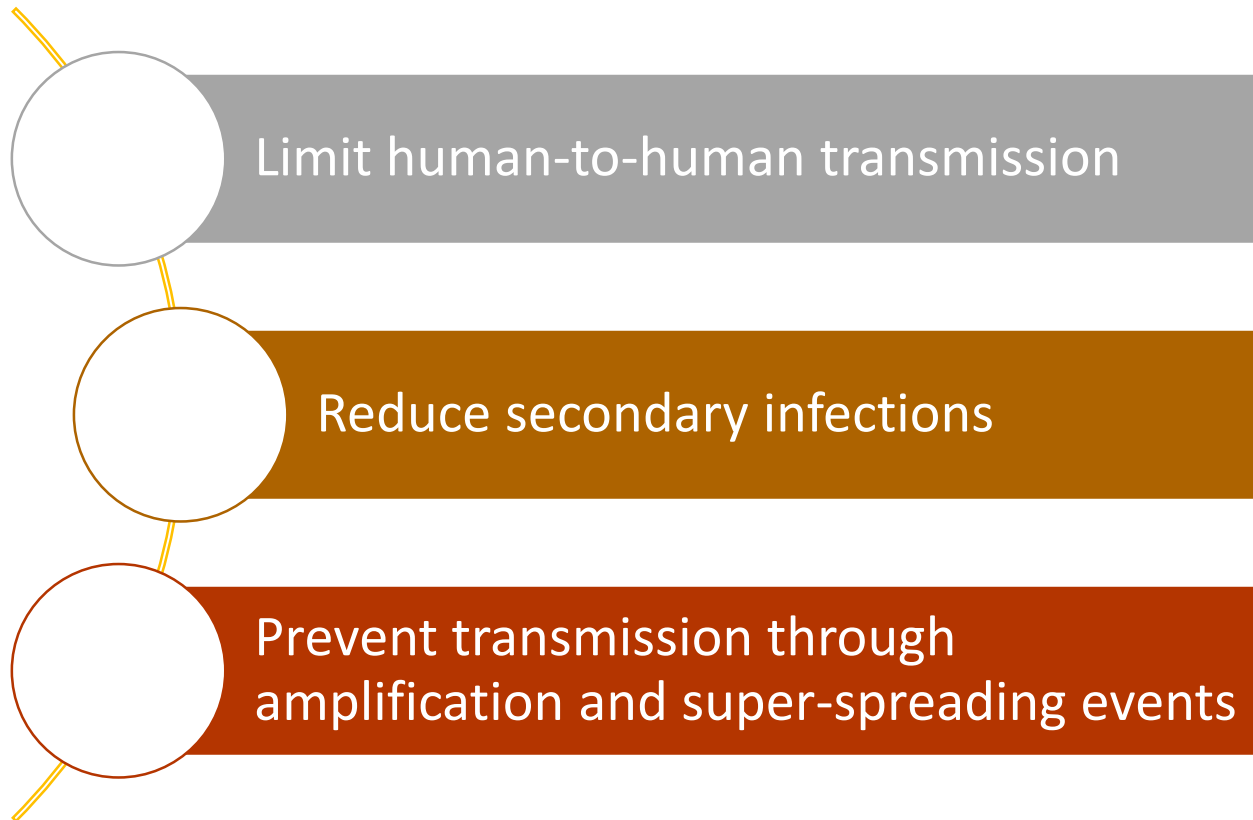


Infection Prevention and Control and COVID-19



Healthcare workers and COVID-19

Research

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China

Dawei Wang, MD, Bo Hu, MD, Chang Hu, MD, Fangfang Zhu, MD, Xing Liu, MD, Jing Zhang, MD, Binbin Wang, MD, Hai Xiang, MD, Zhenshun Cheng, MD, Yong Xiong, MD, Yan Zhao, MD, Yirong Li, MD, Xinghuan Wang, MD, Zhiyong Peng, MD

IMPORTANCE: In December 2019, novel coronavirus (2019-nCoV)-infected pneumonia (NCP) occurred in Wuhan, China. The number of cases has increased rapidly but information on the clinical characteristics of affected patients is limited.

OBJECTIVE: To describe the epidemiological and clinical characteristics of NCP.

DESIGN, SETTING, AND PARTICIPANTS: Retrospective, single-center case series of the 138 consecutive hospitalized patients with confirmed NCP at Zhongnan Hospital of Wuhan University in Wuhan, China, from January 1 to January 28, 2020; final date of follow-up was February 3, 2020.

EXPOSURES: Documented NCP.

MAIN RESULTS AND MEASURES: Epidemiological, demographic, clinical, laboratory, radiological, and treatment data were collected and analyzed. Outcomes of critically ill patients and noncritically ill patients were compared. Presumed hospital-related transmission was suspected if a cluster of health professionals or hospitalized patients in the same wards became infected and a possible source of infection could be traced.

RESULTS: Of 138 hospitalized patients with NCP, the median age was 56 years (interquartile range, 42-66; range, 22-92 years) and 75 (54.3%) were men. Hospital-associated transmission was suspected as the presumed mechanism of infection for affected health professionals (40 [29%]) and hospitalized patients (17 [12.3%]). Common symptoms included fever (136 [98.6%]), fatigue (96 [69.6%]), and dry cough (82 [59.4%]). Lymphopenia (lymphocyte count, $0.8 \times 10^9/L$ [interquartile range (IQR), 0.6-1.1]) occurred in 97 patients (70.3%), prolonged prothrombin time (13.0 seconds [IQR, 12.3-13.7]) in 80 patients (58%), and elevated lactate dehydrogenase (261 U/L [IQR, 182-403]) in 55 patients (39.9%). Chest computed tomographic scans showed bilateral patchy shadows or ground glass opacity in the lungs of all patients. Most patients received antiviral therapy (oseltamivir, 124 [89.9%]), and many received antibacterial therapy (moxifloxacin, 89 [64.4%]; ceftriaxone, 34 [24.6%]; azithromycin, 25 [18.1%]) and glucocorticoid therapy (62 [44.9%]). Thirty-six patients (26.1%) were transferred to the intensive care unit (ICU) because of complications, including acute respiratory distress syndrome (22 [61.1%]), arrhythmia (16 [44.4%]), and shock (11 [30.6%]). The median time from first symptom to dyspnea was 5.0 days, to hospital admission was 7.0 days, and to ARDS was 8.0 days. Patients treated in the ICU (n = 36), compared with patients not treated in the ICU (n = 102), were older (median age, 66 years vs 51 years), were more likely to have underlying comorbidities (26 [72.2%] vs 38 [37.2%]), and were more likely to have dyspnea (23 [63.9%] vs 20 [19.6%]), and anorexia (24 [66.7%] vs 31 [30.4%]). Of the 36 cases in the ICU, 4 (11.1%) received high-flow oxygen therapy, 15 (41.7%) received noninvasive ventilation, and 17 (47.2%) received invasive ventilation (4 were switched to extracorporeal membrane oxygenation). As of February 3, 47 patients (34.1%) were discharged and 6 died (overall mortality, 4.3%), but the remaining patients are still hospitalized. Among those discharged alive (n = 47), the median hospital stay was 10 days (IQR, 7-14.0).

