

Coronavirus Disease 2019 (COVID-19)

Interim Clinical Guidance for Management of Patients with Confirmed Coronavirus Disease (COVID-19)

Summary of Recent Changes

Revisions were made on March 7, 2020, to reflect the following:

- Characteristics of patients with confirmed COVID-19 based on recent epidemiologic data from China, including characteristics of patients with COVID-19 admitted to the intensive care unit and data on pediatric cases
- Data regarding SARS-CoV-2 viral shedding among asymptomatic persons, and data from a recent report of viable SARS-CoV-2 isolation from stool
- Accessibility of investigational drug therapies for COVID-19 treatment through clinical trial enrollment in the United States
- Recently published pediatric surviving sepsis guidance

Updated March 7, 2020

This interim guidance is for clinicians caring for patients with confirmed infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus that causes coronavirus disease (COVID-19).

This update includes additional information from recent reports including:

- Characteristics of patients with confirmed COVID-19 based on recent epidemiologic data from China, including characteristics of patients with COVID-19 admitted to the intensive care unit and data on pediatric cases
- Data regarding SARS-CoV-2 viral shedding among asymptomatic persons, and data from a recent report of viable SARS-CoV-2 isolation from stool
- Accessibility of investigational drug therapies for COVID-19 treatment through clinical trial enrollment in the United States
- Recently published pediatric surviving sepsis guidance

CDC will update this interim guidance as more information becomes available.

Clinical Presentation

Among reports that describe the clinical presentation of patients with confirmed COVID-19, most are limited to hospitalized patients with pneumonia. The incubation period is estimated at 4 days (interquartile range: 2 to 7 days). [1] Some studies have estimated a wider range for the incubation period; data for human infection with other coronaviruses (e.g. MERS-CoV, SARS-CoV) suggest that the incubation period may range from 2-14 days. Frequently reported signs and symptoms of patients admitted to the hospital include fever (77–98%), cough (46%–82%), myalgia or fatigue (11–52%), and shortness of breath (3–31%) at illness onset. [2–5] Among 1,099 hospitalized COVID-19 patients, fever was present in 44% at hospital admission, and developed in 89% during hospitalization. [6] Other less commonly reported respiratory symptoms include sore throat, headache, cough with sputum production and/or hemoptysis. Some patients have experienced gastrointestinal symptoms such as diarrhea and nausea prior to developing fever and lower respiratory tract

signs and symptoms. The fever course among patients with COVID-19 is not fully understood; it may be prolonged and intermittent. A limited number of reports describe identification of asymptomatic or subclinical infection on the basis of detection of SARS-CoV-2 RNA or live virus from throat swab specimens of contacts of confirmed patients. [7–8]

Risk factors for severe illness are not yet clear, although older patients and those with chronic medical conditions may be at higher risk for severe illness. Among more than 44,000 confirmed cases of COVID-19 in China as of Feb 11, 2020, most occurred among patients aged 30–69 years (77.8%), and approximately 19% were severely or critically ill [9]. Case-fatality proportion among cases aged ≥ 60 years was: 60–69 years: 3.6%; 70–79 years: 8%; ≥ 80 years: 14.8%. Patients who reported no underlying medical conditions had an overall case fatality of 0.9%, but case fatality was higher for patients with comorbidities: 10.5% for those with cardiovascular disease, 7% for diabetes, and 6% each for chronic respiratory disease, hypertension, and cancer. Case fatality for patients who developed respiratory failure, septic shock, or multiple organ dysfunction was 49%. [9]

Limited information is available about the clinical presentation, clinical course, and risk factors for severe COVID-19 in children. Of confirmed COVID-19 patients in China as of Feb 11, 2020, only 2.1% were aged < 20 years, and no deaths were reported among those < 10 years of age [9]. From limited published reports, signs and symptoms among children with COVID-19 may be more mild than adults, with most pediatric patients presenting with fever, cough, congestion, and rhinorrhea [10, 12–13], and one report of primarily gastrointestinal symptoms (vomiting and diarrhea) [13]. Prolonged detection of SARS-CoV RNA has been reported in respiratory specimens (up to 22 days after illness onset) and stool specimens (at least 30 days after illness onset) [10–11]. Severe complications of acute respiratory distress syndrome and septic shock were reported in a 13-month old with COVID-19 in China [13].

