COVID-19 in Dutch Intensive Care Units;

Patient characteristics and outcomes

compared with pneumonia patients in the ICU from 2017-2019

Version 2021-11-16

This report has been made possible by the effort of all Dutch ICUs from:

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Introduction

Despite the increased workload in patient care, all hospitals have put great effort in registering the data concerning COVID-19 patients. By using the online data entry system of the National Intensive Care Evaluation (NICE) foundation a limited amount of data (e.g. admission and discharge date and the age of the patient) on all COVID-19 patients has been recorded. By linking this data to more extensive clinical data, which are being collected regular by the NICE registration, it becomes possible to provide more clarity about the important characteristics and outcomes of COVID-19 patients. Because these extensive clinical data are subsequently supplied in batches from the electronic health record (EHR), these are not yet available for every COVID-19 patient. This means, when reading this report, make sure the results concern an overview of all COVID-19 patients or of COVID-19 patients who are linked to the extensive clinical data.

From February 25, 2021, all individual episodes of patients who have had multiple proven COVID-19 episodes will be included. An episode is defined as a consecutive hospital admission period (in one or more hospitals) in which a patient has tested positive at any time. Once a patient is discharged from hospital and after more than three days is re-admitted to hospital with proven COVID-19, this new hospitalization will be considered as a new COVID-19 episode. This allows one patient to have multiple COVID-19 episodes. This report uses data from all recorded episodes.

This report will be updated frequently in order to include more COVID-19 patients and more clinical data in the analyses. When only a limited amount of episodes can be linked this could lead to bias: a distortion of the results can occur if the linked episodes differ from the non-linked episodes, for instance because the patients of linked episodes have been discharged relatively quickly, or because they died. If more data are available, there will be more certainty about the shown differences between time periods and the associations between patient characteristics and their outcomes.

The data included in this report has been processed by the compilers with the utmost care. The compiler cannot be held liable in any way for information that is nevertheless incomplete or incorrect.

In the table below the total number of admitted COVID-19 episodes, the COVID-19 episodes linked to the clinical data, and SARI patients are shown.

	Number of patients	**Number of hospitals**
All COVID-19 episodes	14671	72
Linked COVID-19 episodes	13134	72
SARI patients in 2017-2019	19851	80

Comparison COVID-19 with SARI

In this report, the data of the COVID-19 episodes will be compared with a group of patients who was admitted to a Dutch ICU with severe pneumonia between the period of 1 January 2017 till 31 December 2019. This group is being called Severe Acute Respiratory Infection (SARI). In this report, SARIs will be defined based on the following (APACHE IV) reasons of admission: Pulmonary sepsis; Viral pneumonia; Aspiration pneumonia; Bacterial pneumonia; Fungal pneumonia; Parasitic pneumonia (i.e. Pneumocystis pneumonia); Other pneumonia.

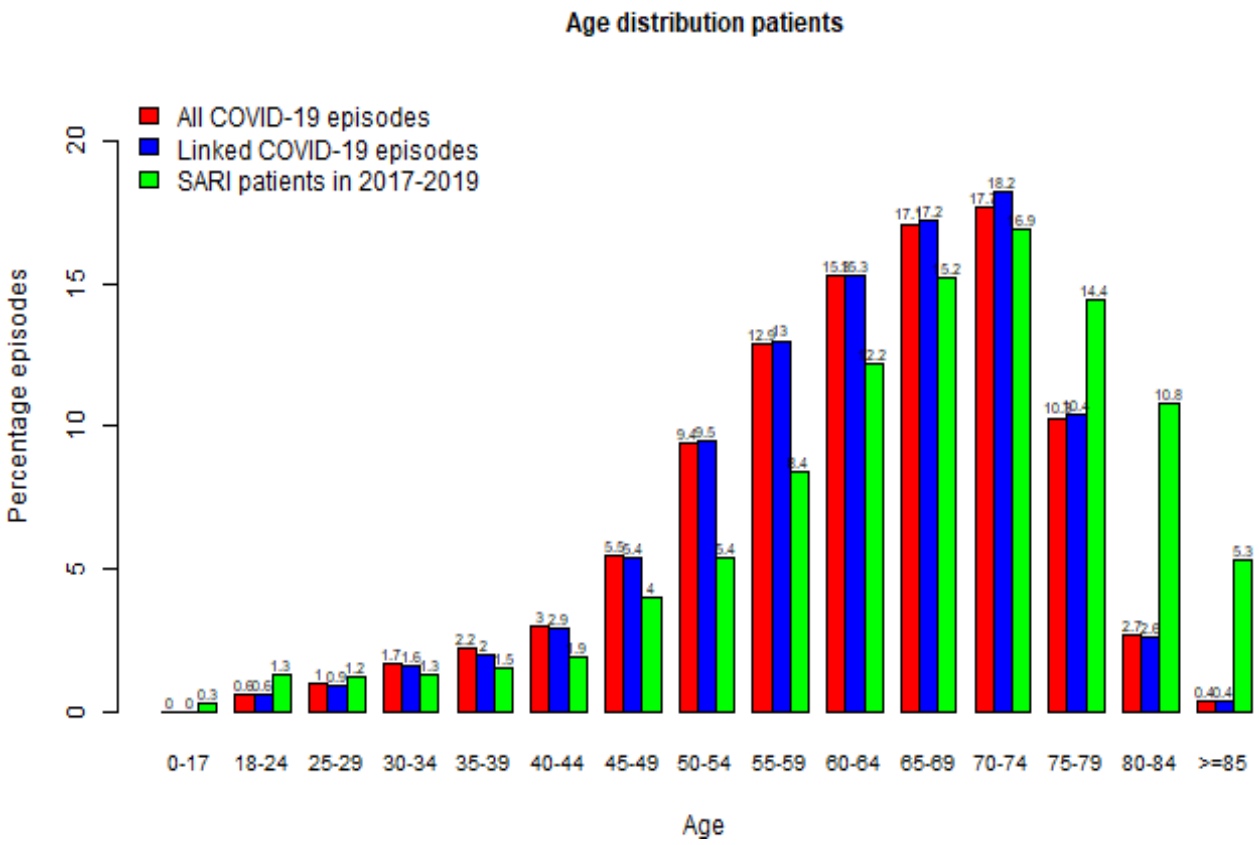
ICU length of stay

The table below shows the mean ICU length of stay of all COVID-19 episodes and admitted SARI patients, of the COVID-19 episodes of which the patients are still in the ICU, and of COVID-19 episodes and SARI patients who have been discharged recently split up into different discharge destinations. If a COVID-19 patient has been transferred to another ICU during the episode, all ICU length of stays will be added up together. The length of stay is calculated in days ((discharge date - admission date)+1).

	Number of COVID-19 episodes	**Mean length of stay (SD)**	**Number of SARI patients**	**Mean length of stay (SD)**
Patients who are currently being treated in the ICU *	368	13.8 (14.5)	0	-
Discharged to nursing ward in same or different hospital	10295	16.5 (18.2)	14111	5.9 (9.6)
Other discharge destination	486	19.3 (24.9)	2296	7.2 (11.2)
Died in the ICU	3522	18.2 (17.1)	3444	7.1 (10.5)
TOTAL	14671	16.9 (18.1)	19851	6.3 (10.0)

**N.B. For the COVID-19 episodes of which the patient is currently admitted, it concerns the ICU length of stay up till the moment that this report was generated and not the final total length of stay.*

The figure and table below show the age distribution of all COVID-19 episodes, the linked COVID-19 episodes and the SARI patients.

