

Slide 1: Prevention of infections in healthcare settings including protection of health care workers

Slide 2: I will be discussing the presentation under the following headings:

- How infection spreads?
- Infection Prevention and Control measures that is IPC measures which includes Standard precautions and Expanded precautions
- Recommended IPC practices for COVID-19

Slide 3: Three things are necessary for an infection to occur:

- Source: that is places where infectious agents (germs) live. Source can be people which can be patient, healthcare worker, Visitor. That person can be symptomatic or asymptomatic. Source can also be environment around patient (air, linen, stethoscope)
- Susceptible Person: For an infection to occur, germs must enter a susceptible person's body and invade tissues, multiply, cause damage leading to disease. Susceptible person can be healthy who is not vaccinated or immune (i.e did not have same infection in past), person with a weakened immune system (like a patient with HIV, someone on immunosuppressants). Additional routes for entry of germs can also increase susceptibility for infection like surgery (SSI), urinary catheters (UTI)
- Transmission can occur through various routes: It can occur by contact, Sprays and splashes which occur when droplets from coughing/sneezing/talking (within 6ft) land on mucosal surface.
- By Inhalation when germs are aerosolized in tiny particles. This aerosol generation can occur while coughing/sneezing or talking or while performing aerosol generating procedures which I will be discussing later.
- Sharps injuries with contaminated needle or sharp instrument can transmit infections like HIV, Hepatitis B

Slide 4: Infection prevention and control measures include standard precautions and contact based precautions.

Standard precautions should be followed while taking care of all patients and include the following:

1. Hand hygiene
2. Use of Personal Protection Equipment (PPE) whenever expecting possible exposure to infectious material
3. Follow respiratory hygiene/cough etiquette principles
4. Ensure appropriate patient placement
5. Properly handle and properly clean and disinfect patient care equipment and instruments/ devices
6. Clean and disinfect environment appropriately

7. Follow safe injection practices
8. Ensure healthcare worker safety including proper handling of needles and other sharps
9. Handle textiles and laundry carefully with minimal agitation

While transmission based precaution includes precaution to be taken based on patients illness and procedure to be done. It includes contact precautions, droplet precautions and airborne precautions.

Slide 5: Hand hygiene includes hand wash and hand rub

- One of the key steps in containing COVID-19 infection
- Hand wash can be done with non-antimicrobial or antimicrobial soap and should be done when
 - hands are visibly dirty
 - contaminated with proteinaceous material
 - visibly soiled with blood or body fluids
- For Hand rub, alcohol based hand rub should be used. As per CDC recommendations, hand rub containing at least 60% ethanol or >70% isopropanol inactivates SARS-CoV-2 and should be used.
- Hand rub is preferred mode of hand hygiene and should be performed if hands are not visibly soiled
- One should avoid unnecessary touching of surfaces in close proximity to the patient

Slide 6: the picture here shows steps to perform hand hygiene as per WHO guidelines. WHO recommends hand rub to be done for 20-30s and hand wash for 40-60s . **However, CDC guidelines recommends atleast 20s for both hand wash and hand rub.**

One should take a sufficient amount of alcohol based hand rub and then perform the following steps as depicted in these pictures. The steps are similar for hand wash and aim that all sides of both hands are decontaminated.

Slide 7: When do we need to perform hand hygiene. WHO's 5 moments of hand hygiene shows the key moments when a HCW should perform hand hygiene, which are 1-5. It should also be performed if hands will be moving from a contaminated-body site to a clean-body site during patient care , Before putting on PPE, After removing gloves/ PPE,

One should wash hands with non-antimicrobial or antimicrobial soap and water if

- contact with spores because alcohols, chlorhexidine, iodophors, and other antiseptic agents have poor activity against spores
- before eating and after using a restroom

Slide 8: Shows routes by which a respiratory pathogen can spread

When an infected person coughs or sneezes or even talks, droplets form which carry germs to short distances (within approximately 6 feet). These droplets can land on a susceptible person's mucosa that is : eyes, nose, or mouth and can cause infection. While the Smaller droplets / aerosol less than 5 micrometer can be inhaled by a person near the infected source i.e spread by short-range airborne route or be carried away by air currents to long distances (>6 ft) and spread infection .

The other route through which the virus can spread is through fomites which form after droplets and aerosol settle on surface. So, when a person touches this object/surface contaminated by the virus infected person, and then touches his own eyes, nose, or mouth, he/she may get exposed to the virus.

According to current evidence, COVID-19 virus is primarily transmitted between people through respiratory droplets and contact route (mucosa). Earlier, it was said that airborne transmission of SARS-COV-2 occurs during AGPs, but now evidence suggests that this virus may spread even in the absence of aerosol generating procedures, particularly in indoor settings with poor ventilation.

