Coronavirus disease 2019 (COVID-19)

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INTRODUCTION

Coronaviruses are important human and animal pathogens. At the end of 2019, a novel coronavirus was identified as the cause of a cluster of pneumonia cases in Wuhan, a city in the Hubei Province of China. It rapidly spread, resulting in an epidemic throughout China, followed by an increasing number of cases in other countries throughout the world. In February 2020, the World Health Organization designated the disease COVID-19, which stands for coronavirus disease 2019 [1]. The virus that causes COVID-19 is designated severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2); previously, it was referred to as 2019-nCoV.

Understanding of COVID-19 is evolving. Interim guidance has been issued by the World Health Organization and by the United States Centers for Disease Control and Prevention [2,3]. Links to these and other related society guidelines are found elsewhere. (See 'Society guideline links' below.)

This topic will discuss the epidemiology, clinical features, diagnosis, management, and prevention of COVID-19. Community-acquired coronaviruses, severe acute respiratory syndrome (SARS) coronavirus, and Middle East respiratory syndrome (MERS) coronavirus are discussed separately. (See "Coronaviruses" and "Severe acute respiratory syndrome (SARS)" and "Middle East respiratory syndrome coronavirus: Virology, pathogenesis, and epidemiology".)

EPIDEMIOLOGY

Geographic distribution — Since the first reports of cases from Wuhan, a city in the Hubei Province of China, at the end of 2019, more than 80,000 COVID-19 cases have been reported in China; these include all laboratory-confirmed cases as well as clinically diagnosed cases in the Hubei Province. A joint World Health Organization (WHO)-China fact-finding mission estimated that the epidemic in China peaked between late January and early February 2020 [4]. The majority of reports have been from Hubei and surrounding provinces, but numerous cases have been reported in other provinces and municipalities throughout China [5,6].

Increasing numbers of cases have also been reported in other countries across all continents except Antarctica, and the rate of new cases outside of China has outpaced the rate in China. These cases initially occurred mainly among travelers from China and those who have had contact with travelers from China [7-11]. However, ongoing local transmission has driven smaller outbreaks in some locations outside of China, including South Korea, Italy, Iran, and Japan, and infections elsewhere have been identified in travelers from those countries [12].

In the United States, several clusters of COVID-19 with local transmission have been identified throughout the country.

Updated case counts in English can be found on the World Health Organization and European Centre for Disease Prevention and Control websites.

Transmission — Understanding of the transmission risk is incomplete. Epidemiologic investigation in Wuhan at the beginning of the outbreak identified an initial association with a seafood market that sold live animals, where most patients had worked or visited and which was subsequently closed for disinfection [13]. However, as the outbreak progressed, person-to-person spread became the main mode of transmission.

Person-to-person spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is thought to occur mainly via respiratory droplets, resembling the spread of influenza. With droplet transmission, virus released in the respiratory secretions when a person with infection coughs, sneezes, or talks can infect another person if it makes direct contact with the mucous membranes; infection can also occur if a person touches an infected surface and then touches his or her eyes, nose, or mouth. Droplets typically do not travel more than six feet (about two meters) and do not linger in the air. However, given the current uncertainty regarding transmission mechanisms, airborne precautions

are recommended routinely in some countries and in the setting of certain high-risk procedures in others. (See 'Infection control for suspected or confirmed cases' below.)

Viral RNA levels appear to be higher soon after symptom onset compared with later in the illness [14]; this raises the possibility that transmission might be more likely in the earlier stage of infection, but additional data are needed to confirm this hypothesis.

The reported rates of transmission from an individual with symptomatic infection vary by location and infection control interventions. According to a joint WHO-China report, the rate of secondary COVID-19 ranged from 1 to 5 percent among tens of thousands of close contacts of confirmed patients in China [15]. In the United States, the symptomatic secondary attack rate was 0.45 percent among 445 close contacts of 10 confirmed patients [16].

Transmission of SARS-CoV-2 from asymptomatic individuals (or individuals within the incubation period) has also been described [17-21]. However, the extent to which this occurs remains unknown. Large-scale serologic screening may be able to provide a better sense of the scope of asymptomatic infections and inform epidemiologic analysis; several serologic tests for SARS-CoV-2 are under development [22].

SARS-CoV-2 RNA has been detected in blood and stool specimens [23,24]. Live virus has been cultured from stool in some cases [25], but according to a joint WHO-China report, fecal-oral transmission did not appear to be a significant factor in the spread of infection [15].

VIROLOGY

Full-genome sequencing and phylogenic analysis indicated that the coronavirus that causes COVID-19 is a betacoronavirus in the same subgenus as the severe acute respiratory syndrome (SARS) virus (as well as several bat coronaviruses), but in a different clade. The structure of the receptor-binding gene region is very similar to that of the SARS coronavirus, and the virus has been shown to use the same receptor, the angiotensin-converting enzyme 2 (ACE2), for cell entry [26]. The Coronavirus Study Group of the International Committee on Taxonomy of Viruses has proposed that this virus be designated severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [27].

