COVID-19, Ebola, Spacesuits, and Infection Control: What PPE Does for HCWs

Steven C. Hatch
University of Massachusetts Medical School

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COVID-19, Ebola, Spacesuits, and Infection Control: what PPE does for HCWs

Steven Hatch, MD, MSc
26 May 2020
USAID PEER/LIBERIA
Objectives

Explain the general concepts of infection control
Highlight differences between infection control approaches, esp contact/droplet vs. airborne
Explain the concept of Personal Protective Equipment
Discuss particular instances of infection control/PPE use (Ebola)
Review N95 versus Surgical Mask protection in COVID
Emphasize the importance of handwashing in the COVID outbreak
https://libraryguides.umassmed.edu/amdogliotticollegeofmedicine

Click on “PEER Workshops”
There are lots of ways to spread microbes

- Direct touch
- Contact with body fluids
- Touching things that have microbes on them (like surfaces)
- Coughing
- Sneezing
- Sex
- Childbirth
- Breastfeeding
- Breathing
Okay, so what do we do to limit this?

- **Public:**
  - Keep people away from each other (social distancing; stay home)
  - Keep people from breathing on each other (mask use*)
  - Reduce the spread of infection via touch (hand washing)
What do we do to limit this? Part 2

- **Hospital:**
  - Isolate patients
  - *Cohort* patients
  - Make sure staff don’t spread *(handwashing, contact precautions)*
  - Make sure staff don’t get sick themselves (PPE)
  - Some critical PPE includes...
But how do we know *which* of the ways these microbes transmit?

Example: The Big E
Clinical Lab Evidence

- Ebola can be recovered from virtually every compartment of the human body
- Detectable for differing lengths (days-months) depending on site
- Ebola stays in sweat for relatively short time
- Ebola in semen is persistent
- Therefore, don’t trust men
- PCR is *not* the same as recoverable virus!
- PCR positivity lasts (much) longer than time of recoverable virus
Ebola resurgence in Liberia (March 2015)

• Ruth Tugbah, developed sx after no new cases in 3 weeks in Liberia
• Boyfriend had detectable RNA in semen at day 175 post-symptom onset
Ebola RNA Persistence in Semen of Ebola Virus Disease Survivors — Preliminary Report

- **100% (9 of 9)** RNA positive at 2-3 months
- **65% (26 of 40)** positive at 4-6 mo
- **26% (11 of 43)** positive at 7-9 mo!

*NEJM 25 October 2015*
Ebola also transmits via mucous membranes

- Nonhuman primate model
- Laboratory-based
- Different strains might have different effects
- Squares with epidemiology
Epidemiologic evidence: Kikwit outbreak, 1994

- Started with 2 villagers who became infected
- Cared for at hospital
- Outbreak subsequently exploded
- 79 healthcare workers infected
- **Barrier precautions** (roughly, **contact precautions**) instituted
- Only one HCW infected after institution of precautions

Peters CJ. FEMS Immunology and Medical Microbiology 18 (1997) 281-289
So what’s with the Tyvek & N95 if Ebola is a disease of contact?

- Ebola is really deadly
- Only a few viral particles are required to infect someone (low LD50!)
- 2 RNs in Dallas infected using heightened contact precautions
- Thus: masks and googles to maximally protect all mucous membranes
- But Ebola PPE is really expensive—can’t work in massive outbreak
Basic categories of hospital infection control

• Standard precautions (handwashing, +/- gloves)
• Contact precautions
• Contact-plus precautions (extra handwashing step)
• Droplet precautions
• Airborne precautions
• (Special category for BL4 agents: Ebola, Marburg, others)
Agents for Contact/Contact-plus Precautions

- Drug-resistant bacteria (e.g., ESBL organisms; VRE; CREs)
- *Clostridium difficile*
- Norovirus
- *E coli* O157:H7
- Scabies
Agents for Droplet Precautions
(ie requires surgical/medical mask)

- Neisseria meningitidis
- Haemophilus influenzae type B
- Mycoplasma pneumoniae
- Bordetella pertussis
- Group A Streptococcus
- Diphtheria
- Plague (pneumonic)
- Influenza
- Rubella
- Mumps
- Adenovirus
- Parvovirus B19
- Rhinovirus
Agents for Airborne Precautions

(ie requires N95 mask—medical/surgical mask inadequate)

- Tuberculosis
- Varicella
- Measles
- Smallpox
- (Ebola, Marburg)
- NB airborne precautions include negative-pressure rooms to prevent microbes from getting into hallway
But what defines the categories of airborne and droplet pathogens?