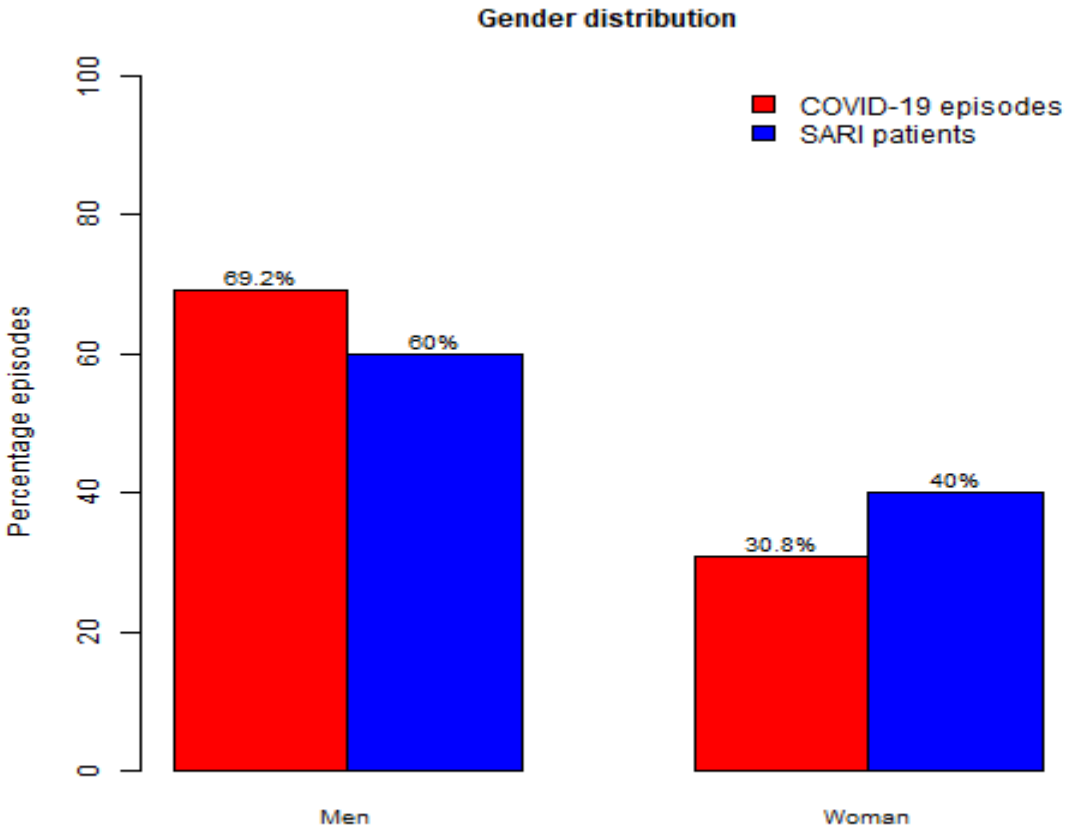


	Mean age (SD)
All COVID-19 episodes	62.2 (12.2)
Linked COVID-19 episodes	62.4 (11.9)
SARI patients in 2017-2019	66.3 (14.2)

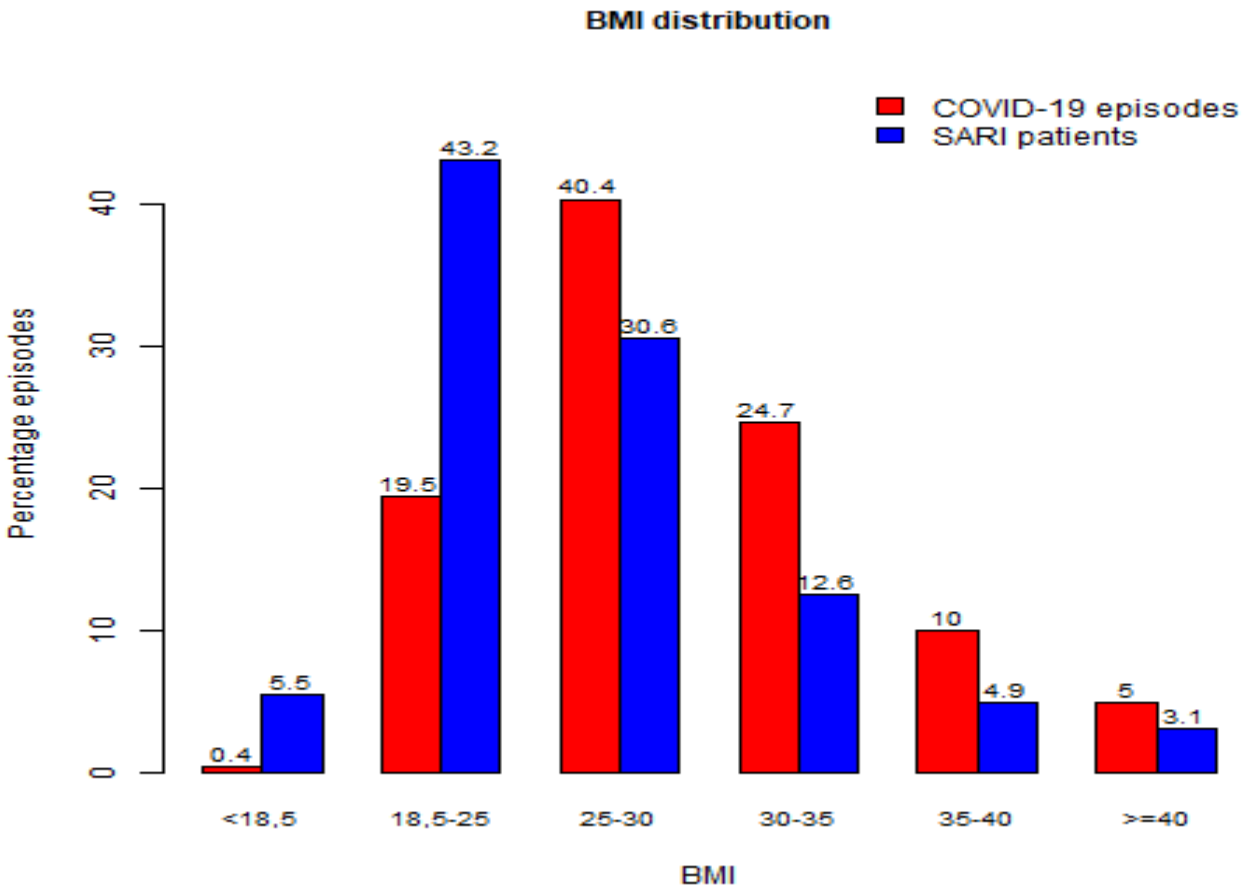
Patient characteristics

In the remainder of this report, the extensive data from the NICE registration will be used. Therefore, from here on, only the linked COVID-19 episodes will be included. This group will continuously be compared with the SARI patients who have been admitted to the ICU in the previous three years (2017-2019).