The Middle East respiratory syndrome (MERS) virus, another betacoronavirus, appears more distantly related [28,29]. The closest RNA sequence similarity is to two bat

coronaviruses, and it appears likely that bats are the primary source; whether COVID-19 virus is transmitted directly from bats or through some other mechanism (eg, through an intermediate host) is unknown [30]. (See "Coronaviruses", section on 'Viral serotypes'.)

In a phylogenetic analysis of 103 strains of SARS-CoV-2 from China, two different types of SARS-CoV-2 were identified, designated type L (accounting for 70 percent of the strains) and type S (accounting for 30 percent) [31]. The L type predominated during the early days of the epidemic in China, but accounted for a lower proportion of strains outside of Wuhan than in Wuhan. The clinical implications of these findings are uncertain.

CLINICAL FEATURES

Incubation period — The incubation period for COVID-19 is thought to be within 14 days following exposure, with most cases occurring approximately four to five days after exposure [32-34].

In a study of 1099 patients with confirmed symptomatic COVID-19, the median incubation period was four days (interquartile range two to seven days) [33].

Using data from 181 publicly reported, confirmed cases in China with identifiable exposure, one modeling study estimated that symptoms would develop in 2.5 percent of infected individuals within 2.2 days and in 97.5 percent of infected individuals within 11.5 days [35]. The median incubation period in this study was 5.1 days.

Spectrum of illness severity — Most infections are not severe, although many patients with COVID-19 have critical illness [34,36-41]. Specifically, in a report from the Chinese Center for Disease Control and Prevention that included approximately 44,500 confirmed infections with an estimation of disease severity [42]:

- Mild (no or mild pneumonia) was reported in 81 percent.
- Severe disease (eg, with dyspnea, hypoxia, or >50 percent lung involvement on imaging within 24 to 48 hours) was reported in 14 percent.
- Critical disease (eg, with respiratory failure, shock, or multiorgan dysfunction) was reported in 5 percent.
- The overall case fatality rate was 2.3 percent; no deaths were reported among noncritical cases.

According to a joint World Health Organization (WHO)-China fact-finding mission, the case-fatality rate ranged from 5.8 percent in Wuhan to 0.7 percent in the rest of China [15]. Most of the fatal cases have occurred in patients with advanced age or underlying medical comorbidities.

Age range — Individuals of any age can acquire severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, although adults of middle age and older are most commonly affected.

In several cohorts of hospitalized patients with confirmed COVID-19, the median age ranged from 49 to 56 years [37-39]. In a report from the Chinese Center for Disease Control and Prevention that included approximately 44,500 confirmed infections, 87 percent of patients were between 30 and 79 years old [42]. Older age was also associated with increased mortality, with a case fatality rate of 8 and 15 percent among those aged 70 to 79 years and 80 years or older, respectively.

Symptomatic infection in children appears to be uncommon, and when it occurs, it is usually mild. In the large Chinese report described above, only 2 percent of infections were in individuals younger than 20 years old [42]. In a small study of 10 children, clinical illness was mild; 80 percent had fever, which resolved within 24 hours, 60 percent had cough, 40 percent had sore throat, and none required supplemental oxygen [43].

Asymptomatic infections — Asymptomatic infections have also been described [34,44-46], but their frequency is unknown.

In a COVID-19 outbreak on a cruise ship where nearly all passengers and staff were screened for SARS-CoV-2, approximately 17 percent of the population on board tested positive as of February 20; about half of the 619 confirmed COVID-19 cases were asymptomatic at the time of diagnosis [47].

Even patients with asymptomatic infection may have objective clinical abnormalities. In another study of 24 patients with asymptomatic infection who all underwent chest computed tomography (CT), 50 percent had typical ground-glass opacities or patchy shadowing, and another 20 percent had atypical imaging abnormalities [21]. Five patients developed low-grade fever, with or without other typical symptoms, a few days after diagnosis.

Clinical presentation — Pneumonia appears to be the most frequent serious manifestation of infection, characterized primarily by fever, cough, dyspnea, and bilateral

infiltrates on chest imaging [33,37-39]. There are no specific clinical features that can yet reliably distinguish COVID-19 from other viral respiratory infections.

In a study describing 138 patients with COVID-19 pneumonia in Wuhan, the most common clinical features at the onset of illness were [39]:

- Fever in 99 percent
- Fatigue in 70 percent
- Dry cough in 59 percent
- Anorexia in 40 percent
- Myalgias in 35 percent
- Dyspnea in 31 percent
- Sputum production in 27 percent

The dyspnea developed after a median of five days of illness. Acute respiratory distress syndrome developed in 20 percent, and mechanical ventilation was implemented in 12.3 percent.

Other cohort studies of patients from Wuhan with confirmed COVID-19 have reported a similar range of clinical findings [37,39,48,49]. However, fever might not be a universal finding. In one study, fever was reported in almost all patients, but approximately 20 percent had a very low grade fever <100.4°F/38°C [37]. In another study of 1099 patients from Wuhan and other areas in China, fever (defined as an axillary temperature over 99.5°F/37.5°C) was present in only 44 percent on admission but was ultimately noted in 89 percent during the hospitalization [33].