Clinical Course

Clinical presentation among reported cases of COVID-19 varies in severity from asymptomatic infection to mild illness to severe or fatal illness. Some reports suggest the potential for clinical deterioration during the second week of illness.[2,5] In one report, among patients with confirmed COVID-19 and pneumonia, just over half of patients developed dyspnea a median of 8 days after illness onset (range: 5–13 days). [2] In another report, the mean time from illness onset to hospital admission with pneumonia was 9 days.[1] Acute respiratory distress syndrome (ARDS) developed in 17–29% of hospitalized patients, and secondary infection developed in 10%. [2,4] In one report, the median time from symptom onset to ARDS was 8 days.[3]

Approximately 20–30% of hospitalized patients with COVID-19 and pneumonia have required intensive care for respiratory support.[2–3] Compared to patients not admitted to an intensive care unit, critically ill patients were older (median age 66 years versus 51 years), and were more likely to have underlying co-morbid conditions (72% versus 37%). [3] Among critically ill patients admitted to an intensive care unit, 11–64% received high-flow oxygen therapy and 47–71% received mechanical ventilation; some hospitalized patients have required advanced organ support with endotracheal intubation and mechanical ventilation (4–42%).[3–4,9] A small proportion have also been supported with extracorporeal membrane oxygenation (ECMO, 3–12%).[3–4,9] Other reported complications include cardiac injury, arrhythmia, septic shock, liver dysfunction, acute kidney injury, and multi-organ failure. Post-mortem biopsies in one patient who died of ARDS reported pulmonary findings of diffuse alveolar damage. [14]

An overall case fatality proportion of 2.3% has been reported among confirmed cases of COVID-19 in China. [9] However, the majority of these cases were among hospitalized patients and therefore this estimate of mortality is likely biased upward. Among hospitalized patients with pneumonia, the case fatality proportion has been reported as 4–15%.[2–4] Among critically ill COVID-19 patients in China, the reported case fatality proportion was 49%. In a report from one hospital, 61.5% of critically ill patients with COVID-19 had died by day 28 of ICU admission. [9,15]

Diagnostic Testing

Information on specimen collection, handling, and storage is available at: [Real-Time RT-PCR Panel for Detection 2019-Novel Coronavirus](#). After initial confirmation of COVID-10, additional testing of clinical specimens can help inform clinical management, including discharge planning.

Laboratory and Radiographic Findings

The most common laboratory abnormalities reported among hospitalized patients with pneumonia on admission included leukopenia (9–25%), leukocytosis (24–30%), lymphopenia (63%), and elevated alanine aminotransferase and aspartate aminotransferase levels (37%). [2,4] Among 1,099 COVID-19 patients, lymphocytopenia was present in 83%; 36% had thrombocytopenia, and 34% had leukopenia. [6] Most patients had normal serum levels of procalcitonin on admission. Chest CT images have shown bilateral involvement in most patients. Multiple areas of consolidation and ground glass opacities are typical findings reported to date. [2–4, 16–24] However, one study that evaluated the time from symptom onset to initial CT scan found that 56% of patients who presented within 2 days had a normal CT. [20]

Limited data are available about the detection of SARS-CoV-2 RNA and infectious virus in clinical specimens. SARS-CoV-2 RNA has been detected from upper and lower respiratory tract specimens, and the virus has been isolated in cell culture from upper respiratory tract specimens and bronchoalveolar lavage fluid. In one case series SARS-CoV-2 viral RNA levels in the first 3 days after symptom onset were higher in specimens collected from the nose than from the throat (as demonstrated by lower cycle threshold values in the nose). [25] A similar time course and pattern of viral RNA detection was reported in one asymptomatic patient after exposure to a patient with confirmed COVID-19. [25]

