Author: Tara N Palmore, MD
Section Editor: Daniel J Sexton, MD
Deputy Editors: Jennifer Mitty, MD, MPH, Allyson Bloom, MD

Contributor Disclosures

All topics are updated as new evidence becomes available and our peer review process is complete.

Literature review current through: Apr 2020. | **This topic last updated:** May 07, 2020.

INTRODUCTION

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, prompting the World Health Organization (WHO) to declare a public health emergency in late January 2020 and characterize it as a pandemic in March 2020. 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 WHO and by the United States Centers for Disease Control and Prevention [1,2]. (See 'Society guideline links' below.)

This topic will provide an overview of infection control issues when caring for patients with COVID-19. The use of specific infection control precautions as they pertain to select specialties is presented elsewhere.

- (See "Coronavirus disease 2019 (COVID-19): Critical care and airway management issues".)
- (See "Coronavirus disease 2019 (COVID-19): Anesthetic concerns, including airway management and infection control".)
- (See "Coronavirus disease 2019 (COVID-19): Considerations in children".)
- (See "Coronavirus disease 2019 (COVID-19): Pregnancy issues".)
- (See "Coronavirus disease 2019 (COVID-19): Arrhythmias and conduction system disease".)

- (See "Coronavirus disease 2019 (COVID-19): Myocardial infarction and other coronary artery disease issues".)
- (See "Coronavirus disease 2019 (COVID-19): Issues related to kidney disease and hypertension".)

OVERVIEW 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 [3]. However, given the current uncertainty regarding transmission mechanisms of SARS-CoV-2, recommendations on airborne precautions in the health care setting vary by location. However, airborne precautions are universally recommended when aerosol-generating procedures are performed. (See 'Approach for most patients' below and 'Aerosol-generating procedures/treatments' below.)

There is also a risk of transmission when infectious droplets cause environmental contamination that in turn serves as a source of indirect (secondary) transmission when susceptible individuals touch these surfaces and then transfer virus to their mouths or other mucous membranes, such as the nose and conjunctiva, via their contaminated hands. Although the frequency and relative importance of environmental contamination in secondary transmission are unknown, environmental disinfection is an integral component of preventing spread of infection in the hospital and home setting. (See 'Environmental disinfection' below and 'Disinfection' below.)

A more detailed discussion of transmission of SARS-CoV-2, including the risk of asymptomatic transmission, is discussed in greater detail in a separate topic review. (See "Coronavirus disease 2019 (COVID-19): Epidemiology, virology, clinical features, diagnosis, and prevention", section on 'Transmission'.)

INFECTION CONTROL IN THE HEALTH CARE SETTING

Infection control interventions to reduce transmission of COVID-19 include universal source control (eg, covering the nose and mouth to contain respiratory secretions), early identification and isolation of patients with suspected disease, the use of appropriate personal protective equipment (PPE) when caring for patients with COVID-19, and environmental disinfection. Limiting transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is an essential component of care in patients with suspected or documented COVID-19. In an early report of COVID-19 in 138 patients from China, it was estimated that 43 percent acquired infection in the hospital setting [4]. In

Washington State, suboptimal use of infection control procedures contributed to the spread of infection to 81 residents, 34 staff members, and 14 visitors in one long-term care facility [5].

Measures for all patients, visitors, and personnel

Screening prior to and upon entry into the health care facility

- **Patients** – Patients should be screened for clinical manifestations consistent with COVID-19 (eg, fever, cough, myalgias, sore throat, dyspnea, anosmia/hyposmia) **prior** to entry into a health care facility. The clinical manifestations of COVID-19 are presented in detail elsewhere. (See "Coronavirus disease 2019 (COVID-19): Epidemiology, virology, clinical features, diagnosis, and prevention", section on 'Clinical manifestations'.)

  Ideally, initial screening should be done over the phone before the patient actually presents to a facility.

  - Many patients with signs and symptoms of COVID-19 can be managed from home through telemedicine and will not need to enter the health care setting. (See "Coronavirus disease 2019 (COVID-19): Outpatient management in adults" and 'Infection control in the home setting' below.)
  - For those who require additional evaluation, referral to a respiratory clinic dedicated to the evaluation and management of patients with presumptive COVID-19 is preferable.
  - However, if a dedicated clinic is not available or the patient requires a higher level of care (for COVID-19 or non-COVID-19-related symptoms), referral to an urgent care or emergency room may be needed.

  All patients should also be screened for respiratory symptoms upon entry into a health care setting. Separate waiting areas for patients with respiratory symptoms should be designated, with seating spaced such that patients are at least six feet (two meters) apart. Screening upon entry will also identify those who warrant additional infection control precautions. (See 'Patients with suspected or confirmed COVID-19' below.)

- **Visitors** – During the COVID-19 pandemic, most hospitals have restricted visitors in the health care setting. Exempted visitors should also be screened for exposure to and symptoms of COVID-19; those with evidence of infection or a known exposure in the last fourteen days should not be allowed to enter the health care setting.

- **Health care workers** – The approach to screening health care workers entering the health care setting depends upon the institution's policies. In general, health care workers should monitor themselves for fever and symptoms of COVID-19 and stay home if they are ill. In one

report of 48 health care workers with confirmed COVID-19 in King County, Washington, 65 percent reported working for a median of two days while exhibiting symptoms of COVID-19 [6]. In addition, symptom screening alone did not identify all cases. Thus, additional measures, such as universal use of masks, are recommended. (See 'Universal use of masks' below.)

Universal use of masks — All patients and any exempted visitors should be given face coverings upon entry into the health care setting (medical or cloth masks) for universal source control [7]. They should be asked to wear the mask throughout their visit. For patients who are admitted, the mask can usually be removed once the patient is in an appropriate room (eg, single room with the door closed for patients with suspected COVID-19). Additional considerations on the use of masks for patients with COVID-19 in the health care setting are discussed below. (See 'Approach for most patients' below.)

Health care workers should also wear a face covering while in the hospital setting.

- A medical mask or respirator **must** be used when caring for patients. Additional information on the use of masks and other infection control measures when caring for patients with suspected or confirmed COVID-19 is discussed below. (See 'Approach for most patients' below.)

- When supplies are limited, cloth face coverings may be reasonable for workers who do **not** engage in patient care and for providers when they are **not** involved in direct patient care activities [7].

Hand hygiene should be performed immediately before and after any contact with the face covering, including cloth coverings. Cloth masks should be changed if they become soiled, damp, or difficult to breathe through, and they should be laundered regularly (eg, daily and when soiled).

The goal of universal masks is to reduce transmission of SARS-CoV-2 from unsuspected virus carriers [8,9]. Although there are no clinical data to support this approach, transmission of COVID-19 from health care workers has been reported [10], and in areas with widespread community transmission, symptom screening alone may not be sufficient, since presymptomatic and asymptomatic transmission can occur [11,12]. (See "Coronavirus disease 2019 (COVID-19): Epidemiology, virology, clinical features, diagnosis, and prevention", section on 'Person-to-person'.)

