

Rapid Review Report

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Key Findings

- There is limited research examining COVID-19 ICU patients undergoing prolonged (>14 days) mechanical ventilation
- Rates of prolonged mechanical ventilation, defined as > 14 days, among COVID-19 ICU patients ranged from 16.7% to 33.3%.
- Overall, studies suggest that length of ICU stay range from 11 to 31 days and length of hospital stay range from 25 to 51 days among COVID-19 patients who have undergone prolonged mechanical ventilation.
- Following ICU discharge, patients are admitted to general wards, subacute nursing facilities, pneumological sub-intensive units, rehabilitation wards or long-term acute care.

Limitations

- Most studies reported on the mean/median days of mechanical ventilation
- Most articles did not report whether patients had underwent invasive versus non-invasive mechanical ventilation
- Most studies were observational in nature

- Most articles were single centre studies with small samples and did not report on long-term outcomes

Summative Statement – choose only one

<input type="checkbox"/> Mature evidence	<input type="checkbox"/> Emerging Supportive evidence
<input type="checkbox"/> Mixed evidence	<input checked="" type="checkbox"/> Weak evidence

Quality Assessment

Adequacy of Primary Studies

The review incorporated 30 observational studies, 26 of which were peer reviewed and 2 that was pre-print.

Methodological Limitations

A number of limitations among these articles should be noted. First, for the purposes of this review, prolonged mechanical ventilation was defined as mechanical ventilation that was > 14 days. However, most articles only reported the mean or median duration of mechanical ventilation. Therefore, the current review incorporated samples with individual participants who underwent fewer than 14 days of mechanical ventilation. Second, due to the nature of the studies, ascertainment bias, selection bias, and confounding were frequently reported. Third, given that most studies included single centred studies with small sample sizes, the generalizability of the findings is limited. Finally, most studies were limited to short-term follow-up and did not report on the long-term outcomes of patients.

Relevance/Generalizability

Almost all studies reported were limited to the first wave of the pandemic. Across studies, ICU interventions varied substantially, with some studies reporting on patient samples undergoing prone positioning, extracorporeal membrane oxygenation (ECMO), tracheotomy, and various trials of antiretroviral therapy. In total, 19 studies were single centre studies and 20 studies had small sample sizes less than 100. Therefore, the generalizability of the findings is limited to these local ICU settings.

Background/Context

The COVID-19 pandemic caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has a high rate of acute respiratory distress syndrome (ARDS). Most ARDS patients require admission to an intensive care unit (ICU) for mechanical ventilation (MV). A subset of these patients undergo prolonged (> 14 days) MV and require post ICU rehabilitation and supportive care. However, little is known about the rates of prolonged mechanical ventilation as well as the demand that these patients will place on in-patient hospital services following ICU discharge.

Purpose

Amidst increasing COVID-19 ICU admissions and patients requiring prolonged mechanical ventilation, the Saskatchewan Health Authority (SHA) must allocate healthcare resources for patients weaning off prolonged mechanical ventilation. Therefore, this review seeks to understand the rates and outcomes of patients requiring prolonged mechanical ventilation to guide healthcare resource allocation decisions in the province

Review Question(s)

- What is the rate of prolonged (>14 days) invasive mechanical ventilation among COVID-19 ICU Patients?
- What is the length of hospital stay among COVID-19 ICU Patients who have undergone prolonged (>14 days) invasive mechanical ventilation?
- What in-patient hospital resources are these patients using following discharge from ICU?

Method

For each Rapid Review, the initial question is posed by a decision-maker in the health care system seeking the evidence base for a specific policy decision. According to the subject of the question, the COVID Evidence Support Team (CEST) Intake Committee allocates the question to the appropriate Working Group. Each Working Group may be comprised of a librarian, researcher, 1-2 clinicians, 1-2 subject matter experts, and a group leader. A reference interview is conducted to establish the parameters of the question to ensure it is articulated in a clear, searchable manner. The librarians assigned to the team then conduct a thorough search of the indexed literature, grey literature, news sources, or other sources as agreed upon. Some reference lists for especially pertinent articles are also reviewed. An Evidence Search Report is thereby created. See Appendix for more details on the search strategy. A Rapid Review of the identified literature is then performed by the researcher using the approach of a systematic review, but without a double review, formal assessment of quality of reported study, or meta-analysis. Importantly, the review is completed in a time-sensitive manner. Relevant evidence is summarized in both tabular and narrative form, key findings and limitations articulated, and the quality of the body of evidence evaluated using a four-point grading system that assesses the methodologies, adequacy of the included studies, the direct relevance to the question and the generalizability of the findings related to the question. The draft Rapid Review Report is reviewed and edited by the Working Group clinicians, experts, and leader. Once revisions are complete, the Rapid Review is submitted to the requesting decision-maker and placed in the COVID-19 repository and database. For certain topics with rapidly changing evidence, after a period of time an updated evidence search is performed, the review process repeated, and an updated Rapid Review released.

Summary of Evidence

Rates of Prolonged (> 14 days) Mechanical Ventilation Among COVID-19 ICU Patients

Within the existing research literature, few studies have examined the rates of prolonged mechanical ventilation among patients with COVID-19 in ICU settings. Among 61 mechanically ventilated ICU patients who received prone positioning in Colorado, 7 (16.7%) patients remained on mechanical ventilation in long-term acute care¹. Similarly, Fiacchini and colleagues² found that among 98 ICU patients, 30 (30.6%) underwent prolonged (≥ 14 days) invasive mechanical ventilation in an ICU in Italy. Among a sample of 12 patients who were admitted to two American ICUs, 4 (33.3%) underwent prolonged mechanical ventilation³. Additionally, a single centre study in the United States found that among a sample of 742 ICU patients, 72 (9.7%) were still under invasive mechanical ventilation during one-month follow-up⁴. These preliminary findings suggest that the rate of prolonged mechanical ventilation varies substantially across patient populations, hospital centres, and geographical areas.

Length of ICU Stay Among COVID-19 ICU Patients Undergoing Prolonged Mechanical Ventilation

In the current review, several studies reported the length of ICU stay among patients who have undergone prolonged mechanical ventilation. In total, 13 studies outlined the duration of ICU stay among patients undergoing prolonged mechanical ventilation. The mean or median duration of ICU stay ranged from 11 days to 31 days^{5,6,7,8,9,10,11,12,13,14,15,16,27}. Of these studies, 2 studies reported a mean/median length of ICU stay between 11-15 days,^{9,16} 4 studies reported a mean/median length of ICU stay between 16-20 days,^{7,8,15,27} 3 studies reported a mean/median length of ICU stay between 21-25 days,^{16,11,13,14} 2 studies reported a mean/median duration of ICU stay between 26-30 days,^{5,12} and 1 study reported a median ICU stay of 31 days¹⁰. Overall, patients who had required extracorporeal membrane oxygenation (ECMO) or tracheotomy tended to report longer duration of ICU stay^{5,10,12,13}.