CONCLUSIONS AND RELEVANCE: In this single-center case series of 138 hospitalized patients with confirmed NCP in Wuhan, China, presumed hospital-related transmission of 2019-nCoV was suspected in 41% of patients, 26% of patients received ICU care, and mortality was 4.3%.

JAMA. doi:10.1001/jama.2020.1585
Published online February 7, 2020.

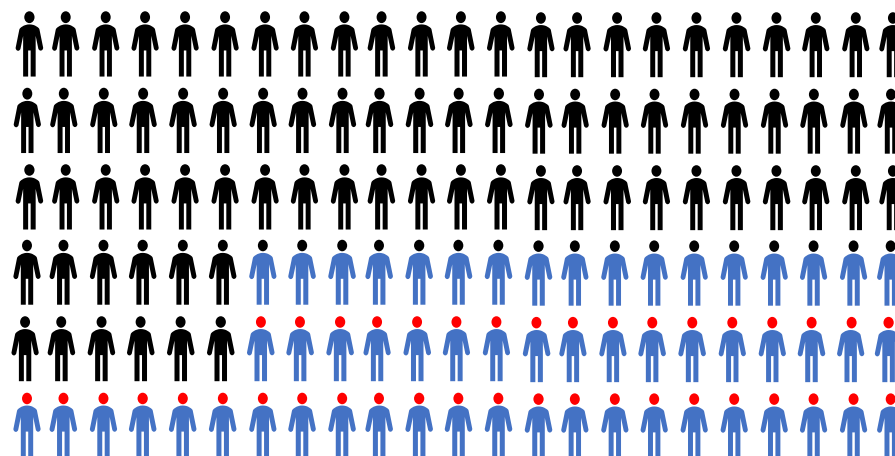
Author Affiliations: Author affiliations are listed at the end of this article.

Corresponding Author: Zhiyong Peng, MD, Department of Critical Care Medicine, Zhongnan Hospital of Wuhan University, Wuhan 430071, Hubei, China (Pzhyong@whu.edu.cn).

Section Editor: Derek C. Angus, MD, MPH, Associate Editor, JAMA (angusdc@upmc.edu).

