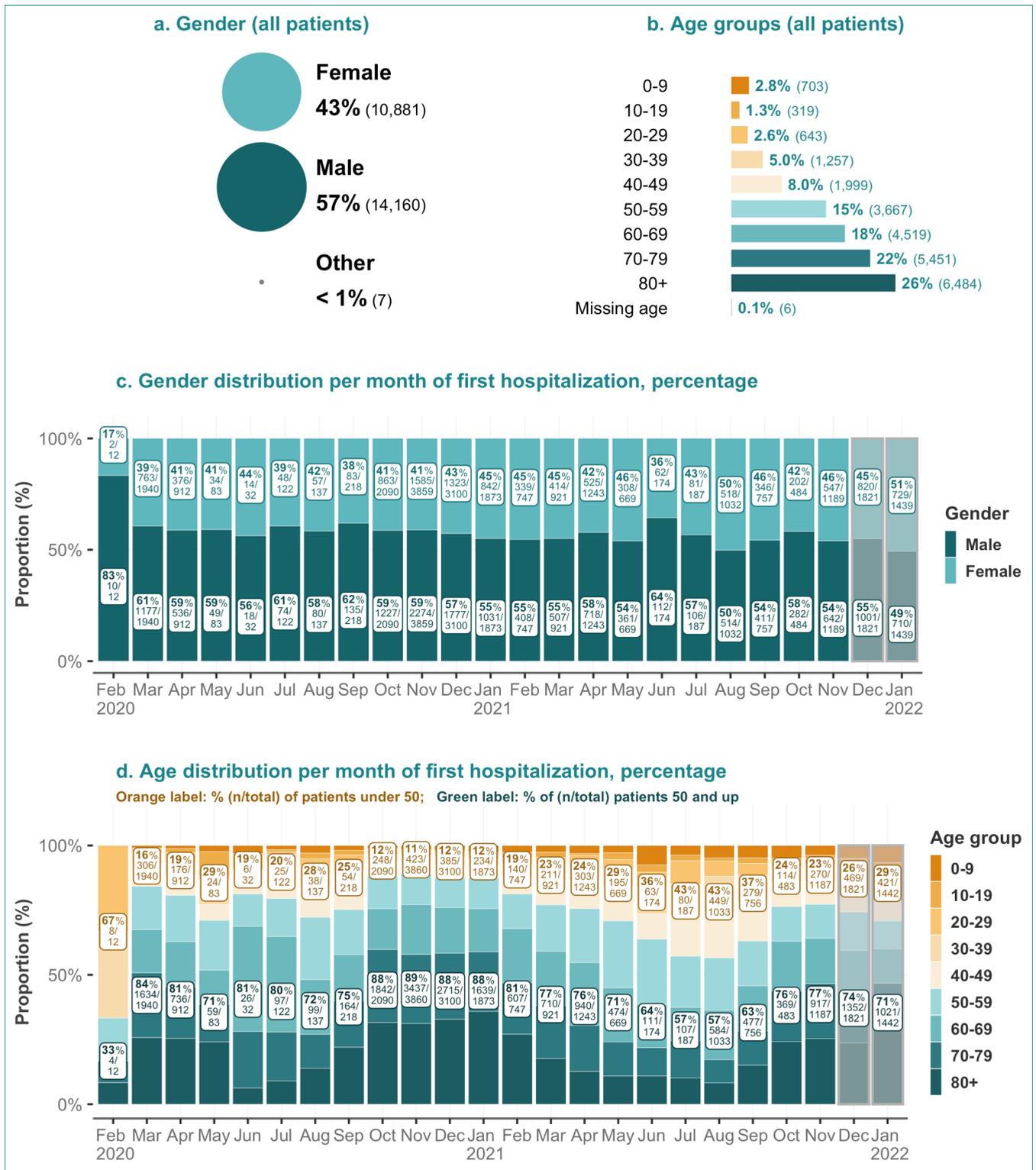*Figure 3*: Demographic characteristics: gender and age distribution of admitted patients, overall and per month. For patients with multiple hospitalizations, the admission date of the first hospitalization was used. Data from the last two months (highlighted gray) is considered provisional due to entry delays. The 'other' gender category was removed from panel c, and the missing age group was removed from panel d.

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3. Patient outcomes

3.1. Outcomes overview

Figure **4** 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. Cases 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.

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.
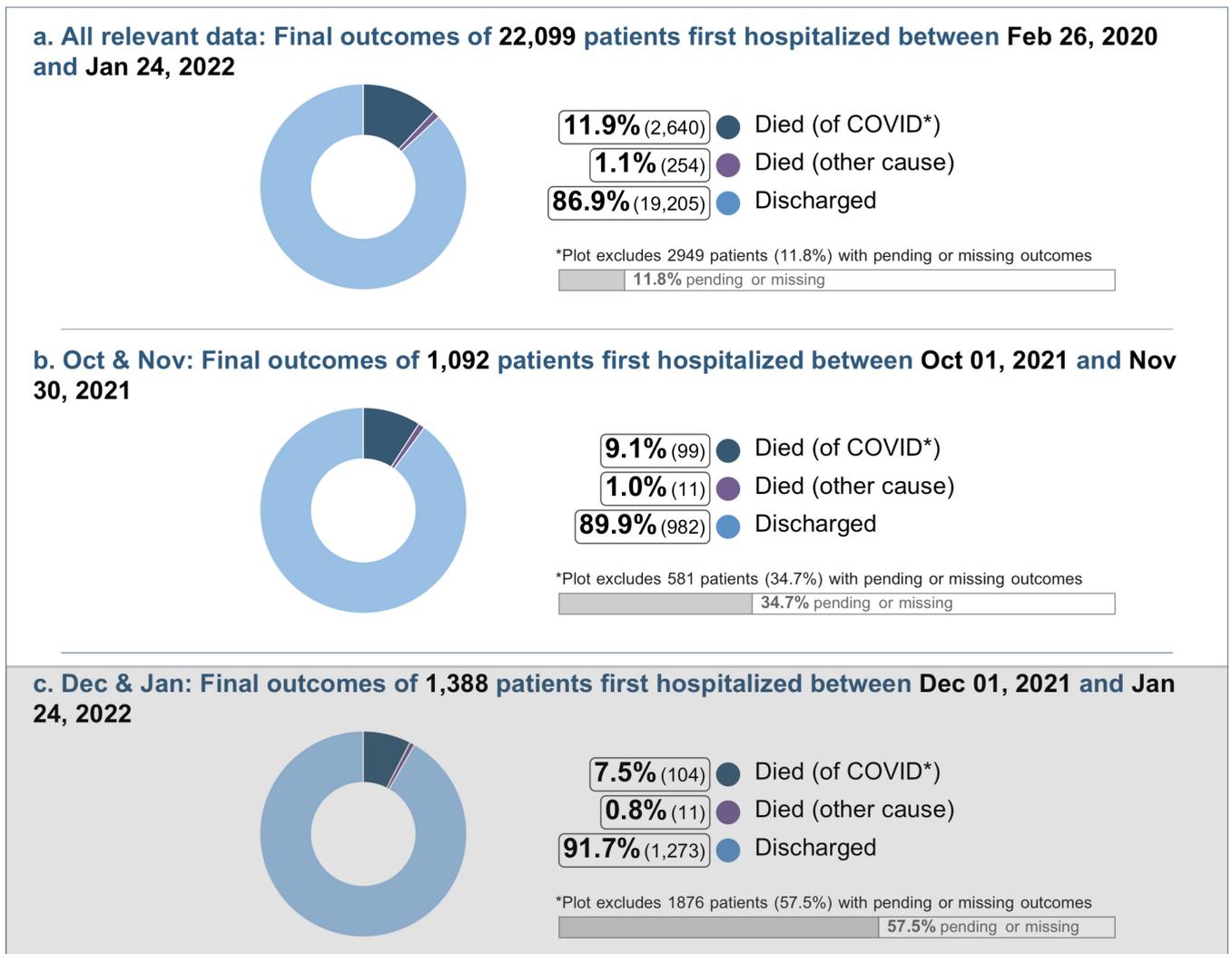
a. All relevant data: Final outcomes of 22,099 patients first hospitalized between Feb 26, 2020 and Jan 24, 2022

11.9% (2,640) ● Died (of COVID*)
1.1% (254) ● Died (other cause)
86.9% (19,205) ● Discharged

*Plot excludes 2949 patients (11.8%) with pending or missing outcomes
11.8% pending or missing

b. Oct & Nov: Final outcomes of 1,092 patients first hospitalized between Oct 01, 2021 and Nov 30, 2021

9.1% (99) ● Died (of COVID*)
1.0% (11) ● Died (other cause)
89.9% (982) ● Discharged

*Plot excludes 581 patients (34.7%) with pending or missing outcomes
34.7% pending or missing

c. Dec & Jan: Final outcomes of 1,388 patients first hospitalized between Dec 01, 2021 and Jan 24, 2022

7.5% (104) ● Died (of COVID*)
0.8% (11) ● Died (other cause)
91.7% (1,273) ● Discharged

*Plot excludes 1876 patients (57.5%) with pending or missing outcomes
57.5% pending or missing

Figure 4: Outcomes for COVID-19 patients hospitalized in CH-SUR hospitals. Includes records up to January 24, 2022. For patients with multiple hospitalizations, only the final outcome is considered.Cases 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

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3.2. Outcomes over time

Figure **5** shows the final outcomes of hospitalized patients over time (Figure **5**a & **5**b), alongside the epidemic curve (Figure **5**a) and the initial disease severity of those admitted over time (Figure **5**c).