SARS-CoV-2 RNA has been detected in blood and stool specimens and SARS-CoV-2 virus has been isolated in cell culture from the stool of a patient with pneumonia 15 days after symptom onset. [26–29]. The duration of SARS-CoV-2 RNA detection in the upper and lower respiratory tracts and in extrapulmonary specimens is not yet known. It is possible that RNA could be detected for weeks, which has occurred in some cases of MERS-CoV or SARS-CoV infection. [30–37] Viable SARS-CoV has been isolated from respiratory, blood, urine, and stool specimens. In contrast, viable MERS-CoV has been isolated only from respiratory tract specimens. [37–39]

Clinical Management and Treatment

For information regarding infection prevention and control recommendations, please see [Interim Infection Prevention and Control Recommendations for Patients with Confirmed Coronavirus Disease 2019 \(COVID-19\) or Persons Under Investigation for COVID-19 in Healthcare Settings](#).

Patients with a mild clinical presentation may not initially require hospitalization. However, clinical signs and symptoms may worsen with progression to lower respiratory tract disease in the second week of illness; all patients should be monitored closely. Possible risk factors for progressing to severe illness may include, but are not limited to, older age, and underlying chronic medical conditions such as lung disease, cancer, heart failure, cerebrovascular disease, renal disease, liver disease, diabetes, immunocompromising conditions, and pregnancy.

The decision to monitor a patient in the inpatient or outpatient setting should be made on a case-by-case basis. This decision will depend not only on the clinical presentation, but also on the patient's ability to engage in monitoring, home isolation, and the risk of transmission in the patient's home environment. For more information, see [Evaluating and Reporting Persons Under Investigation \(PUI\)](#)

No specific treatment for COVID-19 is currently available. Clinical management includes prompt implementation of recommended infection prevention and control measures and supportive management of complications, including advanced organ support if indicated.

Corticosteroids should be avoided, because of the potential for prolonging viral replication as observed in MERS-CoV patients, unless indicated for other reasons. [31, 40–42] For example, for a chronic obstructive pulmonary disease exacerbation or for septic shock per Surviving Sepsis guidelines for [adults](#) and [children](#).

For more information, see: [WHO interim guidance on clinical management of severe acute respiratory infection when novel coronavirus \(nCoV\) infection is suspected](#), [Diagnosis and Treatment of Adults with Community-acquired Pneumonia. An Official Clinical Practice Guideline of the American Thoracic Society and Infectious Diseases Society of America](#), and [Surviving Sepsis Campaign International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children](#)

Investigational Therapeutics

There are currently no antiviral drugs licensed by the U.S. Food and Drug Administration (FDA) to treat patients with COVID-19. In the United States, the National Institutes of Health (NIH) and collaborators are working on development of candidate vaccines and therapeutics for COVID-19. Some in-vitro or in-vivo studies suggest potential therapeutic activity of compounds against related coronaviruses, but there are no available data from randomized controlled trials in humans to support recommending any investigational therapeutics for patients with confirmed or suspected COVID-19 at this time.

Remdesivir is an investigational antiviral drug that was reported to have in-vitro activity against SARS-CoV-2. [43] Some patients with COVID-19 have received intravenous remdesivir for compassionate use outside of a clinical trial setting. In China, multiple clinical trials of investigational therapeutics have been implemented, including two clinical trials of remdesivir. An [NIH adaptive randomized controlled clinical trial](#) of investigational therapeutics for hospitalized COVID-19 patients in the United States was approved by the Food and Drug Administration; the first investigational therapeutic to be studied is remdesivir. Other remdesivir trials for COVID-19 patients in the U.S. are available (participants with [severe](#) and [moderate](#) coronavirus disease). Some COVID-19 patients have received uncontrolled treatment with other investigational antivirals. [4, 28, 44] For information on specific clinical trials underway for treatment of patients with COVID-19, see [clinicaltrials.gov](#), and [www.chictr.org.cn](#)

In the absence of an approved vaccine, community mitigation measures are the primary way to reduce SARS-CoV-2 transmission among persons in the community, and adherence to recommended infection prevention and control measures can reduce the risk of SARS-CoV-2 spread in healthcare facilities. In the absence of an approved therapeutic with demonstrated safety and efficacy in patients with COVID-19, clinical management of COVID-19 patients includes avoidance of corticosteroids, and supportive care of complications, including advanced organ support.

