



University of Nairobi

Optimizing oxygen therapy and IPC measures in the COVID-19 pandemic

An initiative of CPHD and ETAT+ Trainers

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Introduction



Dr. Tauhida Mohammed

Transmission and patient placement



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Personal protective equipment



Dr. Fareen Musa

Correct use and sterilization of PPE



Zeddy Komen

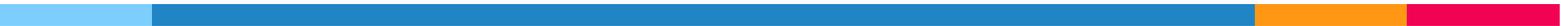
Correct use and sterilization of PPE



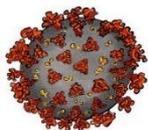
Dr. Sylvia Mwathi

Correct use and sterilization of PPE

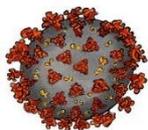
Introduction



What is COVID-19?



Coronavirus disease 2019 (COVID-19) is a respiratory tract infection caused by a newly emergent coronavirus , that was first recognized in Wuhan, China, in December 2019

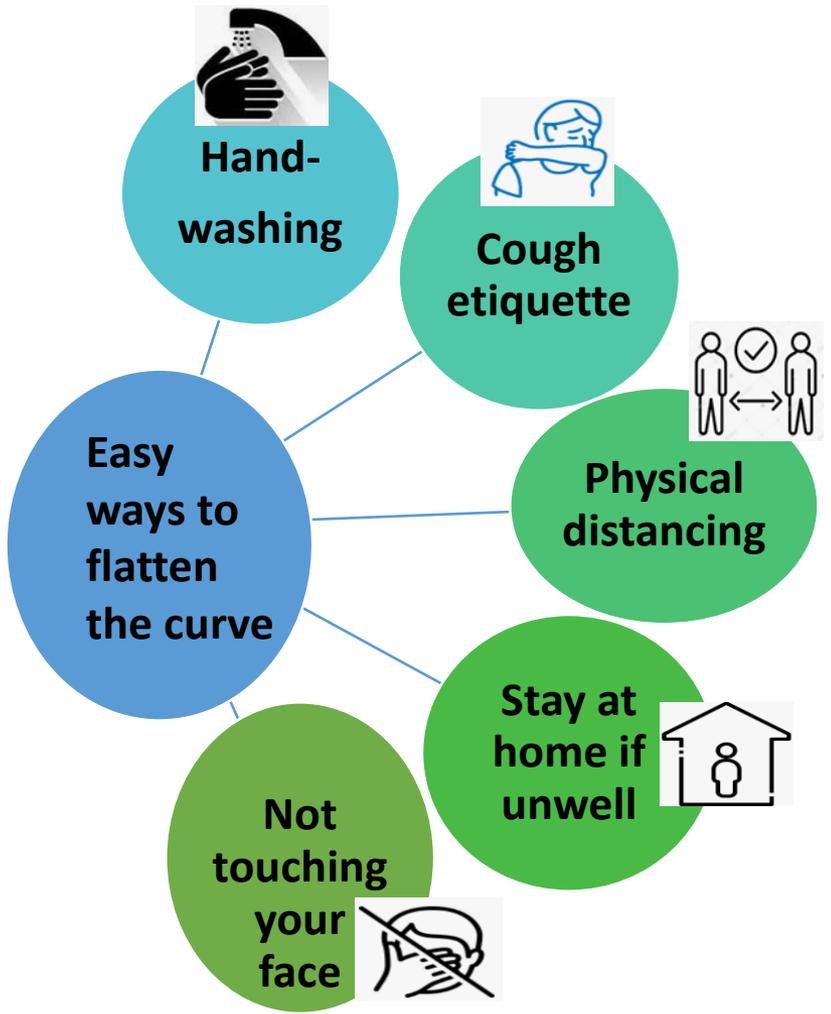
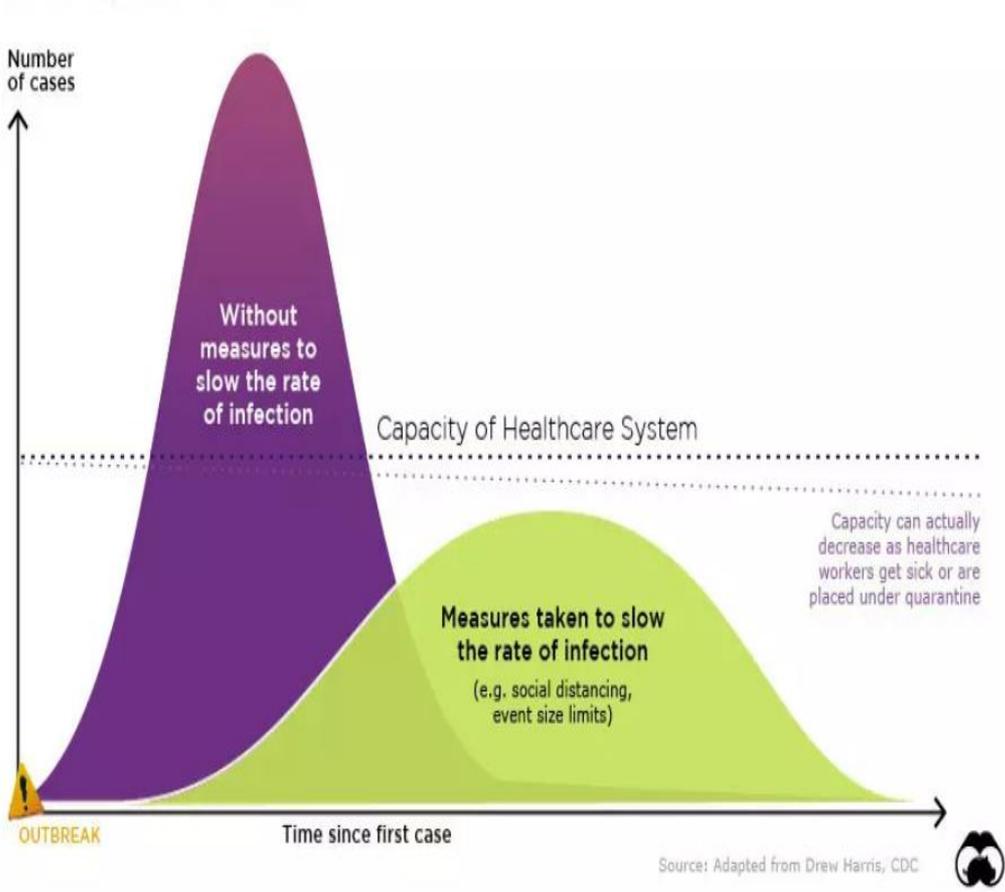