The first mortality peak is seen for patients admitted around the beginning of the epidemic: 16.8% (325 of 1,937) 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% (465 of 3,071) 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 the period between Oct 2021 and Jan 2021 are mirrored by the higher admission severity scores at these times (Figure **5**c) and older patient's ages (Figure **3**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: 41% (1,270 of 3,100) in December 2020.

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[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.

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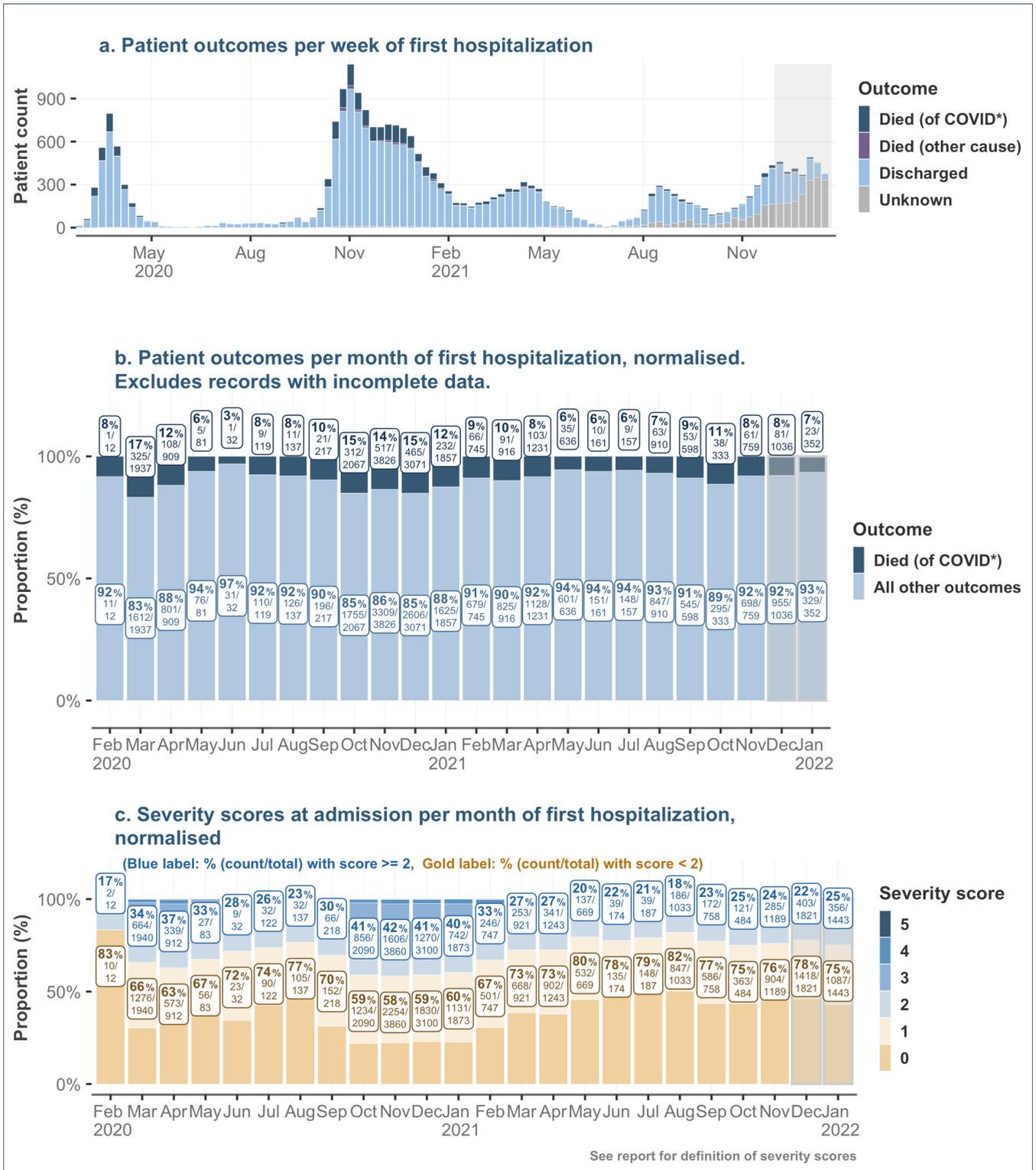
Figure 5: Epidemic curve, patient outcomes and severity scores at admission for COVID-19 patients over time. Includes records up to January 24, 2022. Data from the two last months (highlighted in gray) are considered provisional due to data entry delays. Cases where the cause of death was not certain, 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 October the 31st, the case fatality rate (CFR) increased exponentially with increa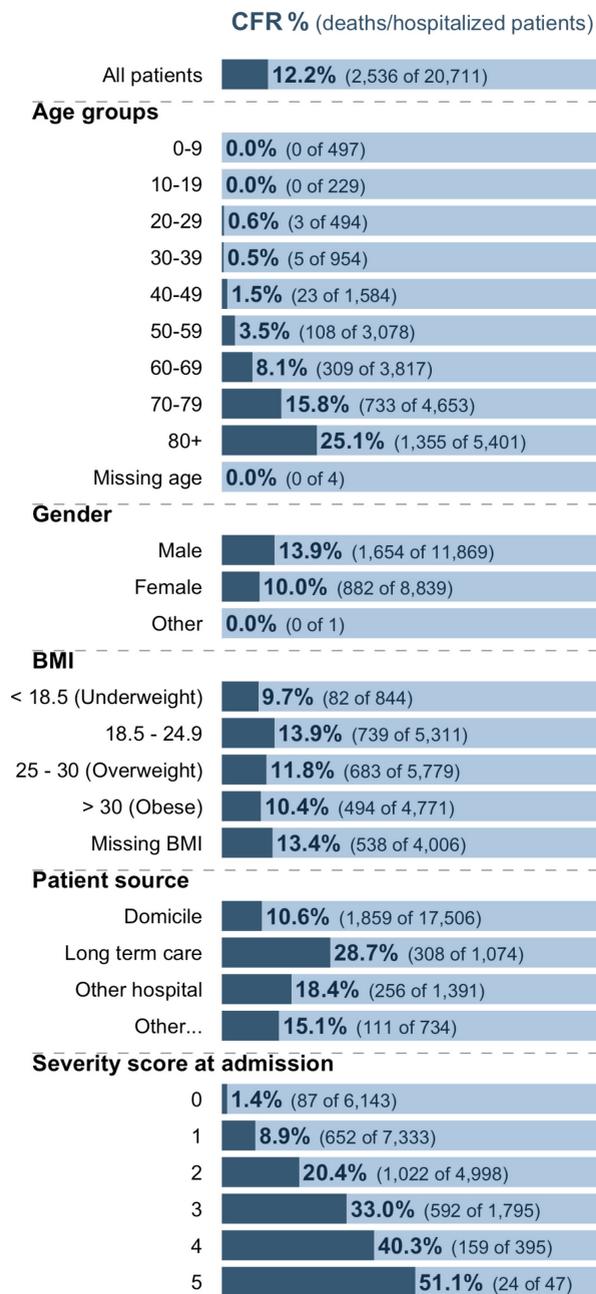sing age, from 0% (0 of 497) in patients aged 0-9, to 3.5% (108 of 3,078) in patients aged 50-59, and to 25.1% (1,355 of 5,401) in patients aged 80+. CFR% was greater in men than in women: 10% (882 of 8,839) vs 13.9% (1,654 of 11,869) respectively. In addition, the CFR% was greater for patients with higher severity scores at admission: 1.4% (87 of 6,143) 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.

The overall CFR % of the most recent period for which enough data is available (months October and November 2021, Figure **6**b) was lower as the CFR % of the whole epidemic period (9.1% and 12.2% respectively). As over the whole epidemic, the fatality rate increases with age. Surprisingly, while the CFR% of the age classes over 59 years old sank in the months of Oct-Nov 2021 compared to the whole epidemic, it slightly increased for the patients aged 50 to 59 (Figure **6**b). Also exceptionally for the months October and November 2021, the CFR % was almost equal for females as for males.

