COVID-19: a review
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Abstract
Severe respiratory distress syndrome coronavirus 2 (SARS-CoV-2) has been at the center of global attention recently, ever since its initial appearance in Wuhan, China, in December of 2019. This novel disease has been a source of growing concern which has been shared internationally by social communities and health care professionals alike, due to its exponentially increasing rate of infection and difficulty to control. Currently, no definitive or effective treatment has been found for COVID-19, but there are several ongoing trials investigating whether a certain medication, vaccination, or supportive therapy might prove to be effective. Coincidentally, SARS-CoV-2 may be a new pathogen, but it resembles SARS-CoV and MERS-CoV coronaviruses in its genome, structure, modes of transmission, and pathogenesis. This has contributed to an advantageous understanding of the virus and has served as the basis of decision-making for infection control plans, research, and management of the disease. As of July, 2020, SARS-CoV-2 has spread to every continent excluding Antarctica, with confirmed cases of COVID-19 in virtually every country, and is responsible for over 500,000 deaths worldwide. This review of the COVID-19 pandemic aims to offer a comprehensive and thorough explanation of the disease, including its significance and impact on surgery, by drawing information from the most up to date and relevant sources available.

Keywords: COVID-19, Coronavirus, Pandemic, Virology, Pathophysiology, Diagnosis, Transmission, Treatment, Surgery

The first coronaviruses capable of human and animal infection were discovered in the 1960s. Since then, over 30 different strands of coronaviruses have been identified\textsuperscript{1}. The latest disease to be caused by a coronavirus is known as COVID-19 and has been classified as a high-risk pandemic by the World Health Organisation (WHO).

The first known cases of COVID-19 were announced to the Chinese division of the WHO by the Chinese government on December 31, 2019\textsuperscript{2,3}. At the time, the disease was being classified as cases of pneumonia with an unknown cause in Wuhan, Hubei province, China. On January 2, 2020, the WHO and Chinese authorities began cooperating with each other in an effort to classify the new disease\textsuperscript{3}. By January 3, 2020, the number of confirmed cases of this nonidentifiable pneumonia had risen to 44 people. The spread of the disease was accelerating, with many countries announcing the appearance of similar cases shortly after\textsuperscript{2,4}. The cause was eventually identified through genomic sequencing as a new type of coronavirus, using samples obtained from patients who had already contracted the disease\textsuperscript{4}.

The first death caused by COVID-19 was announced in China on January 9, 2020. The total number of deaths as of July, 2020 is demonstrated in Figure 1\textsuperscript{5}.

After only a short period of time following these events, on March 11, 2020, the director general of the WHO declared the novel coronavirus (2019-nCoV) and COVID-19 a pandemic. The WHO formulated a plan to limit the spread of the newly discovered virus and recommended that standard infection control precautions (SICPs) be used in every country\textsuperscript{1,2,6}. It is difficult to diagnose the disease due to its long incubation period, occasionally being asymptomatic, or only causing transient mild symptoms which may be confused for another disease. This has contributed to an exponential increase in its spread worldwide, as shown in Figure 2\textsuperscript{7}.

Taxonomy and genome
The virus responsible for causing the disease COVID-19 has been named, “severe acute respiratory syndrome coronavirus 2,” or SARS-CoV-2, by the International Committee of Taxonomy and Virology. At first, the virus was called the “Novel Coronavirus 2019,” or 2019-nCoV\textsuperscript{8,9}. This was appropriately followed by the WHO naming the disease as COVID-19, with the “19” referring to the year 2019\textsuperscript{10,11}. As the name implies, the virus belongs to the large coronavirus family of viruses, known as Coronaviridae, within the order Nidovirales (Figure 3) demonstrates the appearance of COVID-19\textsuperscript{11}.

The typical appearance of coronaviruses is spherical, containing characteristic surface projections resembling a phenomenon known as “solar corona,” where the outer layer of the sun becomes visible and projects outwards from the sun’s surface during a total solar eclipse\textsuperscript{13,14}. Genomic sequencing of the
SARS-CoV-2 virus has led to findings of a 79% genomic similarity with SARS-CoV and a 50% genomic similarity with Middle-Eastern Respiratory Syndrome coronavirus (MERS-CoV), as well as a much greater similarity with 2 previously identified SARS-like coronaviruses. The complete characterization of SARS-CoV-2 has not yet been achieved, but it has been identified and classified as a beta-coronavirus, according to data received from Chinese authorities and the WHO[4].