Other, less common symptoms have included headache, sore throat, and rhinorrhea. In addition to respiratory symptoms, gastrointestinal symptoms (eg, nausea and diarrhea) have also been reported in some patients, but these are relatively uncommon [37,39].

Reports of cohorts in locations outside of Wuhan have described similar clinical findings, although some have suggested that milder illness may be more common [50-52]. As an example, in a study of 62 patients with COVID-19 in the Zhejiang province of China, all but one had pneumonia, but only two developed dyspnea, and only one warranted mechanical ventilation [51].

According to the WHO, recovery time appears to be around two weeks for mild infections and three to six weeks for severe disease [4].

Laboratory findings — In patients with COVID-19, the white blood cell count can vary. Leukopenia, leukocytosis, and lymphopenia have been reported, although lymphopenia

appears most common [23]. Elevated aminotransferase levels have also been described. On admission, many patients with pneumonia have normal serum procalcitonin levels; however, in those requiring intensive care unit (ICU) care, they are more likely to be elevated [37-39].

In one study, high D-dimer levels and more severe lymphopenia were associated with mortality [38].

Imaging findings — Chest CT in patients with COVID-19 most commonly demonstrates ground-glass opacification with or without consolidative abnormalities, consistent with viral pneumonia [49,53]. Case series have suggested that chest CT abnormalities are more likely to be bilateral, have a peripheral distribution, and involve the lower lobes. Less common findings include pleural thickening, pleural effusion, and lymphadenopathy.

Chest CT may be helpful in making the diagnosis, but no finding can completely rule in or rule out the possibility of COVID-19. In a study of 1014 patients in Wuhan who underwent both reverse-transcription polymerase chain reaction (RT-PCR) testing and chest CT for evaluation of COVID-19, a "positive" chest CT for COVID-19 (as determined by a consensus of two radiologists) had a sensitivity of 97 percent, using the PCR tests as a reference; however, specificity was only 25 percent [54]. The low specificity may be related to other etiologies causing similar CT findings. In another study comparing chest CTs from 219 patients with COVID-19 in China and 205 patients with other causes of viral pneumonia in the United States, COVID-19 cases were more likely to have a peripheral distribution (80 versus 57 percent), ground-glass opacities (91 versus 68 percent), fine reticular opacities (56 versus 22 percent), vascular thickening (59 versus 22 percent), and reverse halo sign (11 versus 1 percent), but less likely to have a central and peripheral distribution (14 versus 35 percent), air bronchogram (14 versus 23 percent), pleural thickening (15 versus 33 percent), pleural effusion (4 versus 39 percent), and lymphadenopathy (2.7 versus 10 percent) [55]. A group of radiologists in that study was able to distinguish COVID-19 with high specificity but moderate sensitivity.

In one report of 21 patients with laboratory-confirmed COVID-19 who did not develop severe respiratory distress, lung abnormalities on chest imaging were most severe approximately 10 days after symptom onset [48]. However, chest CT abnormalities have also been identified in patients prior to the development of symptoms and even prior to the detection of viral RNA from upper respiratory specimens [49,56].

EVALUATION AND DIAGNOSIS

Clinical suspicion and criteria for testing — The approach to initial management should focus on early recognition of suspect cases, immediate isolation, and institution of infection control measures. At present, the possibility of COVID-19 should be considered primarily in patients with fever and/or lower respiratory tract symptoms who have had any of the following in the prior 14 days:

- Close contact with a confirmed or suspected case of COVID-19, including through work in health care settings. Close contact includes being within approximately six feet (about two meters) of a patient for a prolonged period of time while not wearing personal protective equipment or having direct contact with infectious secretions while not wearing personal protective equipment.
- Residence in or travel to areas where widespread community transmission has been reported (eg, China, South Korea, Italy, Iran, Japan). (See 'Geographic distribution' above.)
- Potential exposure through attendance at events or spending time in specific settings where COVID-19 cases have been reported.

The possibility of COVID-19 should also be considered in patients with severe lower respiratory tract illness when an alternative etiology cannot be identified, even if there has been no clear exposure.

When COVID-19 is suspected, infection control measures should be implemented and public health officials notified. Patients who do not need emergent care should be encouraged to call prior to presenting to a health care facility for evaluation. Many patients can be evaluated regarding the need for testing over the phone. Infection control precautions are discussed elsewhere. (See 'Infection control for suspected or confirmed cases' below.)

The specific case definitions and clinical criteria for pursuing diagnostic evaluation differ slightly between expert groups.

- The United States Centers for Disease Control and Prevention (CDC) notes that the decision to test for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) should be based on clinical judgment and reminds clinicians that most patients with confirmed COVID-19 have fever (subjective or confirmed) and/or symptoms of acute respiratory illness (eg cough, dyspnea). This guidance expands its previous criteria

to potentially include a wider group of symptomatic patients. In areas where testing capacity is limited, public health officials can guide prioritization of testing. The CDC suggests prioritizing hospitalized patients to inform infection control decisions, symptomatic individuals who have a higher risk of poor outcomes (eg, age ≥65 years, chronic medical condition, immunocompromising conditions), and those with high exposure risk (eg, recent travel to specific locations, contact with patients with COVID-19, or being a health care worker) [57]. Details can be found on the CDC website. An approach to suspected cases when testing is not available is discussed elsewhere.