In the figure below the distribution of men and women in the linked COVID-19 episodes and the SARI patients is shown.



In the graph below, the BMI-distribution of the linked COVID-19 episodes and the SARI patients is shown.

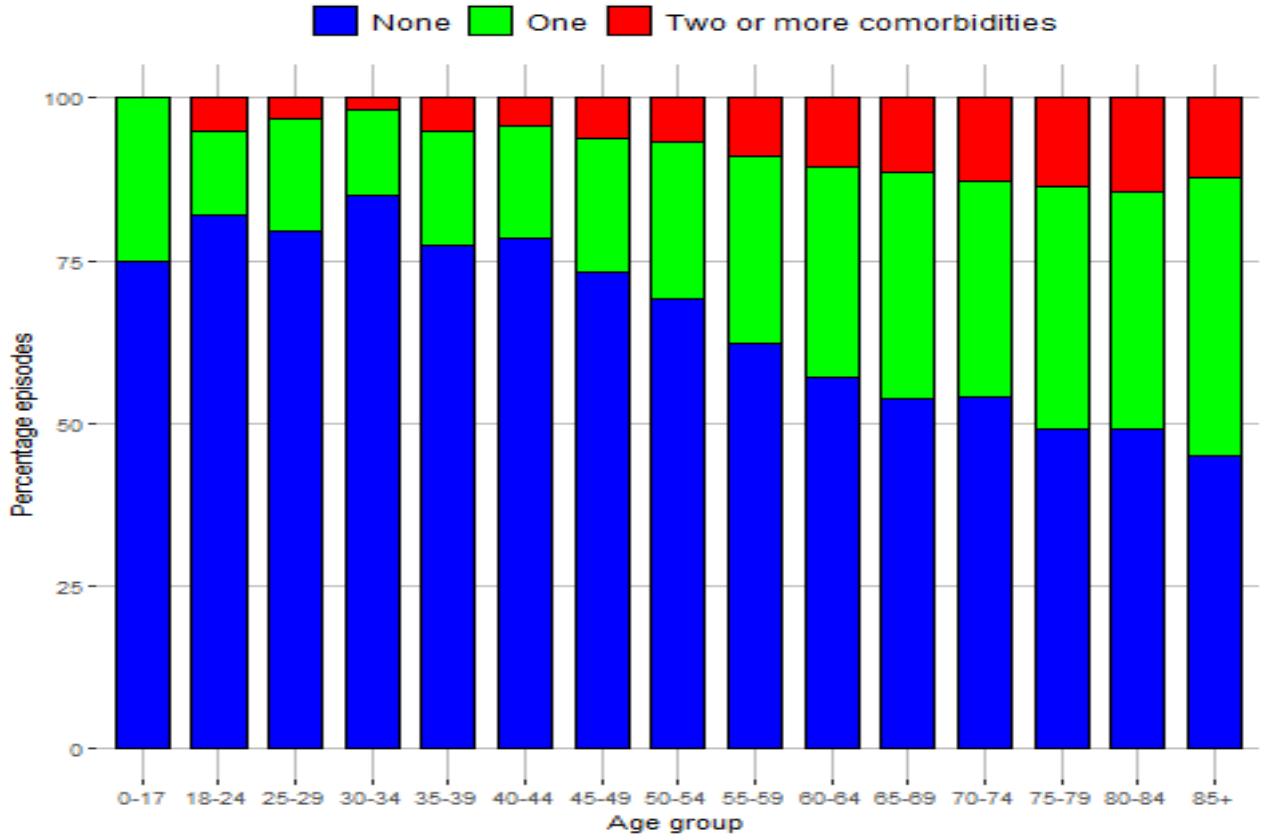


	Mean BMI (SD)
Linked COVID-19 episodes	29.6 (5.6)
SARI patients in 2017-2019	26.2 (6.0)

The table below shows for several different comorbidities (secondary diagnoses) the number and percentage of episodes of which the patient had the concerning comorbidity. Additionally, this table shows the number and percentage of episodes of which the patient were mechanically ventilated at ICU admission, and that were mechanically ventilated within the first 24 hours of ICU admission.

	COVID-19 episodes N(%)	**SARI patients N(%)**
COPD/Respiratory insufficiency	1648 (12.5)	7554 (38.1)
Renal failure	537 (4.1)	1725 (8.7)
Cirrhosis	53 (0.4)	238 (1.2)
Cardiovascular insufficiency	204 (1.6)	764 (3.8)
Malignancy/Haematological insufficiency	339 (2.6)	1962 (9.9)
Immunological insufficiency	1202 (9.2)	3815 (19.2)
Diabetes	2962 (22.6)	4009 (20.2)
Mechanically ventilated at ICU admission	3892 (29.6)	7953 (40.1)
Mechanically ventilated within the 1st 24 hours	8164 (62.2)	11164 (56.2)

In the graph below, the percentage of COVID-19 episodes of which the patient had no, one or more than one comorbidities are given for different age groups.



**Note since the report of 2020-12-10 diabetes is also counted as a comorbidity, as a result of this the percentage of episodes of which patient had one or more comorbidities may have increased compared to previous reports.*

Patient outcomes and determinants

In the table below important characteristics belonging to COVID-19 episodes of which the patient died are compared with COVID-19 episodes of which the patient survived.
N.B. This analysis excludes the episodes of which the patient is still admitted at the Intensive Care. However, the number of these episodes are being shown in the last column of the table.
The listed percentages should be read horizontally.

Per patient characteristic, the number and percentage of episodes of which the patient deceased and survived has been displayed. The column containing the P-value shows whether the differences between the episodes of deceased and survived patients are statistically significant. A P-value smaller than 0.05 shows that the presented differences are statistically significant (cannot be explained based on coincidence). A P-value of 0.05 or bigger means that the discovered differences are probably a coincidence.