**Viral life cycle**

SARS-CoV-2 is similar in its structure and mechanism of action to SARS-CoV, which also originated in China. It was also classified as a pandemic, and experienced 2 short but self-limiting spreads to other parts of the world between 2002 and 2004[9,14,15]. However, SARS-CoV and SARS-CoV-2 are unique when compared with other viruses of the same family, in that they are capable of retaining stability and surviving in the environment much longer than other coronaviruses[14]. Therefore, the viral life cycle of SARS-CoV-2 is believed to be identical to that of SARS-CoV due to their closely related morphology and the fact that they cause the same symptoms. The first stage of its life cycle begins with the virus attaching to receptors on the surface membrane of a host’s cells. This is achieved through their surface projections, which are in fact trimers of the S protein, more specifically, an amino-terminal S1 and carboxyl-terminal S2 subunits connected by a fusion peptide[14]. After this is achieved, it is followed by membrane fusion, which allows the virus to enter the cell. Both the S1 and S2 subunits are essential for attachment and fusion, respectively[14].

*Figure 1.* A world map displaying the number of confirmed COVID-19 related deaths represented as deaths per million people in a population as of July, 2020. This map and data were provided by https://ourworldindata.org/coronavirus-data#confirmed-deaths.

*Figure 2.* A graph representing the total number of confirmed cases of COVID-19 around the world, plotted against time, as of July 2020. This graph and data were provided by https://ourworldindata.org/coronavirus-data#confirmed-cases.
The next stage is disassembly of the virus inside the cell cytoplasm, which allows it to release its viral RNA for translation and replication, although the exact process by which this is achieved by the virus is still unclear[14]. The viral proteases cleave Orf1a and Orf1ab, 2 large polyproteins found in cells, into smaller components ranging from nsp1 to nsp16. These components form replication-transcription complexes, which produce genomic RNA[14]. Eventually, the viral RNA sufficiently increases inside the host cell, triggering the next stage to begin. Concurrently, viral assembly occurs in the host cell’s endoplasmic reticulum and Golgi apparatus, which causes proteins to form a capsule around the newly formed viral RNA. The final stage is viral budding, which is the excretion of the virus from the cell in its newly formed vesicle. This allows the virus to invade neighboring cells and repeat its life cycle[14].

Etiology

There are various ongoing investigations attempting to discover the initial source from which the spread of the virus began[4]. Bat populations in Asia are known to be carriers of coronaviruses, such as with SARS-CoV, MERS-CoV, and other coronaviruses. Therefore, it is reasonably postulated that bats may contain SARS-CoV-2, despite there being minimal evidence to support a zoonotic cause of the disease[10,16,17]. The most likely root of the disease has been narrowed down to the Huanan Seafood Wholesale Market in Wuhan City. Various environmental samples were obtained from the area, and when tested for the virus the results were positive, even though some of the first confirmed carriers of the virus in China reported not visiting this site[4]. In short, there is still no clear and definitive explanation in regards to the etiology of the disease.

Transmission

It is currently being assumed that SARS-CoV-2 is being transmitted in the same way as SARS due to their similarities[18]. The method of transmission of SARS-CoV-2 is predominantly occurring through human-to-human transmission[4]. This can either be by inhalation of respiratory droplets, or coming into direct contact with surfaces which have been touched by someone with the disease[4,18]. The virus can survive on any non-organic object for up to 5 days if certain conditions are met, such as atmospheric temperatures ranging from 22 to 25°C, and a relative humidity of 40%–50%[18]. Presymptomatic transmission can also occur, supported by data showing that some people have tested positive for COVID-19, anywhere between 1 and 3 days before they developed symptoms[18]. There is no data suggesting asymptomatic transmission can occur, since even presymptomatic transmission requires spread via infectious droplets or contact with contaminated surfaces[19,20]. Table 1 shows the total number of confirmed cases and deaths by region, including the confirmed daily cases of each[21].