- Case definitions from the World Health Organization are found in its technical guidance online.
- Case definitions from the European Centre for Disease Prevention and Control are found on its website.

Laboratory testing — Patients who meet the criteria for suspect cases, as discussed above, should undergo testing for SARS-CoV-2 (the virus that causes COVID-19), in addition to testing for other respiratory pathogens. (See "Diagnostic approach to community-acquired pneumonia in adults", section on 'Diagnostic testing for microbial etiology'.)

In the United States, the CDC recommends collection of specimens to test for SARS-CoV-2 from the upper respiratory tract (nasopharyngeal and oropharyngeal swab) and, if possible, the lower respiratory tract (sputum, tracheal aspirate, or bronchoalveolar lavage) [58]. Induction of sputum is not indicated. Additional specimens (eg, stool, urine) can also be collected. Respiratory specimen collection should be performed under airborne precautions.

SARS-CoV-2 RNA is detected by polymerase chain reaction; in the United States, testing is performed by the CDC or a CDC-qualified lab [59]. A positive test for SARS-CoV-2 confirms the diagnosis of COVID-19. If initial testing is negative but the suspicion for COVID-19 remains, the WHO recommends resampling and testing from multiple respiratory tract sites [60]. Negative reverse-transcription polymerase chain reaction (RT-PCR) tests on oropharyngeal swabs despite CT findings suggestive of viral pneumonia have been reported in some patients who ultimately tested positive for SARS-CoV-2 [56].

For safety reasons, specimens from a patient with suspected or documented COVID-19 should **not** be submitted for viral culture.

The importance of testing for other pathogens was highlighted in a report of 210 symptomatic patients with suspected COVID-19; 30 tested positive for another respiratory viral pathogen, and 11 tested positive for SARS-CoV-2 [36].

MANAGEMENT

Home care — Home management is appropriate for patients with mild infection who can be adequately isolated in the outpatient setting [23,61,62]. Management of such patients should focus on prevention of transmission to others, and monitoring for clinical deterioration, which should prompt hospitalization.

Outpatients with COVID-19 should stay at home and try to separate themselves from other people and animals in the household. They should wear a facemask when in the same room (or vehicle) as other people and when presenting to health care settings. United States Centers for Disease Control and Prevention (CDC) recommendations on discontinuation of home isolation are discussed below. (See 'Discontinuation of precautions' below.)

More detailed interim recommendations on home management of patients with COVID-19 can be found on the WHO and CDC websites [62-64].

Hospital care — Some patients with suspected or documented COVID-19 have severe disease that warrants hospital care. Management of such patients consists of ensuring appropriate infection control, as below (see 'Infection control for suspected or confirmed cases' below), and supportive care. Clinical guidance can be found on the World Health Organization (WHO) and CDC websites [23,61].

Patients with severe disease often need oxygenation support. High-flow oxygen and noninvasive positive pressure ventilation have been used, but the safety of these measures is uncertain, and they should be considered aerosol-generating procedures that warrant specific isolation precautions [65]. (See 'Infection control for suspected or confirmed cases' below.)

Some patients may develop acute respiratory distress syndrome and warrant intubation with mechanical ventilation; extracorporeal membrane oxygenation may be indicated in patients with refractory hypoxia. Management of acute respiratory distress syndrome is discussed in detail elsewhere. (See "Evaluation and management of suspected sepsis and septic shock in adults" and "Acute respiratory distress syndrome: Supportive care and oxygenation in adults".)

The WHO and CDC recommend glucocorticoids **not** be used in patients with COVID-19 pneumonia unless there are other indications (eg, exacerbation of chronic obstructive pulmonary disease) [23,61]. Glucocorticoids have been associated with an increased risk for mortality in patients with influenza and delayed viral clearance in patients with Middle East respiratory syndrome coronavirus (MERS-CoV) infection. Although they were widely used in management of severe acute respiratory syndrome (SARS), there was no good evidence for benefit, and there was persuasive evidence of adverse short- and long-term harm [66]. (See "Treatment of seasonal influenza in adults", section on 'Adjunctive therapies' and "Middle East respiratory syndrome coronavirus: Treatment and prevention", section on 'Treatment'.)

Investigational agents are being explored for antiviral treatment of COVID-19, and enrollment in clinical trials should be discussed with patients or their proxies. A registry of international clinical trials can be found on the WHO website and at clinicaltrials.gov.

Several randomized trials are underway to evaluate the efficacy of remdesivir for moderate or severe COVID-19 [67]. Remdesivir is a novel nucleotide analogue that has activity against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in vitro and related coronaviruses (including SARS and MERS-CoV) both in vitro and in animal studies [68,69]. The compassionate use of remdesivir through an investigational new drug application was described in a case report of one of the first patients with COVID-19 in the United States [70]. Any clinical impact of remdesivir on COVID-19 remains unknown.