Length of Hospital Stay Among COVID-19 Patients Undergoing Prolonged Mechanical Ventilation

Within the current literature, a number of studies reported the length of hospital stay among patients who had undergone prolonged mechanical ventilation. In total 11 studies outlined the duration of hospital stay among samples of prolonged mechanically ventilated patients. The mean/median duration of hospital stay ranged from 25 to 51 days^{5,6,9,10,15,17,18,19,20,21,22}. Of these studies, 3 studies reported a mean/median duration of hospital stay between 25-29 days,^{11,15,21} 3 studies reported a mean/median duration of hospital stay between 30-34 days,^{9,18,22} 3 studies reported a mean/median duration of hospital stay between 35-39 days,^{6,17,20} 2 studies reported a mean/median duration of hospital stay between 40-45 days,^{5,10}, and 1 study reported a mean duration of hospital stay of 51 days¹⁹. Similarly, patients who underwent ECMO or tracheotomy tended to report longer duration of hospital stay^{5,10,19}. Importantly another study of 110 adult patients who underwent prolonged mechanical ventilation found that the patients were discharged from hospital after a median of 11 days (IQR: 6-18) after being discharged from ICU¹⁴. However, Breik and colleagues²⁰ found that among 100 patients who underwent prolonged mechanical ventilation in a British ICU found that all surviving patients were successfully discharged from hospital after 60 days.

Post ICU Discharge and Transfers Among COVID-19 ICU Patients Undergoing Prolonged Mechanical Ventilation

Studies reported considerable variation in post ICU transfers and discharges following prolonged mechanical ventilation. Among a sample of 43 survivors who underwent prolonged mechanical ventilation and prone positioning, 23 (37.7%) were discharged to home, 11 (18.1%) were discharged to a long-term acute care hospital/rehabilitation or subacute nursing facility and 16.7% maintained mechanical ventilation in long-term acute care¹. Among a sample of 23 patients admitted to an ICU in Venice found that 5 (22%) patients remained in the ICU, 3 (13%) were transferred to the pneumological sub-intensive unit, and 6 (26%) were decannulated and discharged after a median follow-up of 50 days (IQR, 30.0–71.0 days)¹². Among another a sample of 144 patients admitted to an ICU and underwent tracheotomies in New York city, 54 patients (81%) had been transferred out of the ICU to floor or stepdown beds at a median postoperative time of 10 days (range 2–29). Twenty-two patients (33%) were discharged home or to a rehabilitation center at a median of 22 days postoperatively (range 14–38)²³. Similarly, among 23 tracheotomised patients who underwent prolonged mechanical ventilation, 9 patients (39%) died, 5 (22%) were receiving invasive mechanical ventilation in the ICU, 3 (13%) were discharged from the ICU and are in the pneumological sub-intensive unit, and 6 (26%) had been discharged after a median follow-up of 50 days¹².

Post ICU In-Patient Rehabilitation Service Needs Among COVID-19 Patients Undergoing Prolonged Mechanical Ventilation

A small number of studies discussed the in-patient rehabilitation service needs of patients who had undergone prolonged mechanical ventilation. One study of 110 patients admitted to an ICU and underwent prolonged mechanical ventilation found that 8 (7%) patients required ongoing in-patient rehabilitation, 46 (42%) patients required further rehabilitation at home and 55 (50%) patients were discharged home without requiring further rehabilitation¹⁴. One study of 7 males who underwent prolonged mechanical ventilation in an Italian ICU found that 6 patients (85.7%) still required mechanical ventilation support upon admission to in-patient rehabilitation²⁴. Another case study found that one participant required 2–3 l/minute of supplement oxygenation upon admission to in-patient rehabilitation service²⁹. Importantly, Pancera and colleagues²⁴ reported that all patients required isolation in a special COVID-19 unit for 6–22 days upon admission to in-patient rehabilitation services. Rehabilitation services included physical therapy^{24,26}, pulmonary rehabilitation²⁴, and speech and language pathology²⁶. Physical therapy focused on breathing mechanics, secretion clearance, posture, sitting balance and upper and lower extremity strengthening^{22,26}. Physical rehabilitation treatments included passive or active range of motion exercises and neuromuscular electrical stimulation¹⁵. Speech and language pathology interventions focused on cognitive reorganization, verbal and nonverbal communication, secretion management and swallowing function²⁶. Studies reported that the number of treatment sessions patients received ranged from 2–24 over the course of 13–27 days^{15,24}. Importantly, one study found that, older patients ($P = 0.012$), as well as those who were frail ($P = 0.031$) or had a higher Charlson Comorbidity Index ($P = 0.017$), were significantly more likely to require longer rehabilitation¹⁴.

Conclusions

Within the existing literature, there was a paucity of studies examining COVID-19 ICU patients undergoing prolonged mechanical ventilation. Rates of prolonged mechanical ventilation among COVID-19 ICU patients ranged from 16.7% to 33.3%. Overall, studies suggest that length of ICU stay range from 11 to 31 days and length of hospital stay range from 25 to 51 days among COVID-19 patients who have undergone prolonged mechanical ventilation. Following ICU discharge, research shows that patients are admitted to general wards, subacute nursing facilities, pneumological sub-intensive units, rehabilitation wards or long-term acute care. Patients admitted to rehabilitation wards may require ongoing mechanical ventilation, supplement oxygenation and isolation in special COVID-19 units. In-patient rehabilitation service needs included physical therapy, pulmonary rehabilitation and speech and language pathology. Studies reported that the number of treatment sessions that patients attended ranged from 2–24 treatment

sessions across 13-27 days. Importantly older patients, frail patients, and patients with more comorbidities are more likely to require longer in-patient rehabilitation services.