The virus that causes COVID-19 is designated as **severe acute respiratory syndrome corona virus 2 (SARS-CoV-2)**

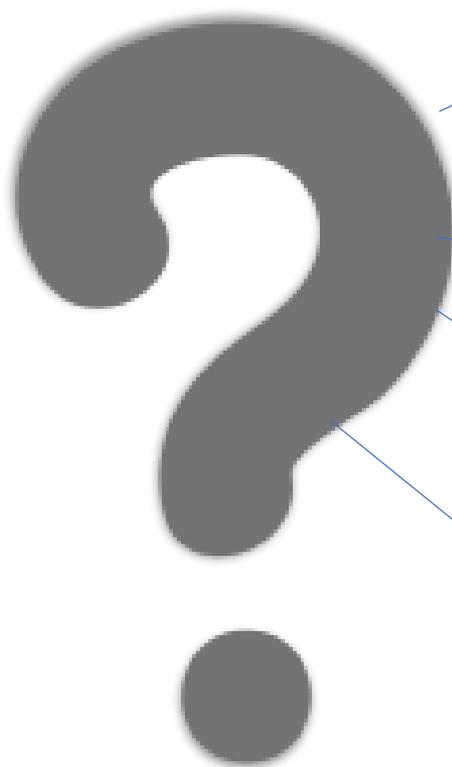


March 11, 2020 , WHO characterized COVID-19 as a **pandemic**

Flattening the COVID19 curve



How prepared are we in our facilities for more COVID-19 cases?