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

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a. All data: CFR % for 20,711 patients first hospitalized between Feb 26 2020 and Nov 30 2021

CFR % (deaths/hospitalized patients)

	CFR %
All patients	**12.2%** (2,536 of 20,711)
Age groups	
0-9	**0.0%** (0 of 497)
10-19	**0.0%** (0 of 229)
20-29	**0.6%** (3 of 494)
30-39	**0.5%** (5 of 954)
40-49	**1.5%** (23 of 1,584)
50-59	**3.5%** (108 of 3,078)
60-69	**8.1%** (309 of 3,817)
70-79	**15.8%** (733 of 4,653)
80+	**25.1%** (1,355 of 5,401)
Missing age	**0.0%** (0 of 4)
Gender	
Male	**13.9%** (1,654 of 11,869)
Female	**10.0%** (882 of 8,839)
Other	**0.0%** (0 of 1)
BMI	
< 18.5 (Underweight)	**9.7%** (82 of 844)
18.5 - 24.9	**13.9%** (739 of 5,311)
25 - 30 (Overweight)	**11.8%** (683 of 5,779)
> 30 (Obese)	**10.4%** (494 of 4,771)
Missing BMI	**13.4%** (538 of 4,006)
Patient source	
Domicile	**10.6%** (1,859 of 17,506)
Long term care	**28.7%** (308 of 1,074)
Other hospital	**18.4%** (256 of 1,391)
Other...	**15.1%** (111 of 734)
Severity score at admission	
0	**1.4%** (87 of 6,143)
1	**8.9%** (652 of 7,333)
2	**20.4%** (1,022 of 4,998)
3	**33.0%** (592 of 1,795)
4	**40.3%** (159 of 395)
5	**51.1%** (24 of 47)

b. October & November: CFR % for 1,092 patients first hospitalized between Oct 01 2021 and Nov 30 2021

CFR % (deaths/hospitalized patients)

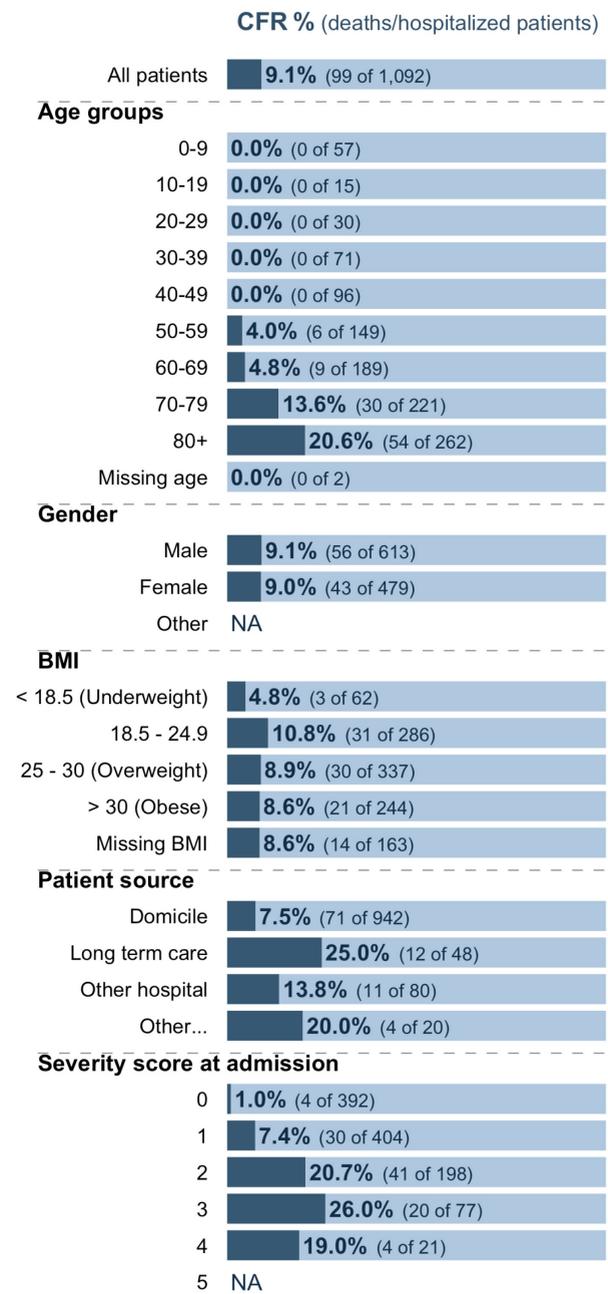|	CFR %
All patients	**9.1%** (99 of 1,092)
Age groups	
0-9	**0.0%** (0 of 57)
10-19	**0.0%** (0 of 15)
20-29	**0.0%** (0 of 30)
30-39	**0.0%** (0 of 71)
40-49	**0.0%** (0 of 96)
50-59	**4.0%** (6 of 149)
60-69	**4.8%** (9 of 189)
70-79	**13.6%** (30 of 221)
80+	**20.6%** (54 of 262)
Missing age	**0.0%** (0 of 2)
Gender	
Male	**9.1%** (56 of 613)
Female	**9.0%** (43 of 479)
Other	NA
BMI	
< 18.5 (Underweight)	**4.8%** (3 of 62)
18.5 - 24.9	**10.8%** (31 of 286)
25 - 30 (Overweight)	**8.9%** (30 of 337)
> 30 (Obese)	**8.6%** (21 of 244)
Missing BMI	**8.6%** (14 of 163)
Patient source	
Domicile	**7.5%** (71 of 942)
Long term care	**25.0%** (12 of 48)
Other hospital	**13.8%** (11 of 80)
Other...	**20.0%** (4 of 20)
Severity score at admission	
0	**1.0%** (4 of 392)
1	**7.4%** (30 of 404)
2	**20.7%** (41 of 198)
3	**26.0%** (20 of 77)
4	**19.0%** (4 of 21)
5	NA

Figure 6: 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 Nov 30 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.

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4. Immune/vaccination status

4.1. 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 (combination category of base immunized and boosted) rose gradually after January 2021 (Figure **7** b). This is expected, given the rise in the proportion of the whole Swiss population that is fully vaccinated (Figure**7**c, source: BAG Dashboard).

During the months of Oct & Nov, when between 64.34% and 66.95% of the Swiss population was fully vaccinated (Figure **7** c), the base immunized and boosted made up only a minority (35.7% and 3.4% respectively) of hospitalizations recorded in CH-SUR (Figure **7** 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) Partially immunized: Patients who received one dose of the vaccines from Moderna (Spikevax®), Pfizer/BioNTech (Comirnaty®), AstraZeneca (Vaxzevria®), Sinopharm®, Sinovac (CoronaVac®) or COVAXIN® before the positive test and have no proof of previous SARS-CoV-2 infection.

c) Base immunized: Patients who received one dose of the Johnson & Johnson (Janssen®) vaccine or two doses of the Spikevax®, Comirnaty®, Vaxzevria®, Sinopharm®, CoronaVac® or COVAXIN® vaccines (FOPH/Federal Vaccination Commission vaccination recommendation). Patients with a prior infection (requiring hospitalisation or not) who received one vaccine dose of the vaccines listed before, independent of the time between disease recovery, date and brand of vaccine and positive test or hospitalization. Patients who have received a combination of the following vaccines: Comirnaty® and Spikevax®; Vaxzevria® and Comirnaty®; Vaxzevria® and Spikevax®. Excludes patients who received one additional booster vaccine (category boosted).

d) Boosted: Patients with base immunization who received one or more additional vaccine doses (booster), independent of the time since last vaccine application (minimum 4 months since last vaccine application).

e) 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).