Glossary

ICU – Intensive care unit

COVID-19 – Coronavirus disease 2019

ECMO – Extracorporeal membrane oxygenation

ARDS – Acute respiratory distress syndrome

Table 1: Summary of Literature

Ref	Sample	Method	Rate of Prolonged Invasive Mechanical Ventilation among COVID-19 ICU Patients	Length of Hospital Stay among COVID-19 ICU Patients Receiving Prolonged Mechanical Ventilation	Post ICU In-Patient Hospital Resource Utilization among COVID-19 Patients Undergoing Prolonged Mechanical Ventilation	Quality of Study/Limitations
5	64 patients with COVID-19 who underwent tracheotomy between April 1 st and May 19 ^h 2020 at two tertiary care hospitals in Brox, New York	Retrospective observational cohort study	Overall, the median duration of mechanical ventilation was 40.5 days (n = 30; IQR: 31.0 = 47.0).	Overall, the median length of ICU stay was 27.5 days (n = 52; IQR: 22.0-34.0) and the median length of hospital stay was 43 days (n = 42; IQR: 37.0-50.0). The average hospital LOS was significantly (P < .001) lower among non-survivors (37.0 days, IQR 27.0–43.0) than survivors (50.0 days, IQR 44.0–50.0).	Not reported.	Peer reviewed Selection bias Small sample size Short follow-up period
1	61 patients mechanically ventilated patients who received prone position ventilation for COVID-19 in an ICU in Denver, Colorado in between March 1 st and May 30 th 2020	Retrospective single centre study	Media duration of mechanical ventilation was 15.6 days (10.5 – 2.6 days).	Of the 42 survivors, 8 (13.1%) remained hospitalized.	Of the 42 survivors, 23 (37.7%) were discharged to home, 11 (18.1%) were discharged to a long-term acute care hospital/rehabilitation or subacute nursing facility and 16.7% maintained mechanical ventilation in long-term acute care.	Peer reviewed Single centre Single centre study
17	53 patients with COVID-19 who were admitted to ICU and underwent	Prospective single-system multi-centre observational cohort study	The average time of intubation before tracheostomy, defined as the time from first intubation to	At the time of manuscript preparation, 16 patients (30.2%) patients have been discharged alive (Figure 2). Of these patients, the	Not reported	Peer reviewed No randomization Small sample size

	tracheotomy within 5 hospitals within the University of Pennsylvania Health System		tracheostomy, was 19.7 days 6.9 days, with a range of 8–42 days.	average hospital length of stay was 37.2 days (range 18–51 days)		
27	391 patients from fifteen COVID-19 dedicated Italian ICUs who underwent invasive mechanical ventilation in between February 22 nd and May 4 th 2020	Prospective multicentre observational study	Overall, the mean duration of mechanical ventilation was 16 days (range 10 – 27). During the period of observation, liberation from mechanical ventilation was achieved in 208 patients (53.2%) after a mean duration of MV of 14 days (range 9-19 days).	Overall, the mean length of ICU stay was 20 days (range 13 – 32).	Not reported	Peer reviewed Lack of standardized procedures across centres Use of different experimental COVID-19 therapies across centres
6	159 patients with COVID-19 who were admitted to ICU in Madrid Spain in between March and April 2020	Prospective observational study	During ICU stay, 88% of patients needed mechanical ventilation, with an average time of 15 days (8-25),	The ICU mortality was 38%, with mean stay of 24 days (10-32). In-hospital mortality was 40%, with mean stay of 36 days (17-53	Not reported	Not peer reviewed Conference presentation
7	36 patients with COVID-19 who were admitted to an ICU in a hospital in Northern Portugal in between March 15 th and May 10 th 2020	Retrospective observational cohort study	Overall, 86.1% of patients required invasive mechanical ventilation, with a median duration of 17 days [8-24]	Median ICU stay was 16 days [7.0-23.5]. At the time of analysis, 9 (25.0%) patients died, 17 (47.2%) remained in hospital, 1 (2.8%) patient remained in the ICU and only 9 (25.0%) patients were discharged from the hospital.	Not reported	Not peer reviewed Small sample size
8	223 critically ill patients with	A multicentre retrospective	Overall, 75% of patients required invasive	Overall, the mean duration of ICU among patients	Not reported	Peer reviewed

	COVID-19 who were admitted to the ICU in 1 of 15 hospitals in Hamburg, Germany between February and June 2020	observational cohort study	mechanical ventilation and The median duration of invasive mechanical ventilation was 15 days (8-25 days).	undergoing mechanical ventilation was 18 days (Range 9 – 27.5 days).		Incomplete laboratory data on certain patients Different therapeutic management strategies between hospitals
18	81 patients with COVID-19 who underwent tracheotomy in between March 21 st and May 20 th 2020	Prospective single centre observational study	The median (interquartile range) duration of invasive mechanical ventilation prior to tracheostomy was 16 (13–20) days. The median (interquartile range) follow-up time was 32 (23–40) days post-tracheostomy insertion. Sixty-five patients (86.7 per cent) had been liberated from invasive mechanical ventilation, with a median (interquartile range) post-tracheostomy duration of ventilation of 12 (7–16) days.	Moreover, 44 (68.7 per cent) had been successfully discharged from hospital in a median (interquartile range) duration of 32 (25–39) days.	Not reported	Peer reviewed Single centre Small sample size
4	156 patients with COVID-19 admitted to a large ICU in the UK in between March to May with follow up occurring in June 2020	Prospective observational cohort study	Of the 156 ICU patients, 136 (87%) received mechanical ventilation, with this occurring less than one hour after IUC admission in 104 (67%) patients. Fifty-two (38% of those intubated)	Not reported	Not reported	Peer reviewed Single centre ICU admission criteria may have influenced ICU patient outcomes

			patients ultimately underwent tracheostomy insertion to facilitate weaning from the ventilator; this occurred a median (IQR) of 15.8 days (12.6 to 21) after ICU admission. By June, 3 (2%) of patients were still in ICU.			
2	30 patients with COVID-19 with severe respiratory failure who underwent prolonged (≥ 14 days) invasive mechanical ventilation in between March 1 st to May 31 st 2020 in an Italian tertiary hospital.	Retrospective cohort study	Among the 98 patients admitted to ICU, 11 (29.7%) underwent prolonged (≥ 14 days) invasive mechanical ventilation.	Not reported	Not reported	Peer reviewed Single centre Short follow-up time Unable to take and analyze tracheal tissue samples
19	37 COVID-19 patients requiring ICU care in between February 27 th and May 20 th 2020 in a tertiary university hospital in Spain	Observational cohort study	In total, 30 patients (81.1%) were intubated and put on mechanical ventilation. Of those patients, 11 (36.7%) required a tracheostomy due to prolonged mechanical ventilation. In tracheostomy patients, length of time on MV was 27.70 ± 9.79 days.	In tracheostomy patients, the duration of hospitalization was 51.40 ± 10.96 days (30.91 ± 10.24 days at ICU).	Not reported	Peer reviewed Single centre Small sample size