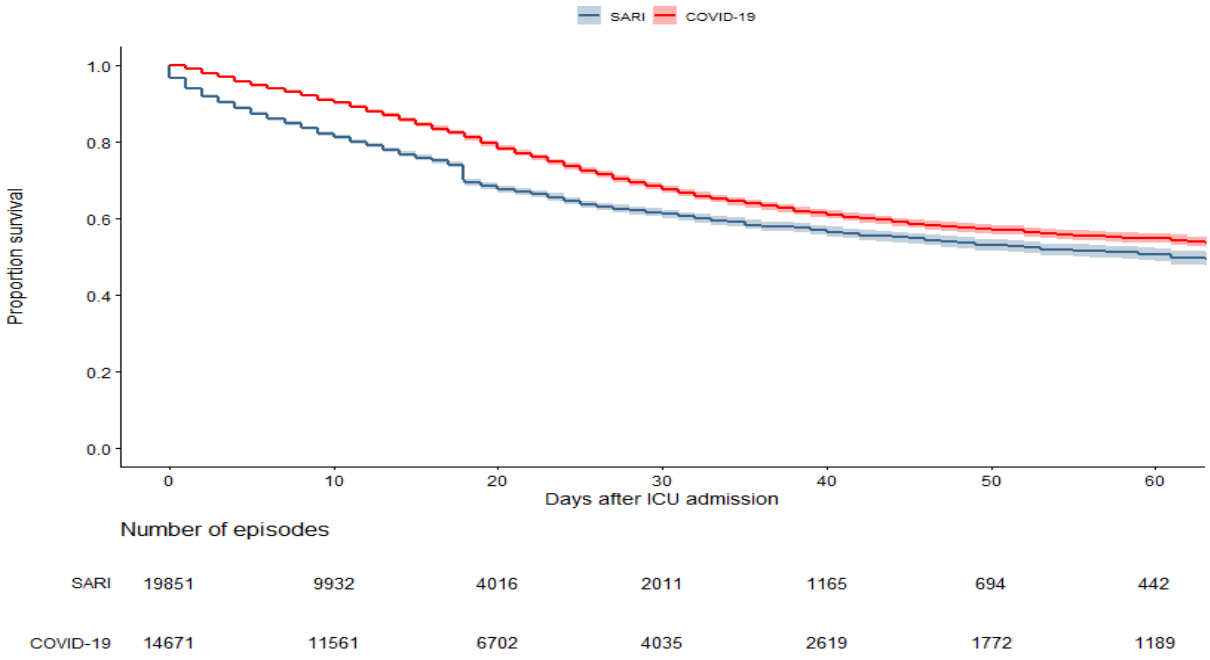
Finally, the association between the patient characteristic and mortality is shown with Odds Ratio's (OR). An OR shows approximately how much the risk of dying is increased in relation to the comparison category, also known as the reference population. Regarding age: due to the small numbers, the seven youngest age categories have been combined into one reference population. Therefore, in the remaining age categories the OR indicate how much more the risk of dying is increased in comparison to this reference population. The 95%-confidence interval (CI) of the OR is displayed in the second last column and indicates whether the association found between the patient characteristics and mortality is statistically significant (confidence interval does NOT include 1) or not significant (confidence interval DOES include1).

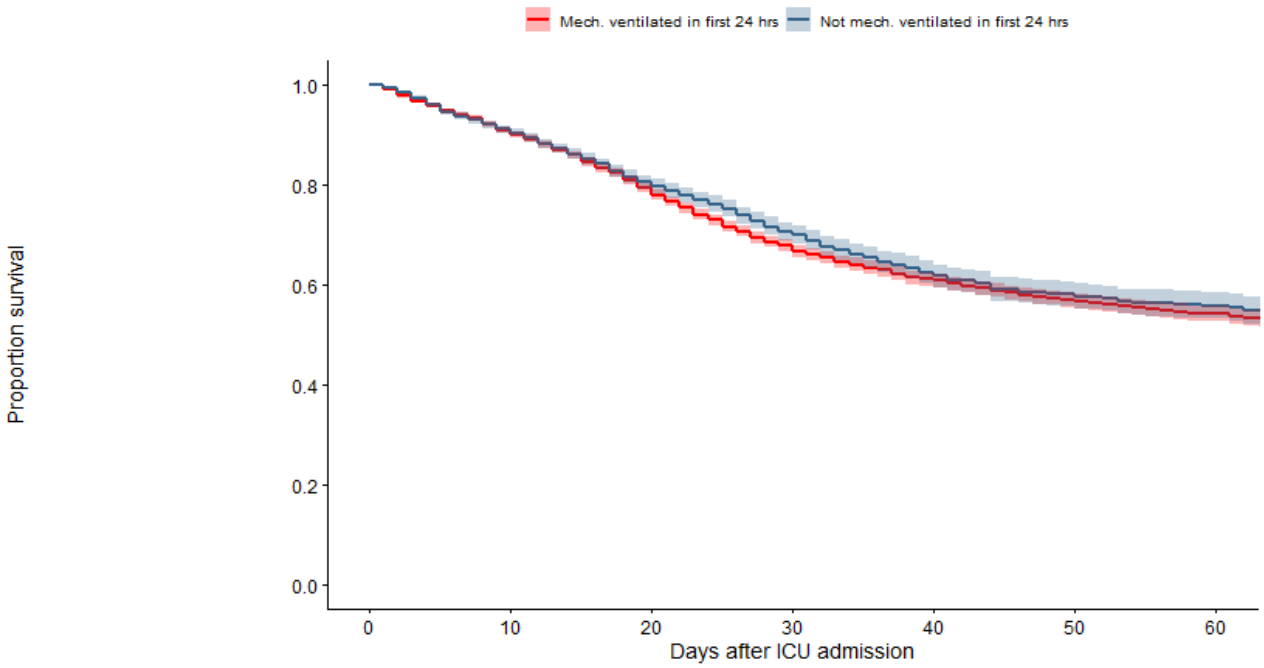
	COVID-19 survivors N (%)	**COVID-19 deceased N (%)**	**P-value**	**Odds ratio (95% CI)**	**COVID-19 still in hospital N**
All episodes	9123 (71.6)	3616 (28.4)			395
Age groups			<0.001		
0-17	2 (66.7)	1 (33.3)		reference	1
18-24	73 (98.6)	1 (1.4)		reference	4
25-29	111 (94.1)	7 (5.9)		reference	4
30-34	195 (96.5)	7 (3.5)		reference	7
35-39	231 (93.1)	17 (6.9)		reference	8
40-45	337 (92.6)	27 (7.4)		reference	13
45-50	638 (91.1)	62 (8.9)		reference	9
50-55	1052 (87.6)	149 (12.4)		1.82 (1.42-2.34)	50
55-60	1407 (85.1)	247 (14.9)		2.26 (1.8-2.84)	50
60-65	1508 (77.2)	446 (22.8)		3.81 (3.08-4.7)	53
65-70	1464 (67.4)	709 (32.6)		6.23 (5.09-7.64)	53
70-75	1317 (56.6)	1010 (43.4)		9.87 (8.08-12.06)	79
75-80	632 (47.8)	690 (52.2)		14.05 (11.37-17.37)	79
80-85	132 (38.8)	208 (61.2)		20.28 (15.26-26.96)	79
>85	15 (31.2)	33 (68.8)		28.32 (14.97-53.55)	79
Gender			<0.001		
Men	6152 (69.8)	2660 (30.2)		reference	276
Woman	2971 (75.7)	956 (24.3)		0.74 (0.68-0.81)	119