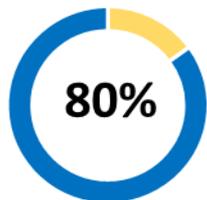
? Adequate personal protective equipment

? Healthcare workers adequately trained on IPC

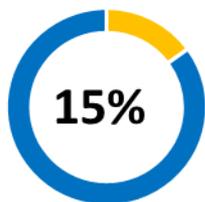
? Proper screening methods. Patient and health workers losing trust in systems leading to suboptimal functioning health systems

?health facilities adequately equipped with oxygen administration equipment eg oxygen plants, concentrators, O₂ cylinders

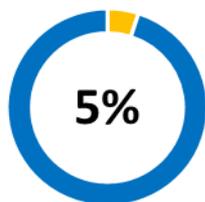
Optimizing oxygen therapy



COVID-19 patients have mild and moderate disease
Are able to go on with daily activities



COVID-19 patients have severe pneumonia and require O₂ therapy.



Develop ARDS are classified as 'critical' and require a ventilator.



Early recognition of patients who need oxygen therapy and monitoring oxygen therapy (using clinical signs & symptoms + pulse oximetry)

Optimizing supplemental O₂ to achieve target SPO₂ (90-96%)

- Using correct dose of oxygen
- Recognition of when high oxygen pressure are required.

Optimizing oxygen therapy



• **For patient who is from home requiring oxygen support** Start with Nasal prongs at standard flow rate according to age and titrate every 15-30 minutes by 0.5L/min to a max of 8l/min high flow rate until SpO₂ is 90-95%.



For a patient who is post resuscitation – Initiate oxygen support with a Non rebreather mask at 10-15l/min for all age groups to deliver FiO₂ of 80-90%.



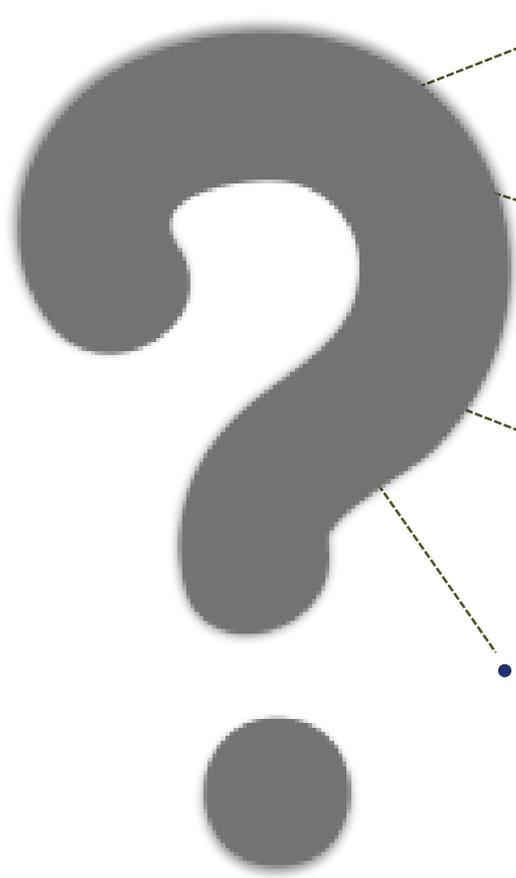
Humidification of the O₂ is indicated for those on high flow rates 4l/min with nasal prongs and when using Non Rebreather Mask



If work of breathing is still increased despite being on maximum flow with NRM and SpO₂ < 90% then **plan patient for mechanical ventilation** as soon as possible