9	28 adult patients admitted to a pediatric intensive care unit between April and June 2020 in Boston	Retrospective cohort study	In total, 24 (85.7%) patients required mechanical ventilation. The median duration of mechanical ventilation was 18 days (IQR 14-21 days).	In total, the median length of ICU stay was 11 days (4.3-18.8 days) and the median length of hospital stay was 34 days (IQR: 19.4-45.5 days)	Not reported	Peer reviewed Single centre study Small sample size
10	37 patients with COVID-19 who received mechanical ventilation and venovenous (VV) extracorporeal membrane oxygenation (ECMO) in ICU at 4 hospitals within a large health care system between March 1 st and June 28 th 2020 in Texas, United States Shih et al., 2019	Retrospective observational study	Among the 21 patients who survived to hospital discharge, the median duration of continuous ventilation was 35 days (IQR: 21.5 – 47 days).	Overall, the median ICU length of stay was 31 days (IQR: 24—51.5 days) and the median hospital length of stay was 44 days (IQR: 31-62 days)	Of those discharged, 12 (57%) patients were discharged to a long-term care or rehabilitation facility, 2 (10%) patients were transferred back to the referring hospital for ventilator weaning, and 7 (33%) were discharged directly home.	Peer reviewed Small sample size No long-term follow-up
					<pre> graph TD A["Initiated on ECMO (n = 37)"] --> B["Decannulated from ECMO (n = 24)"] A --> C["Withdrawal of Care on ECMO (n = 14)"] B --> D["Discharged Alive (n = 21)"] B --> E["Death prior to Discharge (n = 3)"] D --> F["LTAC/Rehab (n = 12)"] D --> G["Transfer back to referring hospital (n = 2)"] D --> H["Home (n = 7)"] F --> I["Home from facility (n = 2)"] </pre>	
23	144 patients with COVID-19 who were admitted to ICU and remained on mechanical ventilation for more than 14 days in a major medical	Prospective observational study	Entire sample	Not reported	During the study period, 67 consecutive patients underwent tracheostomy. At the time of review, 54 patients (81%) had been transferred out of the ICU to floor or stepdown beds at a median	Peer reviewed Single centre Selection bias No randomization

	center in New York City between April 4 th and April 30 th 2020				postoperative time of 10 days (range 2–29). Twenty-two patients (33%) were discharged home or to a rehabilitation center at a median of 22 days postoperatively (range 14–38).	Small sample size
20	100 COVID-19 patients who required mechanical ventilation who underwent tracheostomy at Queen Elizabeth Hospital, England between March 9 th and April 21 st 2020.	Prospective observational cohort study	The average number of ventilator days was 22.9 (± 6.7) among patients who underwent tracheostomy.	All surviving patients were successfully discharged from hospital at 60 days. The mean overall length of hospital stay for surviving patients was 34 (± 8.9) days.	Not reported	Peer reviewed Single centre Non-randomized
11	94 patients with COVID-19 who were admitted to ICU and received mechanical ventilation in between February 28 th and June 30 th 2020 at a hospital in Genova, Italy	Observational study of prospectively collected data	The mean number of mechanical ventilation days was 20.0 \pm 16.3.	Overall the mean length of ICU stay was 21.51 \pm 20.14 days and the mean length of hospital stay was 28.00 \pm 23.00 days.	Not reported	Peer reviewed Single centre Small sample size
12	23 patients with COVI-19 admitted to ICU and underwent tracheostomy at two hospitals	Retrospective cohort study	The mean time that the patients were mechanically ventilated was 29 days	Mean time in ICU was 27 days. After a median follow-up of 50 days (IQR, 30.0–71.0 days), 9 patients (39%) died, 5 (22%) were receiving invasive	Not reported	Peer reviewed Single centre Small sample size

	located in Venice Italy in between February 22 nd and April 26 th 2020V			mechanical ventilation in the ICU, 3 (13%) were discharged from the ICU and are in the pneumological sub-intensive unit, and 6 (26%) were decannulated and discharged.		Short-term follow-up
13	13 patients with COVID-19 who received mechanical ventilation and ECMO at an ICU in Washington in between March 23 rd and April 29 th 2020	Retrospective observational study	The average duration of mechanical ventilation was 22.6 days (IQR: 14.7 – 35.4 days).	Duration of ICU length of stay was 25.3 days (IQR: 16.0 – 42.7 days).	Not reported	Peer reviewed Single centre study Did not adjust for confounding Short study period
24	7 males (age 37-61 years) with COVID-19 who were admitted to ICU and were referred for inpatient rehabilitation following ICU stay in a hospital in Italy in between March and April 2020	Case series study	Patients were admitted to ICU for 14-22 days and received mechanical ventilation	Not reported	On admission, six patients were still supported by mechanical ventilation. All patients were first placed in isolation in a special COVID unit for 6–22days. Patients attended 11–24 treatment sessions for the duration of rehabilitation stay (13–27days), including 6–20 sessions in the COVID unit. The treatment included pulmonary and physical rehabilitation. The initially non-ventilated patient was discharged prematurely due to gallbladder problems, whereas all six mechanically	Peer reviewed Single centre Retrospective and descriptive in nature Outcomes at baseline were simple tests

					ventilated patients were successfully weaned off before transfer to a COVID free unit where they stayed for 7–19days.	
21	164 patients with COVID-19 that were admitted to ICU and underwent mechanical ventilation within the Inova Health System in Northern Virginia between March 5 th and April 26 th 2020. Outcomes were assess on August 9 th 2020.	Retrospective observational study	The mean duration of ventilation support for survivors was 14.6 days (± 12 days; range 1-59 days).	The mean length of hospital stay for patients discharged alive was 24.5 days (± 14.8 SD) (Range: 7–86 days)	Not reported	Peer reviewed Study may not be generalizable to other health systems
28	A 72-year-old male cruise ship employee with a past medical history of coronary artery disease, chronic kidney disease, diabetes mellitus type II, and hypertension was brought to the Emergency Department (ED) with 5 days of worsening shortness of breath,	Case study	Duration of mechanical ventilation was 24 days.	Not reported	On day 24 of hospitalization, the patient was extubated. At that time, he was downgraded from ICU status and remained on a venturi mask with oxygen saturation of 94–92%. At day 30 of hospitalization, he was still alive.	Peer reviewed Single participant case study

	dry cough and fever					
28	A 51-year old healthy female who developed ARDS COVID-19 bilateral pneumonia while vacationing in Colorado.	Case study	Duration of mechanical ventilation was 17 days	Not reported	The patient was discharged to a rehabilitation facility on hospital day 28 requiring 2–3 l/minute of supplement oxygen which was weaned to room air within the week. Two repeat COVID-19 tests were negative for SARSCoV-2 prior to discharge from the hospital. At discharge, she was weak but able to stand and walk short distances and had an otherwise normal neurologic examination.	Peer reviewed Single participant case study
3	12 patients with COVID-19 who were admitted to ICU and received intravenous immunoglobulin (IVIG) at 2 hospitals in the USA in between March and July 2020	Retrospective case study	Four patients underwent prolonged mechanical ventilation	<p><u>Case 3</u> Case 3 was on mechanical ventilation for 49 days. He was removed from mechanical ventilation on day 51 and weaned off oxygen on day 53. The patient was discharged home ambulating on his own and breathing room air on day 60.</p> <p><u>Case 7</u> Case 7 was on mechanical ventilation for 53 days. His ensuing hospital course was complicated by Enterococcus faecalis bacteremia, Acinetobacter pneumonia, and Candida parapsilosis fungemia. He received a tracheostomy on hospital day 42 and was transferred from the ICU to the floor. He continued to be COVID-19 positive by nucleic acid amplification for 46 days. . Interestingly, he became COVID-19 test negative on hospital day 53, improved clinically, and was transferred back to the medical floor. . He was discharged to a rehabilitation facility on hospital day 56.</p>	Peer reviewed Small sample size	