Use of PPE for all patients with respiratory symptoms — All health care workers should use standard, contact, and droplet precautions (ie, gown, gloves, and medical mask), with eye or face protection when evaluating any patient with an undiagnosed respiratory infection, even those who are not under consideration for COVID-19. (See "Coronavirus disease 2019 (COVID-19): Epidemiology, virology, clinical features, diagnosis, and prevention", section on 'Clinical suspicion and criteria for testing'.)

Patients with suspected or confirmed COVID-19

Approach for most patients — The following infection control precautions should be used for all patients with suspected or confirmed COVID-19:

- **Type of room** – Patients should be placed in a single-occupancy room with a closed door and dedicated bathroom. When this is not possible, patients with confirmed COVID-19 can be housed together [7]. Patients with confirmed COVID-19 should **not** be in a positive-pressure room.

  An airborne infection isolation room (AII; ie, a single-patient, negative-pressure room) should be prioritized for patients undergoing aerosol-generating procedures. Additional information on AII rooms, and what to do when these are not available, is found below. (See 'Aerosol-generating procedures/treatments' below.)

- **PPE for providers** – All providers should wear personal protective equipment (PPE) to reduce the risk of exposure:

  - The World Health Organization (WHO) recommends that standard, contact, and droplet precautions (ie, gown, gloves, and medical mask) with eye or face protection be used for all personnel entering the room of a patient with suspected or confirmed COVID-19 [13]. The addition of airborne precautions (ie, respirator) is warranted during aerosol-generating procedures. (See 'Aerosol-generating procedures/treatments' below.)

  - The United States Centers for Disease Control and Prevention (CDC) guidelines are similar, but recommend that an appropriate respirator (eg, an N95 respirator) be used instead of a medical mask. However, if the supply of respirators is limited, the CDC acknowledges medical masks are an acceptable alternative (in addition to contact precautions and eye protection) for most encounters, but respirators should be worn during aerosol-generating procedures [7]. (See 'Aerosol-generating procedures/treatments' below.)

  Goggles or a disposable face shield that covers the front and sides of the face should be used for eye protection; glasses are **not** sufficient. In addition, cloth face coverings are not considered PPE and should **not** be worn for the care of patients.

  Some institutions also require shoe covers for providers caring for patients on a dedicated COVID-19 ward or intensive care unit. In one report, SARS-CoV-2 RNA was widely distributed on floors, and contamination was greater in intensive care units than general wards, although whether this reflected infectious virus and its role in transmitting infection are unknown [14]. Hair covers may be used as well, but are usually not mandatory.

Health care workers should pay special attention to the appropriate sequence of putting on (figure 1) and taking off (figure 2) PPE to avoid contamination. The CDC has created video demonstrations of the proper donning and doffing of PPE. Errors in removal of PPE are common, even in trained clinicians, and are associated with contamination of health care workers with pathogens [15]. In a Cochrane review that evaluated methods to increase compliance with donning and doffing of PPE, several interventions appeared to have some benefit in preventing contamination, including the use of CDC protocols and face-to-face training [16].

As noted above, when supplies are available, the United States CDC recommends the use of N95 rather than medical masks when caring for all patients with suspected or confirmed COVID-19, since there remains uncertainty about the role of airborne transmission of SARS-CoV-2, COVID-19 has been associated with severe infection, and there are no established treatments or vaccines. (See "Coronavirus disease 2019 (COVID-19): Epidemiology, virology, clinical features, diagnosis, and prevention" and "Coronavirus disease 2019 (COVID-19): Management in hospitalized adults".)

However, airborne transmission of SARS-CoV-2 has not clearly been documented, and several studies support the use of standard, contact, and droplet precautions with eye protection for most patients, with use of N95 respirators for those undergoing aerosol-generating procedures [17-20]. As an example, in a report from Hong Kong in which hospitals implemented empiric isolation, SARS-CoV-2 testing, and use of respirators for all aerosol-generating procedures (regardless of apparent patient risk factors), only 11 of 413 health care workers (2.7 percent) who cared for patients with COVID-19 had unprotected exposure and required quarantine, and none developed infection [17].

- **When patients should wear a mask** – Patients should wear a medical mask if being transported out of the room (eg, for studies that cannot be performed in the room). In some institutions, when N95 respirators are not available for routine use, patients with COVID-19 are asked to wear a medical mask during face-to-face contact with health care workers, even when they are in their room, to lower their risk of transmitting infection. When this is done, health care workers must still use appropriate PPE, as described above.

Approach in select settings

Aerosol-generating procedures/treatments — In patients with COVID-19, aerosol-generating procedures should be avoided when possible to reduce the potential risk of transmission to health care workers. Although there is no consensus as to what constitutes an aerosol-generating procedure, in patients with COVID-19, these procedures typically include (listed alphabetically):

- Bronchoscopy (including mini bronchoalveolar lavage)
- Cardiopulmonary resuscitation
- Colonoscopy
- Filter changes on the ventilator
- High-flow oxygen
- Manual ventilation before intubation
- Nasal endoscopy
- Noninvasive ventilation
- Open suctioning of airways
- Tracheal intubation and extubation
- Tracheotomy
- Upper endoscopy (including transesophageal echocardiogram)
- Swallowing evaluation

Similarly, inhaled medications should be administered by metered-dose inhaler when feasible, rather than through a nebulizer, to avoid the risk of aerosolization of SARS-CoV-2 through nebulization.

If avoiding aerosol-generating procedures or use of a nebulizer is not possible, appropriate PPE for health care workers includes use of N95 or other respirators (eg, a powered air-purifying respirator [PAPR]) that offer a higher level of protection [7,13,21]. Other precautions include eye protection (eg, goggles or a disposable face shield that covers the front and sides of the face), gloves, and a gown.

Aerosol-generating procedures should take place in an airborne infection isolation room (AII). These are single-patient rooms at negative pressure relative to the surrounding areas, and with a minimum of six air changes per hour (12 air changes per hour are recommended for new construction or renovation). When an AII room is not available, a portable high-efficiency particulate air (HEPA) unit can be placed in the room, although it does not compensate for the absence of negative air flow. In one institution, a negative-pressure canopy was used for patients receiving continuous positive airway pressure (CPAP), high-flow nasal cannula, and noninvasive ventilation [22].

Health care workers and other personnel (eg, environmental services, maintenance) should not enter the room until sufficient time has passed since an aerosol-generating procedure to allow for removal of infectious particles. The rate of removal depends upon the number of air exchanges per hour, as described on the CDC website [23].

Specimen collection for respiratory viral pathogens — In the setting of the COVID-19 pandemic, respiratory specimens for viral pathogens should be obtained in a single-occupancy

room with the door closed, and visitors should not be present during specimen collection. Nasopharyngeal or oropharyngeal specimen collection is not considered an aerosol-generating procedure that warrants an airborne infection isolation room.

When collecting a nasopharyngeal or oropharyngeal specimen in a patient with suspected or confirmed COVID-19, the United States CDC recommends that health care workers in the room wear an N95 or higher level respirator (or medical mask if a respirator is not available), eye protection (eg, face shield or goggles), gloves, and a gown [24].