Viewpoint
Related article
Audio

N = 138 confirmed cases COVID-19 on a healthcare facility



N = 81 confirmed case, COVID-19, community



N = 17 confirmed case, COVID-19, during hospital stay



N = 40 confirmed case, COVID-19, healthcare worker

Outline

Overview of the natural history of COVID-19

Standard precautions

Transmission-based precautions

Risk evaluation and PPE

Requirements for the use of PPE

Outline

Overview of the natural history of COVID-19

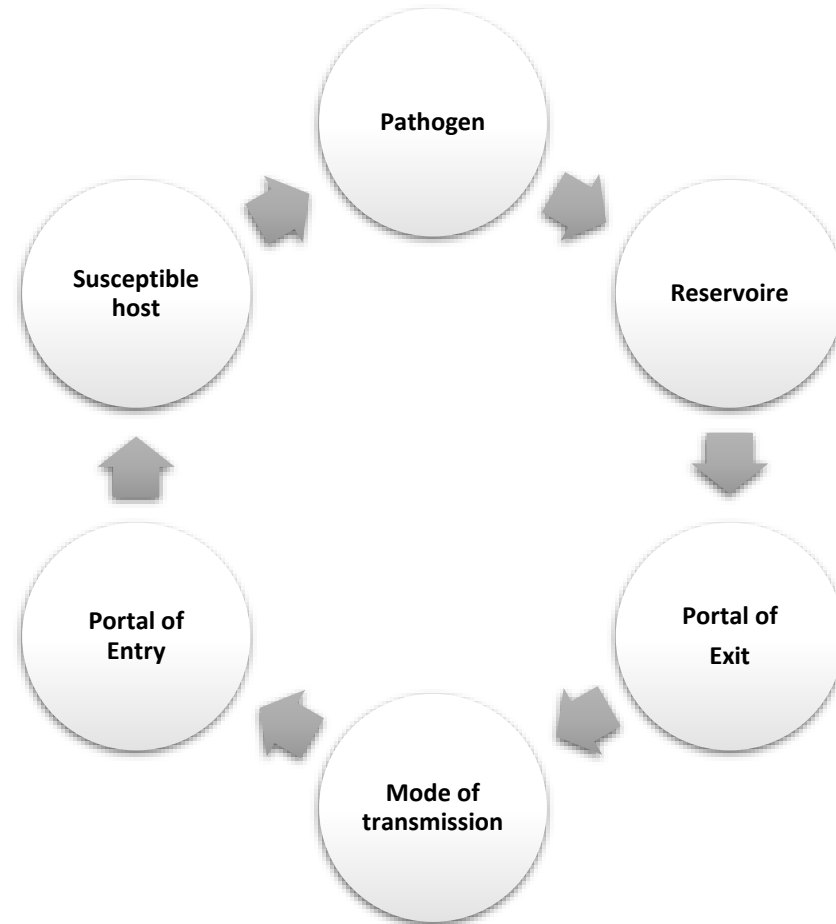
Standard precautions

Transmission-based precautions

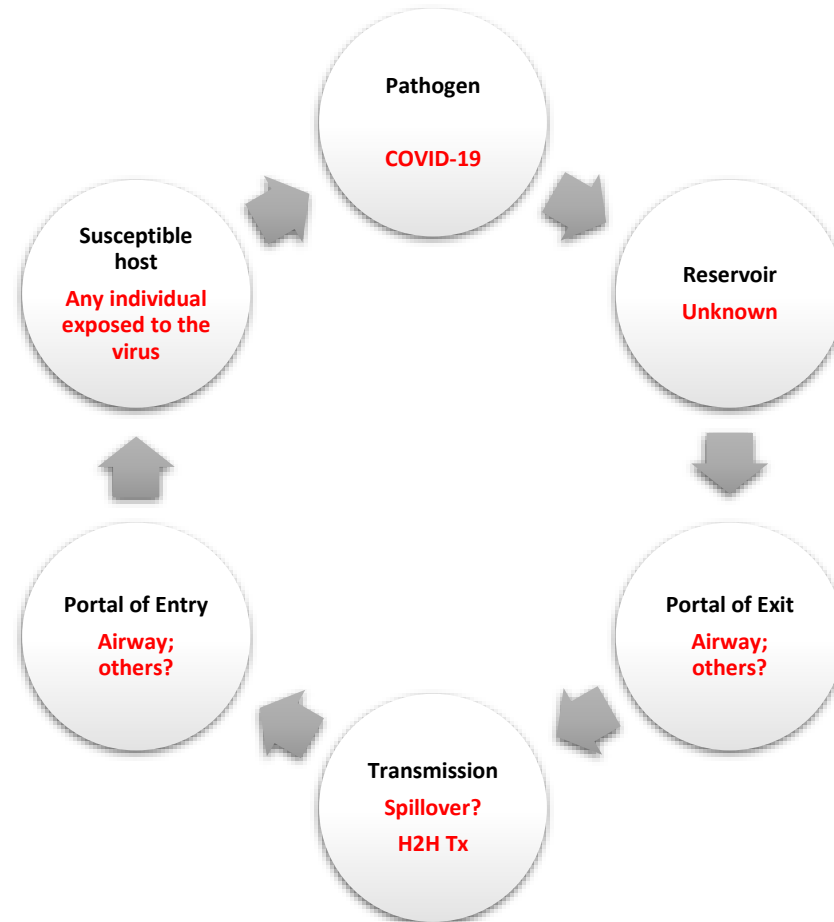
Risk evaluation and PPE

Requirements for the use of PPE

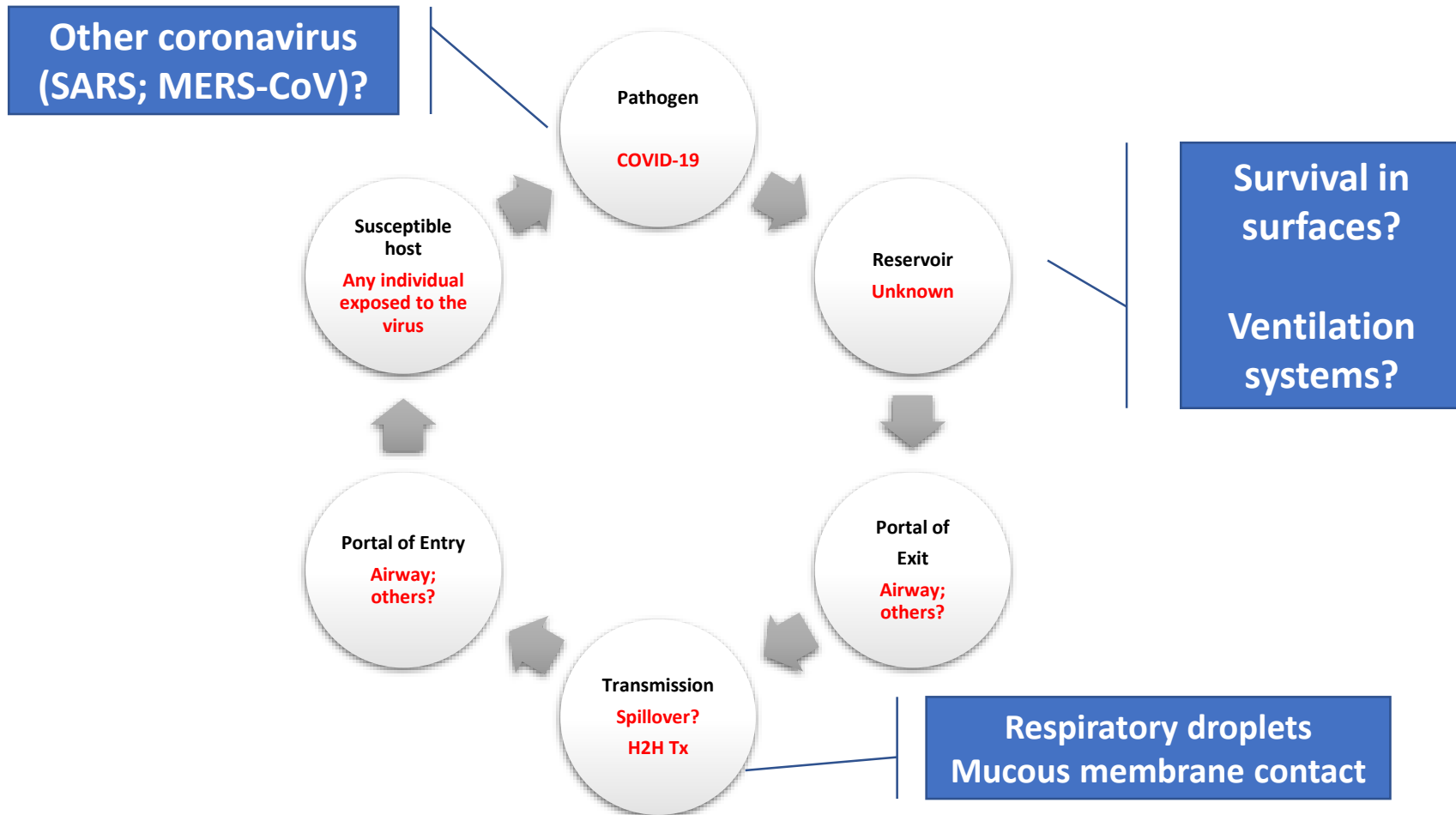
Natural history of COVID-19



Natural history of COVID-19



Natural history of COVID-19



Natural history of COVID-19

Study	N	Route / mechanism of transmission	Findings
Zhu N et al., NEJM 2020	3 cases of "unusual SARI"	Bronchoalveolar lavage fluid (BAL)	SARS-Cov-2 positive in BAL
Fuk-Woo Chan J et al., Lancet 2020	A family of 6 individuals	Respiratory samples (nasopharyngeal swab)	3/6 (50%) patients SARS-Cov-2 ; none of them exposed to seafood market
Chen H et al., Lancet 2020	9 infants	Mother-to-child transmission (intrauterine transmission)	SARS-CoV-2 negative in amniotic fluid, cord blood, neonatal throat swab, and breastmilk
Kai-Wang To K et al., CID 2020	12 patients admitted to a healthcare facility	Saliva	SARS-CoV-2 detected in 11/12 (91.7%) of patients
Wang D et al., JAMA 2020	138 patients admitted to a healthcare facility	Faeces	17/138 (12.3%) referred diarrhea and abdominal pain
?	?	tears, semen, vaginal fluid, other body fluids, viral sanctuaries?	?

Outline