There has also been interest in the combined protease inhibitor lopinavir-ritonavir, which is used for the treatment of HIV infection. This combined agent has in vitro activity against the SARS-CoV [71] and appears to have some activity against MERS-CoV in animal studies [72]. The use of this agent for treatment of COVID-19 has been described in case reports [73-75], but its efficacy is unclear, and it is being evaluated in larger randomized trials.

Other interventions of interest but with limited or no clinical data include chloroquine [76], hydroxychloroquine [77], interferon beta, and convalescent serum.

Practitioners should be aware of local guidelines regarding treatment and also assess their patients for eligibility in available clinical trials. Treatment guidelines from China's National Health Commission include the IL-6 inhibitor tocilizumab for severe infection, although clinical data are limited; the agent is being evaluated in a clinical trial [78].

PREVENTION

In the health care setting

Screening and precautions for fever or respiratory symptoms — Screening patients for clinical manifestations consistent with COVID-19 (eg, fever, cough, dyspnea) prior to entry into a health care facility can help identify those who may warrant additional infection control precautions. This can be done over the phone before the patient actually presents to a facility. Any individual with these manifestations should be advised to wear a facemask. Separate waiting areas for patients with respiratory symptoms should be designated, if possible, at least six feet away from the regular waiting areas.

Symptomatic patients should also be asked about recent travel or potential COVID-19 exposure in the prior 14 days to determine the need for evaluation for COVID-19. (See 'Clinical suspicion and criteria for testing' above.)

In some settings, such as long-term care facilities, the United States Centers for Disease Control and Prevention (CDC) recommends that standard, contact, and droplet precautions in addition to eye protection be used for any patient with an undiagnosed respiratory infection who is not under consideration for COVID-19 [79]. This may help reduce the risk of spread from unsuspected COVID-19 cases. Infection control precautions for suspect COVID-19 cases are discussed below.

In locations where community transmission is ongoing, postponing elective procedures or non-urgent visits and using virtual (eg, through video communication) visits may be useful strategies to reduce the risk of exposure [80].

Infection control for suspected or confirmed cases — Infection control to limit transmission is an essential component of care in patients with suspected or documented COVID-19. In one report of 138 patients with COVID-19 in China, it was estimated that 43 percent acquired infection in the hospital setting [39].

Individuals with suspected infection in the community should be advised to wear a medical mask to contain their respiratory secretions prior to seeking medical attention. (See 'Evaluation and diagnosis' above.)

In the health care setting, the World Health Organization (WHO) and CDC recommendations for infection control for suspected or confirmed infections differ slightly:

- The WHO recommends standard, contact, and droplet precautions, with eye or face protection [81]. The addition of airborne precautions is warranted during aerosol-generating procedures, such as tracheal intubation, noninvasive ventilation, tracheotomy, cardiopulmonary resuscitation, manual ventilation before intubation, and bronchoscopy.

- The CDC recommends standard, contact, and airborne precautions, with eye protection [80]. If an airborne infection isolation room (ie, a single patient negative pressure room) is not readily available, the patient should wear a mask and be placed in a private room with the door closed, and any personnel entering the room should wear the appropriate personal protection equipment. Patients with suspected or confirmed COVID-19 who require hospitalization should be cared for in a facility that can provide an airborne infection isolation room.

  Personal protection equipment for a patient under airborne precautions includes a respirator (eg, an N95 respirator). If supply of respirators is limited, CDC acknowledges that facemasks are an acceptable alternative (in addition to contact precautions and eye protection), but respirators should be worn during aerosol-generating procedures [80].

Elements of the different types of infection control precautions are detailed in the table (table 1).

For health care workers who have had a potential exposure to COVID-19, the CDC has provided guidelines for work restriction and monitoring. The approach depends upon the duration of exposure, the patient's symptoms, whether the patient was wearing a facemask, the type of personal protective equipment used by the provider, and whether an aerosol-generating procedure was performed.

Links to additional infection control guidelines are found below. (See 'Society guideline links' below.)

Discontinuation of precautions — The decision to discontinue infection control precautions for patients with COVID-19 should be made on a case-by-case basis in consultation with experts in infection prevention and control and public health officials. Factors to inform this decision include resolution of clinical signs and symptoms and negative results of reverse-transcription polymerase chain reaction (RT-PCR) testing for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on two sequential paired nasopharyngeal and throat specimens (ie, four specimens total, each handled separately), with each pair collected ≥24 hours apart [82].

Positive RT-PCR tests for SARS-CoV-2 were reported in four laboratory-confirmed COVID-19 patients after they had clinically improved and tested negative on two consecutive tests [83]. The clinical significance of this finding is uncertain; it is unknown whether these individuals continued to shed infectious virus.

Environmental disinfection — To help reduce the spread of COVID-19 virus, environmental infection control procedures should also be implemented [62,64,80,81,84]. In United States health care settings, the CDC states routine cleaning and disinfection procedures are appropriate for COVID-19 virus [80].