Discontinuation of Transmission-Based Precautions or Home Isolation

For recommendations on discontinuation of transmission-based precautions or home isolation for patients who have recovered from COVID-19 illness, please see: [Interim Guidance for Discontinuation of Transmission-Based Precautions and Disposition of Hospitalized Patients with COVID-19](#) and [Interim Guidance for Discontinuation of In-Home Isolation for Patients with COVID-19](#)

Additional resources:

- [Evaluating and Reporting Persons Under Investigation \(PUI\)](#)
- [Resources for Hospitals and Healthcare Professionals Preparing for Patients with Suspected or Confirmed COVID-19](#)
- [Interim Infection Prevention and Control Recommendations for Patients with Confirmed Coronavirus Disease 2019 \(COVID-19\) or Persons Under Investigation for COVID-19 in Healthcare Settings](#)
- [World Health Organization. Interim Guidance on Clinical management of severe acute respiratory infection when novel coronavirus \(nCoV\) infection is suspected](#)
- [American Thoracic Society and Infectious Diseases Society of America Clinical Practice Guidelines. Diagnosis and treatment of adults with community-acquired pneumonia](#)
- [Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016](#)
- [Surviving Sepsis Campaign International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children](#)
- [Clinical Practice Guidelines by the Infectious Diseases Society of America: 2018 Update on Diagnosis, Treatment, Chemoprophylaxis, and Institutional Outbreak Management of Seasonal Influenza](#)

References

1. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, Liu L, Shan H, Lei CL, Hui DSC, Du B, Li LJ, Zeng G, Yuen KY, Chen RC,

