

Rapid evidence checks are based on a simplified review method and may not be entirely exhaustive, but aim to provide a balanced assessment of what is already known about a specific problem or issue. This brief has not been peer-reviewed and should not be a substitute for individual clinical judgement, nor is it an endorsed position of NSW Health.

## Risks associated with surgery in people with COVID-19

### Evidence check question

Are patients with COVID-19 or who have previously had COVID-19 at risk of adverse post-operative outcomes? If so, what is the duration of the heightened risk?

### In brief

- There were no studies reporting empirical data on recovered COVID-19 patients undergoing surgery. One study reported recommendations without data, advising to follow the precautionary principle and undertake the same precautions in the operating room as for a confirmed patient.(1)
- The main surgical outcomes reported in literature for COVID-19 patients were clinical complications from surgery (e.g. pulmonary, thrombotic), including COVID-19 specific ICU admission requiring post-operative supplemental oxygenation, the impact on length of hospital stay and death (i.e. 30 day mortality).(2-10).
- Studies have reported the risk factors that are associated with adverse surgical outcomes in COVID-19 patients undergoing surgery which include, age (e.g. being 70 years or older), being male, positive smoking status, presence of multi- and co-morbidities, having cancer surgery, needing emergency surgery and needing major surgery.(5, 8, 9, 11)
- Researchers from the COVIDSurg Collaborative conducted an international, multicentre, cohort at 235 hospitals in 24 countries, which included all patients undergoing surgery who had SARS-CoV-2 infection confirmed within 7 days before or 30 days after surgery. The analysis included 1,128 patients, who had surgery between January and March 2020. The authors found that post-operative pulmonary complications occurred in half of the patients with perioperative SARS-CoV-2 infection (577 of 1128, 51.2%). The infection was also associated with high mortality, with the 30 day mortality of 38.0% (219 of 577) in these patients, accounting for 81.7% (219 of 268) of all deaths.
- Based on their findings, authors from the studies included in this evidence check advise the following:
  - Testing and appropriate diagnosis of all patients before surgical treatment to determine COVID-19 status, especially as it is difficult to distinguish between non-COVID-19, asymptomatic, or pre-symptomatic cases.(10, 12)
  - To balance the increased risks associated with SARS-CoV-2 infection against the risks of delaying surgery in individual patients.(5)

- To consider postponing non-urgent procedures and promoting non-operative treatment to delay or avoid the need for surgery in COVID-19 patients. This is recommended especially for those with increased vulnerability for adverse outcomes, including elderly patients and those with comorbidities, and in various types of surgeries and procedures, including:
  - adjuvant chemotherapy or elective surgery for stable cancer
  - thoracic operations
  - urological surgery
  - orthopaedic surgery
  - neurosurgery.(6)
- Only one study reported that patients with asymptomatic or mild COVID-19 infection can safely undergo early surgical intervention for hip fracture after appropriate medical optimisation.(4)

## Limitations

Evidence on this topic is emerging rapidly. Limitations of this evidence check include the inclusion of case series or reports of a small number of patients.(3, 13) However, studies reporting on single patient cases were excluded.(14, 15) Furthermore, an initial scoping of the literature found a large number of guidance and studies on surgical care of all patients during the COVID-19 pandemic, which did not assess outcomes in patients diagnosed with COVID-19 (e.g. Couto, et al. 2020).(16) These were excluded, as were those providing clinical guidance on surgical care and management of COVID-19 patients that did not report on empirical data. This review identified one grey literature that met these criteria. Finally, this review did not identify studies discussing the duration of heightened risks of surgical procedures to COVID-19 patients.

## Background

The Australian Health Protection Principal Committee emphasises that surgery on patients with confirmed or suspected COVID-19 should be delayed until they have recovered or performed only in an emergency.(17) This aligns with guidance that has been provided by organisations from other jurisdictions, which often cite the high risk of transmission to healthcare workers and non-COVID-19 patients as a basis for contraindicating non-urgent surgery. However, less frequently cited are potential adverse outcomes of surgical procedures or general anaesthesia on COVID-19 patients. Currently, the evidence base on surgical risk for COVID-19 patients, including outcomes relating to pulmonary functions and post-operative disease course, is underdeveloped.(18) This evidence check thus aimed to review recent literature reporting the impact of various surgical procedures (non-specific to type, severity, or urgency) on COVID-19 patients.