f) Unknown immune status: Patients for whom vaccination and immune information was not available.
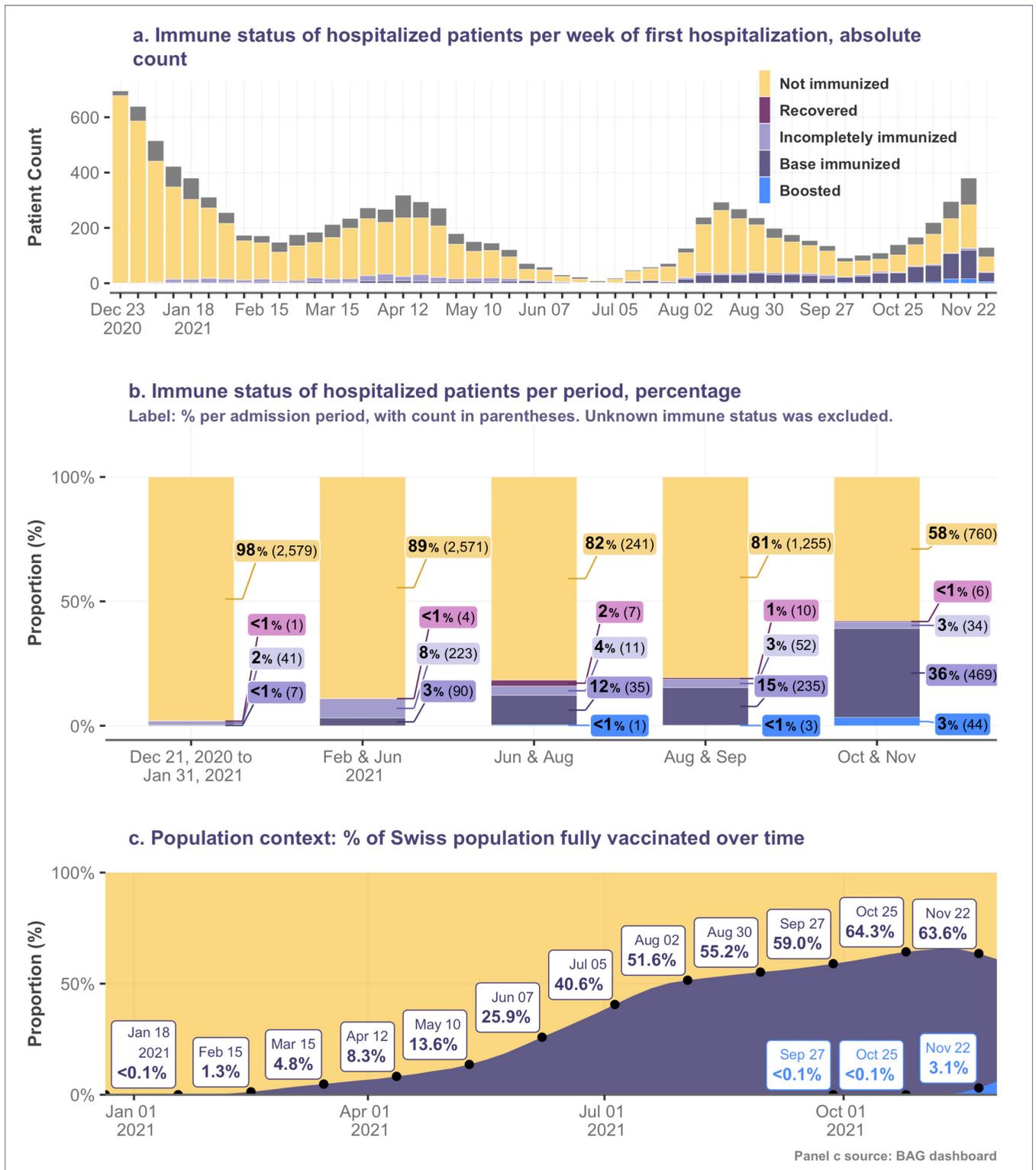
Figure 7: Immune status of hospitalized patients and overall vaccination rate in Switzerland. See footnote for definitions of immune status categories. For patients with multiple hospitalizations, the immune status for the first hospitalization was considered. Panels a and b include patients hospitalized 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 Nov 30 2021 were excluded, as a large proportion of these records have not been completely filled in the database.

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4.2. Patient characteristics by immune status

Fully immunized patients (combination category of base immunized and boosted) were disproportionately older: since vaccination initiation, 42.4% of fully immunized patients (375 of 884) admitted to CH-SUR hospitals were aged 80 and above (Figure **8**a, right panels). In contrast, only 19% of non-immunized patients (1,330 of 7,179) were aged 80 and above (Figure **8**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.

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Legend:
- Unknown status
- Recovered
- Base immunized
- Not immunized
- Incompletely immunized
- Boosted

a. All relevant data: immune status of 10,134 patients first hospitalized between Dec 23, 2020 and Nov 30, 2021

Bar: **17**% (1,682) · **71**% (7,179) · **<1**% (28) · **4**% (361) · **8**% (835) · **<1**% (49)

Not immunized: Gender & age distribution of 7,179 patients

Gender	
Male	55% (3,935)
Female	45% (3,244)

Age	
0-9	4.7% (339)
10-19	1.8% (131)
20-29	3.2% (229)
30-39	6.9% (494)
40-49	10% (745)
50-59	18% (1,267)
60-69	20% (1,418)
70-79	17% (1,226)
80+	19% (1,330)

Incompletely immunized: Gender & age distribution of 361 patients

Gender	
Male	57% (207)
Female	43% (154)

Age	
0-9	0.0% (0)
10-19	0.0% (0)
20-29	0.8% (3)
30-39	2.5% (9)
40-49	3.9% (14)
50-59	8.6% (31)
60-69	19% (67)
70-79	27% (97)
80+	39% (140)

Base immunized: Gender & age distribution of 835 patients

Gender	
Male	58% (488)
Female	42% (347)

Age	
0-9	0.0% (0)
10-19	0.1% (1)
20-29	0.8% (7)
30-39	2.2% (18)
40-49	4.7% (39)
50-59	6.8% (57)
60-69	14% (118)
70-79	29% (238)
80+	43% (357)

Boosted: Gender & age distribution of 49 patients

Gender	
Male	59% (29)
Female	41% (20)

Age	
0-9	0.0% (0)
10-19	2.0% (1)
20-29	0.0% (0)
30-39	0.0% (0)
40-49	6.1% (3)
50-59	6.1% (3)
60-69	16% (8)
70-79	33% (16)
80+	37% (18)

b. Aug & Sep: immune status of 1,787 patients first hospitalized between Aug 01, 2021 and Sep 30, 2021

Bar: **13**% (225) · **70**% (1,259) · **1**% (11) · **3**% (52) · **13**% (237) · **<1**% (3)

Not immunized: Gender & age distribution of 1,259 patients

Gender	
Male	51% (638)
Female	49% (621)

Age	
0-9	6.8% (85)
10-19	2.1% (26)
20-29	6.0% (75)
30-39	13% (166)
40-49	17% (217)
50-59	22% (271)
60-69	19% (235)
70-79	8.2% (103)
80+	6.4% (81)

Incompletely immunized: Gender & age distribution of 52 patients

Gender	
Male	69% (36)
Female	31% (16)

Age	
0-9	0.0% (0)
10-19	0.0% (0)
20-29	3.8% (2)
30-39	9.6% (5)
40-49	15% (8)
50-59	15% (8)
60-69	23% (12)
70-79	12% (6)
80+	21% (11)

Base immunized: Gender & age distribution of 237 patients

Gender	
Male	54% (129)
Female	46% (108)

Age	
0-9	0.0% (0)
10-19	0.0% (0)
20-29	0.4% (1)
30-39	1.7% (4)
40-49	5.1% (12)
50-59	7.2% (17)
60-69	19% (46)
70-79	28% (66)
80+	38% (91)

Boosted: Gender & age distribution of 3 patients

Gender	
Male	33% (1)
Female	67% (2)

Age	
0-9	0.0% (0)
10-19	33% (1)
20-29	0.0% (0)
30-39	0.0% (0)
40-49	0.0% (0)
50-59	33% (1)
60-69	33% (1)
70-79	0.0% (0)
80+	0.0% (0)

c. Oct & Nov: immune status of 1,670 patients first hospitalized between Oct 01, 2021 and Nov 30, 2021

Bar: **22**% (360) · **45**% (758) · **<1**% (6) · **2**% (34) · **28**% (468) · **3**% (44)

Not immunized: Gender & age distribution of 758 patients

Gender	
Male	52% (392)
Female	48% (366)

Age	
0-9	8.3% (63)
10-19	2.0% (15)
20-29	3.8% (29)
30-39	9.2% (70)
40-49	12% (90)
50-59	18% (137)
60-69	18% (138)
70-79	15% (110)
80+	14% (106)

Incompletely immunized: Gender & age distribution of 34 patients

Gender	
Male	47% (16)
Female	53% (18)

Age	
0-9	0.0% (0)
10-19	0.0% (0)
20-29	2.9% (1)
30-39	2.9% (1)
40-49	12% (4)
50-59	12% (4)
60-69	18% (6)
70-79	12% (4)
80+	41% (14)

Base immunized: Gender & age distribution of 468 patients

Gender	
Male	60% (280)
Female	40% (188)

Age	
0-9	0.0% (0)
10-19	0.2% (1)
20-29	0.6% (3)
30-39	2.6% (12)
40-49	4.3% (20)
50-59	6.6% (31)
60-69	13% (59)
70-79	30% (142)
80+	43% (200)

Boosted: Gender & age distribution of 44 patients

Gender	
Male	61% (27)
Female	39% (17)

Age	
0-9	0.0% (0)
10-19	0.0% (0)
20-29	0.0% (0)
30-39	0.0% (0)
40-49	6.8% (3)
50-59	4.5% (2)
60-69	16% (7)
70-79	32% (14)
80+	41% (18)

Figure 8: Demographic characteristics of patients hospitalized by immune status, over three different periods. Patients first hospitalized after Nov 30 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.