Overview of the natural history of COVID-19

Standard precautions

Transmission-based precautions

Risk evaluation and PPE

Requirements for the use of PPE

Standard precautions

1985

HIV

**Universal
precautions**

1987

**“Bdy
substance
isolation”**

1996

**Standard
precautions**

**Transmission-
based
precautions**

Standard precautions

*“(...)
A **set of practices** that are applied to the care of patients, **regardless of the state of infection** (suspicion or confirmation), in any place where health services are provided. (...)”*

Standard precautions



Hand hygiene (water and soap or alcohol-based solutions)



Use of personal protective equipment (PPE) according to risk



Respiratory hygiene (or cough etiquette)



Safe injection practices



Sterilization / disinfection of medical devices



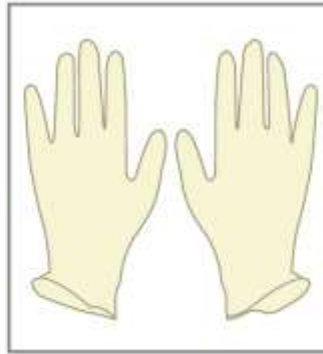
Environmental cleaning

Today's lecture . . .

. . . Our focus will be on the use of **personal protective equipment (PPE)** according to the **risk**



Hand hygiene



Gloves



Gown – other types and styles are also appropriate.



Medical mask – other types and styles are also appropriate.



Protective eyewear - eye visors, goggles, and face shields are examples of protective eyewear.

Outline

Overview of the natural history of COVID-19

Standard precautions

Transmission-based precautions

Risk evaluation and PPE

Requirements for the use of PPE

Transmission-based precautions



Contact precaution

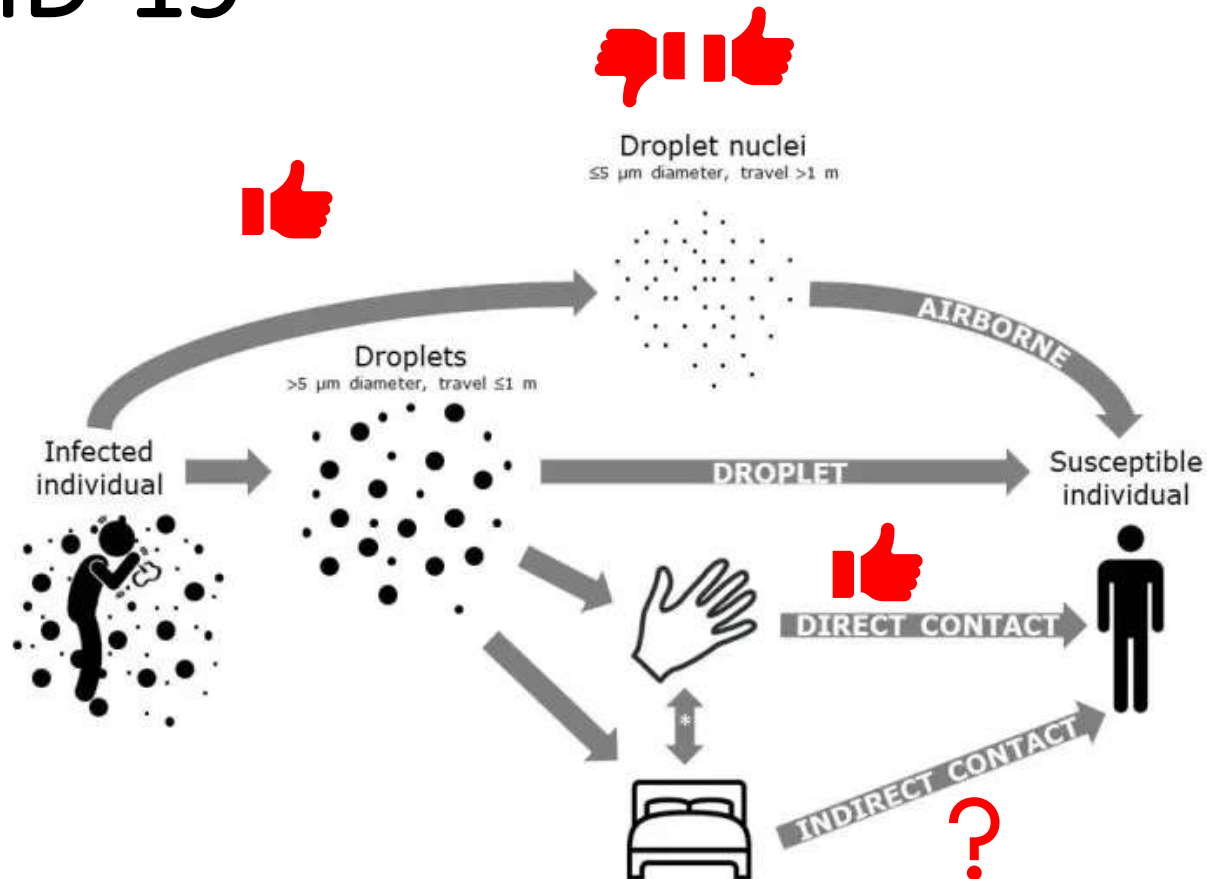


Droplet precaution



Airborne precaution

As a reminder, transmission of COVID-19



* Transmission routes involving a combination of hand & surface = indirect contact.

