SUMMARY OF EXISTING GUIDANCE ON

PPE in Resource-Constrained Settings

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DARTMOUTH CENTER FOR GLOBAL EQUITY

Contents

Introduction

This document summarizes existing technical guidance and lessons from other settings responding to the COVID-19 pandemic on the utilization and management of personal protective equipment (PPE). It is designed to help inform high-level planning and is not intended as a comprehensive national planning document or to substitute for professional medical advice, or expert clinical or epidemiological guidance. This document is not intended to recommend or endorse any specific tests, procedures, opinions, or other information that may be referenced. Implementation of evidence-based practices and guidelines to prevent and reduce transmission is challenging in this time of pandemic in which resources are stretched thin. While prevention of COVID-19 transmission should be the goal, implementing measures that allow for even partial interruption of transmission can have public health benefits.

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Abbreviations

PPE	Personal Protective Equipment
HCW	Healthcare workers
PUI	Person Under Investigation (for COVID-19)
CDC	US Centers for Disease Control and Prevention
WHO	World Health Organization

Section 1: SARS-CoV-2 Transmission in the Healthcare Setting

Key Points

- ☐ Many patients infected with SARS-CoV-2 may be asymptomatic, but can still transmit the disease to others
- ☐ All healthcare providers are at risk of exposure to SARS-CoV-2
- ☐ Optimal PPE (N95 or surgical masks, gloves, gown, face shield) should be worn whenever possible to protect health care workers across the health system; the current global shortage of PPE is making this difficult in most settings
- ☐ Use droplet and contact precautions in all settings. Airborne precautions are recommended for aerosol-generating procedures.

Asymptomatic and pre-symptomatic transmission plays an important role in the spread of SARS-CoV-2. [1,2,3] A recent study of two maternal health wards in New York City found 1 in 8 pregnant women were infected with SARS-CoV-2 and that 78% of the SARS-CoV-2 positive patients were asymptomatic and 10% were presymptomatic.[4] Many healthcare institutions report SARS-CoV-2-positive patients presenting in non-COVID-19 treatment settings, resulting in **large numbers of exposures for healthcare providers, non-clinical staff, and other patients.**[5,6,7,8] Asymptomatic patients have similar viral loads and can transmit the virus.[9]

Droplet, Contact, and Airborne Precautions

Droplets are a primary mode of transmission and may **travel up to 8 meters.**[10] Evidence also indicates that SARS-CoV-2 may be viable in the air for 3 hours.[11] As a result, it is ideal if providers, patients, and visitors wear the highest available standard of PPE at all times to protect themselves and those around them. Given resource constraints in many settings, this document also reviews alternatives to optimal PPE.

Modes of Transmission[12]

TABLE 1: Modes of SARS-CoV-2 Transmission and Specific Information

MODE OF TRANSMISSION	SPECIFIC INFORMATION
Droplet	**Droplets are a primary mode of transmission for SARS-CoV-2.** [13] Primarily occur in **close contact (within 1 m)** with someone who has respiratory symptoms (e.g., coughing or sneezing)[14] Infected individuals have similar viral loads **regardless of the presence or degree of symptoms.**[15] It is currently unclear whether symptomatic patients are more infectious than asymptomatic patients; however, the absence of symptoms such as a cough weakens the likelihood that someone will spread droplets.[16]
Airborne	Airborne transmission is not currently seen as a primary mode of transmission; **however, growing research indicates that airborne transmission may be possible**, particularly in settings where **procedures that generate aerosols are performed or in confined spaces with high concentrations of SARS-CoV-2 particles** (such as patient rooms without adequate ventilation). [17,18,19] **Viral particles <5µm in diameter,** or "droplet nuclei", allow **transmission over distances greater than 1 m**[20] and remain floating in the air for long periods of time[21] Aerosol transmission is possible in confined spaces with long exposures to high concentrations of SARS-CoV-2 particles[22]
Fomite	**Fomite transmission from surfaces is possible;** infectious SARS-CoV-2 can remain on some surfaces for up to 72 hours.[23]
Fecal	**Fecal transmission may be possible** and may represent a greater concern for settings with poor access to water and sanitation.[24,25]

Section 2: Summary of Current PPE Guidance

Guidance on PPE for HCW and other healthcare staff during the COVID-19 pandemic is evolving in light of existing evidence on transmission and available resources.

