PPE 101

Transmission Based Precautions From First Point of Contact
## Course Objectives

<table>
<thead>
<tr>
<th></th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Recognize components of maintaining a safe work environment</td>
</tr>
<tr>
<td>2</td>
<td>Differentiate safe and risky behavior when using PPE</td>
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<tr>
<td>3</td>
<td>Recognize safe and risky behavior in donning and doffing PPE in patient care scenarios</td>
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</tbody>
</table>
Cycle of Transmission

- Germs
- Reservoirs
- Escape Route
- Form of Transmission
- Susceptible Host
Germs, PPE, Fomites, ABHR Defined

**GERMS**
Will apply to any kind of virus, bacteria or fungus that can cause illness in humans

**ABHR**
Alcohol Based Hand Rubs

**Contamination**
Making something unclean by contact with a polluting substance

**Inoculation**
The introduction of a pathogen into another living organism

**Fomite**
Objects or materials that may harbor infectious material

**PPE**
Refers to just about everything we wear to prevent contamination or inoculation
Germs

Reservoirs

Escape Route

Form of Transmission

Susceptible Host

HOLES!
Direct inoculation occurs:
when someone coughs or sneezes near us

Direct inoculation can also occur over longer distances
Cycle of Transmission

- Germs
- Reservoirs
- Escape Route
- Susceptible Host
- Form of Transmission
- HOLES!
Modes of Transmission

**Alarming**

*Amoy Gardens*
SARS transmission through ventilation system several floors away
– fecal to inhaled

*Hotel Restaurant*
Norovirus from aerosolized vomitus - inhaled/swallowed across a room

*Zika, EVD in Semen*
Presence versus transmissibility risk
In order for any PPE to be effective it has to be intact – we look for the holes in our gloves, we wouldn’t put on a ripped gown.

And Likewise,
Our skin has to be INTACT for it to be an effective barrier.
There are many ways that our skin may **NOT** be intact!
As great as intact skin is, it does have a downside.

Our skin is VERY sensitive

- A little piece of hair next to our eye
- An itchy nose
- Sliding glasses
- Falling hair

We might touch our faces **15 times** (or more) every hour!
“Cover your holes”
Highly Sensitive and Hard to Ignore

Probably for good reason it’s hard to ignore the little tickling sensation we get when something is too close to our eyes and eyelashes, or touches our nose hairs.

We touch or cover our mouths with our hands when we are deep in thought, when we yawn or cough or sneeze (yay, please!), out of habit alone or when we are afraid we have spinach in our teeth.

In or out of PPE this is a problem when we are in someone else’s biome.
<table>
<thead>
<tr>
<th>Body Area</th>
<th># of Microorganisms Shed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saliva &amp; Nasal Fluid</td>
<td>10 million/gram</td>
</tr>
<tr>
<td>Back</td>
<td>100 million</td>
</tr>
<tr>
<td>Hand</td>
<td>10,000-100,000</td>
</tr>
<tr>
<td>Feet</td>
<td>1 million</td>
</tr>
<tr>
<td>Scalp</td>
<td>1 million</td>
</tr>
<tr>
<td>Forehead</td>
<td>100-1000</td>
</tr>
<tr>
<td>Armpit</td>
<td>1-10 million</td>
</tr>
<tr>
<td>Groin</td>
<td>1-20 million</td>
</tr>
</tbody>
</table>

The Contaminations Risk We Don’t See

Institute of Validation Technology “People in Cleanrooms: Understanding and Monitoring the Personnel Factor” Tim Sandle Dec 16 2014
The world is covered in a fine patina of feces

- You enter a person's biome when you enter whatever space they have been occupying for a period of time – their home or hospital room
- Even more true in a confined space with an open toilet
- Toilets aerosolize waste and create clouds of fecal matter that slowly drift down to room surfaces over the course of hours. The drier the air in the room, the more likely the particles will stay suspended

Salmonella has been found in a biofilm just below the surface of toilet water 50 days after the bowl was seeded

C. diff has been found in the air above the toilet 90 minutes after flushing
Indirect Inoculation

Remember all those times a day we touch our faces?

We don't intend to, but by interacting with the patient and their environment we can contaminate ourselves and our clothing.