Products approved by the Environmental Protection Agency (EPA) for emerging viral pathogens should be used; a list of EPA-registered products can be found here. Specific guidance on environmental measures, including those used in the home setting, is available on the CDC and WHO websites. Additional information is also found in a separate topic review. (See "Coronaviruses", section on 'Treatment and prevention'.)

The importance of environmental disinfection was illustrated in a study from Singapore, in which viral RNA was detected on nearly all surfaces tested (handles, light switches, bed and handrails, interior doors and windows, toilet bowl, sink basin) in the airborne infection isolation room of a patient with symptomatic mild COVID-19 prior to routine cleaning [85]. Viral RNA was not detected on similar surfaces in the rooms of two other symptomatic patients following routine cleaning (with sodium dichloroisocyanurate). Of note, viral RNA detection does not necessarily indicate the presence of infectious virus.

It is unknown how long SARS-CoV-2 can persist on surfaces; other coronaviruses have been tested and may survive on inanimate surfaces for up to six to nine days without disinfection. In a study evaluating the survival of viruses dried on a plastic surface at room temperature, a specimen containing SARS-CoV (a virus closely related to SARS-CoV-2) had detectable infectivity at six but not nine days [86]. However, in a systematic review of similar studies, various disinfectants (including ethanol at concentrations between 62 and 71 percent) inactivated a number of coronaviruses related to SARS-CoV-2 within one minute [84].

Preventing exposure in the community — The following general measures are recommended to reduce transmission of infection:

- Diligent hand washing, particularly after touching surfaces in public. Use of hand sanitizer that contains at least 60 percent alcohol is a reasonable alternative if the hands are not visibly dirty.

- Respiratory hygiene (eg, covering the cough or sneeze).
- Avoiding touching the face (in particular eyes, nose, and mouth).
- Avoiding crowds (particularly in poorly ventilated spaces) if possible and avoiding close contact with ill individuals.
- Cleaning and disinfecting objects and surfaces that are frequently touched. The CDC has issued guidance on disinfection in the home setting; a list of EPA-registered products can be found here.

In particular, older adults and individuals with chronic medical conditions should be encouraged to follow these measures.

If SARS-CoV-2 is prevalent in the community, residents should be encouraged to practice social distancing by staying home as much as possible.

For people without respiratory symptoms, wearing a medical mask in the community is not recommended, even if COVID-19 is prevalent in the area [2]; wearing a mask does not decrease the importance of other general measures to prevent infection, and it may result in unnecessary cost and supply problems [87].

Individuals who are caring for patients with suspected or documented COVID-19 at home, however, should wear a tightly fitting medical mask when in the same room as that patient.

Individuals who develop an acute respiratory illness (eg, with fever and/or respiratory symptoms) should be encouraged to stay home from school or work for the duration of the illness. Some may warrant evaluation for COVID-19. (See 'Clinical suspicion and criteria for testing' above.)

The CDC has included recommended measures to prevent spread in the community on its website.

Managing asymptomatic individuals with potential exposure — Individuals who have had travel to high-risk areas or are contacts of patients with suspected or confirmed COVID-19 should be monitored for development of consistent symptoms and signs (fever, cough, or dyspnea). Such clinical manifestations should prompt at least self-isolation with social distancing and clinician assessment for the need for medical evaluation. (See 'Clinical suspicion and criteria for testing' above.)

In the United States, the level of risk (based on the travel location or the type of contact) informs whether monitoring and isolation are done by the individual or with the involvement of public health personnel. Categories of risk and the suggested monitoring and isolation strategies can be found on the CDC website.

Global public health measures — On January 30, 2020, the WHO declared the COVID-19 outbreak a public health emergency of international concern and, in March 2020, began to characterize it as a pandemic in order to emphasize the gravity of the situation and urge all countries to take action in detecting infection and preventing spread. The WHO has indicated three priorities for countries: protecting health workers, engaging communities to protect those at highest risk of severe disease (eg, older adults and those with medical comorbidities), and supporting vulnerable countries in containing infection [4].

The WHO does not recommend international travel restrictions but does acknowledge that movement restriction may be temporarily useful in some settings. The WHO advises exit screening for international travelers from areas with ongoing transmission of COVID-19 virus to identify individuals with fever, cough, or potential high-risk exposure [88,89]. Many countries also perform entry screening (eg, temperature, assessment for signs and symptoms). More detailed travel information is available on the WHO website.

In the United States, the CDC currently recommends that individuals avoid all nonessential travel to mainland China, Iran, most European countries (including Italy), and South Korea [90]. Because risk of travel changes rapidly, those coming from other countries should check United States government web sites for possible restrictions on arrival. The CDC has released travel advisories regarding other locations where community transmission has been reported [90]. The CDC website provides updated guidance on travel restrictions as well as risk assessment and management of persons with a suspected exposure to COVID-19.

Although many cases of COVID-19 can be detected through entry screening, some may be missed. As an example, in Germany, 114 travellers returning from Wuhan were considered to be asymptomatic during entry screening but, when tested for COVID-19 virus by RT-PCR, two tested positive [91]. However, the role of asymptomatic patients in transmitting infection to others, and thus the value of PCR testing of asymptomatic individuals on entry, remains unclear. (See 'Transmission' above.)