## Methods (Appendix 1)

PubMed and Google searches were conducted on 6 July 2020 and updated on 9 July 2020. Australian and international clinical and research organisation websites were also reviewed for evidence on surgical outcomes in those diagnosed with COVID-19.

We included studies assessing surgical outcomes in COVID-19 positive patients. We did not exclude studies in which patient COVID-19 status was not determined pre-operatively. This included studies in which patients undergoing surgery were asymptomatic prior to surgery and were diagnosed post-operation.(2, 4, 8, 10) We included cohort studies comparing outcomes between COVID-19 patients and non-COVID-19 patients undergoing surgery around the same time.(2, 6, 7)

## Results

Table 1

Source	Summary
<b>Peer reviewed sources</b>	
<p><a href="#">COVID-19 Outbreak and Surgical Practice: Unexpected Fatality in Perioperative Period</a> Aminian, et al. 2020 (3)</p>	<ul style="list-style-type: none"> <li>• A retrospective case series of four patients who developed perioperative complications in the first few weeks of the COVID-19 outbreak in Iran in February 2020.</li> <li>• Three patients developed post-operative fever and pulmonary complications after uneventful elective operations (Patient 1: 75F, incisional hernia repair, died; Patient 2: 81M, cholecystectomy, died; Patient 3: 54F, cholecystectomy and hysterectomy, recovered). Patient 4 had been scheduled for bariatric surgery but one day before the scheduled surgery he was taken to the emergency department with severe acute respiratory distress which rapidly progressed to cardiopulmonary arrest and died.</li> <li>• The authors surmise that post-operative patients might be another group of patients in which COVID-19 would have a high fatality rate. They believe that a complicated post-operative course may especially be seen more in elderly patients with underlying health conditions.</li> <li>• They note that in the post-operative period, development of fever or pulmonary complications can lead to a diagnostic challenge and can complicate the recovery of patients from elective surgery. In patients with post-operative fever, several diagnostic tests are usually necessary to determine the source. Other forms of infectious pneumonia, aspiration pneumonia, pulmonary embolism, pulmonary oedema, and other conditions are among the differential diagnoses in patients with post-operative pulmonary symptoms.</li> </ul>

Source	Summary
<b>Peer reviewed sources</b>	
	<ul style="list-style-type: none"> <li>• During the current progressive outbreak, a high index of ‘suspicious for COVID-19’ is necessary to make a correct diagnosis and to take correct actions to treat the index patient and to prevent the spread of the virus.</li> </ul>
<p><a href="#">Early outcomes after hip fracture surgery in COVID-19 patients in New York City</a>                      Cheung, et al. 2020 (4)</p>	<ul style="list-style-type: none"> <li>• A retrospective study of 10 patients ≥60 years of age with a hip fracture and COVID-19 who underwent surgical treatment in New York City during the COVID-19 outbreak from March to May 2020.</li> <li>• Eight out of the 10 COVID-19-positive hip fracture patients were asymptomatic on admission with no clinical signs or symptoms of COVID-19 infection. Only two patients presented with hypoxia. All 10 patients underwent surgery within two days of admission.</li> <li>• Five out of the 10 patients, including the patients who presented with hypoxia, subsequently required supplemental oxygen post-operatively. Two patients had persistently elevated oxygen demands requiring prolonged administration of supplemental oxygen therapy beyond post-operative day three. None of the patients were put on mechanical ventilation.</li> <li>• One patient had a presumed venous thromboembolism post-operatively and subsequently died on post-operative day 19, likely due to respiratory failure. There were no other deaths in the early post-operative period.</li> <li>• The average length of inpatient stay was 7.8 days.</li> </ul>