And we then carry that contamination to our mucous membranes.
Germs can be in any body fluid, on any person, flung far and wide from many orifices, and from reservoirs like toilets.

The entire patient environment can become contaminated.

Our bodies are sensitive, especially around our mucous membranes.

We touch our eyes, nose and mouth more often than we realize.
Controlling Exposure

CDC – Components to Healthcare Worker Safety

- Training and Administrative Controls such as Isolation Policies
- Engineering Controls such as negative pressure rooms
- Work Practice, Behavior
- PPE for Healthcare Workers
- Self Identification and Isolation
Promoting Self-Isolation
None of us want to make patients, clients, feel like they are dirty or that we are afraid of them. We all have seen the heartfelt letters, articles and blog posts about not wearing gloves to enhance the real feeling of human interaction.

If your skin is intact, and if you have performed hand hygiene, there is nothing wrong with touching people.

BUT we cannot pretend to know who is MRSA positive or whose hands were not washed recently or well.

**DO NOT** touch your mucous membranes until you have washed or sanitized your hands.
If you could only choose to wear one type of PPE what would it be?
Soap and water versus ABHR (besides C.Diff)

ABHR takes less time, kills more GERMS:
- Need to use the right amount (5-10ml)
- Areas most frequently missed – thumbs, between fingers, finger tips

ABHR can be used on gloved hands

Not effective if soiled
The most ubiquitous form of PPE - everyone wears them now

Hand sanitize before donning, after doffing

Find a repeatable method to doff gloves without contaminating yourself

Drop directly into trash - no shooting, throwing
Behavior in PPE - Gloves

1. Put gloves only on clean hands
2. Wear two pair*
3. Find a method for removal that is less likely to cause self contamination
4. **NEVER touch yourself with your gloved hands**
5. The patient’s environment will be covered in their biome. Don’t think you can avoid contact because you’ll “only be in there for a minute”
6. You can use ABHR on gloved hands
7. Consider the use of extended cuff gloves
8. Always perform hand hygiene after removing gloves
9. **NEVER** lose sight of the cuff of your glove
From what does an isolation gown protect you?

When do you decide what kind of gown you need?

What other methods might be used if you encounter wet surfaces, copious fluids?

When your gown fabric is fluid resistant or impervious, where do the fluids that are resisted go?
Gowns

End users should decide what level of protection is needed based on “...anticipated degree of contact with infectious material and potential for blood and body fluid penetration”

Liquid penetration of gowns is not always visible

Body fluids, including blood, are more likely (than water) to penetrate and carry microorganisms with them

The presence of body fluids during routine care can not consistently be anticipated

Blogs.cdc.gov How Well Do You Think You are Protected Dr. Selcen Kilind-Balci
Review of PPE Guidance and Products

ANSI/AAMI Standards

<table>
<thead>
<tr>
<th>Level</th>
<th>Test Methods Used</th>
<th>Expected Barrier Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Impact Penetration</td>
<td>Minimal water resistance</td>
</tr>
<tr>
<td>2</td>
<td>Impact Penetration &amp; Hydrostatic Pressure</td>
<td>Low water resistance</td>
</tr>
<tr>
<td>3</td>
<td>Impact Penetration &amp; Hydrostatic Pressure</td>
<td>Moderate water resistance</td>
</tr>
<tr>
<td>4</td>
<td>ASTM F1670 Synthetic Blood &amp; ASTM F1671 Viral Penetration Test</td>
<td>Blood and viral penetration resistance</td>
</tr>
</tbody>
</table>
### N95 and Surgical or Isolation Masks

#### NIOSH Reach II Study

**Understanding and Selecting Respiratory Protection Devices**

While it is your employer’s responsibility to provide policies, programs, training, and guidance on respirator use, it is the healthcare workers who implement these procedures. Do you know when to use respiratory protection? If so, do you understand what type of protection to choose and how to use it properly?