				<p><u>Case 8</u> Case 8 was on mechanical ventilation for 40 days. On hospital day 32, she was given IVIG for 4 days at 0.2 g/kg. Following IVIG administration, the patient's condition improved. She was extubated on hospital day 39. She was discharged approximately 2 weeks later.</p> <p><u>Case 10</u> Case 10 was on mechanical ventilation for 23 days. Following IVIG administration, the patient's clinical course slowly improved. He was extubated 12 days following IVIG therapy. He continued to improve and was discharged approximately 1 month later.</p>		
14	110 adults with COVID-19 who were admitted to the ICU and underwent mechanical ventilation for more than 24 hours	<p>Single centre, prospective, non-interventional observational study</p> <p>Rehabilitation status was measured daily using the Manchester Mobility Score (MMS) to identify the time taken to first mobilize (defined as sitting on the edge of the bed or higher) and highest level of</p>	While on ICU, patients required prolonged periods of mechanical ventilation (mean 19±10 days) (range: 2–59).	In total, the mean length of stay in the ICU was 22.6 days. Patients were discharged from the hospital a median of 11 days (IQR: 6–18) after being discharged from the ICU.	<p>Fifty-five (50%) patients were discharged home without requiring further rehabilitation, whereas 46 (42%) required further rehabilitation at home, and 8 (7%) required ongoing inpatient rehabilitation. At the time of hospital discharge, the majority of patients were able to step transfer or walk (MMS of 51), with 83% scoring 7 points on the MMS and therefore able to walk .30 m independently. The four (4%) patients with MMS scores of less than five were all discharged for ongoing inpatient rehabilitation.</p> <p>The time taken to first</p>	<p>Peer reviewed</p> <p>Length of mechanical ventilation not specified</p> <p>Single centre study</p> <p>Limited rehabilitation information was collected</p>

		<p>mobility achieved at ICU discharge</p>			<p>mobilize was found to increase significantly with BMI, from a mean of 10 days to 18 days (P , 0.001) for those with BMI of 20–24 versus 401 kg/m2. At the time of ICU discharge, MMS scores were found be significantly lower in patients with a higher frailty score at admission (P = 0.033) and in those with pre-existing cardiovascular disease (P = 0.019). In those that were discharged from hospital, older patients (P = 0.012), as well as those who were frail (P = 0.031) or had a higher Charlson Comorbidity Index (P = 0.017), were significantly more likely to require further rehabilitation. This may provide a framework for identifying high-risk patients who would require more robust pathways of rehabilitation following discharge from ICU. Given the high proportion of patients with a raised BMI (87% were 25+ kg/m2), workforce planning for any future surges and ongoing rehabilitation would need to factor this increased</p>	
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					dependency.	
15	35 patients with COVID-19 who were admitted to an ICU in Helsinki, Finland	Observational study	Among the 18 patients enrolled in the rehabilitation program, the median number of invasive mechanical ventilation days among patients who underwent rehabilitation was 17 days (IQR: 9- 23 days; Range: 1-19 days).	Overall, the median length of stay in ICU among patients undergoing rehabilitation (n = 18) was 16 days (IQR: 5 – 25 days; Range: 2 – 30 days). The median length of hospital stay among patients undergoing rehabilitation was 27 days (IQR: 8 – 33 days; Range: 6 – 52 days).	The rehabilitation program consisted of passive or active range of motion exercises and neuromuscular electrical stimulation in addition to standard intensive care. Median number of sessions was 6 (IQR=8, min-max=2-14). The results did not support the beneficial effects of early rehabilitation in intensive care unit on improving muscle strength	Pre print Small sample size
26	6 patients with COVID-19 who underwent tracheotomy in an ICU and received in-patient physical therapy and speech language pathology	Retrospective case series	All patients had undergone mechanical ventilation for 14 days of longer	Not reported	All patients had been discharged from intensive care to a medical unit. For all patients, physiotherapy interventions focused on breathing mechanics, secretion clearance, posture, sitting balance, and upper and lower extremity strengthening. Speech language pathology interventions focused on cognitive reorganization, verbal and nonverbal communication, secretion management, and swallowing function. Intensity and duration of the sessions were adapted according to patient response and level of fatigue.	Peer reviewed Small sample size

					Regarding time to achieve functional PT and SLP milestones, all patients achieved upright sitting with PT prior to achieving initial SLP milestone of voicing with finger occlusion. Variations in progression to swallowing trials were patient specific and due to respiratory instability, cognitive deficits, and limitations in production of an effortful swallow. Patient participation in therapy sessions improved following establishment of oral verbal communication.	
16	51 patients with COVID-19 who were admitted to ICU in between February 24 th and April 15 th 2020 in Strasbourg France	Descriptive study	The median duration of mechanical ventilation was 17 days [IQR (1; 31)].	The median length of stay in ICU was 15 days [IQR (2;30)].	It is expected that this altered state of health will result in a post-intensive care syndrome with intensive care unit-acquired weakness (ICUAW) and difficulties to wean the patient from mechanical ventilation. It was estimated that the need for APRC and follow-up care were respectively 40 per 100,000.	Not peer reviewed
22	A single 65 year old man with COVID-19 who was admitted to ICU	Case study	The patient was intubated for 18 days.	The patient was discharged after 34 days once he met all the physical function milestones.	Rehabilitation began on day 6. The initial rehabilitation program focused on positioning and postural drainage. The patient was extubated on day 19 and	Pre print Single participant case study

					began standing and stepping on the same day. Gait exercises began on day 22 and endurance training exercises began on day 28.	
30	A 39 year old male patient with COVID-19 who was admitted to ICU and underwent mechanical ventilation in a hospital in Sinapore	Case study	The patient was intubated for a total of 67 days	Not reported	He was later transferred to an inpatient rehabilitation unit at day 103 after admission as he remained totally dependent in all aspects of mobility despite receiving ward-based physiotherapy. Because of his cognitive deficits, several graded rehabilitation strategies were used focusing on functional skills and compensatory strategy training. Environmental compensations included providing him with a daily routine using a modifiable visual chart of his daily schedule detailing meal, therapy, and recreational timings. Eventually, he was able to plan his own schedule independently upon discharge. He was also successfully taught to self-monitor for signs of physical or cognitive fatigue and take a rest break when required. Task-specific training was performed for ward-based topographical orientation and activities of daily living, and	Peer reviewed Single participant case study