Aerosol-generating procedures (AGP) are procedures which can facilitate transmission, and occur during procedures or tests which provoke coughing or sneezing, propelling droplets from the respiratory system into the air[4,15,18]. These aerosol droplets

Table 1

A table representing the total number of confirmed cases and deaths, as well as the daily cases of each, reported by every continental region and globally as of July 5, 2020.

| Region                          | Europe     | The Americas | Eastern Mediterranean Region | Western Pacific Region | South-East Asia Region | Africa | Globally |
|--------------------------------|------------|--------------|-----------------------------|------------------------|------------------------|--------|----------|
| Total confirmed cases          | 2,774,221  | 5,697,954    | 1,153,157                   | 223,915                | 918,591                | 356,666| 11,125,245|
| Daily confirmed cases          | 16,665     | 122,472      | 18,468                      | 2121                   | 29,859                 | 14,251 | 203,836  |
| Total confirmed deaths         | 199,579    | 262,538      | 27,074                      | 7481                   | 24,473                 | 6746   | 528,204  |
| Daily confirmed deaths         | 369        | 3444         | 555                         | 10                     | 699                    | 118    | 5195     |

This data was provided by the WHO in their 167th situation report and can be viewed from https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200705-covid-19-sitrep-167.pdf?sfvrsn=17e7e93df_2.
are lighter than respiratory droplets, and can linger in the air when generated. If certain precautions are not followed, these droplets may be inhaled and can cause infection.[20]

Other routes of transmission include contact with feces, blood, urine, and conjunctival secretions. However, these are much less common causes of infection.[4,15].

Infection prevention and control

The most straightforward and simple way to avoid infection and spreading of COVID-19 is to avoid areas which are known to have a SARS-CoV-2 outbreak.[15]. Governments worldwide have enacted an international travel ban, preventing further spread of the disease, while also enforcing national lockdowns to control the spread of the disease locally.[1,6,15]. Washing one's hands is also a reliable way to prevent transmission.[6,15]. To avoid the spread of aerosols and droplets, it is also recommended to cover one's mouth and nose when sneezing or coughing with a tissue, disposing of the tissue, and immediately washing one's hands.[6,15,22].

In the case of primary and secondary health care workers in hospital and community settings, extra precautions and preventative measures should be taken whenever possible. Personal protective equipment (PPE) should be used by health care workers to prevent transmission by bodily fluids and aerosols, as recommended by the WHO, the NHS, and Public Health England[6,18,23]. When AGPs need to be performed, health care workers can don gowns and filtering face piece respirators type 3 (FFP3) containing masks, which filter the air inhaled and exhaled through the masks.[21]. The FFP3 masks, when fitted correctly, create an air-tight seal around the nose and mouth.

Table 2 demonstrates that the N95 and FFP2 mask have similar filtering capabilities, while the FFP3 mask is the most efficient at filtering both water and oil based air particles.[23]. Selective usage of PPE has been recommended due to their current overuse, to prevent further shortage of their supply.[23–25]. To maximize the effect of SICPs, it is recommended that everyone practice these procedures consistently.

### Symptoms

The characteristic symptoms of COVID-19 were explored in a cohort study which took place in Wuhan, China. The 41 patients involved in the study had their diagnoses confirmed by testing of their sputum through a polymerase chain reaction, and was comprised of a male to female ratio of ∼3:1. The median age of the patients was 49, and only 13 patients had an underlying disease before acquiring COVID-19. The majority of these patients exhibited symptoms of fever, dry cough, and dyspnea. While examining their blood, lymphopenia was also found.[26]

A joint mission statement by the World Health Organisation (WHO) and the Chinese government reported on 55,924 confirmed cases of COVID-19, which also identified a high proportion of patients exhibiting symptoms of a dry cough and fever.[27]. Other common symptoms include shortness of breath, sputum production, and fatigue. All the recorded symptoms which can present in patients with COVID-19, as reported by this joint mission statement, with their respective prevalence arranged from most to least common, can be seen in Table 3.[27]

Recently, there has been a noticeable presence of anosmia and ageusia in COVID-19 patients, which are a loss of the sensation of smell and taste, respectively. A statement from ENT UK suggested the addition of anosmia and hyposmia as recognized symptoms of COVID-19, to aid in raising awareness of the symptoms, and enhance the effect of SICPs in the community.[28–32]. A survey of 237 patients conducted in the United States noted that anosmia was reported before a confirmed diagnosis in 73% of cases, and was the initial symptom in 27% of cases. Similar findings have also been reported in studies conducted in Italy and Iran.[28–31]. Retrospective data analysis of 169 patients from a hospital in San Diego also showed that anosmia was commonplace, and that loss of smell in COVID-19 may be associated with a milder clinical presentation of the disease.[32]. Some of the more severe COVID-19-induced syndromes include a progression to bilateral viral pneumonia, a secondary infection, and development of acute respiratory distress syndrome (ARDS).[26].