<table>
<thead>
<tr>
<th>Situation</th>
<th>PPE Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Seasonal Influenza</strong></td>
<td>Patient with suspected or confirmed seasonal influenza.</td>
</tr>
<tr>
<td>Close contact</td>
<td>Surgical mask equivalent or higher</td>
</tr>
<tr>
<td>Aerosol-generating procedure</td>
<td>N95 Filtering Facepiece Respirator (FFR) equivalent or higher</td>
</tr>
<tr>
<td><strong>Airborne Precautions</strong></td>
<td>Patient with suspected or confirmed infectious disease requiring airborne precautions (e.g., measles, tuberculosis)</td>
</tr>
<tr>
<td>Close contact</td>
<td>N95 FFR equivalent or higher</td>
</tr>
<tr>
<td>Aerosol-generating procedure</td>
<td>N95 FFR equivalent or higher</td>
</tr>
<tr>
<td><strong>Droplet Precautions</strong></td>
<td>Patient with suspected or confirmed infectious disease requiring droplet precautions (e.g., pertussis)</td>
</tr>
<tr>
<td>Close contact</td>
<td>Surgical mask equivalent or higher</td>
</tr>
<tr>
<td>Aerosol-generating procedure</td>
<td>Surgical mask equivalent or higher</td>
</tr>
</tbody>
</table>
Placing a surgical or isolation mask on a coughing patient can significantly reduce the dispersion distance.

Adding easy to grab tabs onto N95 straps may decrease self-contamination during mask removal, as does utilizing two pair of gloves.

The security of the fit of an N95 mask decreases substantially during use for routine bedside care procedures.

User seal checks, which should be performed immediately before entry to an isolation area, are not reliable for detecting even gross leakage.

Surgical or isolation masks are primarily designed for source control – protecting a clean environment from the wearer.
Behavior in PPE and HCW Safety

Change the culture

- HIV changed healthcare culture, made routine glove use accepted
- Ebola, in its own way, has also changed healthcare culture
  - Taking a comprehensive history - Travel, pets, farms and exotics, immunizations, sick contacts
  - Focus on PPE use
  - PPE Competency
  - Research on efficacy of PPE, materials and methods
- Encourage patient self-isolation with signage and mask stands
Protection: Regular prescription-type wear = 83% contamination
Loupes = 50% contamination
Facemask with shield = 30% contamination

Study was done with a single position during a single orthopaedic procedure
Eye Protection

Options for Eye protection

Good use of eye protection

Poor use of eye protection
Eye Protection – Face shields

{we have a few NETEC photos of folks using shield, I will look for one}
Gown and Gloves – Doffing

When worn together, as they frequently are, the gown can be rolled up with gloved hands.

We encourage people to grab the gown at the sides, (as a less likely to be contaminated site), and bring the sides forward, gathering or rolling in a manner that keeps the dirty side toward the inside.

Having a neck attachment that breaks away is safer than having to reach up near face, neck, hair to untie or un-velcro.

You can remove the gloves and the gown together once the interior aspect of the gown is on the outside. Avoid touching the gown to your clothing or skin and deposit it directly into trash.
PPE - Contact Isolation without aerosols likely

Donning sequence

Doffing sequence
Donning sequence

Droplet Precautions without Aerosols Likely

Doffing sequence
Patients are being educated to watch HCWs and make sure that we are all performing hand hygiene before each first contact.

If the HCW has already donned gloves to enter the room, should they hand sanitize their gloves?

Remove gloves, perform hand hygiene then re-apply gloves?

Tell the patient they have already performed hand hygiene?
Adding Eye Protection to Respiratory Protection
Airborne Precautions

Donning sequence

Doffing sequence
Enhanced – Enteric – C-diff – Precautions Doffing
7.6 million healthcare workers in the US workforce

About half of those are RN’s or LPN’s

Somewhere between 9 - 42 HCW’s per million, so

68 - 319 die annually from occupational infections
Can I re-use my N95 respirator?

Re-use is defined as removing, storing and re-applying the same respirator. It is only recommended under some pretty strict conditions: that you protected the front of the respirator from potential contamination by adding a face shield or that no aerosol generating procedures, including the patient coughing, occurred while you were in their immediate area AND that the respirator is not wet from your own exhaled breath.*

https://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextuse.html
Do I need to change my N95 between patients, if they all have the same symptoms?

If you are moving from room to room, examining or treating many people who may have the same germ, this is considered “extended use” of an N95, and can be done for up to 8 hours or until the inside of the respirator is wet or makes breathing difficult. *

https://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextuse.html
Where and when do I take OFF my N95?

Remove the respirator once you are out of the patient care environment – for most of us this means once we have left the room and closed the door behind us.