					<p>he was able to ambulate and perform ward-based basic activities of daily living independently by day 11 of rehabilitation. Apart from functional training, he was also engaged in virtual reality games using a Nintendo Wii platform (eg, table tennis, boxing) to improve visual learning, perceptual skills, processing speed, and cardiovascular fitness. As his recovery progressed, repetitive task-specific training was directed at facilitating independence in instrumental activities of daily living such as meal preparation and laundry. He was taught strategies for task simplification, such as proper organization of his workspace, and setting up of equipment before tasks (eg, preparation of cleaning kit for tracheostomy wound care). Given impairments in language, he was taught to rephrase his statements using simple sentence structures when communicating. The patient was also educated on his neuropsychological findings by a clinical psychologist who</p>	
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					<p>implemented compensatory strategies such as allowing additional time to process information, refraining from multitasking, requesting for short and simple instructions, providing step-by-step instructions in a written form, and rehearsal when learning new skills. He did not require any psychopharmacological agents. To treat his severe ICU-acquired weakness and functional dependency, strength and endurance tasks were instituted together with functional mobility training by his physiotherapist. Despite cognitive impairments, the patient was able to participate fully in rehabilitation. After 40 days of intensive inpatient rehabilitation, he was discharged home with independent function.</p>	
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Appendix: Evidence Search Details

Search Strategies

MEDLINE

Ovid MEDLINE(R) ALL <1946 to February 15, 2021>

#	Searches	Results
1	exp Coronavirus/ or exp Coronavirus Infections/	55653
2	((corona* or corono*) adj1 (virus* or viral* or virinae*)).ti,ab,kw,kf.	2937
3	(coronavirus* or coronovirus* or coronavirinae* or CoV).ti,ab,kw,kf.	69397
4	("2019-nCoV" or 2019nCoV or nCoV2019 or "nCoV-2019" or "COVID-19" or COVID19 or "CORVID-19" or CORVID19 or "WN-CoV" or WNCov or "HCoV-19" or HCoV19 or "2019 novel*" or Ncov or "n-cov" or "SARS-CoV-2" or "SARSCoV-2" or "SARSCoV2" or "SARS-CoV2" or "SARSCov19or SARS-Cov19" or "SARSCov-19" or "SARS-Cov-19" or Ncovor or Ncorona* or Ncorono* or NcovWuhan* or NcovHubei* or NcovChina* or NcovChinese* or SARS2 or "SARS-2" or SARSCoronavirus2 or "SARS-coronavirus-2" or "SARSCoronavirus 2" or "SARS coronavirus2" or SARSCoronavirus2 or "SARS-coronavirus-2" or "SARSCoronavirus 2" or "SARS coronavirus2").ti,ab,kw,kf.	99709
5	(respiratory* adj2 (symptom* or disease* or illness* or condition*) adj10 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw,kf.	590
6	(("seafood market*" or "food market*" or pneumonia*) adj10 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw,kf.	1861
7	((outbreak* or wildlife* or pandemic* or epidemic*) adj1 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw,kf.	366
8	"severe acute respiratory syndrome".ti,ab,kw,kf.	17413
9	(postcovid* or post-covid* or postcoronavirus* or post-coronavirus*).ti,ab,kw,kf.	868
10	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9	127196
11	limit 10 to (english language and yr="2020 -Current")	102768
12	exp Intensive Care Units/ or exp Critical Care/ or Critical Illness/ or Critical Care Nursing/ or Critical Care Outcomes/	153088
13	(ICU or ICUs or NICU or NICUs or PICU or PICUs or SICU or SICUs or MICU or MICUs or CCU or CCUs or intensive care or critical care or critical* ill* or respiratory care unit?).ti,ab,kw,kf.	232839
14	12 or 13	278724
15	exp Respiration, Artificial/	79481
16	(IMV or ((artificial* or mechanical* or invasiv* or support* or machin*) adj2 (respirat* or ventilat* or breath*))).ti,ab,kw,kf.	70784

17	15 or 16	120445
18	(chronic* or persistent* or prolong* or long-term or long term or permanent* or extended or extensive*).ti,ab.	3263315
19	11 and 14 and 17 and 18	415
20	((chronic* or persistent* or prolong* or long-term or long term or permanent* or extended or extensive* or continu*) adj3 (respirat* or ventilat*)).ti,ab,kw,kf.	26960
21	11 and 14 and 20	122
22	19 or 21	460
23	Incidence/ or Prevalence/ or expTreatment Outcome/ or exp Patient Outcome Assessment/ or Length of Stay/ or Patient Discharge/ or Patient Transfer/ or Prognosis/	1162806
24	(disposition* or clinical course* or prognos* or (rehab* adj2 rate?) or (patient? adj2 (transfer* or discharg*)) or (stay? adj2 (length* or duration)) or incidence* or prevalen* or ((outcome* or status*) adj2 (long term or longer term or treatment* or patient? or clinical*))).ti,ab,kw,kf.	2682650
25	23 or 24	3100245
26	22 and 25	243
27	limit 26 to dt=20210119-20210331	29
28	Intubation, Intratracheal/ or (IMV or ((artificial* or mechanical* or invasiv* or support* or machin* or intratrach* or endotrach*) adj2 (respirat* or ventilat* or breath* or intubat*))).ti,ab,kw,kf.	109100
29	17 or 28	154012
30	(intubat* adj3 (chronic* or persistent* or prolong* or long-term or long term or permanent* or extended or extensive* or continu*)).ti,ab,kw,kf.	2349
31	11 and 14 and 18 and 29	424
32	11 and 14 and 30	25
33	31 or 32	425
34	25 and 33	224
35	34 not 26	4
36	27 or 35	33
37	((rate? or ratio?) adj3 (intubat* or ventilat* or respirat*)).ti,ab,kw,kf.	41065
38	11 and 14 and 29 and 18 and 37	20
39	11 and 14 and (20 or 30) and 37	8
40	38 or 39	23
41	40 not (26 or 36)	10

42	36 or 41	43
43	Continuity of Patient Care/ or Aftercare/ or exp Rehabilitation/ or exp Health Resources/ or exp "Health Services Needs and Demand"/ or exp Hospital Departments/ or (exp Hospital Units/ not exp Intensive Care Units/)	625628
44	(aftercare or after-care or rehab* or habilit* or post-ICU or post-intensive care or post-critical care or post-critical illness* or post-hospital* o posthospital* or post-discharg* or postdischarg* or acute care or outpatient* or out-patient* or ward? postacute or post-acute or ((resource* or service*) adj2 (health* or utiliz* or utilis* or "use" or using or used))).ti,ab,kw,kf.	609414
45	43 or 44	1124571
46	11 and 14 and 18 and 29 and 45	72
47	11 and 14 and (20 or 30) and 45	31
48	46 or 47	84
49	remove duplicates from 48	82
50	49 not (26 or 36 or 41)	42