As noted above, the CDC prefers a respirator rather than a medical mask when caring for all patients with suspected or confirmed COVID-19, as this is a novel virus and there is some uncertainty about airborne transmission of SARS-CoV-2. However, when supplies are limited, respirators should be prioritized for aerosol-generating procedures. (See 'Approach for most patients' above and 'Aerosol-generating procedures/treatments' above.)

When PPE is limited — Limited availability of personal protective equipment (PPE) has complicated medical care of patients with suspected or documented COVID-19 (and other transmissible conditions) worldwide. The CDC has made a spreadsheet available that facilities can use to calculate their "burn rate," or average daily usage rate for PPE, using the change in inventory.

Optimizing the supply of PPE — In the United States, the CDC offers guidance on optimizing the supply of PPE when sudden increases in patient volume threaten a facility's PPE capacity [25].

Strategies include:

- Canceling non-urgent procedures or visits that would warrant use of PPE and favoring home care rather than hospitalization when appropriate.
- Limiting movement outside the patient's room, prioritizing the use of certain PPE for the highest risk situations (eg, aerosol-generating procedures), and designating entire units within a facility to care for known or suspected patients with COVID-19 (ie, cohorting).
- Minimizing face-to-face encounters with the patient, which can be done by excluding nonessential personnel and visitors, limiting the number of people who examine the patient, using medications with extended intervals to reduce nursing encounters, and allowing some providers to perform telephone interviews with hospitalized patients. In some facilities, patients can convey needs to providers using tablets or other electronic interfaces, further reducing some in-person interactions.

- Utilizing alternatives to N95s, such as elastomeric half-mask and full-facepiece air-purifying respirators, as well as PAPRs [26-28].

In a crisis situation, cautious extended or limited reuse of PPE may be reasonable. As an example, the same medical mask can be used for repeated close contact encounters with several different patients (assuming it is not visibly damaged or soiled) [29]. When this strategy is used, the provider should not touch or remove the mask between patient encounters, since the outside surface is presumably contaminated. If the provider does touch the mask, they must immediately perform hand hygiene. The CDC suggests that masks can be used for 8 to 12 hours [29], whereas the WHO states medical masks can be used for up to six hours when caring for a cohort of patients with COVID-19 [30]. More detailed information on extended use and reuse of medical masks and N95 respirators can be found on the CDC and WHO websites [25,29-31].

Decontamination of PPE for reuse — There has been interest in decontamination of personal protective equipment (PPE) for reuse, in particular for N95 respirators. In some centers, decontamination of face shields is also being performed.

The CDC and WHO have highlighted several methods for decontamination of respirators when supplies are critically low (crisis standards) [30,32]. These include:

- **Ultraviolet light** – Decontamination with ultraviolet (UV) light was evaluated in the context of the H1N1 influenza pandemic; in experimental models, UV irradiation was observed to reduce H1N1 influenza viability on N95 respirator surfaces at doses below the threshold observed to impair the integrity of the respirator [33-35]. Coronaviruses can also be inactivated by UV irradiation, but comparable studies have not been performed with SARS-CoV-2, and the dose needed to inactivate the virus on a respirator surface is unknown. Nebraska Medicine has implemented a protocol for UV irradiation of N95 respirators in the context of the COVID-19 pandemic based on the dose generally needed to inactivate other single-stranded RNA viruses on surfaces [36].

- **Hydrogen peroxide vapor** – Duke University Health System is using hydrogen peroxide vapor for N95 decontamination [37]. Hydrogen peroxide vapor has been observed to inactivate other non-coronavirus single-stranded RNA viruses on environmental surfaces [38,39]. In the United States, The US Food and Drug Administration granted an emergency use authorization for use of low-temperature vaporous hydrogen peroxide sterilizers, used for medical instruments, to decontaminate N95 respirators [40].

- **Moist heat** – Moist heat has been observed to reduce the concentration of H1N1 influenza virus on N95 respirator surfaces [34]. In this study, moist heat was applied by preparing a container with 1 L of tap water in the bottom and a dry horizontal rack above the water; the

container was sealed and warmed in an oven to 65°C/150°F for at least three hours; it was then opened, the respirator placed on the rack, and the container resealed and placed back in the oven for an additional 30 minutes. No residual H1N1 infectivity was found. The optimal time and temperature to inactivate SARS-CoV-2 are uncertain; several studies observed inactivation of SARS-CoV after 30 to 60 minutes at 60°C/140°F [41-43].

Ethylene oxide is also used for decontaminating PPE in some institutions. The CDC cautions that off-gassing from ethylene oxide-treated PPE could be harmful to the wearer [32], but some facilities have taken steps to verify safe concentrations prior to deploying this method.

If decontamination of PPE is done, staff should be cautioned to not wear makeup, use lotions or beard oils, or write on masks, as they make decontamination difficult or impossible.

Environmental disinfection — To help reduce the spread of COVID-19, environmental infection control procedures should be implemented [7,13,44-46]. In United States health care settings, the CDC states routine cleaning and disinfection procedures are appropriate for SARS-CoV-2 [7]. 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.

Many hospitals have implemented enhanced environmental cleaning and disinfection protocols for rooms used by patients with known or suspected COVID-19, and for areas used by health care workers caring for such patients, to prevent secondary transmission from fomites. As an example, adjunctive disinfection methods, such as UV light and hydrogen peroxide vapor, are used in some facilities to disinfect the rooms that have housed or been used for aerosol-generating procedures on patients with COVID-19.

Environmental services workers who are cleaning areas potentially contaminated with SARS-CoV-2 should be trained to conduct the cleaning in appropriate PPE [7]. Workers should be fit tested and trained to wear N95 respirators and face shields (or PAPRs) when cleaning patient rooms that are or have been occupied by persons with known or suspected COVID-19 or have been used for aerosol-generating procedures on patients with COVID-19. Environmental services workers can use droplet and contact precautions, plus eye protection (surgical mask, face shield or goggles, gown, and gloves) when cleaning areas used by health care workers who are caring for COVID-19 patients.

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 [47]. 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. The role of environmental contamination in transmission of SARS-CoV-2 is discussed elsewhere. (See "Coronavirus disease 2019 (COVID-19): Epidemiology, virology, clinical features, diagnosis, and prevention", section on 'Environmental contamination'.)

Patients who have had an exposure to COVID-19 — Some patients who require hospitalization for a reason unrelated to COVID-19 may have had close contact with someone with suspected or confirmed COVID-19, including during the 48 hours prior to that patient developing symptoms. (See "Coronavirus disease 2019 (COVID-19): Epidemiology, virology, clinical features, diagnosis, and prevention", section on 'Diagnosis'.)

In this setting, clinicians should use infection control precautions similar to those used for patients with suspected disease, as described above; however, such patients should **not** be cohorted or share a room with patients who have COVID-19. (See 'Approach for most patients' above.)