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4.3. Patient outcomes by immune status

Since the date vaccinations began, Dec 23, 2020, CH-SUR registered only 80 deaths among fully immunized patients (Figure **9**a, right panels: base immunized and boosted). Of these deaths, 44 were among individuals aged 80 and above. Over the same period, there were 608 COVID-caused deaths among non-immunized patients (Figure **9**a, left panel).

During the months of October and November, there were 47 deaths (49%) among non-immunized patients, 5 deaths (5.2%) among partially immunized patients, and 44 deaths (45.8%) among fully immunized patients (Figure **9**). Despite representing a smaller share of the population (36% of non immunized patients at the time of data analysis, see Figure **7**c)), the non-immunized population's death toll represents a larger portion (Figure **9**c). Figure **9**c excludes 3 deaths of which the immune status is unknown.

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 **9**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.

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a. All relevant data: 748 deaths among 7,883 patients first hospitalized between Dec 23, 2020 and Nov 30, 2021

Not immunized:
Age distribution of **608** deaths in **6,823** patients

Age	Patients	Deaths	CFR %
0-9	322	0	0%
10-19	122	0	0%
20-29	214	3	1.4%
30-39	459	1	0.2%
40-49	693	10	1.4%
50-59	1191	36	3.0%
60-69	1348	99	7.3%
70-79	1187	168	14.2%
80+	1287	291	22.6%

Incompletely immunized:
Age distribution of **60** deaths in **345** patients

Age	Patients	Deaths	CFR %
0-9	0	0	-
10-19	0	0	-
20-29	3	0	0%
30-39	8	0	0%
40-49	12	0	0%
50-59	28	3	10.7%
60-69	61	8	13.1%
70-79	97	16	16.5%
80+	136	33	24.3%

Base immunized:
Age distribution of **75** deaths in **672** patients

Age	Patients	Deaths	CFR %
0-9	0	0	-
10-19	1	0	0%
20-29	3	0	0%
30-39	15	0	0%
40-49	31	0	0%
50-59	51	2	3.9%
60-69	103	9	8.7%
70-79	193	22	11.4%
80+	275	42	15.3%

Boosted:
Age distribution of **5** deaths in **43** patients

Age	Patients	Deaths	CFR %
0-9	0	0	-
10-19	1	0	0%
20-29	0	0	-
30-39	0	0	-
40-49	2	0	0%
50-59	3	0	0%
60-69	7	0	0%
70-79	14	3	21.4%
80+	16	2	12.5%

b. Aug & Sep: 108 deaths among 1,359 patients first hospitalized between Aug 01, 2021 and Sep 30, 2021

Not immunized:
Age distribution of **79** deaths in **1,118** patients

Age	Patients	Deaths	CFR %
0-9	83	0	0%
10-19	22	0	0%
20-29	66	1	1.5%
30-39	148	1	0.7%
40-49	196	6	3.1%
50-59	239	10	4.2%
60-69	203	23	11.3%
70-79	93	17	18.3%
80+	68	21	30.9%

Incompletely immunized:
Age distribution of **7** deaths in **43** patients

Age	Patients	Deaths	CFR %
0-9	0	0	-
10-19	0	0	-
20-29	2	0	0%
30-39	4	0	0%
40-49	8	0	0%
50-59	6	1	16.7%
60-69	8	1	12.5%
70-79	6	0	0%
80+	9	5	55.6%

Base immunized:
Age distribution of **22** deaths in **195** patients

Age	Patients	Deaths	CFR %
0-9	0	0	-
10-19	0	0	-
20-29	0	0	-
30-39	4	0	0%
40-49	10	0	0%
50-59	16	1	6.2%
60-69	41	5	12.2%
70-79	56	8	14.3%
80+	68	8	11.8%

Boosted:
Age distribution of **0** deaths in **3** patients

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

c. Oct & Nov: 96 deaths among 1,044 patients first hospitalized between Oct 01, 2021 and Nov 30, 2021

Not immunized:
Age distribution of **47** deaths in **618** patients

Age	Patients	Deaths	CFR %
0-9	52	0	0%
10-19	10	0	0%
20-29	26	0	0%
30-39	57	0	0%
40-49	72	0	0%
50-59	109	4	3.7%
60-69	118	6	5.1%
70-79	90	14	15.6%
80+	84	23	27.4%

Incompletely immunized:
Age distribution of **5** deaths in **29** patients

Age	Patients	Deaths	CFR %
0-9	0	0	-
10-19	0	0	-
20-29	1	0	0%
30-39	1	0	0%
40-49	2	0	0%
50-59	4	0	0%
60-69	5	1	20.0%
70-79	4	0	0%
80+	12	4	33.3%

Base immunized:
Age distribution of **39** deaths in **358** patients

Age	Patients	Deaths	CFR %
0-9	0	0	-
10-19	1	0	0%
20-29	2	0	0%
30-39	10	0	0%
40-49	15	0	0%
50-59	27	1	3.7%
60-69	50	1	2.0%
70-79	109	13	11.9%
80+	144	24	16.7%

Boosted:
Age distribution of **5** deaths in **39** patients

Age	Patients	Deaths	CFR %
0-9	0	0	-
10-19	0	0	-
20-29	0	0	-
30-39	0	0	-
40-49	2	0	0%
50-59	2	0	0%
60-69	6	0	0%
70-79	13	3	23.1%
80+	16	2	12.5%

Figure 9: 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 base immunized, boosted, incompletely immunized or not immunized. Missing age and recovered patients' records and missing immune status were removed. Counts of deaths only include patients who died because of COVID-19 (including those with COVID as suspected cause of death). Case-fatality rate (CFR), especially for the incompletely immunized and boosted categories, should be interpreted with caution due to small sample sizes.

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5. Intensive care unit (ICU) admission

5.1. 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 **10**a). The 60-69 age group had the highest probability of admission to the ICU, with 25.7% admitted (981 of 3,817). Notably, individuals aged 80 and above were least likely to be admitted to the ICU, with only 6.1% admitted (328 of 5,401).
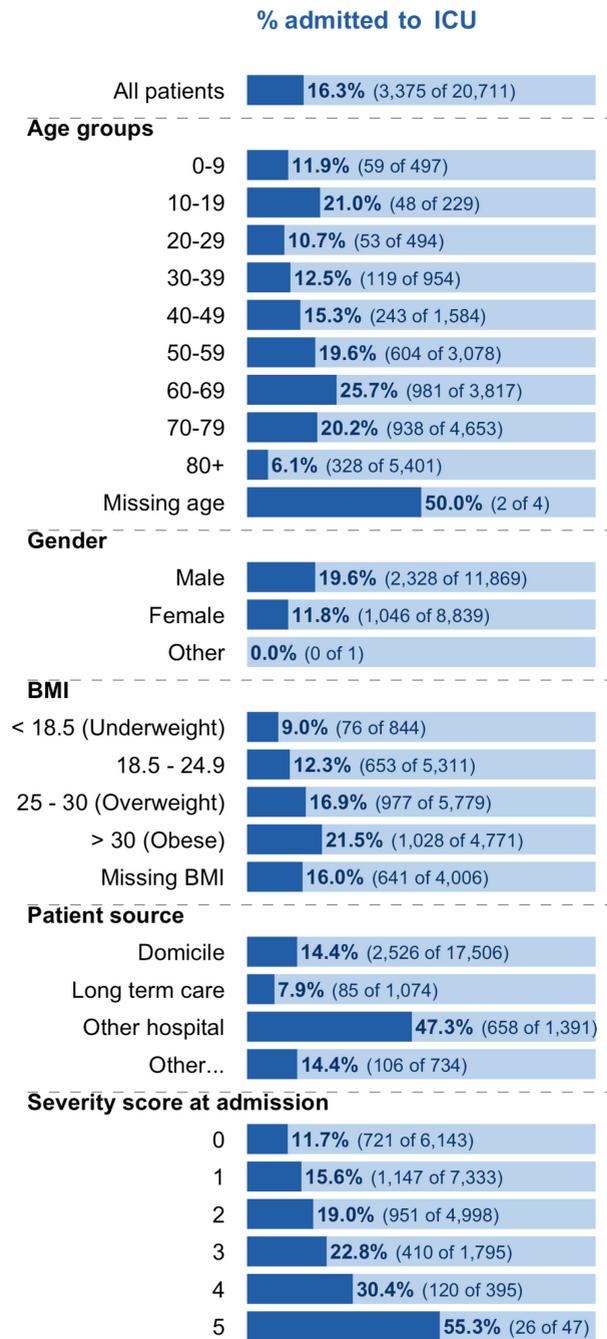
Males were more likely to be admitted in an ICU ward than females. 19.6% of the hospitalized males were admitted in an ICU ward, compared to 11.8% of the hospitalized females.