Standard procedures for nosocomial infection prevention include[26]

- ☐ Hand hygiene (water and soap or alcohol-based solutions)
- ☐ Use of appropriate PPE
- ☐ Respiratory hygiene (coughing into a tissue and then disposing of the tissue)
- ☐ Safe injection practices
- ☐ Sterilization/disinfection of medical devices
- ☐ Environmental cleaning

The following table summarizes current recommendations on optimal PPE and alternative PPE for HCWs and staff, when optimal PPE is not available.

TABLE 2: Standard PPE and Alternatives

PPE TYPE	OPTIMAL PPE	ALTERNATIVES
Masks/Respirator	N95 or higher respirator	Surgical mask
Face/Eye Protection	Face shield or goggles	
Gown	Disposable, non-sterile isolation gown	Cloth gowns Coveralls
Gloves	One set of gloves	

Many settings are unable to provide optimal PPE for all healthcare workers and staff in healthcare settings. The table below summarizes current guidance on PPE for healthcare personnel based on care activities and procedures.

TABLE 3: Recommended PPE by Setting, Personnel, and Activity during COVID-19 Pandemic Table adapted from the WHO. [27]

Medical mask = surgical mask, or N95 mask if available

	Respirator (N95)	Gown	Gloves	Medical Mask	Apron	Eye Protection (goggles/face shield)	Spatial Distance (1m)
Aerosol-generating procedures performed on COVID-19 patients							
Providing direct care to COVID-19 patients							
Preliminary screening not involving direct contact							
Entering the room of COVID-19 patients to clean							
Entering the room of COVID-19 patients to visit							
Manipulation of respiratory samples							
Other areas not involving patient contact							

*if possible
**cloth masks can be an inferior alternative

Additional Guidelines for Optimizing Effectiveness and Durability of PPE [28]

- ☐ Make-up and lotion may compromise PPE and should be prohibited
- ☐ Facial hair should be shaved where possible for optimal infection control

Safe Donning and Doffing of PPE for Optimal Infection Prevention

PPE is highly effective when used properly. Limited data exist on the risk of donning reused PPE and on sources of nosocomial infections for COVID-19; however, doffing errors account for a high rate of nosocomial infections in general healthcare settings.[29] A pre-print study from Wuhan found that medical staff areas (such as changing rooms) had higher concentrations of SARS-CoV-2 in the air than patient areas. The authors hypothesize that this is because aerosol or droplet particles became resuspended when medical staff removed their PPE.[30] See this link for US CDC recommended donning and doffing procedures to limit the spread of SARS-CoV-2 in medical staff areas: https://www.cdc.gov/hai/pdfs/ppe/ppe-sequence.pdf. Emory University has also published useful videos on donning[31] and doffing PPE.[32]

Sanitizing gloves before doffing with quaternary ammonium or bleach may decrease contamination. [33]

Section 3: Managing PPE Constraints

Many settings are currently experiencing significant PPE shortages. Countries and institutions should develop plans to manage national/local supply of PPE, conserve existing PPE, and prioritize PPE use. Rationing and extending PPE use may be necessary for some crisis care settings; however, there is limited evidence on the risks of extended use or reuse of PPE.

Strategies to Manage Supply of PPE

- ☐ Institute clear guidelines on the utilization of scarce PPE in crisis capacity settings to ensure equitable allocation of resources and protection of all healthcare workers and staff [34]
- ☐ Limit COVID-19 testing to high priority groups such as HCWs and high-risk individuals [35]

The table below outlines current recommendations on securing, conserving, and extending PPE.[36,37]

SECURE	CONSERVE	EXTEND
☐ Selectively cancel elective/non-urgent procedures and appointments where HCW use PPE ☐ Collect PPE from other providers, including primary care facilities, laboratories, dental practices, private pharmacies ☐ Use reusable PPE ☐ Use PPE beyond manufacturing shelf life	☐ Extended use of PPE is better than re-use of PPE ☐ HCWs should avoid touching PPE to avoid contamination ☐ Maximize use of engineering controls, such as barriers and maintained ventilation systems to minimize nosocomial infections ☐ Institute administrative controls to minimize patient contacts	☐ For HCWs working with SARS-CoV-2 positive patients: – Re-use PPE as long as it has not been soiled or ripped – Avoid HCWs sharing the same PPE ☐ For HCWs working with patients who have not tested SARS-CoV-2 positive: – Change PPE between patients if possible, to avoid transmission

Mask Conservation

Shortages of masks, particularly N95 and higher efficiency masks, currently represent the most significant concern for healthcare workers.