Patients should continue infection control precautions specific for COVID-19 for the duration of their quarantine (14 days after their last contact with the patient).

Some institutions are testing asymptomatic patients after an exposure. However, a negative test does not rule out subsequent development of infection with SARS-CoV-2, and therefore, infection control precautions should be continued for the duration of the incubation period, despite a negative result.

INFECTION CONTROL IN THE HOME SETTING

Home management is appropriate for patients with mild infection who can be adequately isolated in the outpatient setting [44,48,49]. (See "Coronavirus disease 2019 (COVID-19): Outpatient management in adults" and "Coronavirus disease 2019 (COVID-19): Management in hospitalized adults".)

Management of such patients should include instructions on how to prevent transmission to others.

Isolation at home — Outpatients with suspected or confirmed COVID-19 (including those awaiting test results) should stay at home and try to separate themselves from other people and animals in the household [50]. They should also avoid having visitors enter the home.

Patients should wear a face cover if they must be in the same room (or vehicle) as other people. Some authorities recommend a medical mask [51]; however, when supplies of personal protective

equipment (PPE) are limited, a cloth face cover should be used. Detailed information on the use of cloth face covers can be found on the United States Centers for Disease Control and Prevention (CDC) website. A caregiver can also wear a face cover when around the patient, but if a cloth face cover is used, it is unclear how much protection it provides to the wearer.

Other steps to reduce transmission in the home include [51-54]:

- Limiting the number of caregivers and, if possible, using caregivers who do not have risk factors for developing severe disease. (See "Coronavirus disease 2019 (COVID-19): Epidemiology, virology, clinical features, diagnosis, and prevention", section on 'Risk factors for severe illness'.)
- Having patients use a separate bedroom and bathroom, if available.
- Minimizing patients' exposure to shared spaces and ensuring shared spaces in the home have good air flow, such as an air conditioner or an opened window. When sharing spaces cannot be avoided, patients and caregivers should try to remain six feet (two meters) apart, if possible, and face covers should be used.
- Ensuring caregivers perform hand hygiene after any type of contact with patients or their immediate environment. In addition, caregivers should wear gloves when touching the patient's blood, stool, or body fluids, such as saliva, sputum, nasal mucus, vomit, and urine.
- Educating caregivers on how to carefully put on and take off PPE. As an example, caregivers should first remove and dispose of gloves, and then immediately clean their hands with soap and water or alcohol-based hand sanitizer. After that, the face cover (if used) should be removed, and the caregiver should again perform hand hygiene.
- Instructing family members to **avoid** sharing dishes, drinking glasses, cups, eating utensils, towels, bedding, or other items with the patient. After the patient uses these items, they should be washed thoroughly; disposable gloves should be worn when handling these items. In addition, thermometers should not be shared, or should be thoroughly disinfected before use by other household members.

More detailed recommendations on home management of patients with COVID-19 can be found on the World Health Organization and CDC websites [44,45,55].

Disinfection — Disinfection of frequently touched surfaces is also important. In the home, high-touch surfaces should be cleaned and disinfected daily. These include tables, hard-backed chairs, doorknobs, light switches, remote controls, handles, desks, toilets, and sinks. For disinfection, diluted household bleach solutions, alcohol solutions with at least 70% alcohol, and most common

Environmental Protection Agency-registered household disinfectants are thought to be effective. More detailed information on how to clean and disinfect, including guidance for patients, is found on the CDC and World Health Organization websites [52,56].

DISCONTINUATION OF PRECAUTIONS

The decision to discontinue infection control precautions for patients with suspected or proven COVID-19 should be made in consultation with experts in infection prevention and control and/or public health officials. If patients are ready to be discharged home prior to meeting criteria for discontinuation of precautions, they can be sent home with instructions to self-isolate until they meet either test-based or non-test-based criteria.

Once infection control precautions/home isolation are discontinued, patients should still continue to follow public health recommendations for wearing face covers in public settings where social distancing is difficult to achieve. (See "Coronavirus disease 2019 (COVID-19): Epidemiology, virology, clinical features, diagnosis, and prevention", section on 'Personal preventive measures'.)

Special considerations for health care workers are found below. (See 'After infection' below.)

Patients with confirmed infection

Symptomatic patients — Test-based and symptom-based strategies can be used to inform when infection control precautions should be discontinued in patients with COVID-19 [57-59]. Symptom-based strategies allow for discontinuation of precautions after symptom resolution and specific time intervals, whereas a test-based strategy requires resolution of symptoms and two negative reverse transcription polymerase chain reaction (RT-PCR) tests for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on sequential respiratory specimens collected ≥24 hours apart. A detailed discussion of testing is found in a separate topic review. (See "Coronavirus disease 2019 (COVID-19): Epidemiology, virology, clinical features, diagnosis, and prevention", section on 'NAAT (RT-PCR) to diagnose current infection'.)

The United States Centers for Disease Control and Prevention (CDC) suggests the following test- or symptom-based strategies [57,59]. A discussion about which strategy to use is found below. (See 'Deciding whether to use a test- or non-test-based strategy' below.)

- When a **test-based** strategy is used, patients may discontinue infection control precautions specific for COVID-19/home isolation when there is:
    - Resolution of fever without the use of fever-reducing medications **AND**

- Improvement in respiratory symptoms (eg, cough, shortness of breath) **AND**
- Negative results of a US Food and Drug Administration emergency use authorized molecular assay for COVID-19 from at least two consecutive respiratory specimens collected ≥24 hours apart (total of two negative specimens)

There is no clear guidance as to when repeat testing should be performed. We obtain the first test once the patient has met the criteria for the symptom-based strategy. If the first test is positive, a second test should be obtained after 72 hours. If negative, the second test is obtained 24 hours later.

- When a **symptom-based** strategy is used, patients may discontinue infection control precautions specific for COVID-19/home isolation when the following criteria are met:
  - At least 10 days have passed since symptoms first appeared **AND**
  - At least three days (72 hours) have passed since recovery (defined as resolution of fever without the use of fever-reducing medications **and** improvement in respiratory symptoms [eg, cough, shortness of breath])

  When a symptom-based strategy is used, it may be reasonable to continue precautions or extend the period of isolation beyond the 10 days in select patients, such as those who are likely to remain infectious for longer periods of time (eg, immunocompromised patients), as well as certain employees (eg, those who work with vulnerable populations). This should be determined on a case-by-case basis.

  A seven-day duration was previously used, but was updated based on evidence on duration of viral shedding [60]. (See "Coronavirus disease 2019 (COVID-19): Epidemiology, virology, clinical features, diagnosis, and prevention", section on 'Viral shedding and period of infectivity'.)

Protocols in other countries and at specific institutions may differ; as an example, when a non-test-based strategy is used, the World Health Organization (WHO) suggests home isolation for patients with documented COVID-19 be continued for at least two weeks after symptom resolution [52]. Information on other institutional protocols is found elsewhere. (See "Coronavirus disease 2019 (COVID-19): Management in hospitalized adults", section on 'Institutional protocols'.)