Patients transferred in from other hospitals had a high probability of ICU admission: 47.3% of such patients (658 of 1,391) were admitted to the ICU (Figure **10**a).

ICU admission probability also increased slightly with increasing BMI, and increased steeply with increasing admission severity scores (Figure **10**a).

Figure **10**b shows the ICU admissions for the most recent period with available data. The admissions to ICU across groups are roughly similar to what is observed across all hospitalized patients. Given the smaller sample size of this period of observation, larger oscillations in the percentages are expected, making the real trends difficult to identify.

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a. All relevant data: Patients first hospitalized between Feb 26 2020 and Nov 30 2021

% admitted to ICU

All patients	**16.3%** (3,375 of 20,711)
Age groups	
0-9	**11.9%** (59 of 497)
10-19	**21.0%** (48 of 229)
20-29	**10.7%** (53 of 494)
30-39	**12.5%** (119 of 954)
40-49	**15.3%** (243 of 1,584)
50-59	**19.6%** (604 of 3,078)
60-69	**25.7%** (981 of 3,817)
70-79	**20.2%** (938 of 4,653)
80+	**6.1%** (328 of 5,401)
Missing age	**50.0%** (2 of 4)
Gender	
Male	**19.6%** (2,328 of 11,869)
Female	**11.8%** (1,046 of 8,839)
Other	**0.0%** (0 of 1)
BMI	
< 18.5 (Underweight)	**9.0%** (76 of 844)
18.5 - 24.9	**12.3%** (653 of 5,311)
25 - 30 (Overweight)	**16.9%** (977 of 5,779)
> 30 (Obese)	**21.5%** (1,028 of 4,771)
Missing BMI	**16.0%** (641 of 4,006)
Patient source	
Domicile	**14.4%** (2,526 of 17,506)
Long term care	**7.9%** (85 of 1,074)
Other hospital	**47.3%** (658 of 1,391)
Other...	**14.4%** (106 of 734)
Severity score at admission	
0	**11.7%** (721 of 6,143)
1	**15.6%** (1,147 of 7,333)
2	**19.0%** (951 of 4,998)
3	**22.8%** (410 of 1,795)
4	**30.4%** (120 of 395)
5	**55.3%** (26 of 47)

b. Oct & Nov: Patients first hospitalized between Oct 01 2021 and Nov 30 2021

% admitted to ICU

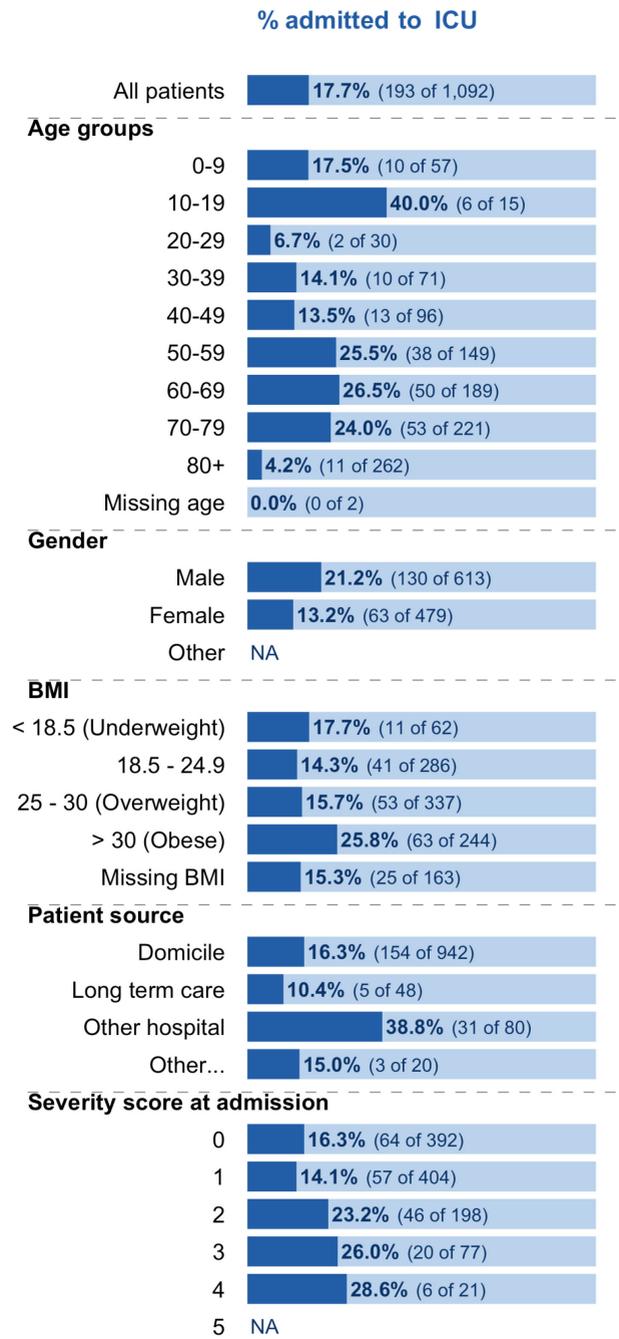|	
All patients	**17.7%** (193 of 1,092)
Age groups	
0-9	**17.5%** (10 of 57)
10-19	**40.0%** (6 of 15)
20-29	**6.7%** (2 of 30)
30-39	**14.1%** (10 of 71)
40-49	**13.5%** (13 of 96)
50-59	**25.5%** (38 of 149)
60-69	**26.5%** (50 of 189)
70-79	**24.0%** (53 of 221)
80+	**4.2%** (11 of 262)
Missing age	**0.0%** (0 of 2)
Gender	
Male	**21.2%** (130 of 613)
Female	**13.2%** (63 of 479)
Other	NA
BMI	
< 18.5 (Underweight)	**17.7%** (11 of 62)
18.5 - 24.9	**14.3%** (41 of 286)
25 - 30 (Overweight)	**15.7%** (53 of 337)
> 30 (Obese)	**25.8%** (63 of 244)
Missing BMI	**15.3%** (25 of 163)
Patient source	
Domicile	**16.3%** (154 of 942)
Long term care	**10.4%** (5 of 48)
Other hospital	**38.8%** (31 of 80)
Other...	**15.0%** (3 of 20)
Severity score at admission	
0	**16.3%** (64 of 392)
1	**14.1%** (57 of 404)
2	**23.2%** (46 of 198)
3	**26.0%** (20 of 77)
4	**28.6%** (6 of 21)
5	NA

Figure 10: 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 Nov 30 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.

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5.2. ICU admission by immune status