Source	Summary
<b>Peer reviewed sources</b>	
	<ul style="list-style-type: none"> <li>Findings from the study suggest that hip fracture patients who present with asymptomatic or mild COVID-19 infection may have temporarily increased oxygen demands post-operatively, but they can safely undergo early surgical intervention after appropriate medical optimisation.</li> </ul>
<p><a href="#">Mortality and pulmonary complications in patients undergoing surgery with perioperative SARS-CoV-2 infection: an international cohort study</a></p> <p>COVIDSurg Collaborative (5)</p>	<ul style="list-style-type: none"> <li>This international, multicentre, cohort study at 235 hospitals in 24 countries included all patients undergoing surgery who had SARS-CoV-2 infection confirmed within seven days before (294, 26.1%) or 30 days after surgery. The analysis included 1,128 patients who had surgery between January and March 2020, of whom 835 (74.0%) had emergency surgery and 280 (24.8%) had elective surgery.</li> <li>This study identified that post-operative pulmonary complications occur in half of patients (577 of 1,128, 51.2%) with perioperative SARS-CoV-2 infection and are associated with high mortality: 30 day mortality in these patients was 38.0% (219 of 577), accounting for 81.7% (219 of 268) of all deaths.</li> <li>Those who were found to be most vulnerable to adverse outcomes include:                             <ul style="list-style-type: none"> <li>Men: OR 1.75 [95% CI 1.28-2.40], p&lt;0.0001</li> <li>People aged 70 years or older: OR 2.30 [1.65–3.22], p&lt;0.0001</li> <li>Those with comorbidities (ASA grades 3-5): OR 2.35 [1.57–3.53], p&lt;0.0001</li> <li>Those having cancer surgery: OR 1.55 [1.01-2.39], p=0.046</li> <li>Those needing emergency surgery: OR 1.67 [1.06-2.63], p=0.026</li> <li>Those needing major surgery: OR 1.52 [1.01-2.31], p=0.047.</li> </ul> </li> </ul>

Source	Summary
<b>Peer reviewed sources</b>	
	<ul style="list-style-type: none"> <li>The authors thus recommend that thresholds for surgery during the COVID-19 pandemic should be higher than during normal practice, particularly in men aged 70 years and older. The increased risks associated with SARS-CoV-2 infection should be balanced against the risks of delaying surgery in individual patients. Consideration should be given for postponing non-urgent procedures and promoting non-operative treatment to delay or avoid the need for surgery.</li> </ul>
<p><a href="#">Factors Associated With Surgical Mortality and Complications Among Patients With and Without Coronavirus Disease 2019 (COVID-19) in Italy</a> Doglietto, et al. 2020 (6)</p>	<ul style="list-style-type: none"> <li>A matched cohort study conducted in the general, vascular and thoracic surgery, orthopaedic, and neurosurgery units of Spedali Civili Hospital (Brescia, Italy) included patients who underwent surgical treatment from February to April 2020 and had positive test results for COVID-19 either before or within one week after surgery. The data set included 123 patients (41 with COVID-19 [33.3%] and 82 controls, or non-COVID-19 patients having surgery [66.7%]) for 53 variables. Of the 41 COVID-19 positive patients, 33 (80.5%) had positive results for COVID-19 preoperatively and eight (19.5%) had positive results within five days of surgery.</li> <li>30 day mortality was significantly higher for those with COVID-19 (OR 9.5; 95% CI, 1.77-96.53). Complications were also significantly higher (OR 4.98; 95% CI, 1.81-16.07); pulmonary complications were the most common (OR 35.62; 95% CI, 9.34-205.55), but thrombotic complications were also significantly associated with COVID-19 (OR, 13.2; 95% CI, 1.48-∞). Different models (cumulative link model and classification tree) identified COVID-19 as the main variable associated with complications.</li> <li>The authors recommend that wherever possible, surgery should be postponed in patients with COVID-19 because it is an additional surgical risk factor that overweighs traditional ones.</li> </ul>