Asymptomatic patients — Some patients may have been tested for SARS-CoV-2 and had laboratory-confirmed COVID-19 without any symptoms when they were tested. Similar to patients with symptoms, the United States CDC has provided recommendations for test- and non-test-based strategies [57,59]. The non-test-based strategy uses time since diagnosis.

- **Time-based strategy** – If a time-based strategy is used, infection control precautions specific for COVID-19/home isolation can be discontinued when at least 10 days have passed since the date of their first positive COVID-19 test, as long as there was no evidence of subsequent illness. If symptoms developed, the symptom-based strategy should be used. (See 'Symptomatic patients' above.)

  When using a time-based strategy, it may be reasonable to continue precautions or extend the period of isolation beyond the 10 days in select patients, such as those who are likely to remain infectious for longer periods of time (eg, immunocompromised patients), as well as certain employees (eg, those who work with vulnerable populations).

- **Test-based strategy** – If a test-based strategy is used, infection control precautions specific for COVID-19/home isolation can be discontinued when patients have negative results of a US Food and Drug Administration emergency use authorized molecular assay for COVID-19 from at least two consecutive respiratory specimens collected ≥24 hours apart (total of two negative specimens).

A discussion about which strategy to use is found below. (See 'Deciding whether to use a test- or non-test-based strategy' below.)

Deciding whether to use a test- or non-test-based strategy — The decision to use a test- or non-test-based strategy must be determined on a case-by-case basis, since each strategy has potential limitations.

As an example, the use of non-test-based strategies may not prevent all instances of secondary spread. These strategies that use time since diagnosis or time since illness onset and recovery are based upon findings that transmission is most likely to occur in the early stage of infection. However, data are limited, particularly in immunocompromised patients [57,58].

By contrast, a test-based strategy may unnecessarily prolong the need for infection control precautions and isolation, since there have been reports of prolonged detection of RNA without direct correlation to viral culture. In a German study of nine patients with mild infection, no infectious virus was found in respiratory specimens after day 8 of symptoms despite the detection of high titers of viral RNA through the third week, suggesting prolonged shedding of viral RNA is not necessarily reflective of transmissibility [60,61].

Test-based and non-test-based strategies differ for symptomatic and asymptomatic patients and are detailed above. (See 'Symptomatic patients' above and 'Asymptomatic patients' above.)

A more detailed discussion of viral shedding and the period of infectivity is found in a separate topic review. (see "Coronavirus disease 2019 (COVID-19): Epidemiology, virology, clinical features,

diagnosis, and prevention", section on 'Viral shedding and period of infectivity')

Suspected cases with negative initial testing — In some patients, initial testing is negative, but there is still suspicion for COVID-19. In this setting, a second test should be performed, and infection control precautions should be continued pending the result. When two tests are negative, precautions can often be discontinued; however, if concern for COVID-19 remains high, such as in a patient with consistent clinical symptoms and an exposure to a person with known or suspected COVID-19, infection control precautions should be continued at least until criteria for discontinuation of precautions using a symptom-based strategy are met. (See 'Symptomatic patients' above.)

The accuracy and predictive values of SARS-CoV-2 testing have not been systematically evaluated, and a single negative test may not sufficiently exclude the diagnosis. In addition, the quality of nasopharyngeal swab collection may vary. Additional information on diagnostic testing is presented elsewhere. (See "Coronavirus disease 2019 (COVID-19): Epidemiology, virology, clinical features, diagnosis, and prevention", section on 'Diagnosis'.)

Suspected cases when testing was not performed — 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. In areas where community transmission of SARS-CoV-2 is widespread, these patients are often treated presumptively for COVID-19 (eg, home isolation, supportive care) and the decision to discontinue transmission-based precautions should be made using the symptom-based strategy described above. (See 'Symptomatic patients' above.)

ADDITIONAL CONSIDERATIONS

Return to work for health care workers

After potential or known exposure — For health care workers who have had a potential exposure to COVID-19, the United States Centers for Disease Control and Prevention (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 medical mask, the type of personal protective equipment (PPE) used by the provider, and whether an aerosol-generating procedure was performed. Some local health departments allow asymptomatic health care workers to return to work following an exposure if they adhere to cough and hand hygiene, wear a medical mask while at the health care facility until 14 days after the exposure, and monitor daily for fever or respiratory symptoms, the presence of which would prompt immediate self-isolation [62].

After infection — For health care workers with confirmed or suspected COVID-19, decisions about return to work should be made in the context of the provider's local circumstances (eg,

availability of testing, staffing shortages) [63]. Test- or non-test-based strategies can be used. More detailed information regarding criteria for return to work, as well as return to work practices and work restrictions, is found on the CDC website.

Long-term care facilities — Similar to other health care settings, certain measures should be used for all patients, visitors, and providers entering the facility. These include symptom screening and use of face covers for everyone entering the facility, regardless of symptoms. In addition, standard, contact, and droplet precautions, as well as eye protection, should be used for any patient with an undiagnosed respiratory infection [64]. A more detailed discussion of infection control precautions can be found above. (See 'Measures for all patients, visitors, and personnel' above and 'Patients with suspected or confirmed COVID-19' above.)

Additional strategies to reduce the risk of COVID-19 infection in long-term care facilities include limiting visitors except in rare circumstances (eg, compassionate care situations), screening staff daily for symptoms before entering the facility, discontinuing use of common dining rooms and canceling all group activities, and monitoring the clinical status and vital signs of all residents at least three times per 24-hour period, including daily temperature measurements [65-67]. Since older adults with COVID-19 may not show typical symptoms (eg, fever or respiratory symptoms), the CDC recommends that a temperature >100.0°F, as well as the presence of atypical symptoms, such as worsening malaise, new dizziness, or diarrhea, prompt isolation and further evaluation for COVID-19 [64].

Once an outbreak has occurred, the facility should identify an area to care for residents with suspected or confirmed COVID-19, and dedicated staff should be assigned to work only in that area of the facility. Roommates who have been exposed but are asymptomatic should **not** be placed with another roommate until 14 days after their exposure, assuming they have not developed symptoms or had a positive test. If the facility has airborne infection isolation rooms (ie, single-patient, negative-pressure rooms), they should be prioritized for patients who require aerosol-generating procedures (eg, patients with tracheostomies requiring nebulizer treatments). When this is not possible, a private room should be used, with a portable high-efficiency particulate air (HEPA) filter, if available.

Additional information on infection control in long-term care facilities can be found on the CDC website.

Dialysis — Similar to other health care settings, dialysis centers should identify patients with signs and symptoms of respiratory infection (eg, fever, cough) before they enter the treatment area. If a patient has suspected infection when they arrive, they should be placed in a private room. If that is not possible, they should wear a mask and be separated by at least six feet (two meters) from the

nearest patient. Staff should wear PPE as described above. A more detailed discussion of infection control in dialysis centers is presented in a separate topic review. (See "Coronavirus disease 2019 (COVID-19): Issues related to kidney disease and hypertension", section on 'Patients receiving in-center hemodialysis'.)