Definition of 'Droplet' and 'Droplet nuclei' from Annex C: Respiratory droplets, in Natural Ventilation for Infection Control in Health-Care Settings, Atkinson J., et al., Editors. 2009: Geneva.

© Jon Otter

Transmission-based precautions and COVID-19

Scenario	Precaution
For any suspected or confirmed case of COVID-19	Standard + contact + droplet precautions
For any suspected or confirmed case of COVID-19 and aerosol-generating procedure (AGP)	Standard + contact + airborne precautions

Outline

Overview of the natural history of COVID-19

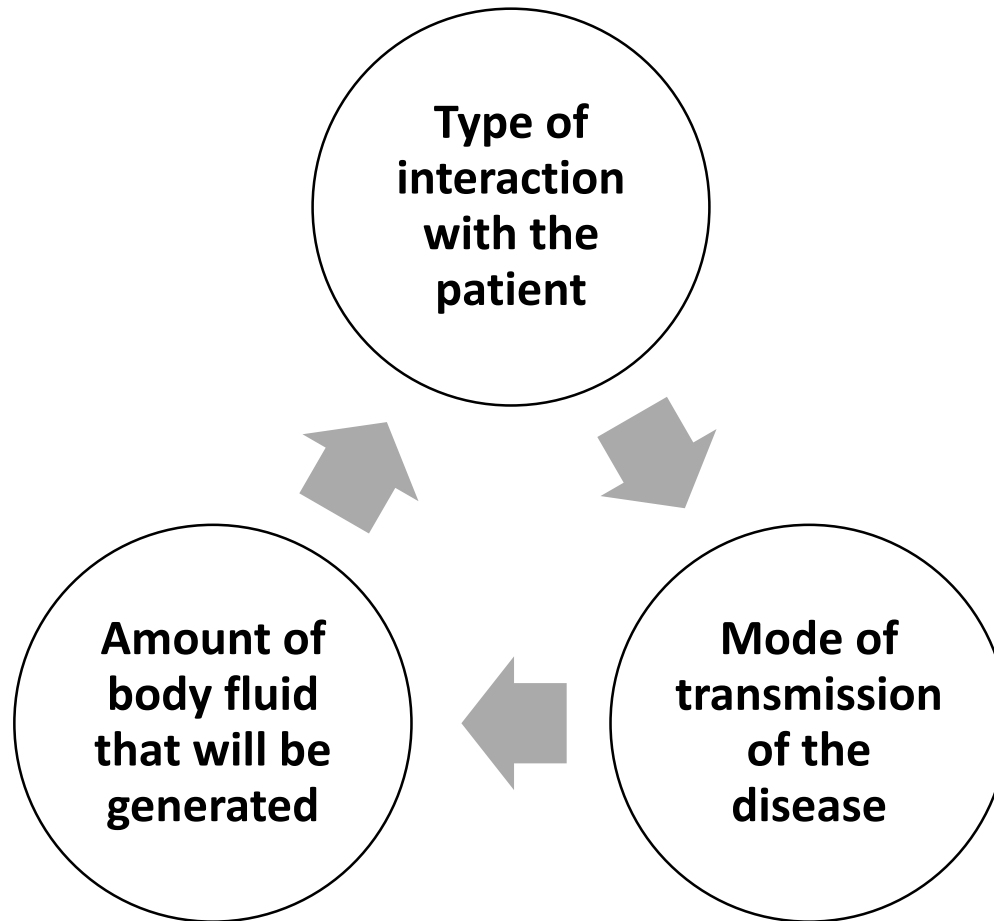
Standard precautions

Transmission-based precautions

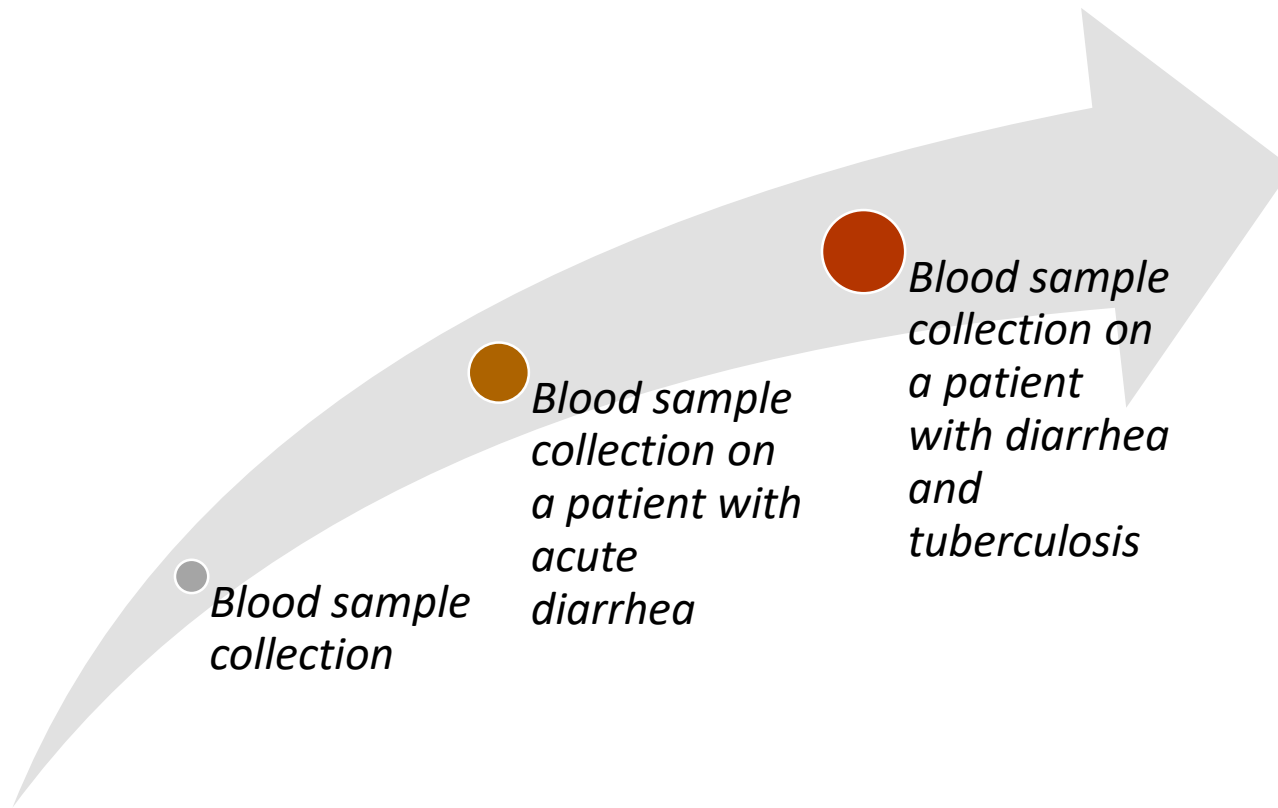
Risk evaluation and PPE

Requirements for the use of PPE

Risk evaluation and PPE



Risk evaluation and PPE



Some questions to consider . . .



Does the patient fulfill case definition criteria for the disease?



What is the infectious agent and its mode of transmission?



What type of procedure will the patient be undergoing?



Is there any risk of contamination?



Where should the patient be located?



What type of PPE will need to be used?

General principles of PPE



Hand hygiene should always be performed despite PPE use.



Remove and replace if necessary any damaged or broken pieces of re-usable PPE as soon as you become aware that they are not in full working order.



Remove all PPE as soon as possible after completing the care and avoid contaminating the environment outside the isolation room; any other patient or worker; and yourself.



Discard all items of PPE carefully and perform hand hygiene immediately afterwards.

Gloves (sterile / nonsterile)

- Gloves are an essential item of PPE and are used to prevent the healthcare worker from being exposed to direct contact with the blood or body fluid of an infected patient.**
- Gloves DO NOT replace hand hygiene.**



Gloves

Gowns (and aprons)