Transmission through droplets can be prevented by taking droplet precautions; through airborne route by airborne precautions. To prevent transmission by fomites, one should take contact precautions and perform hand hygiene and avoid touching eye, mouth, nose, face.

Slide 9: Use of personal protective equipment

PPE act as a barrier to prevent entry of virus into the body and include the following:

- Gloves should be used when touching blood, body fluids, secretions, excretions, contaminated items; mucous membranes or non-intact skin (so basically before touching any potentially infectious material)
- Gowns/coverall: when contact of clothing or exposed skin is anticipated
- PPE for Contact Precautions protects from fomites → and includes gown/coverall and gloves
- PPE for droplet Precautions protects mucosa (eye, nose, mouth) from droplets and includes surgical masks and goggles/ faceshield. Surgical mask covers nose and mouth while goggles/ face shield provide eye protection.
- PPE used for airborne Infection precautions filters air to be inspired and includes Particulate respirator.

Slide 10: So, now we know that SARS-CoV-2 can spread through droplets, fomites and aerosols → the following PPE is recommended when taking care of COVID-19 patients

- NIOSH-approved N95 or equivalent or higher-level respirator
- *facemask can be if a respirator is not available, but while performing aerosol generating procedure, respirator is must!
- Gown/ coverall (with or without apron) : If you look at gown, it doesnot cover head, neck and lower legs while coveralls are designed to cover the whole body and sometimes even feet
 - Gloves (most people use 2 pairs of gloves)
 - Eye protection (with goggles/ face shield)

- personal eyeglasses and contact lenses are NOT considered adequate eye protection
- Head cover and shoe cover should be donned (if using gown)

* Patients with confirmed or possible SARS-CoV-2 infection should wear facemask/ N95 respirator to contain spread of infection

Slide 11: Type of PPE for respiratory protection

- For this, We have respirators which filter air before it is inhaled (thereby providing respiratory protection)
 - They protect against hazardous airborne particles (including dust particles and infectious agents), gases, or vapors
- These differ from face masks as face masks protect from droplets and not aerosol
- There are 3 types respirators
 - Filtering Face piece (FFP) respirators
 - Half- or full-face elastomeric respirators
 - Powered air purifying respirators (PAPR)

Slide 12: Filtering Face-piece Respirators (FFR) which includes N95 Respirators

- These are disposable half-face piece respirators that filter out particles
- It has a sub-micron filter capable of filtering particles less than 5 microns in diameter
- **Filter series available are:** N (not resistant to oil), R (somewhat oil resistant), P (oil proof)
- **Number indicates filter efficiency**
- Various FFRs available are N95, N99, N100, R95, P95, P99, P100
- Most commonly used is N95 respirator : N= not resistant to oil, and 95 means it filters atleast 95% of airborne particles (<5 micrometer in diameter)
- FFRs are approved by the CDC's National Institute for Occupational Safety and Health (NIOSH)
- Must be worn throughout the period of exposure
- Picture shows FFR without exhalation and with exhalation valve (does not filter the expired air) and hence should not be used for source control

Slide 13: When using respirators, one must perform User Seal check

Should be performed each time respirator is donned to ensure proper fit. It can be done with positive or negative pressure check

To perform positive pressure check: (Positive pressure check can't be done in FFR with exhalation valve)

- As shown in this picture, place hands over facepiece
- And then, exhale gently into facepiece
- It is considered satisfactory if slight positive pressure built up inside without any outward leakage of air at the seal
- Leak is present if any of the following is present:
 - feeling of air movement on face along seal of facepiece
 - fogging of glasses
 - no pressure built up inside

To perform, negative pressure check

- As shown in the picture: Place hands over facepiece
 - Inhale
 - It is considered satisfactory if facepiece collapses on face
- AND
- You don't feel air passing between face and facepiece
 - Either of Positive pressure or negative pressure check can be done
 - If unsatisfactory → readjust nose piece and repeat

Slide 15: Other respirators include

Elastomeric Half Facepiece Respirator

- These are Reusable facepiece (While FFR are disposable)
- They contain replaceable cartridges or filters
- Protects against particles, gases and vapours

- Covers nose and mouth

Elastomeric Full Facepiece Respirator

- More effective face seal
- Provides eye protection

Powered Air-Purifying Respirator (PAPR)

- These are also reusable
- Contain replaceable filters or cartridges
- Protects against particles, gases and vapors
- Provide Eye protection
- These are battery powered with blower that pulls air through attached filters or cartridges
- Low breathing resistance

Slide 15: Steps of donning

- Identify and gather the proper PPE to don (like gown size)
- Perform hand hygiene using hand sanitizer
- Put on gown/coverall first
- Respirator (NIOSH approved N95 or higher respirator)
- Goggles/ face shield
 - Should not interfere with fit of respirator
 - The flexible frame of goggles should provide good seal with the skin of the face, covering the eyes and the surrounding areas and even accommodating for prescription glasses
 - *fogging is common with goggles
- Gloves (if using 2 pair of gloves can put on first pair in the beginning)
- Combination of PPE will affect sequence –therefore be practical