### Table 2

| Properties                  | N95 (NIOSH-42CFR84) | FFP2 | FFP3 |
|-----------------------------|--------------------|------|------|
| Assigned protection factor  | ≥ 95% (85 L/min)   | ≥ 94% (95 L/min) | ≥ 99% (95 L/min) |
| Filter efficiency           | ≤ 8%               | ≤ 6% | ≤ 2% |
| Test agent used             | NaCl               | NaCl and Paraffin | NaCl and Paraffin |
| Total inward leakage (TIL)  | ≤ 245 Pa (95 L/min) | ≤ 300 Pa (95 L/min) |
| Inhalation resistance       | ≤ 245 Pa (95 L/min) | ≤ 300 Pa (95 L/min) |
| Exhalation resistance       | ≤ 245 Pa (95 L/min) | ≤ 300 Pa (95 L/min) |
| Rebreathed CO2              | ≤ 1%               | ≤ 1% |

The data for this table was provided by https://www.hse.gov.uk/news/assets/docs/face-mask-equivalence-aprons-gown-eye-protection.pdf. NA indicates not applicable.

### Table 3

| Symptom                      | Frequency (%) |
|------------------------------|---------------|
| Fever                        | 87.9          |
| Dry cough                    | 67.7          |
| Fatigue                      | 38.1          |
| Sputum production            | 33.4          |
| Shortness of breath          | 18.6          |
| Myalgia/arthralgia           | 14.8          |
| Sore throat                  | 13.9          |
| Headache                     | 13.6          |
| Chills                       | 11.4          |
| Nausea or vomiting           | 5.0           |
| Diarrhoea                    | 3.7           |
| Haemoptysis                  | 0.9           |
| Nasal congestion             | 0.8           |

The data in this table was provided by the WHO-China in their joint mission statement and can be viewed from https://www.who.int/docs/default-source/coronaviruse/who-china-joint-mission-on-covid-19-final-report.pdf.
Comorbidities that have been found to predispose patients to more severe symptoms and a higher risk of mortality include diabetes mellitus, cardiac diseases, hypertension, chronic obstructive pulmonary disorder, cancer, the male sex, and old age\cite{33–36}. There is no strong evidence to suggest that asthma leads to a more severe expression of symptoms or a higher risk of mortality\cite{17–39}.

Pathophysiology

Previous studies examining similar coronavirus strains have demonstrated that they typically enter host cells by binding to a host cell’s receptor, via receptor-binding domains on their S proteins\cite{40}. The similarities between the SARS-CoV and SARS-CoV-2 viral surface S proteins suggest that the receptor on the surface of a host’s cell membrane which allows for cell invasion to occur is angiotensin-converting enzyme 2 (ACE2). ACE2 can be found in the lungs, liver, heart, intestines, vascular endothelium, kidneys, and testes\cite{14,41–43}. This process leads to ACE2 down-regulation on the cell membrane. ACE2 has been found to have a protective effect against acute lung injury when observed in mice, which explains the extensive lung injury caused by the binding of viral S proteins to the host cell’s ACE2 receptors.

Little is known about the nature of the host immune response to SARS-CoV-2. It is speculated that, like all viral pathogens, an increased expression of pathogen-associated molecular patterns secondary to intracellular replication activates pattern-recognition receptors on antigen-presenting cells such as macrophages and dendritic cells. This cascade of events triggers the release of proinflammatory cytokines, and the presentation of the viral antigen by these cells to MHC class 1 CD4+ T-helper cells (Th1). Th1 cells then stimulate the production of CD8+ T cells, which are capable of recognizing and killing host cells containing viral RNA. Th1 cells also stimulate T-dependent B cells to produce antigen-specific IgM and IgG antibodies. A dysregulated and disproportionate cytokine response to this initial injury can lead to the development of ARDS\cite{44,45}.