- Gowns are used in addition to gloves if there is **risk of fluids or blood** from the patient splashing onto the healthcare worker's body.
- The same gown can be used when providing care to more than one patient but only those patients in a cohort area and only if the gown does not have direct contact with a patient.
- Plastic aprons should be used in addition to gowns if the material of the gown is not fluid repellent and the task to be performed may result in splashes onto the healthcare worker's body.



*An example of a gown.
Other styles of gowns can
also be used.*

Facial mucosa protection (face shield, eye visor, goggles)

- ❑ Masks, and eye protection, such as eyewear and goggles, are also important pieces of PPE and are used to protect the eyes, nose or mouth mucosa of the health-care worker from any risk of contact with a patient's respiratory secretions or splashes of blood, body fluids, secretions or excretions.



Face shield

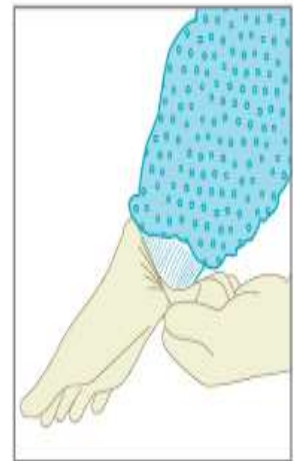
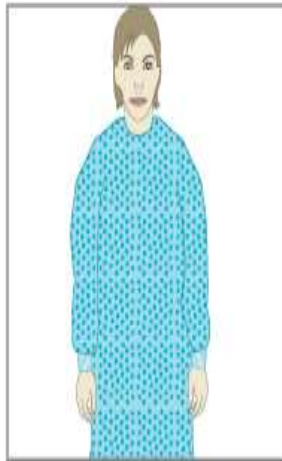


Goggles

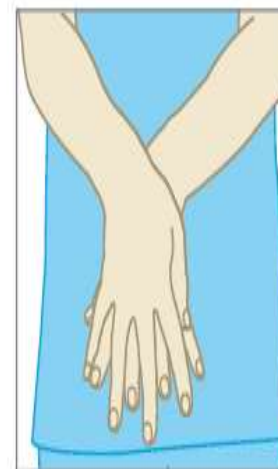
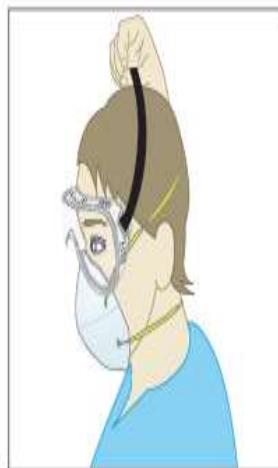
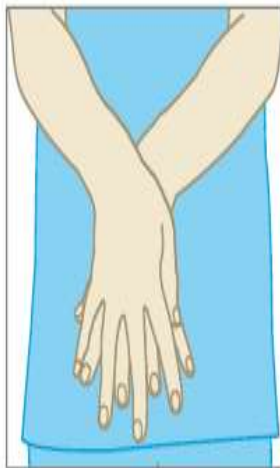


Eye visor

Putting on a PPE



Doffing a PPE



Respirator (N95) or medical mask?



"(...) The lack of research on facemasks and respirators is reflected in varied and sometimes conflicting policies and guidelines. Further research should focus on examining the efficacy of facemasks against specific infectious threats such as influenza and tuberculosis, (...)"

Respirator (N95) or medical mask?



“(...) SARS care often necessitated aerosol-generating procedures [AGP] such as intubation, which also may have contributed to the prominent nosocomial spread. (...)”

“(...) the factors associated with transmission of SARS-CoV, ranging from self-limited animal-to-human transmission to human superspreader events, remain poorly understood (...)”