Slide 16: Steps of doffing

- Should be done slowly and deliberately in a sequence that prevents self-contamination
- Always take assistance while doffing
- Perform hand hygiene after each step

- First, Inspect gown/coverall for gross contamination and clean with alcohol swab
- Remove gloves : using gloved hand, grasp outside edge near wrist or over palm →Peel away from hand, turning glove inside-out →Hold in opposite gloved hand→Slide ungloved finger under the wrist of the remaining glove →Peel off from inside, creating a bag for both gloves→ Discard
- Face shield or goggles : Carefully remove face shield or goggles by grabbing the strap and pulling upwards and away from head. Do not touch the front of face shield or goggles.
- Gown/coverall : (outside and sleeves contaminated) : Unfasten ties →Peel gown away from neck and shoulder →Turn contaminated outside toward the inside→Fold or roll into a bundle→Discard
- Mask or respirator: Lift the bottom elastic over your head first→ lift off the top elastic→Discard→Do not touch the front of the respirator or facemask.
- **Facemask:** Carefully untie (or unhook from the ears) and pull away from face without touching the front.
- Perform hand hygiene

Slide 17: Respiratory Hygiene/ Cough Etiquette

- **Visual Alerts should be put** at the entrance to outpatient facilities eg:symptoms of respiratory infections, respiratory hygiene/cough etiquette as shown in this poster by MOHFW
- **Respiratory Hygiene/Cough Etiquette is** recommended for all individuals with signs and symptoms of respiratory infection
 - Cover mouth and nose with a tissue when coughing or sneezing →dispose tissue after use
 - Perform hand hygiene after contact with respiratory secretions and contaminated objects
 - Ensure availability of tissues, no-touch receptacles (like foot pedal operated) for disposing used tissue, alcohol- based hand rub in waiting area
- **Masking and Separation of Persons with Respiratory Symptoms should be done** during periods of increased respiratory infection activity in community as is being done for COVID-19 (at entrance to healthcare facility, in waiting area)
- **Droplet Precautions should be taken**

Slide 18: Patient Placement (COVID-19)

- One should evaluate need for hospitalization
 - Home care is preferable if individual's situation allows
 - If admitted → single-person room with attached bathroom, door closed
- *Airborne Infection Isolation Rooms (AIIRs) reserved for patients undergoing aerosol generating procedures
- There should be designated healthcare workers to take care of only these patients
 - Limit transport and movement of the patient outside of the room(communicate before transfer)
 - Perform procedures and tests bedside, use portable x-ray machines rather than shifting patient for these tests
 - If being transported, patients should wear facemask during transport

Slide 19: Airborne Infection Isolation Rooms (AIIRs)

- These are single-patient rooms at negative pressure relative to the surrounding areas, and with a minimum of 6 air changes/hour
- *12 air changes/hour for new construction or renovation
- *Install multiple exhaust fans if AIIR not available
- This prevents airborne diseases(aerosols) from escaping the room and infecting other people
 - Air from these rooms exhausted directly to outside or filtered through a high-efficiency particulate air (HEPA) filter
 - Room doors should be kept closed except when entering or leaving the room to maintain negative pressure
 - One should monitor proper negative-pressure function of these rooms

Slide 20: Patient-care equipment and devices

- May be contaminated with blood, body fluids or fomites
- Policies and procedures for containing, transporting, and handling equipments should be established
- Remove organic material using recommended cleaning agents before high level disinfection and sterilization. This will enable effective disinfection and sterilization process.
- Wear PPE according to the level of anticipated contamination when handling such equipment

Slide 21: Care of the environment

- Routine and targeted cleaning of environmental surfaces as indicated by the level of patient contact and degree of soiling
- Clean and disinfect surfaces that are likely to be contaminated with pathogens
 - Like those close proximity to the patient (bed rails, over bed tables)
 - Frequently touched surfaces (door knobs) disinfected more frequently
- EPA-registered disinfectants that have microbicidal activity against pathogens most likely to contaminate the patient-care environment for appropriate contact times
 - e.g.:sodium hypochlorite solution (1%) or ordinary bleach (5%) is effective against SARS-CoV-2
- Dedicated medical equipment for suspected or confirmed COVID-19 patients should be considered

Slide 22: Safe injection practices

- Use aseptic technique to avoid contamination of sterile injection equipment
- Do not administer medications from a syringe to multiple patients
- Use fluid infusion and administration sets for one patient only
- Use single-dose vials for parenteral medications whenever possible
- If multi-dose vials must be used, both the needle and syringe used to access vial must be sterile.
- Do not keep multi-dose vials in the immediate patient treatment area
 - store in accordance with the manufacturer's recommendations; discard if sterility is compromised or questionable
- Do not use bags or bottles of intravenous solution as a common source of supply for multiple patients
- These measures are mainly to avoid cross contamination and contamination from environment