Embase

Embase <1974 to 2021 February 15>

#	Searches	Results
1	exp *Coronavirinae/ or exp *Coronavirus infection/	18567
2	((corona* or corono*) adj1 (virus* or viral* or virinae*)).ti,ab,kw.	2294
3	(coronavirus* or coronovirus* or coronavirinae* or CoV).ti,ab,kw.	67872
4	("2019-nCoV" or 2019nCoV or nCoV2019 or "nCoV-2019" or "COVID-19" or COVID19 or "CORVID-19" or CORVID19 or "WN-CoV" or WNCov or "HCoV-19" or HCoV19 or "2019 novel*" or Ncov or "n-cov" or "SARS-CoV-2" or "SARSCoV-2" or "SARSCoV2" or "SARS-CoV2" or "SARSCov19or SARS-Cov19" or "SARSCov-19" or "SARS-Cov-19" or Ncovor or Ncorona* or Ncorono* or NcovWuhan* or NcovHubei* or NcovChina* or NcovChinese* or SARS2 or "SARS-2" or SARSCoronavirus2 or "SARS-coronavirus-2" or "SARSCoronavirus 2" or "SARS coronavirus2" or SARSCoronavirus2 or "SARS-coronavirus-2" or "SARSCoronavirus 2" or "SARS coronavirus2").ti,ab,kw.	94235
5	(respiratory* adj2 (symptom* or disease* or illness* or condition*) adj10 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw.	715
6	(("seafood market*" or "food market*" or pneumonia*) adj10 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw.	2103
7	((outbreak* or wildlife* or pandemic* or epidemic*) adj1 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw.	169
8	"severe acute respiratory syndrome*".ti,ab,kw.	16881

9	(postcovid* or post-covid* or postcoronavirus* or post-coronavirus*).ti,ab,kw.	789
10	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9	121261
11	limit 10 to (abstracts and english language and yr="2020 -Current")	61494
12	exp *intensive care unit/ or *intensive care/	108926
13	(ICU or ICUs or NICU or NICUs or PICU or PICUs or SICU or SICUs or MICU or MICUs or CCU or CCUs or intensive care or critical care or critical* ill* or respiratory care unit?).ti,ab,kw.	375771
14	12 or 13	399681
15	exp *artificial ventilation/	63248
16	(IMV or ((artifical* or mechanical* or invasiv* or support* or machin*) adj2 (respirat* or ventilat* or breath*))).ti,ab,kw.	115410
17	15 or 16	152234
18	(chronic* or persistent* or prolong* or long-term or long term or permanent* or extended or extensive*).ti,ab.	4356503
19	11 and 14 and 17 and 18	482
20	((chronic* or persistent* or prolong* or long-term or long term or permanent* or extended or extensive* or continu*) adj3 (respirat* or ventilat*)).ti,ab,kw.	38833
21	11 and 14 and 20	156
22	19 or 21	538
23	Incidence/ or Prevalence/ or expTreatment Outcome/ or exp Patient Outcome Assessment/ or Length of Stay/ or Patient Discharge/ or Patient Transfer/ or Prognosis/	2480380
24	(disposition* or clinical course* or prognos* or (rehab* adj2 rate?) or (patient? adj2 (transfer* or discharg*)) or (stay? adj2 (length* or duration)) or incidence* or prevalen* or ((outcome* or status*) adj2 (long term or longer term or treatment* or patient? or clinical*))).ti,ab,kw.	3927318
25	23 or 24	4783768
26	22 and 25	343
27	limit 26 to dd=20210119-20210331	74
28	endotracheal intubation/ or (IMV or ((artifical* or mechanical* or invasiv* or support* or machin* or intratrach* or endotrach*) adj2 (respirat* or ventilat* or breath* or intubat*))).ti,ab,kw.	164019
29	17 or 28	197937
30	(intubat* adj3 (chronic* or persistent* or prolong* or long-term or long term or permanent* or extended or extensive* or continu*)).ti,ab,kw.	3431
31	11 and 14 and 18 and 29	501

32	11 and 14 and 30	28
33	31 or 32	508
34	25 and 33	328
35	34 not 26	13
36	27 or 35	87
37	((rate? or ratio?) adj3 (intubat* or ventilat* or respirat*)).ti,ab,kw.	57440
38	11 and 14 and 29 and 18 and 37	25
39	11 and 14 and (20 or 30) and 37	10
40	38 or 39	30
41	40 not (26 or 36)	12
42	36 or 41	99
43	exp aftercare/ or exp rehabilitation/ or health care planning/ or exp health service/ or hospital department/ or (exp "hospital subdivisions and components"/ not exp intensive care unit/)	5904674
44	(aftercare or after-care or rehab* or habilit* or post-ICU or post-intensive care or post-critical care or post-critical illness* or post-hospital* o posthospital* or post-discharg* or postdischarg* or acute care or outpatient* or out-patient* or ward? postacute or post-acute or ((resource* or service*) adj2 (health* or utiliz* or utilis* or "use" or using or used))).ti,ab,kw.	863383
45	43 or 44	6221030
46	11 and 14 and 18 and 29 and 45	422
47	11 and 14 and (20 or 30) and 45	139
48	46 or 47	460
49	remove duplicates from 48	450
50	49 not (26 or 36 or 41)	153
51	limit 50 to conference abstract status	33
52	50 not 51	120

CINAHL

#	Query	Limiters/Expanders	Results
S1	MH "Coronavirus+" OR MH "Coronavirus Infections+"	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	24,995
S2	TX ((corona* or corono*) N1 (virus* or viral* or	Expanders - Apply equivalent	720

	virinae*))	subjects Search modes - Boolean/Phrase	
S3	TX (coronavirus* or coronovirus* or coronavirinae* or CoV)	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	25,881
S4	TX ("2019-nCoV" or 2019nCoV or nCoV2019 or "nCoV-2019" or "COVID-19" or COVID19 or "CORVID-19" or CORVID19 or "WN-CoV" or WNCov or "HCoV-19" or HCoV19 or "2019 novel*" or Ncov or "n-cov" or "SARS-CoV-2" or "SARSCoV-2" or "SARSCoV2" or "SARS-CoV2" or "SARSCov19or SARS-Cov19" or "SARSCov-19" or "SARS-Cov-19" or Ncovor or Ncorona* or Ncorono* or NcovWuhan* or NcovHubei* or NcovChina* or NcovChinese* or SARS2 or "SARS-2" or SARScoronavirus2 or "SARS-coronavirus-2" or "SARScoronavirus 2" or "SARS coronavirus2" or SARScoronavirus2 or "SARS-coronavirus-2" or "SARScoronavirus 2" or "SARS coronavirus2")	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	41,073
S5	TX (respiratory* N2 (symptom* OR disease* OR illness* OR condition*) N10 (Wuhan* OR Hubei* OR China* OR Chinese* OR Huanan*))	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	1,356
S6	TX (("seafood market*" OR "food market*" OR pneumonia*) N10 (Wuhan* OR Hubei* OR China* OR Chinese* OR Huanan*))	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	832
S7	TX ((outbreak* OR wildlife* OR pandemic* OR epidemic*) N1 (Wuhan* OR Hubei* OR China* OR Chinese* OR Huanan*))	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	972
S8	(TX (postcovid* or post-covid* or postcoronavirus* or post-coronavirus*)) OR TX "severe acute respiratory syndrome"	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	6,729
S9	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	54,677
S10	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8	Limiters - Published Date: 20200101-20211231 Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	43,384
S11	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8	Limiters - Published Date: 20200101-20211231 Expanders - Apply equivalent subjects	42,405