	COVID-19 survivors N (%)	COVID-19 deceased N (%)	P-value	Odds ratio (95% CI)	COVID-19 still in hospital N
BMI groups			<0.001		
<18.5	32 (61.5)	20 (38.5)		1.25 (0.71-2.2)	2
18.5-25	1613 (66.8)	803 (33.2)		reference	84
25-30	3571 (70.9)	1466 (29.1)		0.82 (0.74-0.91)	144
30-35	2274 (74.3)	785 (25.7)		0.69 (0.62-0.77)	105
35-40	947 (75.8)	302 (24.2)		0.64 (0.55-0.74)	35
>40	486 (77.9)	138 (22.1)		0.57 (0.46-0.7)	18
Comorbidities					
COPD & respiratory insufficiency No	8147 (73.1)	3004 (26.9)	<0.001	reference	335
COPD & respiratory insufficiency Yes	976 (61.5)	612 (38.5)		1.7 (1.52-1.9)	60
Renal failure No	8904 (72.8)	3326 (27.2)	<0.001	reference	367
Renal failure Yes	219 (43)	290 (57)		3.55 (2.96-4.24)	28
Cardiovascular insufficiency No	9032 (72)	3514 (28)	<0.001	reference	384
Cardiovascular insufficiency Yes	91 (47.2)	102 (52.8)		2.88 (2.17-3.83)	11
Malignancy No	8970 (72.3)	3443 (27.7)	<0.001	reference	382
Malignancy Yes	153 (46.9)	173 (53.1)		2.95 (2.36-3.67)	13
Immunological insufficiency No	8466 (73.1)	3117 (26.9)	<0.001	reference	349
Immunological insufficiency Yes	657 (56.8)	499 (43.2)		2.06 (1.82-2.33)	46
Number of comorbidities			<0.001		
None	5870 (77.4)	1711 (22.6)		reference	214
1	2621 (67.6)	1256 (32.4)		1.63 (1.5-1.78)	121
>1	632 (49.3)	649 (50.7)		3.44 (3.04-3.89)	60
Diagnoses at ICU-admission					
Cardiopulmonary resuscitation No	9076 (72.1)	3513 (27.9)	<0.001	reference	391
Cardiopulmonary resuscitation Yes	47 (31.3)	103 (68.7)		5.66 (4.00-8.01)	4
Mechanical ventilation at admission No	6649 (74.3)	2302 (25.7)	<0.001	reference	291
Mechanical ventilation at admission Yes	2474 (65.3)	1314 (34.7)		1.53 (1.41-1.67)	104
Gastrointestinal bleeding No	9105 (71.6)	3604 (28.4)	0.212	reference	394
Gastrointestinal bleeding Yes	18 (60)	12 (40)		1.68 (0.81-3.5)	1
Diabetes No	7261 (73.6)	2607 (26.4)	<0.001	reference	304
Diabetes Yes	1862 (64.9)	1009 (35.1)		1.51 (1.38-1.65)	91
Diagnoses in 1st 24 hours of ICU-admission					
Acute renal failure No	8735 (73.6)	3141 (26.4)	<0.001	reference	367
Acute renal failure Yes	388 (45)	475 (55)		3.4 (2.96-3.92)	28
Mechanical ventilation within the 1st 24 hours No	3750 (78.1)	1053 (21.9)	<0.001	reference	167
Mechanical ventilation within the 1st 24 hours Yes	5373 (67.7)	2563 (32.3)		1.7 (1.56-1.85)	228
Confirmed infection No	1786 (71.9)	699 (28.1)	0.771	reference	101
Confirmed infection Yes	7337 (71.6)	2917 (28.4)		1.02 (0.92-1.12)	294
Vasoactive medication No	4874 (77.4)	1426 (22.6)	<0.001	reference	205
Vasoactive medication Yes	4249 (66)	2190 (34)		1.76 (1.63-1.91)	190

Kaplan Meier survival curve

In the figure below, one can see a first estimate of the percentage of COVID-19 episodes (the vertical axis) of which patients survived the hospitalisation, including a period in ICU, since the day of ICU admission until a certain moment in time (the horizontal axis). In the first figure a distinction has been made between all COVID-19 episodes (black line), the linked COVID-19 episodes (the red line) and the SARI patients from the years 2017-2019 (blue line). The second figure shows the linked COVID-19 episodes of which the patient has (dotted) or has not (solid) been mechanically ventilated at the first day of admission.
These estimations have to be interpreted with care, because the episodes of which the patient is currently being treated have been included in these analyses too and consequently their outcome is not yet known. Therefore, based on this figure we cannot conclude that COVID-19 patients have a better prognosis compared to the SARIs. The current group of COVID-19 episodes and the previous SARI patients possibly differ regarding important clinical characteristics such as age and secondary diseases such as diabetes or COPD. Further research could prove whether the survival chance differs between the COVID-19 and SARI population.





Aantal episoden at risk

Mech. ventilated in first 24 hrs	8164	7088	4588	2827	1847	1217	785
Not mech. ventilated in first 24 hrs	4970	3457	1643	946	619	446	320

Variations over time

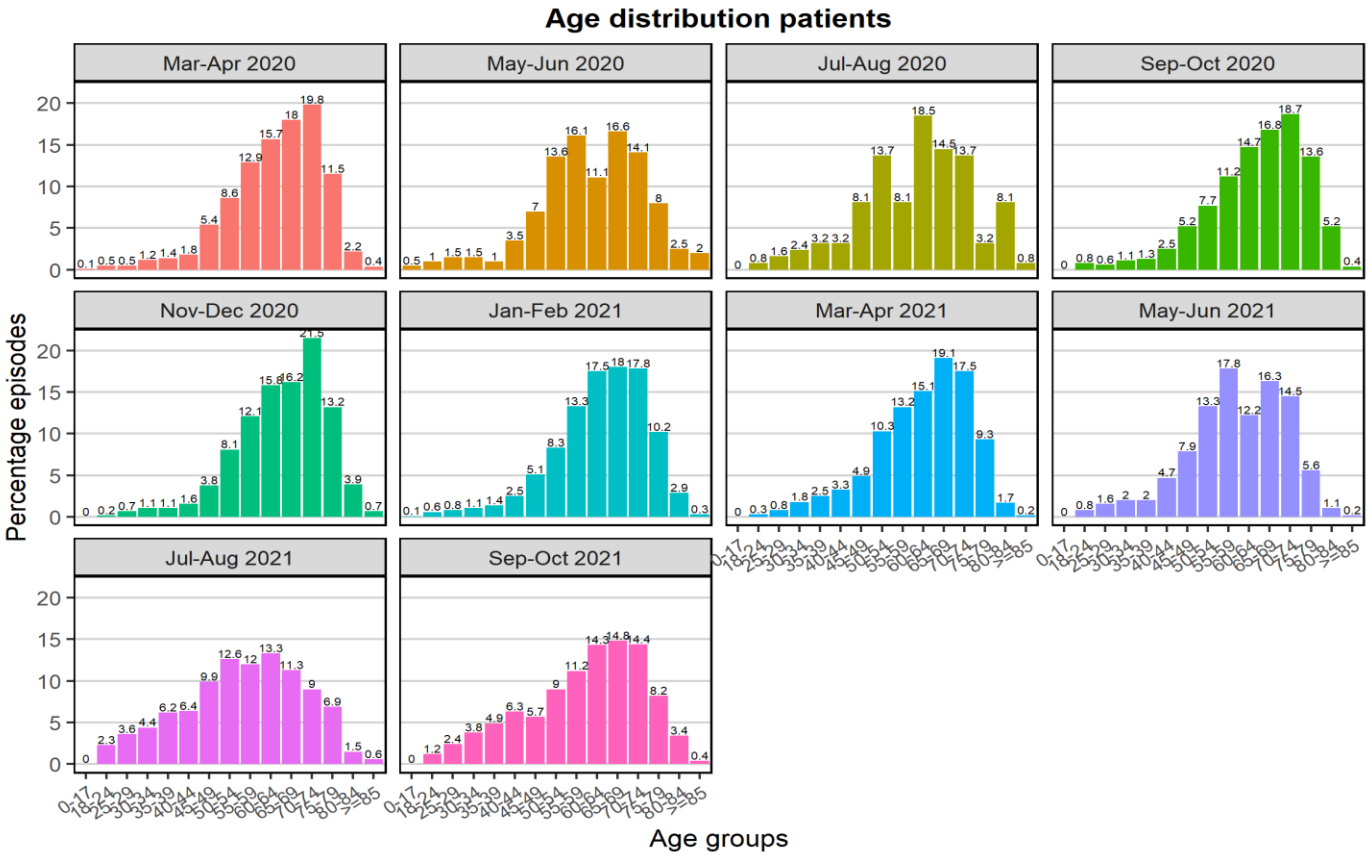
COVID-19 is a new clinical condition for which new knowledge is continuously being obtained, new treatment methods are used and as a result the prognoses / outcomes of the patients may change. To provide insight into these changes, the section below of the report will break down some important patient characteristics and outcomes into two-month periods of the COVID-19 epidemic.