Slide 23 and 24: Recommended routine IPC practices during COVID-19 pandemic. These are guideline recently released by CDC

These practices are applicable to all patients along with standard precautions, not just those with suspected or confirmed SARS-CoV-2 infection and include

- Implementing Telehealth and Nurse-Directed Triage Protocols (whether the pt can be managed at home/in-person/ED visit is required)
- Screening and Triaging everyone entering a Healthcare Facility for signs and symptoms of COVID-19 (including temperature check)
- Re-evaluating admitted patients for signs and symptoms of COVID-19 by daily evaluation for COVID-19 symptoms
- Encouraging Physical Distancing: ensure >6ft distance (in between beds, in waiting area), modifying in-person group healthcare activities→ eg by virtual meets, performing such activities in smaller groups
- Implement Universal Source Control Measures
 - Source control means: Covering a person's mouth and nose to prevent spread of respiratory secretions when they are talking, sneezing, or coughing
 - Using face mask or cloth face covering
 - Universal means that it is recommended for everyone in a healthcare facility irrespective of symptoms due to presence of presymptomatic and asymptomatic cases who can still spread infection
 - Respirators with an exhalation valve not recommended for source control as expired air is not filtered as hence spreads infection
- Implementing Universal Use of Personal Protective Equipment
 - In communities with **Moderate to substantial community** transmission
 - Healthcare workers should wear eye protection in addition to their facemask
 - Wear an N95 or higher-level respirator for:
 - Aerosol generating procedures
 - Surgical procedures posing higher risk for transmission (ENT surgery)
 - **Minimal to no community transmission**→ universal eye protection and respirator recommendations are optional
- Consider performing **targeted** SARS-CoV-2 testing of patients without signs or symptoms of COVID-19: like pre-admission or pre-procedure diagnostic testing
 - * In communities with moderate to sustained SARS-CoV-2 transmission
- Consider postponing elective procedures, surgeries, and non-urgent outpatient visits

- Creating a Process to Respond to SARS-CoV-2 Exposures Among HCP and others which includes
 - Notifying the health department about suspected or confirmed cases
 - Investigation and management of exposed HCP
 - Having a dedicated Contact tracing team

Slide 25: So that was general patient care. Now coming to recommended IPC practices when caring for a patient with suspected or confirmed SARS-CoV-2 infection. In addition to general patient care, one should

- Establish Reporting within and between Healthcare Facilities and to Public Health Authorities regarding COVID-19 positive cases: staff working in the hospital should be aware about patients with suspected or confirmed SARS-CoV-2 infection and facility plans for response
- Wear full PPE: Respirator/ facemask, eye protection, gloves, gowns
- For Collection of diagnostic respiratory specimens: PPE with respirator should be used
- Manage visitor access and movement within the facility: only those essential for patient care should be allowed
- Environmental infection control measures should be undertaken like **routine** cleaning and disinfection procedure
- Aerosol Generating Procedures (AGPs)

Slide 26: Aerosol Generating Procedures (AGPs)

- Procedure that generate aerosol are bronchoscopy, suctioning, endotracheal intubation, CPR, nebulization, Non-invasive ventilation etc
- Should be performed cautiously and avoided if possible
- If performed, precautions to be followed:
 - Wear full PPE (N95 or higher-level respirator must)
 - Limit number of person during procedure
 - Should ideally take place in an Airborne Infection Isolation Rooms (AIIRs)
- MDI with spacer is preferred for administration of inhaled medication over nebulisation as nebulisation generates aerosol
- Medical mask on face if child receiving oxygen therapy with nasal prong or HHHFNC

Slide 27: While performing **Intubation and ventilation, following precautions should be taken to limit aerosol generation:**

- Avoid bag and mask ventilation (viral filter/Heat and Moisture Exchanger filter)
- Most skilled member of the team should perform intubation, video-laryngoscope can help in better visualization
- Rapid sequence intubation should be done
- Cuffed endotracheal tube should be preferred
- Closed suction or in-line suction should be done. If not available, clamp ET tube rather than bagging during suction
- Neuromuscular blocking agents should be used during intubation or suction

Slide 28: **Summary**

- Follow standard precautions for care of all patients
- Follow expanded precautions depending on clinical situation
- Triaging at entry to healthcare facility
- Don full PPE if caring for a patient with suspected or confirmed COVID-19
- Avoid Aerosol Generating Procedures (AGP) if possible
- Respirator must if performing AGP

Slide 29: I have used the following references for this presentation

Slide 30: Thank you!!