		Narrow by Language: - english Search modes - Boolean/Phrase	
		Limiters - Published Date: 20200101-20211231 Expanders - Apply equivalent subjects	
S12	((MH "Critical Care+") OR (MH "Intensive Care Units+"))	Search modes - Boolean/Phrase	5,308
		Limiters - Published Date: 20200101-20211231 Expanders - Apply equivalent subjects	
S13	TX ((ICU or ICUs or NICU or NICUs or PICU or PICUs or SICU or SICUs or MICU or MICUs or CCU or CCUs or intensive care or critical care or critical* ill* or respiratory care unit#))	Search modes - Boolean/Phrase	26,677
		Expanders - Apply equivalent subjects	
S14	S12 OR S13	Search modes - Boolean/Phrase	26,895
		Expanders - Apply equivalent subjects	
S15	(MH "Respiration, Artificial+")	Search modes - Boolean/Phrase	34,905
		Expanders - Apply equivalent subjects	
S16	TX ((IMV or ((artificial* or mechanical* or invasiv* or support* or machin*) N2 (respirat* or ventilat* or breath*))))	Search modes - Boolean/Phrase	42,815
		Expanders - Apply equivalent subjects	
S17	S15 OR S16	Search modes - Boolean/Phrase	62,272
		Expanders - Apply equivalent subjects	
S18	TI ((chronic* or persistent* or prolong* or long-term or long term or permanent* or extended or extensive*)) OR AB ((chronic* or persistent* or prolong* or long-term or long term or permanent* or extended or extensive*))	Search modes - Boolean/Phrase	613,172
		Expanders - Apply equivalent subjects	
S19	S11 and S14 and S17 and S18	Search modes - Boolean/Phrase	168
		Expanders - Apply equivalent subjects	
S20	TX ((chronic* or persistent* or prolong* or long-term or long term or permanent* or extended or extensive* or continu*) N3 (respirat* or ventilat*))	Search modes - Boolean/Phrase	18,138
		Expanders - Apply equivalent subjects	
S21	S11 and S14 and S20	Search modes - Boolean/Phrase	141
		Expanders - Apply equivalent subjects	
S22	S19 or S21	Search modes - Boolean/Phrase	267

S23	((MH "Incidence") or (MH "Prevalence") or (MH "Treatment Outcomes+") OR (MH "Prognosis") OR (MH "Outcome Assessment") OR (MH "Patient-Reported Outcomes+") OR (MH "Treatment Duration") or (MH "Length of Stay") or (MH "Patient Discharge+"))	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	698,266
S24	TX ((disposition* OR "clinical course*" OR prognos* OR (rehab* N2 rate#) OR (patient# N2 (transfer* OR discharg*)) OR (stay# N2 (length* OR duration)) OR incidence* OR prevalen* OR ((outcome* OR status*) N2 ("long term" OR "longer term" OR treatment* OR patient# OR clinical*))))	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	1,376,865
S25	S23 or S24	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	1,429,554
S26	S22 and S25	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	185
S27	S22 and S25	Limiters - Published Date: 20210101-20211231 Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	31
S28	(MH "Intubation, Intratracheal+") OR (TX ((IMV OR ((artificial* OR mechanical* OR invasiv* OR support* OR machin* OR intratrach* OR endotrach*) N2 (respirat* OR ventilat* OR breath* OR intubat*)))))	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	59,199
S29	S17 or S28	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	76,669
S30	TX (intubat* N3 (chronic* or persistent* or prolong* or long-term or long term or permanent* or extended or extensive* or continu*))	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	1,402
S31	S11 and S14 and S18 and S29	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	170
S32	S11 and S14 and S30	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	11
S33	S31 or S32	Expanders - Apply equivalent subjects	174

		Search modes - Boolean/Phrase	
		Expanders - Apply equivalent subjects	
S34	S25 and S33	Search modes - Boolean/Phrase	125
		Expanders - Apply equivalent subjects	
S35	S34 not S26	Search modes - Boolean/Phrase	0
		Expanders - Apply equivalent subjects	
S36	S27 or S35	Search modes - Boolean/Phrase	31
		Expanders - Apply equivalent subjects	
S37	TX ((rate# OR ratio#) N3 (intubat* OR ventilat* OR respirat*))	Search modes - Boolean/Phrase	23,436
		Expanders - Apply equivalent subjects	
S38	S11 and S14 and S29 and S18 and S37	Search modes - Boolean/Phrase	20
		Expanders - Apply equivalent subjects	
S39	S11 and S14 and (S20 or S30) and S37	Search modes - Boolean/Phrase	28
		Expanders - Apply equivalent subjects	
S40	S38 or S39	Search modes - Boolean/Phrase	40
		Expanders - Apply equivalent subjects	
S41	S40 not (S26 or S36)	Search modes - Boolean/Phrase	8
		Expanders - Apply equivalent subjects	
S42	S36 or S41	Search modes - Boolean/Phrase	39
		Expanders - Apply equivalent subjects	
S43	(((MH "Continuity of Patient Care+") OR (MH "After Care")) OR ((MH "Rehabilitation+") OR (MH "Health Services+") OR (MH "Health Services Needs and Demand+")) OR (MH "Health Facility Departments+") OR ((MH "Hospital Units+") NOT (MH "Intensive Care Units+"))	Search modes - Boolean/Phrase	1,365,893
		Expanders - Apply equivalent subjects	
S44	TX (aftercare OR after-care OR rehab* OR habit* OR post-ICU OR "post-intensive care" OR "post-critical care" OR "post-critical illness*" OR "post-hospital* o posthospital*" OR post-discharg* OR postdischarg* OR "acute care" OR outpatient* OR out-patient* OR "ward# postacute" OR post-acute OR ((resource* OR service*) N2 (health* OR utiliz* OR utilis* OR use OR using OR used)))	Search modes - Boolean/Phrase	1,306,635
		Expanders - Apply equivalent subjects	

S45	S43 OR S44	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	2,163,352
S46	S11 and S14 and S18 and S29 and S45	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	97
S47	S11 and S14 and (S20 or S30) and S45	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	83
S48	S46 or S47	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	157
S49	S48 not (S26 or S36 or S41)	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	40

Keywords Used in Varying Combinations

COVID | Coronavirus | nCOV | SARS-2

“Intensive Care” | “Critical Care” | ICU | CCU | NICU | PICU

“Mechanical Ventilation” | “Invasive Ventilation” | “Mechanical Intubation” | “Invasive Intubation”

Prolonged | Persistent | Permanent | Chronic | Continuous | Extended | Long-Term | Extensive

Rates | Ratio | Prevalence | Incidence

Rehabilitation | Habilitation | Aftercare | Health Services

Sources

- Grey Literature was searched
- Refer to the evidence search report for extensive sources.



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