When reviewing SARS-CoV it was noted that adaptive immunity can be present after an infection by the virus for up to 2 years\cite{46,47}, but there is as of yet no evidence to confirm that the duration of immunity would be similar with SARS-CoV-2. Therefore, further research regarding the immune system’s response to SARS-CoV-2 should be conducted before any conclusions can be made\cite{46}. There have been multiple investigations into the production of SARS-CoV-2-specific IgG and IgM antibodies post-infection\cite{45}, but these have yielded mixed results so far as the efficacy of these antibodies in providing immunity is concerned\cite{48–54}. These mixed results could be attributed to the variety of nonvalidated serological tests used in these studies. A higher validity and greater coherence would be achieved in future studies through the use of similarly validated tests, larger sample sizes, and more appropriate study methodologies.

Diagnostic techniques

Laboratory techniques

The WHO recommends the use of nucleic acid amplification tests (NAATs) such as reverse transcriptase polymerase chain reaction (RT-PCR) on either upper respiratory tract samples, such as throat swabs, or lower respiratory tract samples, such as sputum\cite{55}. However, the use of fecal samples has also been investigated, as the receptor ACE2 can also be found in fecal matter of people infected by COVID-19\cite{56,57}. The sensitivity of the RT-PCR test is ~89%\cite{58}.

There has been recent research into the use of serological tests for COVID-19 diagnosis. The “Solidarity II” project is a WHO-led international collaboration on the use of these tests\cite{59}. Both the US and UK governments have approved the use of the Roche Elecsys Anti-SARS-CoV-2 immunoassay for the general public, which has demonstrated a sensitivity and specificity of >80% and >95% in preliminary studies, respectively\cite{60,61}. Further research into the appropriate timing of serological testing after symptom onset is required.

Radiographic techniques

The use of radiological imaging techniques has been very useful in the diagnosis of COVID-19. The presence of bilateral peripheral ground-glass opacities in thoracic computed tomography (CT) images, with or without consolidation, was established as having a reliable sensitivity for the diagnosis of the disease while it is still in its early stages\cite{62}. A recent meta-analysis of 63 studies concluded that even though thoracic CT images demonstrated a high sensitivity and negative predictive value (NPV) (94% and 95.4%–99.8%, respectively), the specificity and positive predictive value (PPV) for this test were poor (37% and 1.5%–30.7%, respectively)\cite{58}. Therefore, the use of thoracic CT imaging techniques with the purpose of screening or diagnosing COVID-19 would not be beneficial in regions with a low infection rate. The studies which were included were conducted in eight different countries, where the range of the infection rate of COVID-19 in their populations was between 1.0% (Taiwan) and 39.0% (China).

The use of chest x-rays as a radiologic diagnostic technique has also been examined. A plain chest x-ray demonstrates a poor sensitivity for the diagnosis of the disease in its early stages, which has been corroborated by several studies\cite{62–64}.

Treatments

Supportive treatment

The guidance for the management of COVID-19 supports the use of low-flow supplemental oxygen through nasal cannulas in hypoxemic patients, with a target O2 saturation of 94%–96%\cite{65}. Continuous positive airway pressure or noninvasive ventilation may be used as alternatives to invasive mechanical ventilation. However, the use of high-flow nasal oxygen (HFNO) is not recommended as the risk of aerosol generation in older machines can be quite high. The risk of transmission through HFNO in bacterial infections has also been examined. A plain chest x-ray demonstrates a poor sensitivity for the diagnosis of the disease in its early stages, which has been corroborated by several studies\cite{62–64}.
Chemotherapeutic agents

Several therapies are currently being trialled for the targeted active treatment of COVID-19[70]. Convalescent plasma refers to the plasma obtained from patients who have recovered from a disease. Administration of convalescent plasma to patients suffering from the same disease provides antibodies to help combat the invading pathogen and may provide some benefit to developing endogenous adaptive immunity. A rolling Cochrane systematic review of the literature has concluded that at the present time there is little evidence to confirm the effectiveness or safety of the use of convalescent plasma to treat COVID-19[71]. The WHO “Solidarity” trial is investigating four treatment options for COVID-19: hydroxychloroquine, lopinavir/ritonavir, remdesivir, and interferon β1a[82]. The use of convalescent plasma as a treatment for COVID-19 is also being investigated in London as a branch of the REMAP-CAP trial[73].