Role of serologic testing — Serologic tests, as soon as generally available and adequately evaluated, should be able to identify patients who have a prolonged illness (eg, greater than 14 days) and a negative polymerase chain reaction (PCR) test, as well as those who had previous infection. However, these tests are not useful for assessing the presence of infection in an exposed patient and, until their sensitivity and specificity are further assessed, they should not be used for determining the use of infection control precautions. Additional information on serologic testing is presented elsewhere. (See "Coronavirus disease 2019 (COVID-19): Epidemiology, virology, clinical features, diagnosis, and prevention", section on 'Serology to identify prior infection'.)

Preventing infection in the community — To reduce the risk of transmission in the community, individuals should be advised to practice diligent hand hygiene, as well as respiratory hygiene (eg, covering their cough), and to avoid close contact with ill individuals, if possible. In addition, residents should greet each other without contact, refrain from shaking hands, and avoid gathering in groups. If community transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is present, residents should be encouraged to practice social distancing by staying home as much as possible and maintaining six feet (two meters) distance from others when they have to leave home. In some locations, face coverings are advised in public settings. Additional measures are discussed in detail in a separate topic review. (See "Coronavirus disease 2019 (COVID-19): Epidemiology, virology, clinical features, diagnosis, and prevention", section on 'Personal preventive measures'.)

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) – International and government guidelines for general care" and "Society guideline links: Coronavirus disease 2019 (COVID-19) – Guidelines for specialty care" and "Society guideline links: Coronavirus disease 2019 (COVID-19) – Resources for patients".)

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 topics (see "Patient education: Coronavirus disease 2019 (COVID-19) overview (The Basics)" and "Patient education: Coronavirus disease 2019 (COVID-19) and pregnancy (The Basics)" and "Patient education: Coronavirus disease 2019 (COVID-19) and children (The Basics)")

SUMMARY AND RECOMMENDATIONS

- 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, prompting the World Health Organization (WHO) to declare a public health emergency in late January 2020 and characterize it as a pandemic in March 2020. The virus that causes COVID-19 is designated severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). (See 'Introduction' above.)

- Limiting transmission of SARS-CoV-2 is an essential component of care in patients with suspected or documented COVID-19. This includes universal source control (eg, covering the nose and mouth to contain respiratory secretions), early identification and isolation of patients with suspected disease, use of appropriate personal protective equipment (PPE) when caring for patients with COVID-19, and environmental disinfection. (See 'Measures for all patients, visitors, and personnel' above and 'Infection control in the health care setting' above and 'Infection control in the home setting' above.)

- Person-to-person spread of SARS-CoV-2 is thought to occur mainly via respiratory droplets, resembling the spread of influenza. However, given the current uncertainty regarding transmission mechanisms of SARS-CoV-2, airborne precautions are recommended in certain settings. Thus, in hospitalized patients, the following types of infection control precautions should be used for those with suspected or confirmed COVID-19 (see 'Patients with suspected or confirmed COVID-19' above):

- Patients should ideally be placed in a single-occupancy room with a closed door and dedicated bathroom; however, when this is not possible, patients with confirmed COVID-19 can be housed together. An airborne infection isolation room (ie, a single-patient negative-pressure room) should be prioritized for patients undergoing aerosol-generating procedures. (See 'Approach for most patients' above and 'Aerosol-generating procedures/treatments' above.)

- Standard, contact, and droplet precautions (ie, gown, gloves, and medical mask), with eye or face protection (eg, face shield or goggles) should be used for all personnel entering the room. An N95 respirator should be used for all aerosol-generating procedures. In the United States, an N95 respirator is preferred for all settings, but the Centers for Disease Control and Prevention (CDC) acknowledges that medical masks are an acceptable alternative when PPE is limited. (See 'Approach for most patients' above and 'Aerosol-generating procedures/treatments' above and 'When PPE is limited' above.)

- Health care workers should pay special attention to the appropriate sequence of putting on (figure 1) and taking off (figure 2) PPE to avoid contamination. (See 'Approach for most patients' above.)

- When availability of PPE is limited, strategies to preserve the supply include canceling non-urgent procedures or visits that would warrant use of PPE and prioritizing the use of certain PPE for the highest risk situations. Cautious extended or limited reuse of PPE and decontamination of PPE for reuse can also be considered in select situations. (See 'When PPE is limited' above.)

- In some hospitalized patients, initial testing is negative, but the suspicion for COVID-19 remains high. In this setting, additional testing should be performed to help inform the decision to continue transmission-based precautions. (See 'Suspected cases with negative initial testing' above.)

- To help reduce the spread of COVID-19, environmental infection control procedures should be implemented in both health care and home settings. 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. (See 'Environmental disinfection' above and 'Disinfection' above.)

- Outpatients with suspected or confirmed COVID-19 (including those awaiting test results) who do not require hospitalization should stay at home and separate themselves from other people and animals in the household. Other strategies to help prevent transmission within the household include use of face covers, not sharing items such as dishes, towels, and bedding,

and disinfection of frequently touched surfaces. (See 'Infection control in the home setting' above.)

- In symptomatic patients with confirmed COVID-19, test-based or symptom-based strategies can be used to inform when transmission-based precautions should be discontinued. If patients are ready to be discharged home prior to meeting criteria for discontinuation of precautions, they can be sent home with instructions to self-isolate until the criteria are met. (See 'Discontinuation of precautions' above.)

- In patients who were presumptively diagnosed with COVID-19 based upon a compatible illness but were not tested, the decision to discontinue transmission-based precautions should be made using the symptom-based strategy. (See 'Suspected cases when testing was not performed' above.)

- Some patients may have been tested for SARS-CoV-2 and had laboratory-confirmed COVID-19 without any symptoms when they were tested. For such patients, a test- or time-based strategy can be used to discontinue infection control precautions, as long as there was no evidence of subsequent illness. (See 'Asymptomatic patients' above.)

- Additional infection control considerations for health care workers and long-term health care facilities are discussed above. (See 'Additional considerations' above.)

REFERENCES

1. Centers for Disease Control and Prevention. 2019 Novel coronavirus, Wuhan, China. Information for Healthcare Professionals. https://www.cdc.gov/coronavirus/2019-nCoV/hcp/index.html (Accessed on February 14, 2020).

2. World Health Organization. Novel Coronavirus (2019-nCoV) technical guidance. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance (Accessed on February 14, 2020).

3. World Health Organizaiton. Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations. https://www.who.int/news-room/commentaries/detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations (Accessed on March 28, 2020).

4. Wang D, Hu B, Hu C, et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. JAMA 2020.

5. McMichael TM, Clark S, Pogosjans S, et al. COVID-19 in a Long-Term Care Facility - King County, Washington, February 27-March 9, 2020. MMWR Morb Mortal Wkly Rep 2020; 69:339.

6. Chow EJ, Schwartz NG, Tobolowsky FA, et al. Symptom Screening at Illness Onset of Health Care Personnel With SARS-CoV-2 Infection in King County, Washington. JAMA 2020.