The table below shows the number of COVID-19 episodes per two months.

	Number of episodes	**Number of episodes of which the patient is deceased (%) ***	**Number of episodes linked to clinical data (%)**
March-April 2020	2669	820 (30.7)	2601 (97.5)
Mei-June 2020	199	37 (18.6)	190 (95.5)
July-August 2020	124	30 (24.2)	118 (95.2)
Sept-Oct 2020	1422	468 (32.9)	1363 (95.9)
November-Dec 2020	2203	719 (32.6)	2092 (95.0)
Jan-Feb 2021	2020	563 (27.9)	1968 (97.4)
March-April 2021	2983	751 (25.2)	2855 (95.7)
Mei-June 2021	1122	226 (20.1)	1043 (93.0)
July-August 2021	724	140 (19.3)	543 (75.0)
Sept-Oct 2021	743	172 (23.1)	328 (44.1)

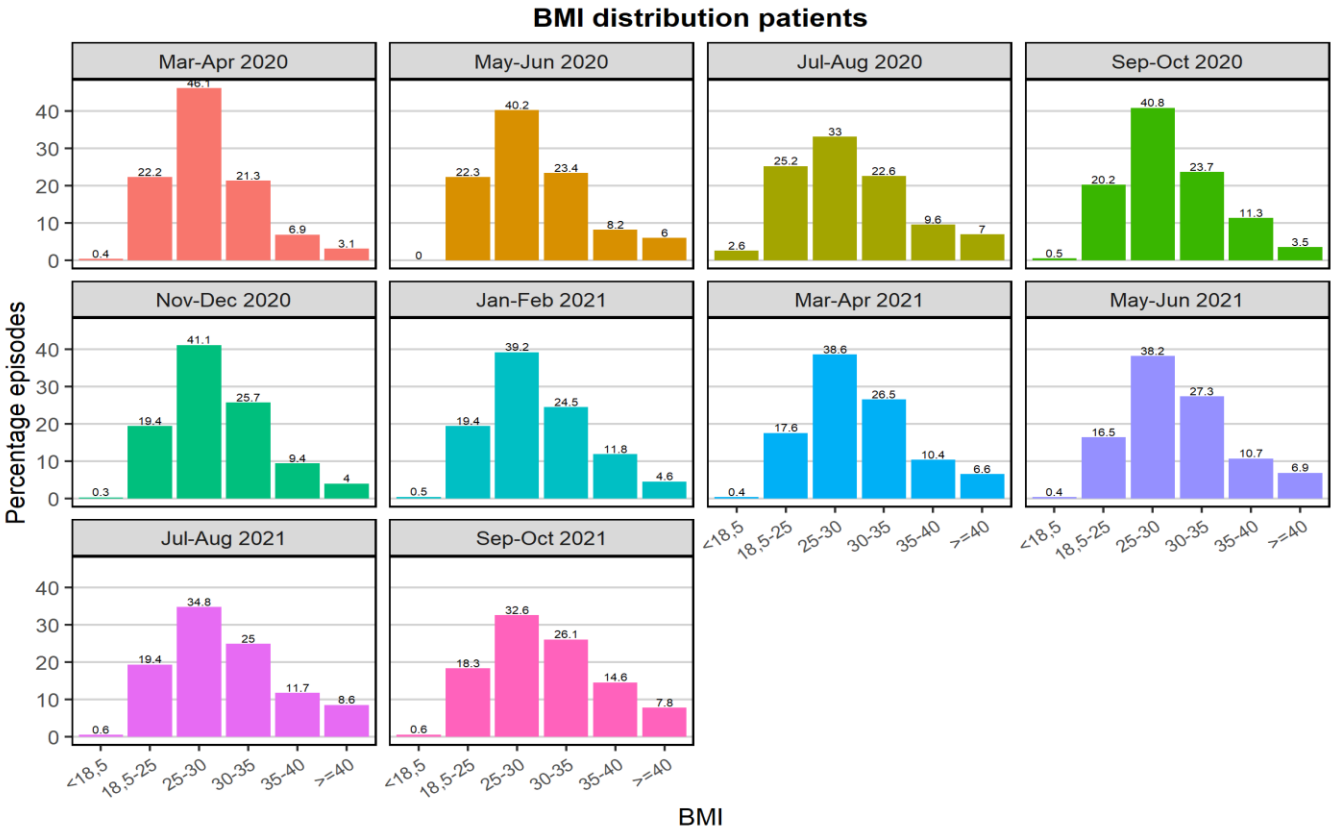
** Note a large proportion of patients of the episodes from the more recent periods are still hospitalized of which a part may still die, so the numbers can still rise (considerably).*

The figure and table below shows the age distribution of the patients from all COVID-19 episodes over different time periods.