SPECIAL SITUATIONS

Pregnant women — Minimal information is available regarding COVID-19 during pregnancy. Intrauterine or perinatal transmission has not been identified [92-95]. In two reports including a total of 18 pregnant women with suspected or confirmed COVID-19 pneumonia, there was no laboratory evidence of transmission of the virus to the neonate [92,93]. However, two neonatal cases of infection have been documented [96]. In one case, the diagnosis was made at day 17 of life after close contact with the infant's mother and a maternity matron who were both infected with the virus. The other case was diagnosed 36 hours after birth; the source and time of transmission in that case were unclear.

The approach to prevention, evaluation, diagnosis, and treatment of pregnant women with suspected COVID-19 should be similar to that in nonpregnant individuals (as described above), with consideration that pregnant women with other potentially severe respiratory infections, such as influenza, severe acute respiratory syndrome (SARS)-CoV, or Middle East respiratory syndrome (MERS)-CoV, appear to be more vulnerable to developing severe disease.

Additionally, the American College of Obstetricians and Gynecologists (ACOG) specifies that infants born to mothers with confirmed COVID-19 should be considered a patient under investigation and appropriately isolated and evaluated [97]. (See 'Evaluation and diagnosis' above.)

It is unknown whether the virus can be transmitted through breast milk; however, droplet transmission could occur through close contact during breastfeeding. ACOG recommends that mothers with confirmed COVID-19 or symptomatic mothers with suspected COVID-19 take precautions to prevent transmission to the infant during breastfeeding (including assiduous hand hygiene and using a facemask) or consider having a different individual feed expressed breast milk to the infant [97].

COVID-19 testing not readily available — In some cases, testing for COVID-19 may not be accessible, particularly for individuals who have a compatible but mild illness that does not warrant hospitalization and do not have a known COVID-19 exposure or high-risk travel history.

In the United States, there is limited official guidance for this situation, and the approach may depend on the prevalence of COVID-19 in the area. If the clinician has sufficient concern for possible COVID-19 (eg, there is community transmission), it is reasonable to advise the patient to self-isolate at home (if hospitalization is not warranted) and alert the clinician about worsening symptoms. The optimal duration of home isolation in such

cases is uncertain. Clinicians should contact their local public health department for guidance. In the state of Washington, the Department of Public Health suggests that individuals with compatible symptoms without exposure to a diagnosed case should continue home isolation until 72 hours after fever and symptoms have resolved [98].

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Coronavirus disease 2019 (COVID-19)".)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topic (see "Patient education: Coronavirus disease 2019 (COVID-19) (The Basics)")

SUMMARY AND RECOMMENDATIONS

- In late 2019, a novel coronavirus, now designated SARS-CoV-2, was identified as the cause of an outbreak of acute respiratory illness in Wuhan, a city in China. In February 2020, the World Health Organization (WHO) designated the disease COVID-19, which stands for coronavirus disease 2019. (See 'Introduction' above.)

- Since the first reports of COVID-19, infection has spread to include more than 80,000 cases in China and increasing cases worldwide, prompting the WHO to declare a public health emergency in late January 2020 and characterize it as a pandemic in March 2020. The rate of new infections outside of China has surpassed that within China, as epidemics have grown in other countries. (See 'Epidemiology' above.)

- The possibility of COVID-19 should be considered primarily in patients with fever and/or lower respiratory tract symptoms who reside in or have recently (within the prior 14 days) traveled to areas where community transmission has been reported (eg, China, South Korea, Italy, Iran, Japan) or who have had recent close contact with a confirmed or suspected case of COVID-19. Clinicians should also be aware of the possibility of COVID-19 in patients with severe respiratory illness when no other etiology can be identified. (See 'Clinical features' above and 'Evaluation and diagnosis' above.)

- Upon suspicion of COVID-19, infection control measures should be implemented and public health officials notified. In health care settings in the United States, the Centers for Disease Control and Prevention (CDC) recommends standard, contact, and airborne precautions (table 1), as well as eye protection. (See 'Infection control for suspected or confirmed cases' above.)

- In addition to testing for other respiratory pathogens, upper and lower respiratory tract specimens should be tested for SARS-CoV-2. Additional specimens (eg, stool, urine) can also be collected. (See 'Evaluation and diagnosis' above.)

- Management consists of supportive care. Home management may be possible for patients with mild illness who can be adequately isolated in the outpatient setting. (See 'Management' above.)

- To reduce the risk of transmission in the community, individuals should be advised to wash hands diligently, practice respiratory hygiene (eg, cover their cough), and avoid close contact with ill individuals, if possible. Facemasks are not routinely recommended for asymptomatic individuals to prevent exposure in the community. (See 'Preventing exposure in the community' above.)

- The WHO has issued interim guidance on surveillance case definitions, laboratory diagnosis, and clinical management. The CDC has also issued interim guidance. (See 'Society guideline links' above.)