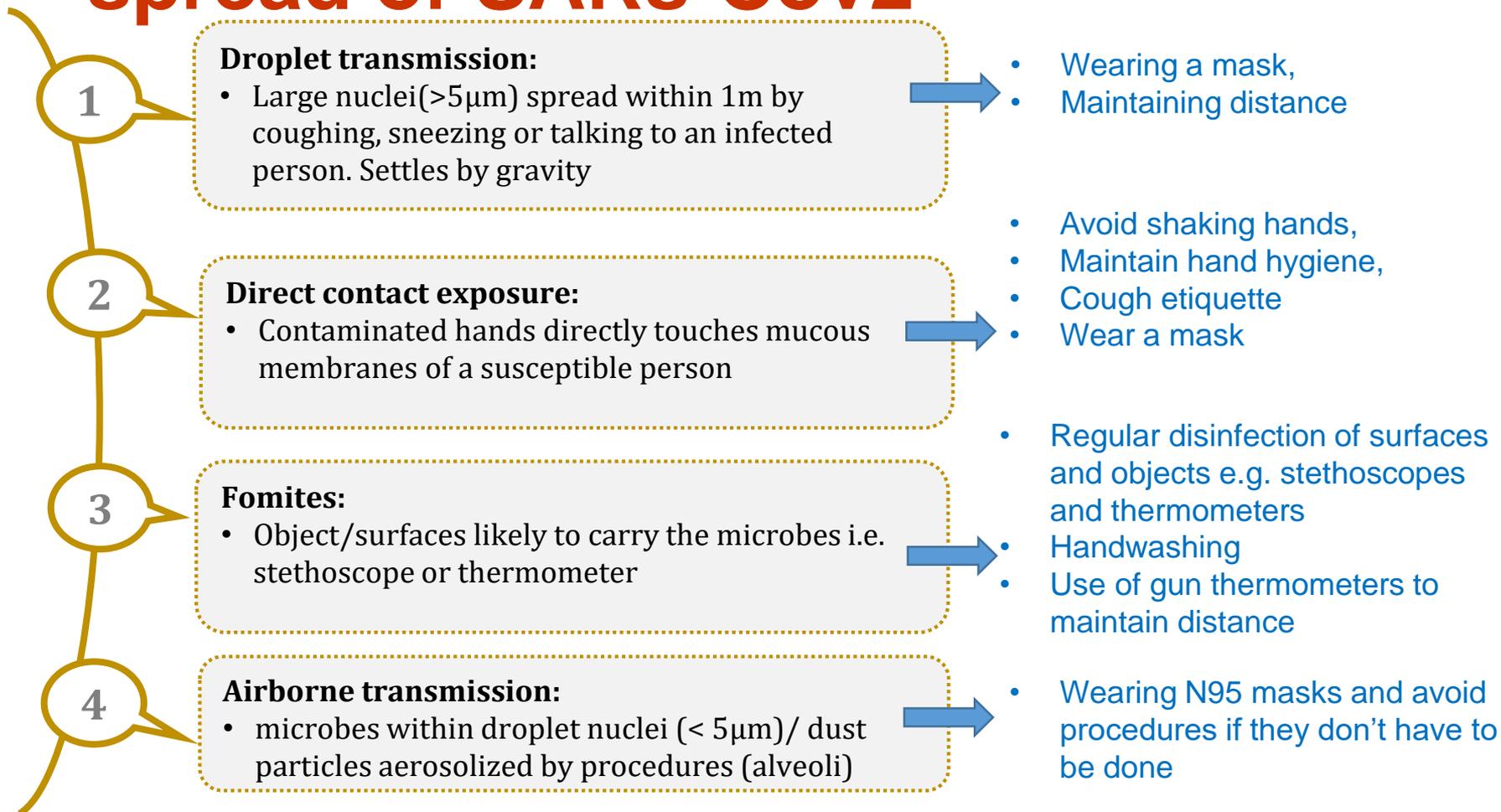
Transmission and patient placement

What is the size of SARS-COV 2 virus?