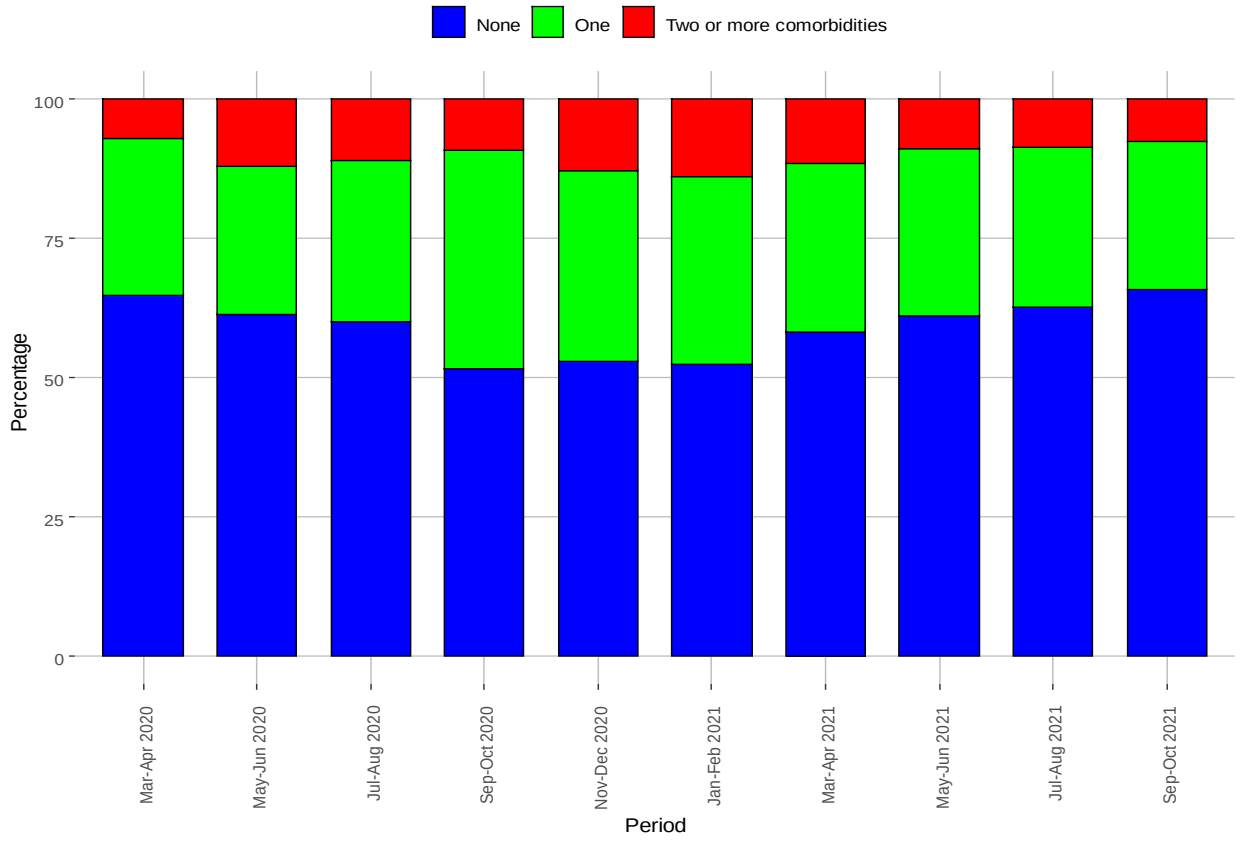
	Mean age (SD)	Median Age (IQR)
March-April 2020	63.4 (11.2)	65 (57-72)
May-June 2020	60.8 (13.1)	61 (53-70)
July-August 2020	60.3 (13.3)	64 (51-70)
Sept-Oct 2020	64.2 (11.9)	66 (57-73)
Nov-Dec 2020	64.7 (11.1)	66 (58-73)
Jan-Feb 2021	62.8 (11.5)	64 (57-71)
March-April 2021	61.9 (11.7)	64 (55-71)
May-June 2021	59.1 (12.0)	59 (52-69)
July-August 2021	55.1 (14.6)	56 (46-66)
Sept-Oct 2021	59.0 (14.4)	61 (50-70)

The figure and table below shows the BMI distribution of the patients of all COVID-19 episodes over different time periods.



	Mean BMI (SD)	Median BMI (IQR)
March-April 2020	28.7 (4.9)	27.8 (25.3-31.1)
May-June 2020	29.4 (5.7)	28.4 (25.3-32.2)
July-August 2020	29.4 (6.6)	28.0 (24.7-32.9)
Sept-Oct 2020	29.3 (5.3)	28.7 (25.6-32.0)
Nov-Dec 2020	29.4 (5.3)	28.4 (25.7-32.4)
Jan-Feb 2021	29.7 (5.6)	28.7 (25.8-32.8)
March-April 2021	30.1 (5.9)	29.1 (26.0-32.9)
May-June 2021	30.3 (6.0)	29.4 (26.1-33.3)
July-August 2021	30.3 (6.4)	29.3 (25.9-33.8)
Sept-Oct 2021	30.7 (6.8)	29.7 (26.3-34.0)

In the graph below, the percentage episodes of which the patients had no, one or more than one comorbidities are given for different periods.



**Note since the report of 2020-12-10 diabetes is also counted as a comorbidity, as a result of this the percentage episodes of which patients had no, one or more than one comorbidities may have increased compared to previous reports.*

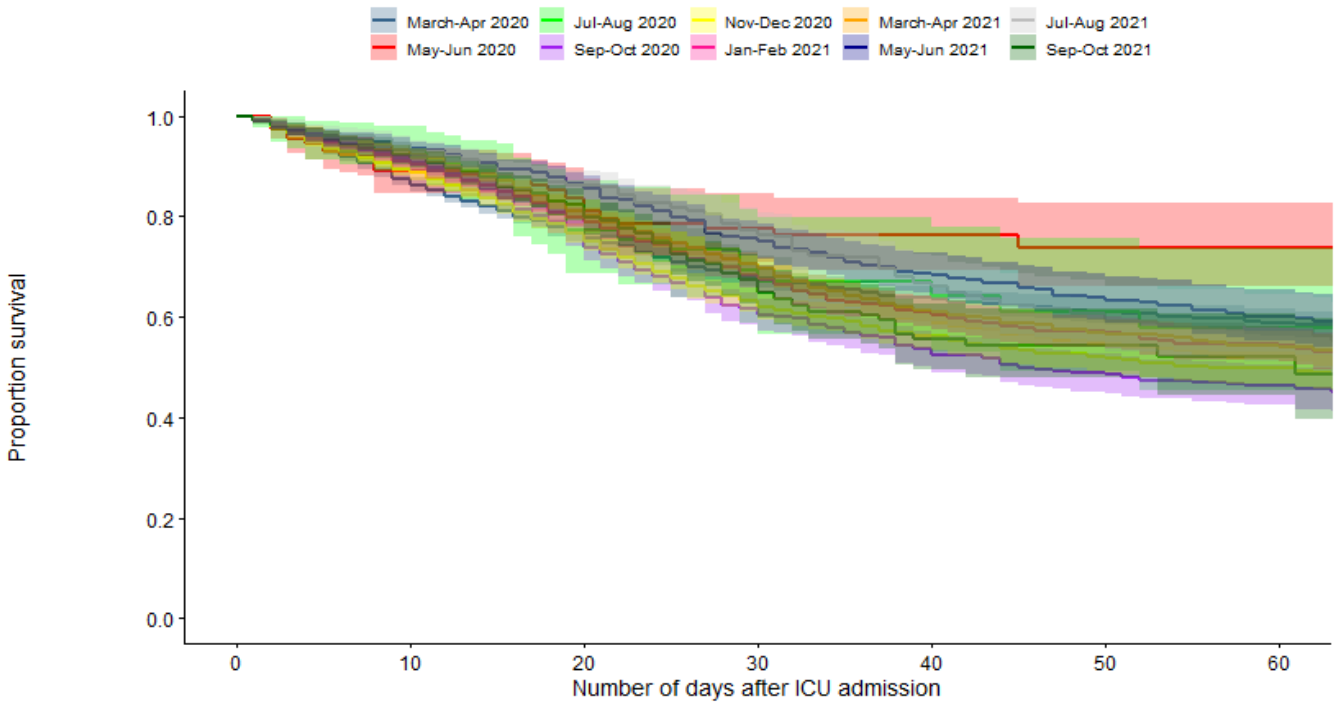
The table below shows per two months period the mean ICU length of stay of all COVID-19 episodes, of the COVID-19 episodes of which the patient is still in the ICU, and of COVID-19 episodes of which the patient has been discharged recently split up into different discharge destinations. If a patient has been transferred to another ICU during an episode, all ICU length of stays will be added up together. The length of stay is calculated in days ((discharge date - admission date)+1). Note that the most recent period still yields many uncertain results because a large part of this population is still included, so the averages shown will most likely increase.