Hydroxychloroquine is an antimalarial medication which is also used in the treatment of systemic lupus erythematosus and rheumatoid arthritis. Studies in China and France, using small sample sizes, have found that hydroxychloroquine holds potential benefits in the treatment of COVID-19[74-77]. A large multinational registry analysis concluded that both chloroquine and hydroxychloroquine are associated with decreased in-hospital survival and increased frequency of ventricular arrhythmias. However, this article was later retracted due to concerns over the veracity of the primary data sources[78,79].

The Lopinavir-Ritonavir drug combination (Kaletra) is currently used in the treatment of human immunodeficiency virus (HIV). This combination has been used to treat both SARS and MERS in the past, and a systematic review has concluded that it is effective against both in vitro and in vivo animal studies[80]. However, a randomized-controlled trial of 199 patients found no therapeutic benefit from lopinavir/ritonavir in hospitalized patients with severe COVID-19[81].

The “RECOVERY Trial,” currently being conducted at the University of Oxford, aims to investigate the use of Lopinavir-Ritonavir in COVID-19 patients, as well as interferon β1a, hydroxychloroquine, and dexamethasone[82].

Remdesivir is an antiviral agent which is also being investigated for the potential treatment of COVID-19. It has been shown to reduce SARS-CoV-2 replication in vitro, as well as inducing a suppression of MERS-CoV replication when it was tested in mice[82]. A recent randomized-controlled trial of 237 patients found no therapeutic benefit from remdesivir in COVID-19 patients[83]. The European “Discovery Trial,” which is currently ongoing, will explore the use of Remdesivir, as well as Lopinavir-Ritonavir, with and without interferon and hydroxychloroquine, to determine their applicability as treatment options for COVID-19[70,84]. The University of Southampton is also trialling the use of inhaled interferon-β in COVID-19 patients[85].

Vaccination

As of June 9, 2020, the WHO has established 10 candidate vaccines in clinical evaluation and 126 candidate vaccines in preclinical evaluation[86]. Furthermore, 4 of the 10 vaccines currently in clinical evaluation are inactivated forms of the SARS-CoV-2 virus, while the remaining 6 vaccines are investigating viral vectors, DNA/RNA, and protein subunits of the virus[86].

Surgery

As with all clinical services, the COVID-19 pandemic has had a profound impact on the provision of safe surgical care. This was in response to concerns over the severity of pulmonary complications that the SARS-CoV-2 virus may confer to patients in the perioperative period. The 4 royal colleges of surgery of Great Britain and Ireland issued a guide regarding the prioritization of surgery during the COVID-19 pandemic, which details revised timeframes for most nonobstetric and nonophthalmic procedures[87]. These actions appear to have been well-founded, as a recent cohort study of 1128 patients in 24 countries has demonstrated that pulmonary complications occurred in 51% of patients who had COVID-19 diagnosed perioperatively, among whom the 30-day mortality was 38%. The overall 30-day mortality of the cohort was 24% and was significantly associated with male sex and age of older than 70 years[88].

The paucity of data on transmission of the COVID-19 virus has also led to concerns for safety of operating theater staff. Given the likely transmission of the virus by respiratory droplets, specific guidance for staff safety during airway interventions and AGIs has been published for anesthetic and ENT staff as well[89,90]. There have also been concerns over the possibility of viral transmission from uncontrolled release of pressurized gas from laparoscopic ports, as well as from surgical smoke plumes[91]. A review of the available literature concluded that though there is no scientific evidence to suggest that COVID-19 transmission occurs through either laparoscopic or open surgical approaches, modifications should be made to surgical practice to mitigate the theoretical risk of transmission[92]. Such recommendations include minimal use of energy devices to reduce smoke plume, as well as use of lower abdominal insufflation pressure (<12 mm Hg). Already, some hospitals have re-established laparoscopic procedures based on local staff and equipment[91,93]. A review of articles pertaining to surgery and COVID-19 recommended that open surgery should still be considered when safe measures for laparoscopic procedures cannot be guaranteed[94].

Attention must also be given to the safe reintroduction of elective surgery, as further postponement of surgery can result in severe consequences, such as worsening patient conditions and an increased risk of surgery[95]. A recent study in 190 countries estimated that over 28 million operations had been cancelled or rescheduled over 12 weeks of peak disruption, with an estimated average requirement of 45 weeks needed to correct this backlog of procedures after a 20% increase to their current surgical volume has been implemented[96]. Guidance for centers on recovery of surgical services during and after COVID-19 is published and regularly updated by the Royal College of Surgeons of England and outlines key considerations such as local COVID-19 incidence and prevalence, PPE, testing capabilities, and workforce capacities[97].