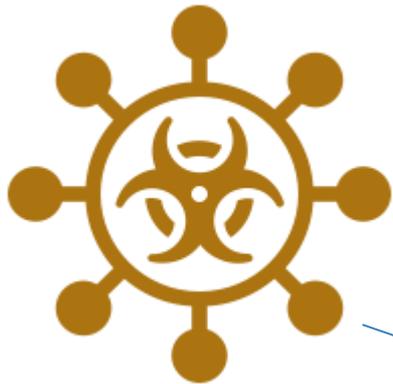
- > 5-10 μm in diameter; nasopharynx
- Virus transmission up-to 1 meter range
- Beyond that they fall mostly due to gravity¹
- However, in strong ambient air cross-flows (opening doors, moving objects), these droplets can behave like aerosols and cover a long range

Modes of transmission & stopping spread of SARs-Cov2



Infection can be spread by symptomatic or asymptomatic patients.- when unwell should be isolated to break the cycle of spread. HCWs should take IPC precautions when attending to all patients

Aerosolizing procedures



- **Airborne transmission** - Microbes within droplet nuclei, **<5µm in diameter**, travel over distances greater **>1 m**.¹
- In the context of COVID-19 airborne transmission is possible in **specific circumstances** that generate aerosols.
- These aerosol-generating procedures **stimulate coughing** e.g. tracheal intubation or cardiopulmonary resuscitation.²
- Additional **infection prevention and control** precautions.
- They should be carried out in **negative pressure room** .

Aerosolizing procedures

- Appropriate PPE.
- Use adequately ventilated rooms; **negative pressure room** 12 air changes/hr.
- Avoid unnecessary persons in the room.
- Care for the patient in same room when mechanical ventilation commences.

Aerosolizing procedures



Mechanical ventilation



Nebulization



Bronchoscopy



suctioning



Cardiopulmonary resuscitation

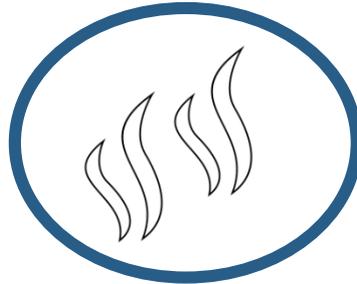


Chest physiotherapy

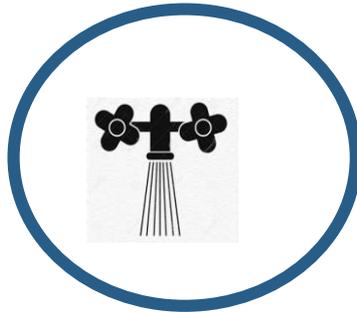
Apply airborne precautions-use of fit tested particulate respirators is a must!!

Aerosol and surface stability of SARS-CoV2 – in experimental setting

Air
3 hours



Steel
48 hours



Plastics
72 hours



Negative pressure rooms

Minimize spread of airborne infections

Trap and keep potentially harmful particles within the negative pressure room by preventing internal air from leaving the space.

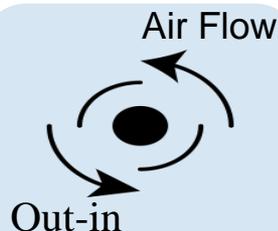
Room should be sealed to prevent excess air leakage..

The tighter the room is constructed ,the more efficient the air pressure differential can be maintained.

Exhaust fan

Located outdoors as far as possible from public areas , not less than 25 feet with discharge above the roof

Require minimum of 12 air changes of exhaust per hour.



Room pressure

Electronic monitor – wall mounted control panel ,sensor and alarms when pressurization is lost.