Source	Summary
<b>Peer reviewed sources</b>	
<p><a href="#">Urology Surgical Activity and COVID-19: Risk Assessment at the Epidemic Peak the Parisian Multicenter Experience</a></p> <p>Ingels, et al. 2020 (2) (Preprint ahead of publication, abstract only)</p>	<ul style="list-style-type: none"> <li>• This multicentre observational cohort study included all patients receiving a urological procedure in Paris academic urological centres during the four initial weeks of surgical restrictions. Their status was updated within three weeks after the procedure. The post-operative COVID-19 confirmed group was compared with non-COVID-19 patients using Chi-square tests for categorical and Wilcoxon tests for continuous variables.</li> <li>• During the four-week period, 552 patients received surgery within eight centres. At follow-up, 57 (10%) patients were lost. Among the 11 pre-operative COVID-19 cases, one remained in ICU, no new admission, and no death. For the non-COVID-19 patients, 57 (12%) developed COVID-19-related symptoms; only one case (0.2%) required COVID-19 specific ICU and three (0.6%) patients died of COVID-19 after surgery.</li> <li>• The authors concluded that performing urological surgery during the COVID-19 epidemic peak has a limited impact on ICU admissions but presents a small but real (0.6%) risk of specific mortality. Surgical activities should be maintained according to this risk.</li> </ul>
<p><a href="#">The Effects of COVID-19 on Perioperative Morbidity and Mortality in Patients With Hip Fractures</a></p> <p>Kayani, et al. 2020 (7) (Preprint ahead of publication, abstract only)</p>	<ul style="list-style-type: none"> <li>• This multicentre cohort study included 340 COVID-19-negative patients versus 82 COVID-19-positive patients undergoing surgical treatment for hip fractures across nine NHS hospitals in Greater London, UK. Predefined perioperative outcomes were recorded within a 30 day post-operative period. Univariate and multivariate analysis were used to identify risk factors associated with increased risk of mortality.</li> </ul>

Source	Summary
<b>Peer reviewed sources</b>	
	<ul style="list-style-type: none"> <li>• COVID-19-positive patients had increased post-operative mortality rates compared to COVID-19-negative patients (30.5% (25/82) vs 10.3% (35/340) respectively, <math>p &lt; 0.001</math>). Risk factors for increased mortality in patients with COVID-19 undergoing surgery included positive smoking status (hazard ratio (HR) 15.4 (95% confidence interval (CI) 4.55 to 52.2; <math>p &lt; 0.001</math>) and greater than three comorbidities (HR 13.5 (95% CI 2.82 to 66.0, <math>p &lt; 0.001</math>).</li> <li>• COVID-19-positive patients had increased risk of post-operative complications (89.0% (73/82) vs 35.0% (119/340) respectively; <math>p &lt; 0.001</math>), more critical care unit admissions (61.0% (50/82) vs 18.2% (62/340) respectively; <math>p &lt; 0.001</math>), and increased length of hospital stay (mean 13.8 days (SD 4.6) vs 6.7 days (SD 2.5) respectively; <math>p &lt; 0.001</math>), compared to COVID-19-negative patients.</li> </ul>
<p><a href="#">Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19 infection</a> Lei, et al. 2020 (8)</p>	<ul style="list-style-type: none"> <li>• A retrospective cohort study of 34 patients with COVID-19 (during incubation period) in China undergoing a wide range of surgeries (Table 1 in the article).</li> <li>• All patients developed pneumonia after surgery. Common post-operative complications included ARDS (11 [32.4%]), shock (10 [29.4%]), secondary infection (10 [29.4%]), arrhythmia (8 [23.5%]), acute cardiac injury (5 [14.7%]), and acute kidney injury (2 [5.9%]).</li> <li>• ICU patients were more likely to have ARDS, shock, second infection and acute cardiac injury than non-ICU patients.</li> <li>• All patients received antiviral therapy (lopinavir/ritonavir) and antibiotic therapy. Some of the patients received glucocorticoid therapy (16 [47.1%]) and immunoglobulin therapy (14 [41.2%]), and one (2.9%) patient received kidney replacement therapy. In ICU, seven (46.7%) patients</li> </ul>