The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) and the European Association of Endoscopic Surgeons (EAES) have released revised guidelines which mirror the considerations and adaptations established by the 4 royal colleges of surgery in the United Kingdom. These include postponing elective operations, proper sterilization, and preventative measures being followed, added safety measures such as filtering of released gases and minimal hospital stay for patients. Since there was little evidence to indicate otherwise, both minimally invasive and open procedures are still considered safe and recommended in these guidelines as well[98].
Conclusions
The genome of the SARS-CoV-2 coronavirus is similar to the SARS-CoV coronavirus, and further research is required to confirm whether they behave in a similar way in vivo. Even though bat populations in Asia are known to be carriers of a wide range of coronaviruses, there is currently no evidence to prove that SARS-CoV-2 originated from them. The primary method of transmission between humans is believed to be via inhalation of respiratory droplets, but transmission through the fecal-oral route, urine, and blood is also possible. Although presymptomatic transmission commonly occurs, further research is required to ascertain whether transmission can occur by asymptomatic people. The 3 most commonly reported symptoms of COVID-19 are fever, dry cough, and fatigue. Further research is being carried out to determine the prevalence of anosmia as a symptom of COVID-19 infections. Comorbidities that predispose COVID-19 patients to a more severe infection include: diabetes mellitus, cardiac diseases, hypertension, chronic obstructive pulmonary disorder, cancer, the male sex, and old age. Currently there is little evidence to support the hypothesis that asthma confers a higher risk of morbidity and mortality. An RT-PCR of upper respiratory tract samples, as well as thoracic CT, have both demonstrated an acceptable sensitivity as tests for COVID-19 infections. However, chest x-rays have demonstrated a poor sensitivity as a screening test in the early stages of the disease. Current recommended supportive measures for COVID-19 include low-flow supplemental oxygen, conservative fluid management, continuous positive airway pressure, and intubation for severe hypoxaemia. The use of HFNO is not recommended as this may promote viral spread, as well as placing strain on a hospital’s oxygen-delivery capacity.

The main therapeutic agents under investigation for treatment of COVID-19 include: convalescent plasma, hydroxychloroquine, Lopinavir-Ritonavir, Remdesivir, and interferon-β. The early phases of vaccination trials have been launched internationally, with the majority testing exposure to viral surface proteins, rather than the inactivated virus. We anticipate the first results from these trials by December, 2020.

Assistance with study
None.

Ethical approval
The collection of data, informed consent of patients or participants, or ethical requirements to share data were not mandatory when writing this review, as all of the data used was available to the public and gathered from other sources. At no point during the writing of this manuscript was new data generated by the authors or their affiliations in any fashion. As such, ethical approval to proceed with the writing of this manuscript did not constitute or direct any part of the writing of this review, and therefore no ethical approval was sought/obtained. Ethics approval was not required for this review.

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Author contribution
C.P. was responsible for the initial conception of the review, as well as researched the available materials and wrote the references for the following sections: abstract, introduction, taxonomy and genome, viral life cycle, etiology, transmission, and infection prevention and control, pathophysiology, surgery, Figure 1, Figure 2, Table 1, and Table 2. C.P. also wrote the content in those sections, and revised the entire paper to ensure the integrity and accuracy of the content included in the manuscript was correct to the best of the author’s knowledge. S.C. researched the available materials and wrote the references for the following sections: symptoms, pathophysiology, diagnostic techniques, treatments, surgery, conclusion, and Table 3. He also wrote the content in those sections and revised those sections to ensure the integrity and accuracy of the content included in those sections was correct to the best of his knowledge. S.J. was most responsible for the initial conception of the review and aided in the revising of the entire manuscript. He played a pivotal role in the design of the review and guided the writing of the review, but did not contribute to it. All authors agreed to be personally accountable for the submitted version of the manuscript and agreed upon the included content of the manuscript before completion. All authors have agreed that the integrity and content of this manuscript is to the best of their knowledge accurate and appropriate.

Conflicts of interest disclosure
The authors declare that they have no financial conflict of interest with regard to the content of this report.

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There was no registration unique identifying number for this review. The writing of this manuscript did not involve human subjects and does not constitute a clinical trial. Registration in a publicly available database was not required for this review.

Guarantor
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