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Topic 126981 Version 23.0

GRAPHICS

Types of precautions for infection control

Type of precaution	Selected patients	Major specifications
Standard	All patients	Perform hand hygiene before and after every patient contact.* Gloves, gowns, eye protection as required. Safe disposal or cleaning of instruments and linen. Cough etiquette: Patients and visitors should cover their nose or mouth when coughing, promptly dispose used tissues, and practice hand hygiene after contact with respiratory secretions.
Contact ¶	Colonization of any bodily site with multidrug-resistant bacteria (MRSA, VRE, drug-resistant gram-negative organisms) Enteric infections (Norovirus, *Clostridioides* [formerly *Clostridium*] *difficile**, *Escherichia coli* O157:H7) Viral infections (HSV, VZV, RSV Δ, parainfluenza, enterovirus, rhinovirus ◇, certain coronaviruses [eg, COVID-19, MERS-CoV]) Scabies Impetigo Noncontained abcesses or decubitus ulcers (especially for *Staphylococcus aureus* and group A *Streptococcus*) §	**In addition to standard precautions:** Private room preferred; cohorting allowed if necessary. Gloves required upon entering room. Change gloves after contact with contaminated secretions. Gown required if clothing may come into contact with the patient or environmental surfaces or if the patient has diarrhea. Minimize risk of environmental contamination during patient transport (eg, patient can be placed in a gown). Noncritical items should be dedicated to use for a single patient if possible.
Droplet ¶	**Known or suspected:** *Neisseria meningitidis* *Haemophilus influenzae* type B *Mycoplasma pneumoniae* *Bordetella pertussis* Group A *Streptococcus* § Diphtheria Pneumonic plague Influenza Rubella Mumps Adenovirus Parvovirus B19 Rhinovirus ◇ Certain coronaviruses ¥	**In addition to standard precautions:** Private room preferred; cohorting allowed if necessary. Wear a mask when within three feet of the patient. Mask the patient during transport. Cough etiquette: Patients and visitors should cover their nose or mouth when coughing, promptly dispose used tissues, and practice hand hygiene after contact with respiratory secretions.

Airborne	**Known or suspected:** Tuberculosis Varicella Measles Smallpox Certain coronaviruses ¥ Ebola ‡	**In addition to standard precautions:** Place the patient in an AIIR (a monitored negative pressure room with at least 6 to 12 air exchanges per hour). Room exhaust must be appropriately discharged outdoors or passed through a HEPA filter before recirculation within the hospital. A certified respirator must be worn when entering the room of a patient with diagnosed or suspected tuberculosis. Susceptible individuals should not enter the room of patients with confirmed or suspected measles or chickenpox. Transport of the patient should be minimized; the patient should be masked if transport within the hospital is unavoidable. Cough etiquette: Patients and visitors should cover their nose or mouth when coughing, promptly dispose used tissues, and practice hand hygiene after contact with respiratory secretions.

This system of isolation precautions is recommended by the United States Healthcare Infection Control Practices Advisory Committee.

MRSA: methicillin-resistant *S. aureus*; VRE: vancomycin-resistant enterococci; RSV: respiratory syncytial virus; HSV: herpes simplex virus; VZV: varicella-zoster virus; COVID-19: coronavirus disease-2019; MERS-CoV: Middle East Respiratory Syndrome coronavirus; AIIR: airborne infection isolation room; HEPA: high-efficiency particulate aerator; SARS: severe acute respiratory syndrome.
* Alcohol-based hand disinfectant is an acceptable alternative to soap and water in all situations EXCEPT in the setting of norovirus and *C. difficile* infection, for which soap and water should be used.
¶ Many hospitals favor simplifying the approach to isolation precautions for viral respiratory pathogens by placing all patients with suspected viral illness on both contact and droplet precautions.
Δ RSV may be transmitted by the droplet route but is primarily spread by direct contact with infectious respiratory secretions. Droplet precautions are not routinely warranted but are appropriate if the infecting agent is not known, if the patient may be coinfected with other pathogens that require droplet precautions, and/or if there is a chance of exposure to aerosols of infectious respiratory secretions.
◇ The most important route of transmission for rhinovirus is via droplets; contact precautions should be added if copious moist secretions and close contact are likely to occur (eg, young infants).
§ Patients with invasive group A streptococcal infection associated with soft tissue involvement warrant both droplet precautions and contact precautions. Droplet precautions alone are warranted for patients with streptococcal toxic shock or streptococcal pneumonia, as well as for infants and young children in the setting of pharyngitis or scarlet fever. Droplet and contact precautions may be discontinued after the first 24 hours of antimicrobial therapy.
¥ Refer to UpToDate topics on coronaviruses, including COVID-19, MERS-CoV, and SARS, for specific information on infection control precautions.
‡ Refer to the UpToDate topic on prevention of Ebola virus infection for full discussion of infection control issues.

Data from Siegel JD, Rhinehart E, Jackson M, et al. 2007 Guideline for isolation precautions: preventing transmission of infectious agents in health care settings. Am J Infect Control 2007; 35:S65.

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