- Tang CL, Wang T, Chen PY, Xiang J, Li SY, Wang JL, Liang ZJ, Peng YX, Wei L, Liu Y, Hu YH, Peng P, Wang JM, Liu JY, Chen Z, Li G, Zheng ZJ, Qiu SQ, Luo J, Ye CJ, Zhu SY, Zhong NS; China Medical Treatment Expert Group for Covid-19. Clinical Characteristics of Coronavirus Disease 2019 in China. *N Engl J Med*. 2020 Feb 28. doi: 10.1056/NEJMoa2002032. [Epub ahead of print]
- Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The Lancet*. 2020 Jan 24.
 - Wang D, Hu B, Hu C, Zhu F, Liu X et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan. Published online February 7, 2020.
 - Chen N, Zhou M, Dong X, Qu J, Gong F. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet*. 2020 Jan 30. [Epub ahead of print]
 - Holshue ML, DeBolt C, Lindquist S, Lofy KH, Wiesman J et al. First Case of 2019 Novel Coronavirus in the United States. *N Engl J Med*. 2020 Jan 31. doi: 10.1056/NEJMoa2001191. [Epub ahead of print]Huang C, Wang Y, Li X, Ren L, Zhao J, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*. 2020 Jan 24. [Epub ahead of print]
 - Li Q, Guan X, Wu P, Wang X, Zhou L, et al. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. *N Engl J Med*. 2020 Jan 29.
 - Chan JF, Yuan S, Kok K, To KK, Chu H, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet*. 2020 Jan 24. [Epub ahead of print]
 - Hoehl S, Berger A, Kortenbusch M, Cinatl J, Bojkova D, Rabenau H, Behrens P, Böddinghaus B, Götsch U, Naujoks F, Neumann P. Evidence of SARS-CoV-2 Infection in Returning Travelers from Wuhan, China. *New England Journal of Medicine*. 2020 Feb 18.
 - [Novel Coronavirus Pneumonia Emergency Response Epidemiology Team](#)  . [The Epidemiological Characteristics of an Outbreak of 2019 Novel Coronavirus Diseases (COVID-19) in China]. *Zhonghua Liu Xing Bing Xue Za Zhi*. 2020;41(2):145–151. DOI:10.3760/cma.j.issn.0254-6450.2020.02.003.
 - Kam KQ, Yung CF, Cui L, Lin Tzer Pin R, Mak TM, Maiwald M, Li J, Chong CY, Nadua K, Tan NWH, Thoon KC. A Well Infant with Coronavirus Disease 2019 (COVID-19) with High Viral Load. *Clin Infect Dis*. 2020 Feb 28. pii: ciaa201. doi: 10.1093/cid/ciaa201. [Epub ahead of print]
 - Cai J, Xu J, Lin D, Yang Z, Xu L, Qu Z, Zhang Y, Zhang H, Jia R, Liu P, Wang X, Ge Y, Xia A, Tian H, Chang H, Wang C, Li J, Wang J, Zeng M. A Case Series of children with 2019 novel coronavirus infection: clinical and epidemiological features. *Clin Infect Dis*. 2020 Feb 28. pii: ciaa198. doi: 10.1093/cid/ciaa198. [Epub ahead of print]
 - Wei M, Yuan J, Liu Y, Fu T, Yu X, Zhang ZJ. Novel Coronavirus Infection in Hospitalized Infants Under 1 Year of Age in China. *JAMA*. 2020 Feb 14. doi: 10.1001/jama.2020.2131. [Epub ahead of print]
 - Chen F, Liu ZS, Zhang FR, Xiong RH, Chen Y, Cheng XF, Wang WY, Ren J. [First case of severe childhood novel coronavirus pneumonia in China]. *Zhonghua Er Ke Za Zhi*. 2020 Feb 11;58(0):E005. doi: 10.3760/cma.j.issn.0578-1310.2020.0005. [Epub ahead of print] Chinese.
 - Xu Z, Shi L, Wang Y, Zhang J, Huang L, Zhang C, Liu S, Zhao P, Liu H, Zhu L, Tai Y, Bai C, Gao T, Song J, Xia P, Dong J, Zhao J, Wang FS. Pathological findings of COVID-19 associated with acute respiratory distress syndrome. *Lancet Respir Med*. 2020 Feb 18. pii: S2213-2600(20)30076-X. doi: 10.1016/S2213-2600(20)30076-X. [Epub ahead of print]
 - Yang X, Yu Y, Xu J, Shu H, Xia J, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. *Lancet Respir Med*. 2020. Published Online February 21, 2020 [https://doi.org/10.1016/S2213-2600\(20\)30079-5](https://doi.org/10.1016/S2213-2600(20)30079-5)
 - Chang D, Mingguai L, Wei L, Lixin X, Guangfa Z et al. Epidemiologic and Clinical Characteristics of Novel Coronavirus Infections Involving 13 Patients Outside Wuhan China. Published online February 7, 2020.
 - Zhu N, Zhang D, Wang W, Li X, Yang B, et al; China Novel Coronavirus Investigating and Research Team. A Novel Coronavirus from Patients with Pneumonia in China, 2019. *N Engl J Med*. 2020 Jan 24. [Epub ahead of print]
 - Phan LT, Nguyen TV, Luong QC, Nguyen TV, Nguyen HT et al. Importation and Human-to-Human Transmission of a Novel Coronavirus in Vietnam. *N Engl J Med*. 2020 Jan 28. doi: 10.1056/NEJMc2001272. [Epub ahead of print]
 - Lei J, Li J, Li X, Qi X. CT Imaging of the 2019 Novel Coronavirus (2019-nCoV) Pneumonia. *Radiology*. 2020 Jan 31:200236. doi: 10.1148/radiol.2020200236. [Epub ahead of print]