Source	Summary
<b>Peer reviewed sources</b>	
	<p>received high-flow oxygen or non-invasive ventilation, and five (33.3%) required invasive mechanical ventilation, 1 (6.7%) of whom received extracorporeal membrane oxygenation as rescue therapy.</p> <ul style="list-style-type: none"> <li>• Seven patients died after admission to the ICU, they all underwent surgeries at the surgical difficulty category level 3. All these patients had one or more coexisting medical conditions, the most common comorbidities being cardiovascular disease (4 [57.1%]), cancer (4 [57.1%]) and hypertension (3 [42.9%]). The median duration from first symptom to death was nine days (IQR, 6-11). All these patients developed respiratory failure and had three or more complications. The most common complications among the seven patients included ARDS (7 [100%]), shock (4 [57.1%]), arrhythmia (4 [57.1%]) and acute cardiac injury (4 [57.1%]).</li> </ul>
<p><a href="#">Clinical and Transmission Characteristics of Covid-19 — A Retrospective Study of 25 Cases from a Single Thoracic Surgery Department</a> Li, et al. 2020 (9)</p>	<ul style="list-style-type: none"> <li>• In this retrospective study, the authors analysed clinical and transmission features of 25 cases of Covid-19 from a single thoracic department in Tongji Hospital in China, including 13 patients and 12 health care staff. Nineteen (76%) of the infected cases were confirmed by SARS-CoV-2 nucleic acid test, the rest were clinically diagnosed as suspected Covid-19 cases, and 19 (76%) of the infected cases had positive exposure history.</li> <li>• The authors found that chest operation was significantly associated with death in COVID-19 patients (P=0.039), and COPD is significantly associated with severe COVID-19 and death (P=0.040, and P=0.038, respectively).</li> </ul>

Source	Summary
<b>Peer reviewed sources</b>	
	<ul style="list-style-type: none"> <li>• These findings suggest that COVID-19 is associated with poor prognosis for patients undergoing thoracic operation, especially for those with COPD. The authors believe that operation in COVID-19 patients could lead to lung function impairment and decreased immunity.</li> </ul>
<p><a href="#">Cancer patients in SARS-CoV-2 infection: a nationwide analysis in China</a></p> <p>Liang, et al. 2020 (11)</p>	<ul style="list-style-type: none"> <li>• The authors established a prospective cohort to monitor COVID-19 cases throughout China. As of 31 January 2020, they have collected and analysed 2,007 cases from 575 hospitals in 31 provincial administrative regions. All cases were diagnosed with laboratory-confirmed COVID-19 acute respiratory disease and were admitted to hospital. 417 cases were excluded because of insufficient records of previous disease history.</li> <li>• Patients with cancer were observed to have a higher risk of severe events (a composite endpoint defined as the percentage of patients being admitted to the ICU requiring invasive ventilation, or death) compared with patients without cancer (seven [39%] of 18 patients vs 124 [8%] of 1,572 patients; Fisher's exact p=0.0003).</li> <li>• Patients who underwent chemotherapy or surgery in the past month had a numerically higher risk (three [75%] of four patients) of clinically severe events than did those not receiving chemotherapy or surgery (six [43%] of 14 patients). These odds were further confirmed by logistic regression (odds ratio [OR] 5.34, 95% CI 1.80–16.18; p=0.0026) after adjusting for other risk factors, including age, smoking history, and other comorbidities. Based on these findings, the authors recommend that an intentional postponing of adjuvant chemotherapy or elective surgery for stable cancer should be considered in endemic areas.</li> </ul>