• Concept dates back to at least 1930s
• “Droplets”—particles (eg blobs of mucus) 5-10 μm in diameter
• Governed by Laws of Isaac Newton (ie gravity)
• “Airborne” <5 μm
• Picked up in air currents, as aerosols, can be viable for hours
• N95 mask protects against aerosols
"the rapid international spread of COVID-19 suggests that using arbitrary droplet size cutoffs may not accurately reflect what actually occurs with respiratory emissions"
Droplet versus aerosol

- Dichotomy may be (probably is) overly simplistic
- Microbe transmission may be on a spectrum rather than a binary
- Repeat: this is a *practical* categorization
- But does that make it right?
- Evolution didn’t take into account CPR, intubation, ventilation
- “Local aerosols”?
- ie short-range aerosols generated by these procedures
“COVID might be everywhere!”
Okay, but is COVID an airborne or droplet-spread infection?


Does COVID aerosolize? Experimental evidence

- NEJM paper from March 17
- Detectable RNA (PCR) up to 3+ hours after aerosolization
- “Aerosols...were generated with the use of a three-jet Collison nebulizer and fed into a Goldberg drum to create an aerosolized environment”
- But does this simulate real life?
- “Cough heard round the world”
Does COVID aerosolize, round #2? Epidemiologic evidence

- ~2800 HCWs
- ~2400 followed >48wks, and ~1400 followed >1 yr
- Randomized N95 use vs. surgical masks
- Lab-confirmed influenza 207/2512 in N95 vs 193/2668 in med mask
- No difference in lab-confirmed respiratory illness
- No difference in clinical respiratory illness
- No difference in influenza-like illness
Does COVID aerosolize, round #3?
Direct (but small) epidemiologic evidence

Annals of Internal Medicine

Observation: Brief Research Report

COVID-19 and the Risk to Health Care Workers:
A Case Report

16 March 2020
So you have a patient who you didn’t realize had COVID, but then you find out he did. How might you do a study to find out something about the risk of transmitting infection?
<table>
<thead>
<tr>
<th>Procedure</th>
<th>HCWs With Swab Done on Day 1, n</th>
<th>HCWs With Swab Done on Day 2, n</th>
<th>HCWs With Swab Done on Day 4, n</th>
<th>HCWs With Swab Done on Day 5, n</th>
<th>HCWs With Swab Done on Day 14, n</th>
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</tbody>
</table>
Retrospective contact tracing study of 41 HCWs in Singapore

All took care of one COVID-pos pt whose dx was not known until extubation (thus not “optimal” PPE, most wore surgical masks)

Nobody got infected
So where does this leave us?
Current recs

• All evidence suggests this virus is transmitted in two principal ways:
• Through air at close range
• Through fomites (picking up virus via fingers, then contact with mucous membranes, mainly mouth/eyes/nose) at short or long range
• Airborne precautions are ideal but they are not required
• N95s for situations involving aerosolization (CPR, intubation, vent mgt, procedures, surgeries)
• Facemasks for nearly all other situations
• Contact: gown, gloves, eye protection in add’n to mask
• Take things off slowly, carefully, and in order
• Wash your hands afterwards!
Handwashing is critical!

- Spread by droplets & fomites
- Optimal hand hygiene will significantly reduce spread of virus!
- More than just hospital infection control
- Need to educate pts at point of care

https://www.who.int/gpsc/5may/Your_5_Moments_For_Hand_Hygiene_Poster.pdf?ua=1
Handwashing is critical!—part two

Areas Most Often Missed During Hand Washing

- Most Often Missed
- Often Missed
- Less Often Missed

Taylor, L., Nursing times 74, 54 (1978)
Handwashing is critical!—part three

• Getting in between fingers, backs of hands, fingertips critically important
• Alcohol gel: rub 20-30 secs!
• Soap/H2O: 40-60 secs!
• Find a song to sing and sing it (for timing)
• Alcohol preferred if hands not visibly soiled
¿Questions?