7. Centers for Disease Control and Prevention. Interim Infection Prevention and Control Recommendations for Patients with Confirmed 2019 Novel Coronavirus (2019-nCoV) or Patients Under Investigation for 2019-nCoV in Healthcare Settings. https://www.cdc.gov/coronavirus/2019-nCoV/hcp/infection-control.html (Accessed on April 15, 2020).

8. Klompas M, Morris CA, Sinclair J, et al. Universal Masking in Hospitals in the Covid-19 Era. N Engl J Med 2020.

9. Leung NHL, Chu DKW, Shiu EYC, et al.. Respiratory virus shedding in exhaled breath and efficacy of face masks. Nat Med 2020.

10. McMichael TM, Clark S, Pogosjans S, et al. COVID-19 in a Long-Term Care Facility — King County, Washington, February 27–March 9, 2020. MMWR Morb Mortal Wkly Rep 2020.

11. Wei WE, Li Z, Chiew CJ, et al. Presymptomatic Transmission of SARS-CoV-2 - Singapore, January 23-March 16, 2020. MMWR Morb Mortal Wkly Rep 2020; 69:411.

12. Arons MM, Hatfield KM, Reddy SC, et al. Presymptomatic SARS-CoV-2 Infections and Transmission in a Skilled Nursing Facility. N Engl J Med 2020.

13. World Health Organization. Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected. January 25, 2020. https://www.who.int/publications-detail/infection-prevention-and-control-during-health-care-when-novel-coronavirus-(ncov)-infection-is-suspected-20200125 (Accessed on February 04, 2020).

14. Guo ZD, Wang ZY, Zhang SF, et al. Aerosol and Surface Distribution of Severe Acute Respiratory Syndrome Coronavirus 2 in Hospital Wards, Wuhan, China, 2020. Emerg Infect Dis 2020; 26.

15. Okamoto K, Rhee Y, Schoeny M, et al. Impact of doffing errors on healthcare worker self-contamination when caring for patients on contact precautions. Infect Control Hosp Epidemiol 2019; 40:559.

16. Verbeek JH, Rajamaki B, Ijaz S, et al. Personal protective equipment for preventing highly infectious diseases due to exposure to contaminated body fluids in healthcare staff. Cochrane Database Syst Rev 2020; 4:CD011621.

17. Cheng VCC, Wong SC, Chen JHK, et al. Escalating infection control response to the rapidly evolving epidemiology of the coronavirus disease 2019 (COVID-19) due to SARS-CoV-2 in Hong Kong. Infect Control Hosp Epidemiol 2020; 41:493.

18. Wong SC, Kwong RT, Wu TC, et al. Risk of nosocomial transmission of coronavirus disease 2019: an experience in a general ward setting in Hong Kong. J Hosp Infect 2020.

19. Ng K, Poon BH, Kiat Puar TH, et al. COVID-19 and the Risk to Health Care Workers: A Case Report. Ann Intern Med 2020.

20. Zhan M, Qin Y, Xue X, Zhu S. Death from Covid-19 of 23 Health Care Workers in China. N Engl J Med 2020.

21. Infectious Diseases Society of America guidelines on infection prevention for health care personnel caring for patients with suspected or known COVID-19. https://www.idsociety.org/globalassets/idsa/practice-guidelines/covid-19/infection-prevention/idsa-covid-19-guideline_ip_version-1.0.pdf (Accessed on April 29, 2020).

22. Adir Y, Segol O, Kompaniets D, et al. Covid19: minimising risk to healthcare workers during aerosol producing respiratory therapy using an innovative constant flow canopy. Eur Respir J 2020.

23. United States Centers for Disease Control and Prevention. Guidelines for Environmental Infection Control in Health-Care Facilities. https://www.cdc.gov/infectioncontrol/guidelines/environmental/appendix/air.html#tableb1 (Accessed on April 15, 2020).

24. United States Centers for Disease Control and Prevention. Healthcare infection prevention and control FAQs. https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control-faq.html (Accessed on April 04, 2020).

25. United States Centers for Disease Control and Prevention (CDC). Strategies for Optimizing the Supply of PPE. https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/index.html (Accessed on March 25, 2020).

26. Pompeii LA, Kraft CS, Brownsword EA, et al. Training and Fit Testing of Health Care Personnel for Reusable Elastomeric Half-Mask Respirators Compared With Disposable N95 Respirators. JAMA 2020.

27. United States Centers for Disease Control and Prevention. Elastomeric Respirators: Strategies During Conventional and Surge Demand Situations. https://www.cdc.gov/coronavirus/2019-ncov/hcp/elastomeric-respirators-strategy/index.html (Accessed on April 29, 2020).

28. United States Centers for Disease Control and Prevention. Considerations for Optimizing the Supply of Powered Air-Purifying Respirators (PAPRs). https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/powered-air-purifying-respirators-strategy.html (Accessed on April 29, 2020).

29. Unites States Centers for Disease Control.Strategies for Optimizing the Supply of Facemasks https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/face-masks.html (Accessed on March 27, 2020).

30. World Health Organization. Rational use of personal protective equipment for coronavirus disease (COVID-19) and considerations during severe shortages. https://www.who.int/publications-detail/rational-use-of-personal-protective-equipment-for-coronavirus-disease-(covid-19)-and-considerations-during-severe-shortages (Accessed on April 07, 2020).

31. United States Centers for Disease Control and Prevention. Optimizing the supply of N95 respirators. https://www.cdc.gov/coronavirus/2019-ncov/hcp/respirators-strategy/index.html (Accessed on April 17, 2020).

32. Centers for Disease Control and Prevention. Decontamination and Reuse of Filtering Facepiece Respirators using Contingency and Crisis Capacity Strategie https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/decontamination-reuse-respirators.html (Accessed on April 02, 2020).

33. Lindsley WG, Martin SB Jr, Thewlis RE, et al. Effects of Ultraviolet Germicidal Irradiation (UVGI) on N95 Respirator Filtration Performance and Structural Integrity. J Occup Environ Hyg 2015; 12:509.

34. Heimbuch BK, Wallace WH, Kinney K, et al. A pandemic influenza preparedness study: use of energetic methods to decontaminate filtering facepiece respirators contaminated with H1N1 aerosols and droplets. Am J Infect Control 2011; 39:e1.

35. Mills D, Harnish DA, Lawrence C, et al. Ultraviolet germicidal irradiation of influenza-contaminated N95 filtering facepiece respirators. Am J Infect Control 2018; 46:e49.

36. Lowe JJ, Paladino KD, Farke JD, et al. N95 Filtering Facepiece Respirator Ultraviolet Germicidal Irradiation (UVGI) Process for Decontamination and Reuse https://www.nebraskamed.co

m/sites/default/files/documents/covid-19/n-95-decon-process.pdf?date=03252020 (Accessed on March 25, 2020).

37. https://www.safety.duke.edu/sites/www.safety.duke.edu/files/N95%20Decontamination%20Procedure.pdf (Accessed on March 27, 2020).