Extended use and reuse of N95 masks:

- ☐ Contact with the outer surface of mask should be prevented
- ☐ Wearing a face shield or putting a cloth barrier over medical masks/ respirators to prevent contamination by droplets
- ☐ Store masks for reuse in a paper bag with user name and date
- ☐ Rotating masks, with seven-day intervals of non-use is being employed in some settings
- ☐ Wet, soiled, bent, or crushed masks cannot be reused
- ☐ If possible, disinfect mask by baking in 70 C oven for 30 minutes or by placing under UV light for 30 minutes [38]

Prioritize the use of N95 masks for the following activities:

- ☐ Aerosol-generating procedures (such as intubation)
- ☐ Activities with prolonged close contact with confirmed or suspected COVID-19 cases
- ☐ Care activities where splashes or sprays are anticipated such as bathing and toileting

Section 4: Crisis Capacity Alternatives to Standard PPE

Some protection is better than no protection. If standard PPE is no longer available, anything that covers the eyes, nose, mouth, and body is better than no covering, though there is little evidence regarding which alternatives are most effective.

Important Note: The alternatives to standard PPE listed in this section should be used as a **last resort only** when no other options are available. None of these alternatives have been proven to adequately protect HCWs against SARS-CoV-2.

PPE TYPE	ALTERNATIVES
Masks	**Cloth masks:** ☐ Cloth masks **are not recommended for providers** – Medical masks and N95 respirators should be saved for frontline healthcare workers and particularly vulnerable populations, such as the elderly and cancer patients – If HCWs must wear a cloth mask they should also wear a face shield to protect them from droplets ☐ The US CDC is now recommending that **individuals wear homemade cloth masks in public** to reduce droplet transmission from asymptomatic patients. Wearing a cloth mask reduces droplet transmission from asymptomatic persons in community settings and is a useful precaution as long as it does not replace social distancing and proper handwashing. [39]
Face Shields	Some providers are making their own face shields using clear plastic sheets or are wearing goggles (such as ski goggles) when there are not enough medical grade face shields available. The efficacy of these is currently unknown.
Isolation Gowns[40]	☐ Disposable laboratory coats ☐ Reusable (washable) patient gowns or laboratory coats ☐ Disposable aprons ☐ Clothing that covers the front and arms ☐ Plastic bags

Section 5: Additional Resources

- ☐ Detailed instructions for extended use and limited re-use of different forms of PPE: https://www.nebraskamed.com/sites/default/files/documents/covid-19/COVID-Extended-Use-Reuse-of-PPE-and-N95.pdf?date=03182020
- ☐ Creative suggestions for PPE alternatives from JAMA (such as scuba masks in place of face shields): https://jamanetwork.com/journals/jama/fullarticle/2763590
- ☐ Facility Checklist for N95 Respirator Optimization (attached on following pages): https://www.cdc.gov/coronavirus/2019-ncov/hcp/checklist-n95-strategy-h.pdf
- ☐ Guidelines for Production of Gowns (and other PPE)
  - From the US CDC Website: "Considerations for Selecting Protective Clothing used in Healthcare for Protection against Microorganisms in Blood and Body Fluid" https://www.cdc.gov/niosh/npptl/topics/protectiveclothing/
  - From the WHO: "Preferred Product Characteristics for Personal Protective Equipment for the Health Worker on the Frontline Responding to Viral Hemorrhagic Fevers in Tropical Climates" (not COVID-19 specific, but many of the recommendations may be transferable) https://apps.who.int/iris/bitstream/handle/10665/272691/9789241514156-eng.pdf?ua=1

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