	Number of episodes	**Mean length of ICU stay (SD)**
Period March-April 2020		
Patients who are currently being treated in the ICU *	0	-
Discharged to nursing ward in same or different hospital	1817	22 (17.4)
Other discharge destination	103	26.4 (33)
Died in the ICU	749	15.9 (18.4)
TOTAL	**2669**	**20.4 (18.8)**
Period May-June 2020		
Patients who are currently being treated in the ICU *	0	-
Discharged to nursing ward in same or different hospital	159	15.7 (14.9)
Other discharge destination	10	19.8 (32.4)
Died in the ICU	30	13.4 (10.4)
TOTAL	**199**	**15.5 (15.5)**
Period July-August 2020		
Patients who are currently being treated in the ICU *	0	-
Discharged to nursing ward in same or different hospital	95	13.5 (15.8)
Other discharge destination	7	22.7 (21.9)
Died in the ICU	22	16.6 (16.6)
TOTAL	**124**	**14.6 (16.3)**
Period Sept-Oct 2020		
Patients who are currently being treated in the ICU *	0	-
Discharged to nursing ward in same or different hospital	982	15.7 (17.6)
Other discharge destination	34	16.3 (19.0)
Died in the ICU	406	19.6 (14.0)
TOTAL	**1422**	**16.8 (16.8)**
Period Nov-Dec 2020		
Patients who are currently being treated in the ICU *	0	-
Discharged to nursing ward in same or different hospital	1514	16.7 (18.1)
Other discharge destination	63	16.4 (17.7)
Died in the ICU	626	18.1 (14.4)
TOTAL	**2203**	**17.1 (17.1)**
Period Jan-Feb 2021		
Patients who are currently being treated in the ICU *	0	-
Discharged to nursing ward in same or different hospital	1483	15.9 (16.6)
Other discharge destination	39	18.0 (21.0)
Died in the ICU	498	18.6 (15.2)
TOTAL	**2020**	**16.6 (16.4)**

	Number of episodes	Mean length of ICU stay (SD)
Period March-April 2021		
Patients who are currently being treated in the ICU *	0	-
Discharged to nursing ward in same or different hospital	2215	15.1 (16.1)
Other discharge destination	98	19.4 (27.2)
Died in the ICU	670	19.5 (14.3)
TOTAL	**2983**	**16.2 (16.3)**
Period May-June 2021		
Patients who are currently being treated in the ICU *	1	187 (NA)
Discharged to nursing ward in same or different hospital	872	14.9 (17.1)
Other discharge destination	49	21.3 (24.5)
Died in the ICU	200	19.4 (14.7)
TOTAL	**1122**	**16.2 (17.9)**
Period July-August 2021		
Patients who are currently being treated in the ICU *	2	96.5 (16.3)
Discharged to nursing ward in same or different hospital	555	13.6 (14.2)
Other discharge destination	39	18.2 (18.5)
Died in the ICU	128	20.2 (14.3)
TOTAL	**724**	**15.2 (15.3)**
Period Sept-Oct 2021		
Patients who are currently being treated in the ICU *	83	26.9 (9)
Discharged to nursing ward in same or different hospital	477	10.9 (9.1)
Other discharge destination	33	9.4 (10.7)
Died in the ICU	150	16.5 (10.2)
TOTAL	**743**	**13.8 (10.7)**

**N.B. For the COVID-19 episodes of which the patient is currently admitted, it concerns the ICU length of stay up till the moment that this report was generated and not the final total length of stay.*

The figure below shows an initial estimate per period of the percentage of COVID-19 episodes (the vertical axis) of which the patient survived hospitalization, including admission to the ICU, until a certain moment (the horizontal axis) after the start of the ICU admission.
These estimates must be interpreted with caution, because the patients who are currently being treated have also been included and the outcome of them is therefore not yet known.



Number of episodes at risk

March-Apr 2020	2669	2185	1495	959	628	395	240
May-Jun 2020	199	147	100	66	41	28	19
Jul-Aug 2020	124	95	44	33	24	18	13
Sep-Oct 2020	1422	1161	649	365	250	179	121
Nov-Dec 2020	2203	1738	1026	614	422	294	200
Jan-Feb 2021	2020	1606	940	566	379	255	178
March-Apr 2021	2983	2401	1315	794	507	341	229
May-Jun 2021	1122	896	494	308	197	147	106
Jul-Aug 2021	724	560	297	184	112	79	55
Sep-Oct 2021	743	589	329	133	48	25	17

The table below shows the (univariate) Odds Ratio (OR) of the two monthly periods. An OR shows approximately how much the risk of dying is increased in relation to the reference group, i.e. the months March and April. The 95% confidence interval of the OR indicates whether the relationship found between the period and mortality is significant (confidence interval includes 1 NOT) or not significant (confidence interval includes 1 DO). Note this is a univariate analysis meaning that no adjustment has been made for differences in patient characteristics over time. It is also important to realize that a large proportion of patients from the episodes of the more recent periods are still hospitalized. These are included in the calculations as survivors, while a part may still die, so that the odds ratio can still rise (considerably).

	Odds ratio (CI)
Period March-April 2020	Reference
Period May-June 2020	0.52 (0.36-0.74)
Period July-August 2020	0.72 (0.47-1.09)
Period Sept-Oct 2020	1.11 (0.96-1.27)
Period Nov-Dec 2020	1.09 (0.97-1.23)
Period Jan-Feb 2021	0.87 (0.77-0.99)
Period March-April 2021	0.76 (0.68-0.85)
Period May-June 2021	0.57 (0.48-0.67)
July-August 2021	0.54 (0.44-0.66)
Period Sept-Oct 2021	0.68 (0.56-0.82)

COVID-19 and SOFA

For this report, the data of the COVID-19 episodes are also linked to the information about organ failure that is supplied to NICE in the Sequential Organ Failure Assessment (SOFA) registration module. About half of the ICUs in the Netherlands register this SOFA data. In the table below, in addition to the number of COVID-19 episodes that could be linked to the clinical information, the number of COVID-19 episodes that could be linked to the SOFA data is shown.

	Number of COVID-19 episodes
Linked to clinical (MDS) data	13134
Linked to organ failure (SOFA) data	6757

The table below shows in how many COVID-19 episodes and how many SARI patients received treatment with different types of organ support. For the patients receiving the particular organ support it is also shown how many calendar days they received this support on average during the ICU admission. Finally, the average number of calendar days on which the measured platelet was <50 is shown.

	COVID-19 episodes N (%)	**Mean number of days (SE)**	**SARI patients N (%)**	**Mean number of days (SE)**
Basic respiratory support	4950 (73.3)	10.6 (11.9)	5126 (59.1)	6.5 (8.5)
Advanced respiratory support	32 (0.5)	4.4 (8.8)	169 (1.9)	3.7 (6.7)
Artificial liver support	1 (0)	1 (-)	0 (0)	-
Cardiac support using cardiac assist device	22 (0.3)	8.8 (16.9)	57 (0.7)	10.4 (14.3)
Renal support using renal replacement therapy	543 (8)	10.6 (10.7)	565 (6.5)	8.1 (9.4)
Measured platelets value <50	278 (4.1)	2.6 (3.8)	512 (5.9)	4.8 (5.6)