38. Holmdahl T, Walder M, Uzcátegui N, et al. Hydrogen Peroxide Vapor Decontamination in a Patient Room Using Feline Calicivirus and Murine Norovirus as Surrogate Markers for Human Norovirus. Infect Control Hosp Epidemiol 2016; 37:561.

39. Rudnick SN, McDevitt JJ, First MW, Spengler JD. Inactivating influenza viruses on surfaces using hydrogen peroxide or triethylene glycol at low vapor concentrations. Am J Infect Control 2009; 37:813.

40. United States Centers for Disease Control and Prevention. Decontamination and Reuse of Filtering Facepiece Respirators. https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/decontamination-reuse-respirators.html (Accessed on April 04, 2020).

41. Kariwa H, Fujii N, Takashima I. Inactivation of SARS coronavirus by means of povidone-iodine, physical conditions and chemical reagents. Dermatology 2006; 212 Suppl 1:119.

42. Yunoki M, Urayama T, Yamamoto I, et al. Heat sensitivity of a SARS-associated coronavirus introduced into plasma products. Vox Sang 2004; 87:302.

43. Duan SM, Zhao XS, Wen RF, et al. Stability of SARS coronavirus in human specimens and environment and its sensitivity to heating and UV irradiation. Biomed Environ Sci 2003; 16:246.

44. World Health Organization. Home care for patients with suspected novel coronavirus (nCoV) infection presenting with mild symptoms and management of contacts. Updated February 4, 2020. https://www.who.int/publications-detail/home-care-for-patients-with-suspected-novel-coronavirus-(ncov)-infection-presenting-with-mild-symptoms-and-management-of-contacts (Accessed on February 14, 2020).

45. Centers for Disease Control and Prevention. Interim guidance for persons who may have 2019 Novel Coronavirus (2019-nCoV) to prevent spread in homes and residential communities. https://www.cdc.gov/coronavirus/2019-ncov/hcp/guidance-prevent-spread.html#First_heading (Accessed on February 06, 2020).

46. Kampf G, Todt D, Pfaender S, Steinmann E. Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. J Hosp Infect 2020; 104:246.

47. Ong SWX, Tan YK, Chia PY, et al. Air, Surface Environmental, and Personal Protective Equipment Contamination by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) From a Symptomatic Patient. JAMA 2020.

48. Centers for Disease Control and Prevention. Interim Clinical Guidance for Management of Patients with Confirmed 2019 Novel Coronavirus (2019-nCoV) Infection, Updated February 12, 2020. https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-guidance-management-patients.html (Accessed on February 14, 2020).

49. World Health Organization. Novel Coronavirus (2019-nCoV) technical guidance: Patient management. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/patient-management (Accessed on February 02, 2020).

50. United States Centers for Disease Control and Prevention. If you have animals. https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/animals.html (Accessed on April 05, 2020).

51. World Health Organization. Advice on the use of masks in the context of COVID-19. https://www.who.int/publications-detail/advice-on-the-use-of-masks-in-the-community-during-home-care-and-in-healthcare-settings-in-the-context-of-the-novel-coronavirus-(2019-ncov)-outbreak (Accessed on April 10, 2020).

52. WHO. Home care for patients with suspected novel coronavirus (nCoV) infection presenting with mild symptoms and management of contacts. https://www.who.int/publications-detail/home-care-for-patients-with-suspected-novel-coronavirus-(ncov)-infection-presenting-with-mild-symptoms-and-management-of-contacts (Accessed on March 22, 2020).

53. United States Centers for Disease Control and Prevention. Caring for someone at home https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/care-for-someone.html (Accessed on April 10, 2020).

54. United States Centers for Diseae Control and Prevention. Cleaning and disinfection for households. https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cleaning-disinfection.html.

55. Centers for Disease Control and Prevention. Interim Guidance for Implementing Home Care of People Not Requiring Hospitalization for 2019 Novel Coronavirus (2019-nCoV). Updated January 31, 2020. https://www.cdc.gov/coronavirus/2019-ncov/hcp/guidance-home-care.html (Accessed on February 04, 2020).

56. United States Centers for Disease Control. Clean and Disinfect. https://www.cdc.gov/coronavirus/2019-ncov/prepare/cleaning-disinfection.html (Accessed on March 27, 2020).

57. United States Centers for Disease Control and Prevention. Discontinuation of isolation for persons with COVID -19 not in healthcare settings. https://www.cdc.gov/coronavirus/2019-ncov/hcp/disposition-in-home-patients.html (Accessed on May 05, 2020).

58. United States Centers for Disease Control and Prevention. Ending Home Isolation for Immunocompromised Persons with COVID-19. https://www.cdc.gov/coronavirus/2019-ncov/hcp/ending-isolation.html (Accessed on May 07, 2020).

59. United States Centers for Disease Control and Prevention. Discontinuation of transmission-based precautions and disposition of patients with COVID-19 in healthcare settings (Interim Guidance) https://www.cdc.gov/coronavirus/2019-ncov/hcp/disposition-hospitalized-patients.html (Accessed on May 01, 2020).

60. United States Centers for Disease Control and Prevention. Symptom-based strategy to discontinue isolation for persons with COVID-19. Decision Memo https://www.cdc.gov/coronavirus/2019-ncov/community/strategy-discontinue-isolation.html (Accessed on May 04, 2020).

61. Wölfel R, Corman VM, Guggemos W, et al. Virological assessment of hospitalized patients with COVID-2019. Nature 2020.

62. https://www.doh.wa.gov/Portals/1/Documents/1600/coronavirus/HealthCareworkerReturn2Work.pdf (Accessed on March 23, 2020).

63. Centers for Disease Control and Prevention. Criteria for Return to Work for Healthcare Personnel with Confirmed or Suspected COVID-19 (Interim Guidance) https://www.cdc.gov/coronavirus/2019-ncov/healthcare-facilities/hcp-return-work.html (Accessed on May 01, 2020).

64. Centers for Disease Control and Prevention. Strategies to Prevent the Spread of COVID-19 in Long-Term Care Facilities (LTCF). https://www.cdc.gov/coronavirus/2019-ncov/healthcare-facilities/prevent-spread-in-long-term-care-facilities.html (Accessed on March 08, 2020).

65. US Centers for Disease Control and Prevention. Preventing the Spread of COVID-19 in Retirement Communities and Independent Living Facilities (Interim Guidance). https://www.cdc.gov/coronavirus/2019-ncov/community/retirement/guidance-retirement-response.html (Accessed on March 27, 2020).

66. US Centers for Disease Control and Prevention. Preparing for COVID-19: Long-term Care Facilities, Nursing Homes https://www.cdc.gov/coronavirus/2019-ncov/healthcare-facilities/prevent-spread-in-long-term-care-facilities.html (Accessed on March 27, 2020).

67. D'Adamo H, Yoshikawa T, Ouslander JG. Coronavirus Disease 2019 in Geriatrics and Long-Term Care: The ABCDs of COVID-19. J Am Geriatr Soc 2020.

Topic 127501 Version 8.0