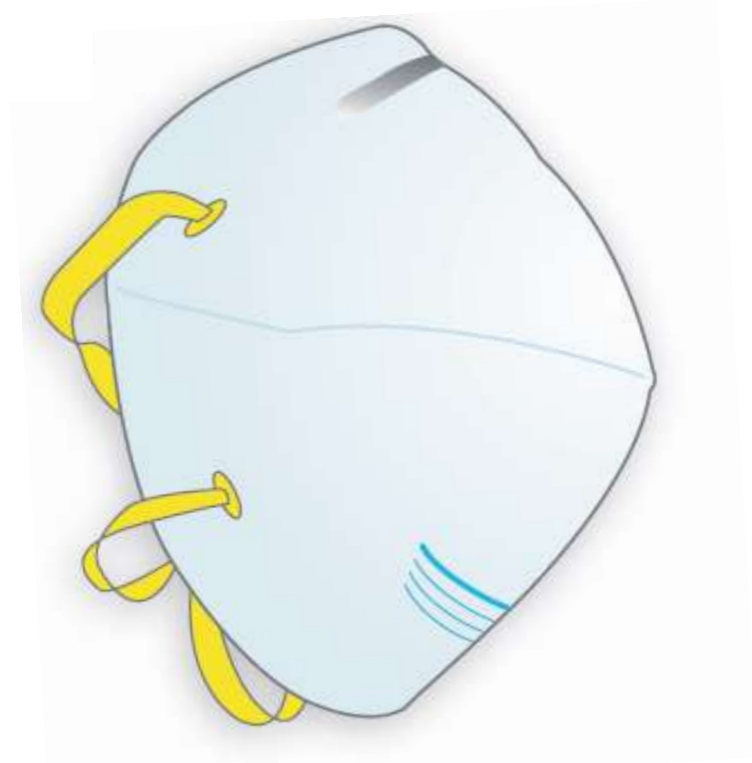
Medical masks (droplet precaution)

- Wear a medical mask when within a 1 metre range of the patient.
- Put the patient in a single room or in a room that contains only other patients with the same diagnosis, or with similar risk factors, and ensure that every patient is separated by at least one metre.
- Ensure that the transportation of a patient to areas outside of the designated room is kept to a minimum.
- Perform hand hygiene immediately after removing the medical mask.

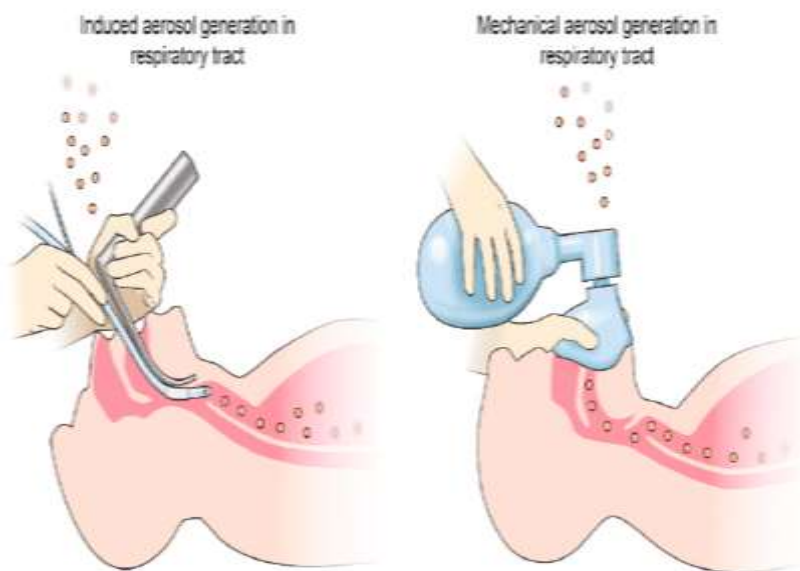


Respirator [N95] (airborne precaution)

- Use a respirator whenever entering and providing care within the patient isolation facilities ensuring that the seal of the respirator is checked before every use.
- Perform hand hygiene immediately after removing the respirator.
- Aerosol-generating procedures (AGP) . . .



Aerosol-generating procedures (AGP)



**Number of healthcare providers
exposed should be limited**

Aerosol-generating procedures (AGP)

Bronchoscopy

Cardiopulmonary resuscitation

Noninvasive ventilation (BiPAP, CPAP, HFOV)

Surgery

Tracheal intubation

Manual ventilation

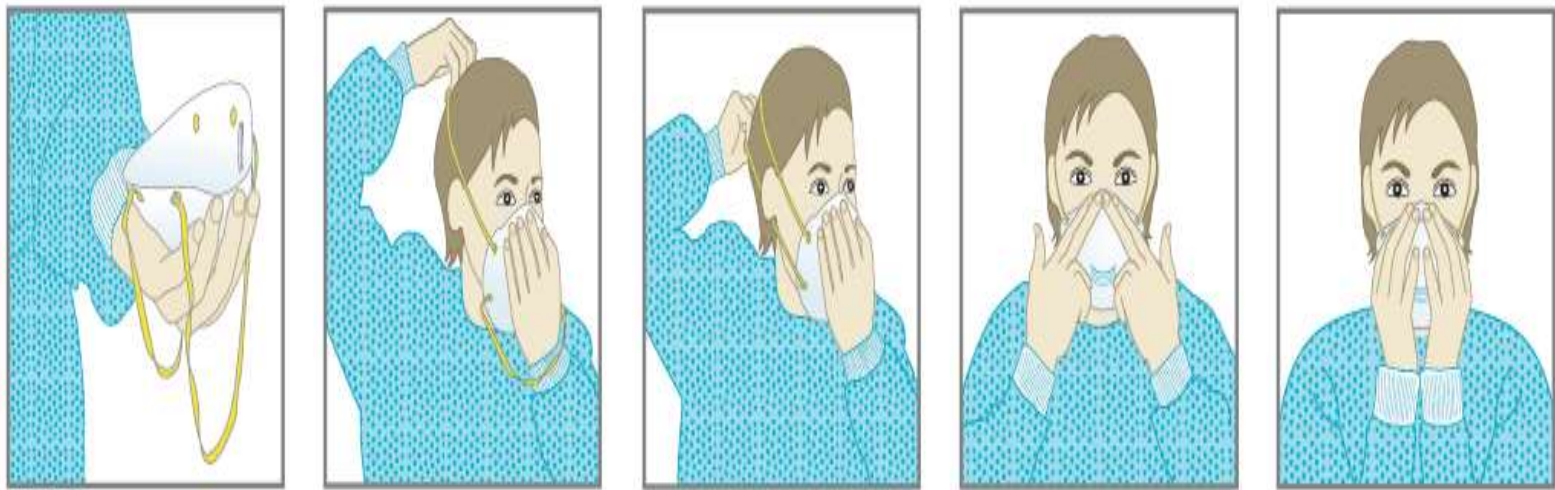
Sputum induction

Suctioning

Laser plume

Necropsy

Perform a particulate respirator seal check



Outline

Overview of the natural history of COVID-19



Standard precautions

Transmission-based precautions

Risk evaluation and PPE

Requirements for the use of PPE

Requirements and technical specifications, use of PPE

Requirements and technical specifications of personal protective equipment (PPE) for the novel coronavirus (2019-nCoV) in healthcare settings