20. Bernheim A, Mei X, Huang M, Yang Y, Fayad ZA, Zhang N, Diao K, Lin B, Zhu X, Li K, Li S. Chest CT Findings in Coronavirus Disease-19 (COVID-19): Relationship to Duration of Infection. *Radiology*. 2020 Feb 20:200463.
21. Xu X, Yu C, Qu J, Zhang L, Jiang S, Huang D, Chen B, Zhang Z, Guan W, Ling Z, Jiang R, Hu T, Ding Y, Lin L, Gan Q, Luo L, Tang X, Liu J. Imaging and clinical features of patients with 2019 novel coronavirus SARS-CoV-2. *Eur J Nucl Med Mol Imaging*. 2020 Feb 28. doi: 10.1007/s00259-020-04735-9. [Epub ahead of print]
22. Yang W, Cao Q, Qin L, Wang X, Cheng Z, Pan A, Dai J, Sun Q, Zhao F, Qu J, Yan F. Clinical characteristics and imaging manifestations of the 2019 novel coronavirus disease (COVID-19): A multi-center study in Wenzhou city, Zhejiang, China. *J Infect*. 2020 Feb 26. pii: S0163-4453(20)30099-2. doi: 10.1016/j.jinf.2020.02.016. [Epub ahead of print]
23. Ai T, Yang Z, Hou H, Zhan C, Chen C, Lv W, Tao Q, Sun Z, Xia L. Correlation of Chest CT and RT-PCR Testing in Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases. *Radiology*. 2020 Feb 26:200642. doi: 10.1148/radiol.2020200642. [Epub ahead of print]
24. Shi H, Han X, Jiang N, Cao Y, Alwalid O, Gu J, Fan Y, Zheng C. Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: a descriptive study. *Lancet Infect Dis*. 2020 Feb 24. pii: S1473-3099(20)30086-4. doi: 10.1016/S1473-3099(20)30086-4. [Epub ahead of print]
25. Zou L, Ruan F, Huang M, Liang L, Huang H, et al. SARS-CoV-2 Viral Load in Upper Respiratory Specimens of Infected Patients. *N Engl J Med*. 2020 Feb 19. doi: 10.1056/NEJMc2001737. [Epub ahead of print]
26. Zhang W, Du RH, Li B, Zheng XS, Yang XL, Hu B, Wang YY, Xiao GF, Yan B, Shi ZL, Zhou P. Molecular and serological investigation of 2019-nCoV infected patients: implication of multiple shedding routes. *Emerging Microbes & Infections*. 2020 Jan 1;9(1):386-9.
27. Chen W, Lan Y, Yuan X, Deng X, Li Y, Cai X, Li L, He R, Tan Y, Deng X, Gao M, Tang G, Zhao L, Wang J, Fan Q, Wen C, Tong Y, Tang Y, Hu F, Li F, Tang X. Detectable 2019-nCoV viral RNA in blood is a strong indicator for the further clinical severity. *Emerg Microbes Infect*. 2020 Dec;9(1):469-473.
28. Young BE, Ong SWX, Kalimuddin S, Low JG, Tan SY, Loh J, Ng OT, Marimuthu K, Ang LW, Mak TM, Lau SK, Anderson DE, Chan KS, Tan TY, Ng TY, Cui L, Said Z, Kurupatham L, Chen MI, Chan M, Vasoo S, Wang LF, Tan BH, Lin RTP, Lee VJM, Leo YS, Lye DC; Singapore 2019 Novel Coronavirus Outbreak Research Team. Epidemiologic Features and Clinical Course of Patients Infected With SARS-CoV-2 in Singapore. *JAMA*. 2020 Mar 3. doi: 10.1001/jama.2020.3204. [Epub ahead of print]
29. Zhang Y, Chen C, Zhu S, Shu C, Wang D, Song J, et al. Isolation of 2019-nCoV from a Stool Specimen of a Laboratory-Confirmed Case of the Coronavirus Disease 2019 (COVID-19)[J]. *China CDC Weekly*, 2020, 2(8): 123-124
30. Memish ZA, Assiri AM, Al-Tawfiq JA. Middle East respiratory syndrome coronavirus (MERS-CoV) viral shedding in the respiratory tract: an observational analysis with infection control implications. *Int J Infect Dis*. 2014 Dec;29:307-8.
31. Zumla A, Hui DS, Perlman S. Middle East respiratory syndrome. *Lancet*. 2015 Sep 5;386(9997):995-1007. doi: 10.1016/S0140-6736(15)60454-8. Epub 2015 Jun 3. Review.
32. Chan KH, Poon LL, Cheng VC, Guan Y, Hung IF et al. Detection of SARS coronavirus in patients with suspected SARS. *Emerg Infect Dis*. 2004 Feb;10(2):294-9.
33. Cheng PK, Wong DA, Tong LK, Ip SM, Lo AC et al. Viral shedding patterns of coronavirus in patients with probable severe acute respiratory syndrome. *Lancet*. 2004 May 22;363(9422):1699-700.
34. Hung IF, Cheng VC, Wu AK, Tang BS, Chan KH et al. Viral loads in clinical specimens and SARS manifestations. *Emerg Infect Dis*. 2004 Sep;10(9):1550-7.
35. Peiris JS, Chu CM, Cheng VC, Chan KS, Hung IF, et al; HKU/UCH SARS Study Group. Clinical progression and viral load in a community outbreak of coronavirus-associated SARS pneumonia: a prospective study. *Lancet*. 2003 May 24;361(9371):1767-72.
36. Liu W, Tang F, Fontanet A, Zhan L, Zhao QM et al. Long-term SARS coronavirus excretion from patient cohort, China. *Emerg Infect Dis*. 2004 Oct;10(10):1841-3.
37. Corman VM, Albarak AM, Omrani AS, Albarak MM, Farah ME, et al. Viral Shedding and Antibody Response in 37 Patients With Middle East Respiratory Syndrome Coronavirus Infection. *Clin Infect Dis*. 2016 Feb 15;62(4):477-483.
38. Al-Abdely HM, Midgley CM, Alkhamis AM, Abedi GR, Lu X, et al. Middle East respiratory syndrome coronavirus infection dynamics and antibody responses among clinically diverse patients, Saudi Arabia. *Emerg Infect Dis*. 2019 Apr;25(4):753-766.
39. Al-Abdely HM, Midgley CM, Alkhamis AM, Abedi GR, Tamin A et al. Infectious MERS-CoV Isolated From a Mildly Ill