Source	Summary
<b>Peer reviewed sources</b>	
<p><a href="#">Hazardous Postoperative Outcomes of Unexpected COVID-19 Infected Patients: A Call for Global Consideration of Sampling all Asymptomatic Patients Before Surgical Treatment</a></p> <p>Nahshon, et al. 2020 (10)</p>	<ul style="list-style-type: none"> <li>• This report is a review on surgical outcomes of COVID-19 patients who were preoperatively asymptomatic and not tested. Searches were conducted in PubMed 4 April 2020. Four reports (including Li, et al. 2020 (9), Lei, et al. 2020 (8), and Aminian, et al. 2020 (3)) were included, comprising 64 COVID-19 carriers, of whom 51 were diagnosed only in the post-operative period.</li> <li>• Synthesis of these reports suggested a 14/51 (27.5%) post-operative mortality rate and severe, mostly pulmonic, complications as well as medical staff exposure and transmission.</li> <li>• The authors believe that COVID-19 may have potential hazardous implications on the perioperative course. This review presents results of unacceptable mortality rate and a high rate of severe complications. The authors recommend further well-designed studies, as well as a global consideration of sampling all asymptomatic patients before surgical treatment.</li> </ul>
<p><a href="#">Abdominal Surgery in Patients with COVID-19: Detection of SARS-CoV-2 in Abdominal and Adipose Tissues</a></p> <p>Safari, et al. 2020 (13)</p>	<ul style="list-style-type: none"> <li>• This case study from Iran of four COVID-19 patients undergoing abdominal surgeries to examine for tissue involvement by SARS-CoV-2.                         <ul style="list-style-type: none"> <li>○ Patient 1: underwent a laparoscopic cholecystectomy gallbladder empyema and died from severe respiratory failure.</li> <li>○ Patient 2: has Crohn’s disease and underwent emergent laparotomy for a perforation in the terminal ileum and recovered.</li> <li>○ Patient 3: underwent an open appendectomy and recovered.</li> <li>○ Patient 4: underwent emergent laparotomy for a perforated peptic ulcer and died from sepsis.</li> </ul> </li> </ul>

Source	Summary
<b>Peer reviewed sources</b>	
	<ul style="list-style-type: none"> <li>• Patient 1 was the second case with gallbladder disease reported in the literature who died after laparoscopic cholecystectomy with COVID-19 pneumonia. Unlike the other case who developed COVID-19 pneumonia two weeks after cholecystectomy, the current case had COVID-19 at the time of surgery.(3)</li> <li>• The authors concluded that it is unknown whether surgical stress and post-operative physiological changes can exacerbate the COVID-19 infection and worsen the outcomes of surgical patients.</li> </ul>
<b>Grey literature</b>	
<p><a href="#">Practice guideline: Pre-operative work-up for SARS-CoV-2 infection in asymptomatic patients scheduled for surgery under general anesthesia</a></p> <p>Federatie Medisch Specialisten 2020 (12)</p>	<ul style="list-style-type: none"> <li>• A review of the scientific literature and clinical recommendations.</li> <li>• The authors discuss that when patients report no symptoms of COVID-19 during pre-operative screening, it is impossible to make a clinically relevant distinction between the three categories of patients: those without COVID-19 infection, those with asymptomatic COVID-19 infection, or those with pre-symptomatic COVID-19 infection. This means that patients who are initially asymptomatic, pre-symptomatic or mildly symptomatic can subsequently develop moderate to severe COVID-19 disease, placing them at significant risk for adverse post-operative outcomes i.e. ICU admittance or increased mortality.</li> <li>• The authors also describe their findings from their review of literature underscores the need for meticulous history-taking to identify COVID-19 symptomatology prior to surgery. Comorbidities that are common to surgical populations, including hypertension, cardiovascular disease,</li> </ul>

Source	Summary
<b>Peer reviewed sources</b>	
	COPD, asthma and malignancies, also place patients at significantly higher risk of severe COVID-19 disease.

## Appendix 1

### PubMed search terms

((("outcome"[Title/Abstract] OR "death"[Title/Abstract]) OR "mortality"[Title/Abstract]) OR "complication"[Title/Abstract]) AND (((((((("2019-nCoV"[Title/Abstract] OR "ncov"[Title/Abstract]) OR "covid-19"[Title/Abstract]) OR "covid19"[Title/Abstract]) OR "covid-19"[Title/Abstract]) OR "coronavirus"[MeSH Terms]) OR "coronavirus"[Title/Abstract]) OR "sars-cov-2"[Title/Abstract]) OR "severe acute respiratory syndrome coronavirus 2"[Supplementary Concept])) AND ("surgery"[Title/Abstract] OR "operat"[Title/Abstract])

### Google search terms

- surgery in COVID-19 patients
- surgical risk COVID-19 patients
- surgical risk COVID-19 patients

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