(interim recommendations, 2/6/2020)

Key considerations

- In December 2019 a novel coronavirus (2019-nCoV) was identified as the causative agent of a severe acute respiratory illness among people exposed in a seafood market in Wuhan, China¹;
- Human-to-human transmission has been documented, including in healthcare workers, and aerosol-generating procedures (AGP)² may play a role in the spread of the disease (1, 2);
- There are uncertainties in the natural history of the 2019-nCoV, including source(s), transmissibility mechanisms, viral shedding, and persistence of the virus in the environment and on fomites;
- As of 6 February 2020, the following precautions are recommended for the care of patients with suspected or confirmed cases of 2019-nCoV³:
 - For any suspected or confirmed cases of 2019-nCoV: standard + contact + droplet precautions
 - For any suspected or confirmed cases of 2019-nCoV and AGP: standard + contact + airborne precautions
- The use of personal protective equipment (PPE) by healthcare workers requires an evaluation of the risk related to healthcare-related activities;
- These recommendations are preliminary and subject to review as new evidence becomes available.

Estimates of personal protective equipment (PPE)

The figures presented in this technical recommendation are rough estimates and based upon simulation exercises on the use of PPE during previous outbreaks with similar transmission modes, such as Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS).

- The number of PPE units should vary according to disease severity and the number of aerosol-generating procedures per patient.
- Suspected and confirmed cases of 2019-nCoV should be isolated in adequately ventilated single rooms. When single rooms are not available, patients suspected of being infected with 2019-nCoV should be grouped together (cohort).
- **For each patient/day it is recommended⁴:**
 - Gown – 25 units
 - Medical mask – 25 units

¹ Updated information on the 2019-nCoV can be obtained at: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>

² Aerosol-generating procedures (AGP): it includes the following procedures: positive pressure ventilation (BiPAP and CPAP), endotracheal intubation, airway suction, high frequency oscillatory ventilation, tracheostomy, chest physiotherapy, nebulizer treatment, sputum induction, and bronchoscopy.

³ For the most update information available for infection prevention and control for the 2019-nCoV, please refer to <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance>.

⁴ Phin, N.F. et al. Personal protective equipment in an influenza pandemic: a UK simulation exercise. Journal of Hospital Infection, Volume 71, Issue 1, 15 – 21.

- Technical guidance based on WHO documents
- Expert consultation
- Tailored to the region needs

<https://bit.ly/2HDK2bg>

Use of PPE according to level of care

(<https://bit.ly/2HDK2bg>)

Level of care	Hand hygiene	Gown	Medical mask	Respirator (N95 or FFP2)	Goggle (eye protection) OR Face shield (facial protection)	Gloves
Triage	X		X			
Collection of specimens for laboratory diagnosis	X	X		X	X	X
Suspected or confirmed case of COVID-19 requiring healthcare facility admission and NO aerosol-generating procedure	X	X	X		X	X
Suspected or confirmed case of COVID-19 requiring healthcare facility admission and WITH aerosol-generating procedure	X	X		X	X	X

Technical specifications, PPE



Technical description and specifications of personal protective equipment (PPE)

Table 2 presents the technical description and specifications of personal protective equipment (PPE) in the context of the 2019-nCoV. **

Table 2 – Technical description and specifications of personal protective equipment (PPE)

Item	Technical description and specifications
Alcohol-based hand rub solution	Bottle of 100ml & 500ml Hand rub formulations containing 75% isopropanol or 80% ethanol.
Apron	Polyester with PVC coating or 100% PVC or 100% rubber. Waterproof. Minimum basis weight: 250g/m ² . Adjustable neck strap (reusable). Covering size: 70-90 cm (width) X 120-150cm (height), or standard adult size.
Bags for medical waste	Disposal bag for bio-hazardous waste, 30x50cm, with "Biohazard" print, autoclavable polypropylene. 50 or 70 micra thickness
Body bag	Made of linear enforced, U-shape zipper and 2 zipper pulls with tie ribs. Adult size 250x120cm Protector Body Bag specifications: 6 handles Impermeable, linear reinforced LLDPE, LDPE, EVA, PEVA, (avoid PVC), minimum thickness 400 microns; Should be able to hold 100-125 kilos (200-250 lbs), Should contain no chlorides: burning of chlorides pollute the environment and can cause damage to retort chambers. Body bags should be non-carcinogenic to health of funeral workers when used for cremations. At least 6 handles included in the body bag to allow burial team to hand carry it safely Heat-sealed: insure superior strength and safety, Provide full containment of blood borne pathogens Cracking point of 25 - 32 degrees below zero Shelf life: minimum 10 years Bag and hands should be of white color
Disinfectant for surfaces – hypochlorite solution 0.05% (regular cleaning) or 0.5% (disinfection of spill)	NaDCC, granules, 1kg, 65 to 70% + dosage spoon
Disposable towel for hand drying (paper or tissue)	50 to 100m roll
Face shields	Made of clear plastic and provides good visibility to both the wearer and the patient, Adjustable band to attach firmly around the head and fit snugly against the forehead, Fog resistant (preferable), Completely cover the sides and length of the face, May be re-usable (made of robust material which can be

** This list is based upon the "Disease commodity package - Novel Coronavirus (nCoV)", WHO. Available at [https://www.who.int/publications-detail/disease-commodity-package--novel-coronavirus-\(ncov\)](https://www.who.int/publications-detail/disease-commodity-package--novel-coronavirus-(ncov)), access date Jan 31, 2020.

In summary,

- The use of **personal protective equipment (PPE)** by healthcare workers requires an **evaluation of the risk** related to healthcare-related activities;
- The following precautions are recommended for the care of patients with suspected or confirmed cases of COVID-19:
 - For any suspected or confirmed cases of COVID-19
 - **standard + contact + droplet precautions**
 - For any suspected or confirmed cases of COVID-19 and AGP
 - **standard + contact + airborne precautions**

as of February 19, 2020 – subject to change as new evidence become available