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

In both periods considered, the predominant immune status (see section 4 for definitions of immune status) to be admitted to ICU were non immunized patients (81% and 68% 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 (Aug and Sep: 86.0% of patients were above 50 and Oct and Nov: 90.0% of patients were above 50). In comparison, non immunized patients admitted to the ICU included proportionally more patients from younger age classes, as only 62.2% (Aug, Sep) and 77% (Oct, Nov) were aged above 50.
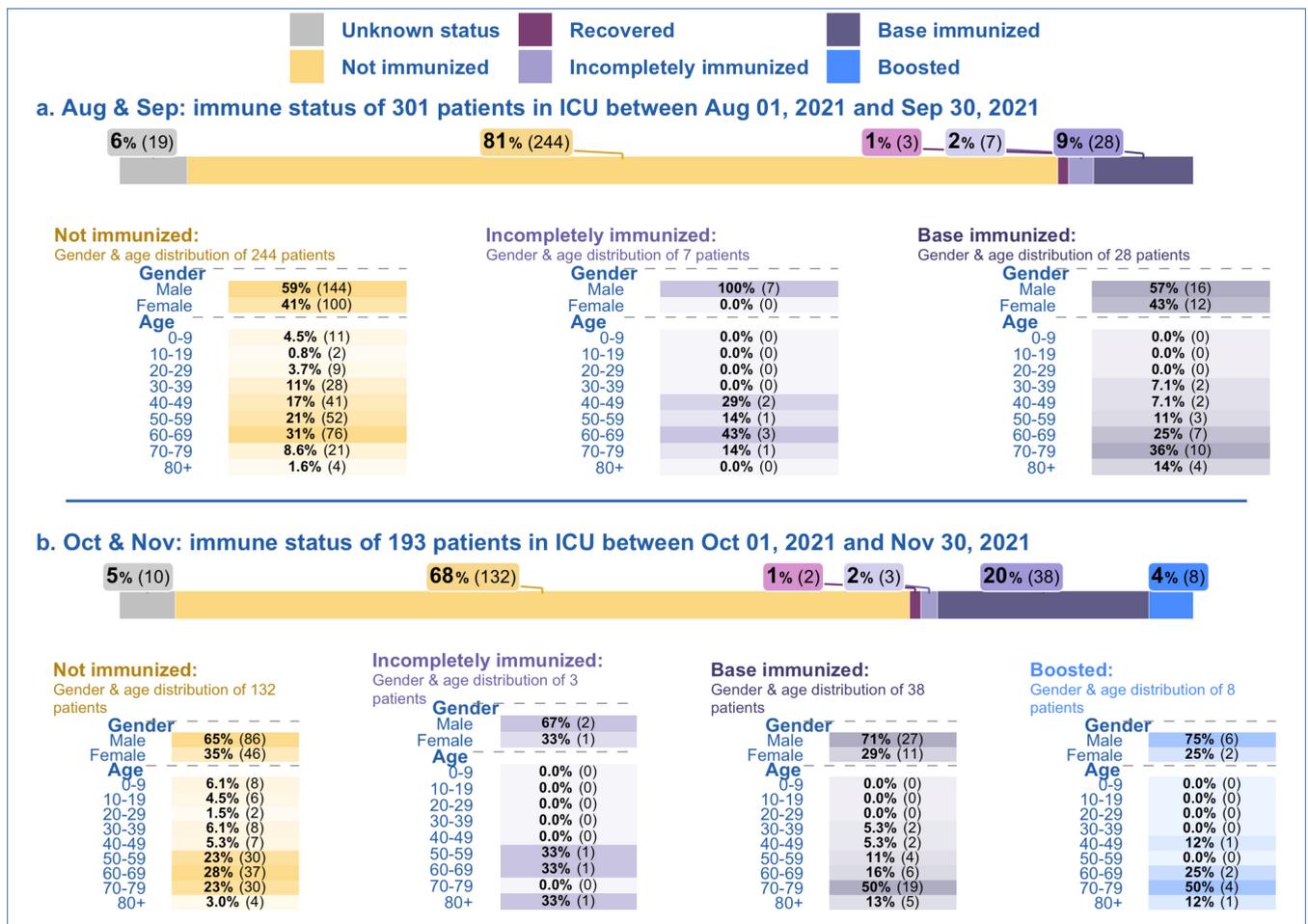
Figure 11: *Demographic characteristics of patients in ICU by immune status, over two different periods. Patients in ICU after Nov 30 2021 were excluded, as a large proportion of these records have not been completely filled in the database. Patients with missing ages and gender marked 'Other' are not shown. Data (% of share) on ICU admissions for the incompletely immunized and boosted categories should be interpreted with caution due to small sample sizes.*

5.3. ICU admission over time

Figure **12** 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.
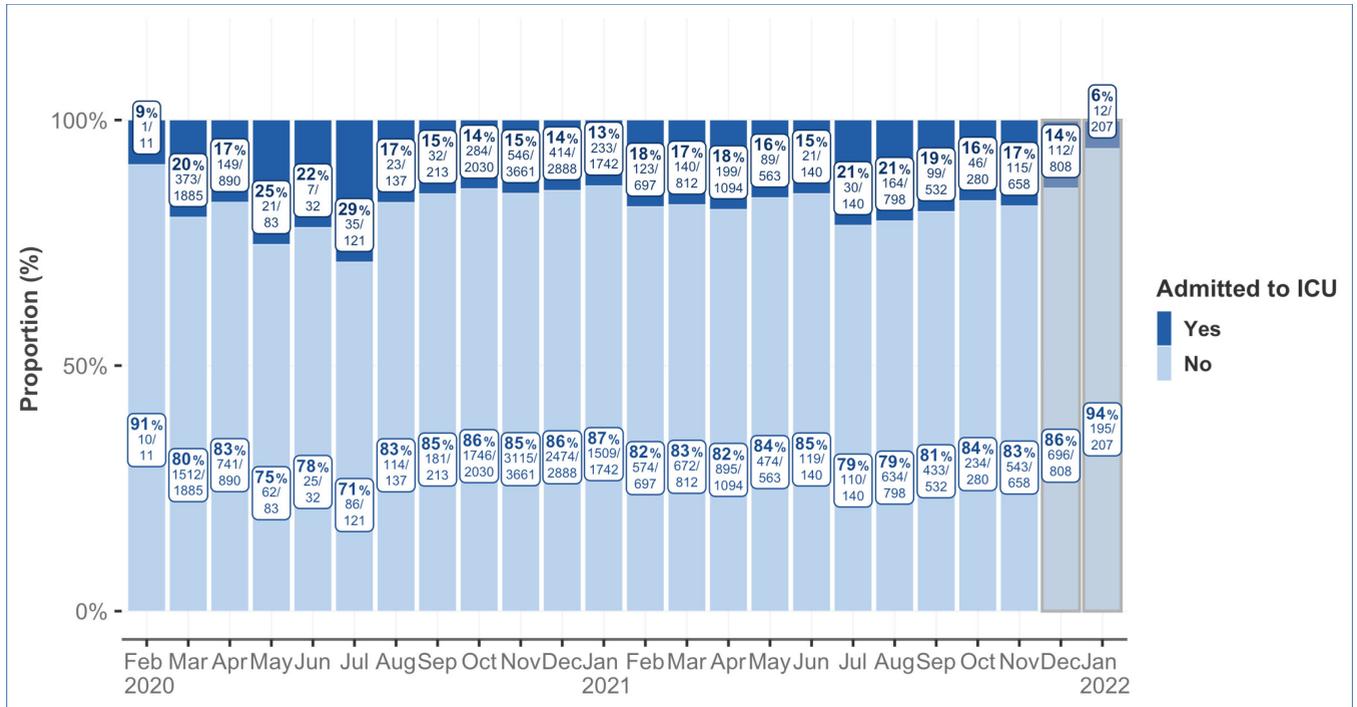

Figure 12: *Percentage and proportion of patients admitted to the ICU over time. For patients with multiple hospitalizations, we considered whether they were admitted to the ICU during any of their hospitalizations. Records with incomplete data (patients still hospitalized or with a pending outcome in the database) were not included. Data from the last two months (highlighted gray) are considered provisional due to data entry delays.*

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6. 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 12.9% (3,237 of 25,048) (Figure **13**a).

The proportion of nosocomial cases peaked in January 2022: 21.1% (285 of 1,351) of patients hospitalized in that month had infections of nosocomial origin (Figure **13**c). Notably, this peak in nosocomial proportion roughly coincides with the peak of hospitalizations (Figure **13**b). In the recent months, this proportion raised again, accounting for 14.5% and 21.1% of the hospitalizations registered in CH-SUR over the months of December 2021 and January 2022 respectively.
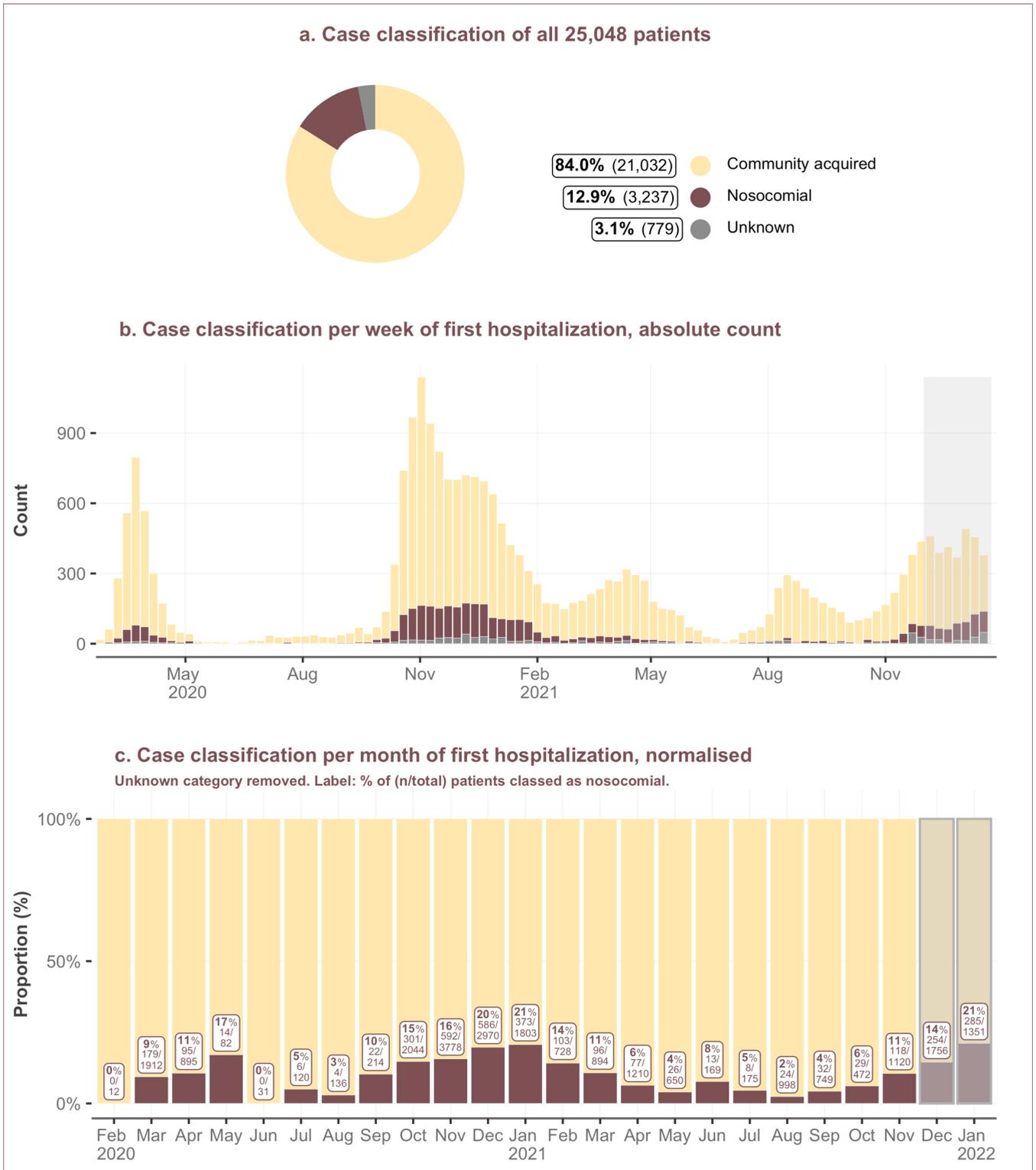
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Figure 13: Case classification (infection source) for patients over time