Patient, Saudi Arabia. *Open Forum Infect Dis.* 2018 May 15;5(6):ofy111.

40. Arabi YM, Mandourah Y, Al-Hameed F, Sindi AA, Almekhlafi GA, et al; Saudi Critical Care Trial Group. Corticosteroid Therapy for Critically Ill Patients with Middle East Respiratory Syndrome. *Am J Respir Crit Care Med.* 2018 Mar 15;197(6):757-767.
41. Russell CD, Millar JE, Baillie JK. Clinical evidence does not support corticosteroid treatment for 2019-nCoV lung injury. *Lancet.* 2020 Feb 6; S0140-6736(20)30305-6.
42. Metlay JP, Waterer GW, Long AC, Anzueto A, Brozek J, et al. Diagnosis and treatment of adults with community-acquired pneumonia. An Official Clinical Practice Guideline of the American Thoracic Society and Infectious Diseases Society of America. *Am J Respir Crit Care Med.* 2019 Oct 1;200(7):e45-e67.
43. Wang M, Cao R, Zhang L, Yang X, Liu J, Xu M, Shi Z, Hu Z, Zhong W, Xiao G. Remdesivir and chloroquine effectively inhibit the recently emerged novel coronavirus (2019-nCoV) in vitro. *Cell Res.* 2020 Feb 4. doi: 1038/s41422-020-0282-0. [Epub ahead of print] PubMed PMID: 32020029.
44. Xu XW, Wu XX, Jiang XG, Xu KJ, Ying LJ, Ma CL, Li SB, Wang HY, Zhang S, Gao HN, Sheng JF, Cai HL, Qiu YQ, Li LJ. Clinical findings in a group of patients infected with the 2019 novel coronavirus (SARS-Cov-2) outside of Wuhan, China: retrospective case series. *BMJ.* 2020 Feb 19;368:m606. doi:10.1136/bmj.m606.