It can be difficult to find and grasp the straps or strings of respirator, especially with gloved hands. You can make this easier by placing a folded over piece of tape on the center of the straps before you put it on. That gives you a tab to hold onto and pull to facilitate respirator removal.
Training in PPE

**Figure 3. Contamination of Personnel During Removal of Fluorescent Lotion-Contaminated Gloves Before and After an Intervention**

**A** By Provider Type

<table>
<thead>
<tr>
<th>Provider Type</th>
<th>Before Intervention</th>
<th>After Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physicians</td>
<td>80%</td>
<td>20%</td>
</tr>
<tr>
<td>Nurses</td>
<td>60%</td>
<td>40%</td>
</tr>
<tr>
<td>Allied Health Care Personnel</td>
<td>40%</td>
<td>20%</td>
</tr>
<tr>
<td>Overall</td>
<td>60%</td>
<td>40%</td>
</tr>
</tbody>
</table>

**B** All Personnel

<table>
<thead>
<tr>
<th>Time Point</th>
<th>Fluorescent Lotion Contamination, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Intervention (n=50)</td>
<td>80%</td>
</tr>
<tr>
<td>Immediately after Intervention (n=90)</td>
<td>20%</td>
</tr>
<tr>
<td>1 mo After Intervention (n=50)</td>
<td>40%</td>
</tr>
<tr>
<td>3 mo After Intervention (n=50)</td>
<td>40%</td>
</tr>
</tbody>
</table>

Frequency of fluorescent lotion contamination before and immediately after an educational intervention and overall frequency of contamination for all personnel types before, immediately after, and 1 and 3 months after the intervention.

\[ P < .001 \] compared with before the intervention.
### Behavior in PPE – HCW Safety

<table>
<thead>
<tr>
<th>Two guidelines borrowed from Fire/EMS</th>
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</thead>
<tbody>
<tr>
<td><strong>First</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Second</strong></td>
</tr>
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<td></td>
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</tbody>
</table>
Does your institution inadvertently reward dangerous behavior?
   Call light timers
   Alarm fatigue strategies
   Awards for “selflessness”

Does leadership set a good and consistent example?

Consider evaluating current donning and doffing competency
   Include glove removal, hand hygiene (ABHR and handwashing)
Behavior in PPE - HCW Safety

Safer Behavior

- Situational awareness – what have I touched, what in this room/environment may be contaminated, is this procedure/treatment/intervention likely to involve body fluids?
- Planning ahead – put supplies and equipment where and when they are needed without dirtying environment, wearing two pair of gloves, placing gloves or hand sanitizer where it can be reached safely, leave a pen in the patient care area
- Utilizing alternative barriers when fluids are or may be encountered
- Securing eyeglasses so they don’t slide
- Adding tabs to mask string/elastic
- Making sure to wash or hand sanitize before touching eyes, nose or mouth
Hand Hygiene

- Before eating
- Before putting gloves on
- Before and after having direct contact with a patient’s intact skin (taking a pulse or blood pressure, performing physical examinations, lifting the patient in bed)
- After contact with blood, body fluids or excretions, mucous membranes, non-intact skin, or wound dressings

- After contact with inanimate objects (including medical equipment) in the immediate vicinity of the patient
- If hands will be moving from a contaminated-body site to a clean-body site during patient care
- After glove removal
- After using a restroom

https://www.cdc.gov/handhygiene/providers/index.html
Changes to Patient Care Environment

- Place hand sanitizer where it is visible when opening door
- Place trash bins where they are needed for appropriate doffing
- Have gloves and hand sanitizer within easy reach of staff performing patient care
- Use chux or other physical barriers if care requires leaning against/over bed
- Curtains should not come in contact with staff clothing
- Toilet covers!
- Rotate pumps and monitors so the displays can be seen from door or window
- Pens, pens, pens!
- If your staff carry phones, can they be easily disinfected?
  - Do they get left OUT of room, or IN pocket?
1. Consider adding the donning and doffing of your facilities contact PPE ensemble to your list of annual competencies
2. Discuss safer strategies – Time Out Model
3. Model good behavior and techniques
4. Empower all levels of staff to point out breaches without reprisal
5. Assure staff that their safety and well-being is important
6. Err on the side of caution, protect until proven