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7. Health Complications

Incidence of complications among hospitalized patients from Feb 2020 to Jan 2022

All Patients with Complications

Figure 14: Incidence of complications arising during COVID infection. The reported complications are shown overall and per age group.

Out of 22,849 patients with complete complications data record and known age and gender (9,844 women and 13,005 men) hospitalized from Feb 2020 to Jan 24, 2022, 18,325 patients had complications (80.2%).

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Complications [3] were more common among males: 58.8% males and 41.2% females hospitalized patients suffered from at least one complication.

Pneumonia was the most common complication observed among all hospitalized patients and was more common among men than women (65.8% men and 54.7% women, Figure **14**). Children and adolescents suffered less frequently from this complication than patients aged 18 years old and above. Pneumonia affected 6.0% of the male and 7.8% of the female patients aged under 18, but over 55% of the male and female patients aged 18 years old and older. Regarding the younger age group (younger than 18), PIMS is a relevant complication. It is more common in boys than girls (14.8% and 8.1% respectively, Figure **14**).

Despite being the most common complication among hospitalized patients, pneumonia ranked fourth between the complications with the highest associated mortality among patients aged over 64 (Figure **16**). ARDS, especially for the older age group (65+), was the complication with the highest associated mortality: 47.3% of men and 43.6% of women affected by ARDS as a complication of COVID-19 died (Figure **16**).
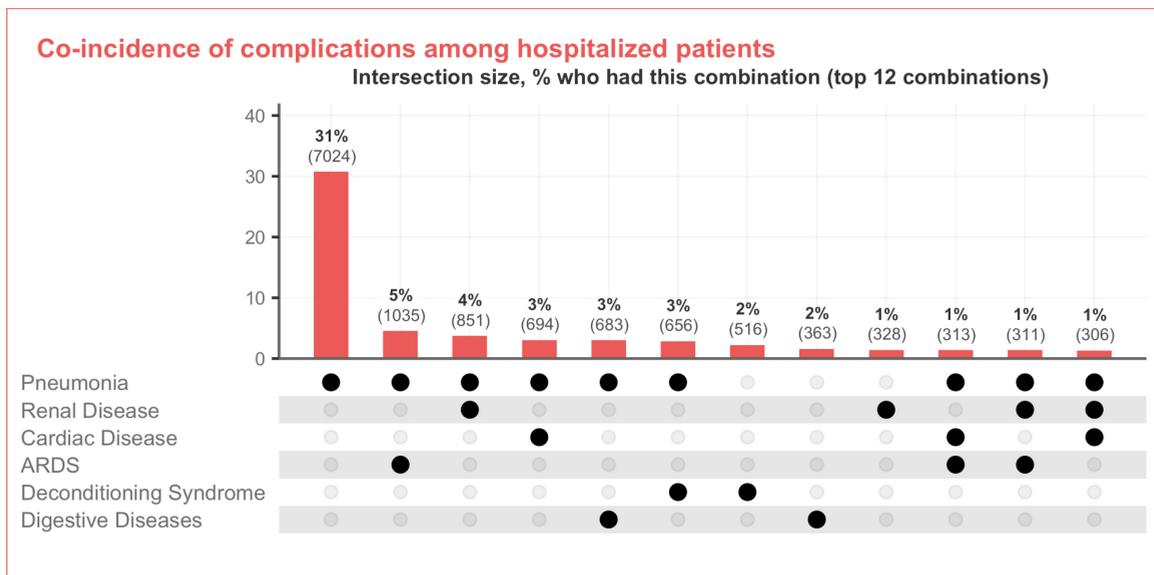

Figure 15: *Complications are represented by their combinations (co-occurences). The top 12 combinations are represented.*

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[3] Only the top 9 most prevalent complications, and PIMS, are displayed. Other complications available in the database include: Acute Otitis Media, Encephalitis, Febrile Convulsion, Osteo-articular Disease, ENT, Non Bacterial Infections, Psychiatric Alteration, Other Respiratory Diseases (defined as a patient having a respiratory disease complication which was neither pneumonia nor ARDS).

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Mortality by complications among hospitalized patients, per age group

Note: There were no deaths in the age group of below 18.

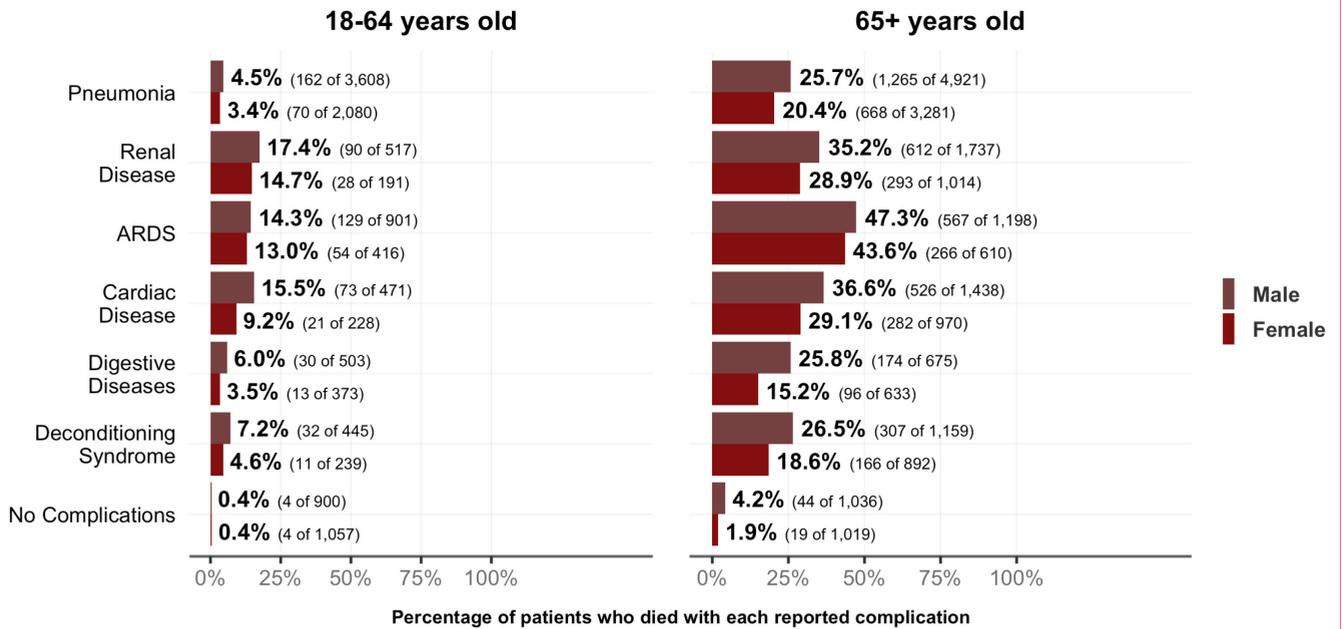**Figure 16**: *Mortality is depicted for each complication: showing the percentage of patients with the complication who died.*

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