Negative pressure rooms in medical facilities isolate patients with infectious conditions

Case definition of COVID 19

Suspected case

- Acute respiratory illness and/or fever $>38^{\circ}\text{C}$ **AND** no known cause that fully explains the presentation **AND** a history of travel to a community with COVID-19 transmission at least **14 days** prior to symptom onset; OR
- **Any** acute respiratory illness **AND** having been in contact with a confirmed or probable COVID-19 case in the last 14 days prior to symptom onset; OR
- Severe acute respiratory illness **AND** requiring hospitalization **AND** the absence of an alternative diagnosis fully explaining the clinical presentation

Test for
COVID-19

Confirmed case

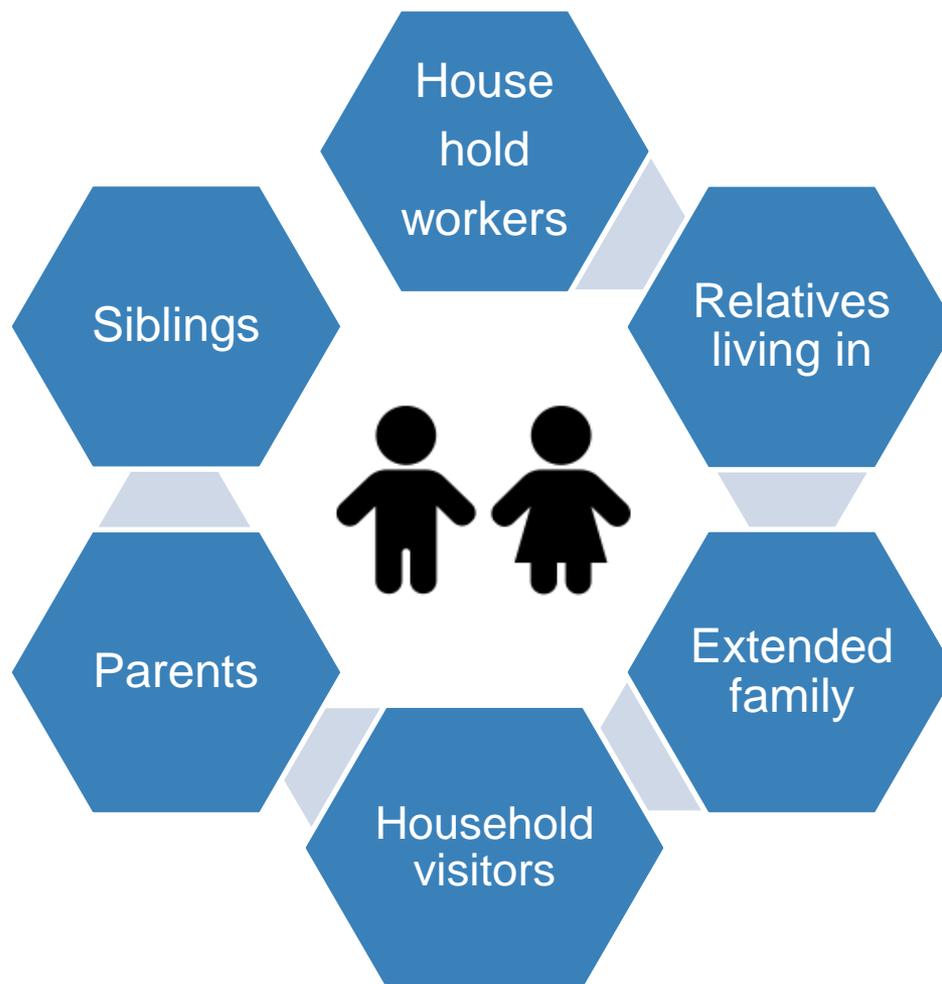
- A person with **laboratory** confirmation of COVID-19 infection, **irrespective** of clinical signs and symptoms

Probable COVID-19 cases
when results are pending

Identifying a child's household contacts

Experience from China:

- **>50%** of all patients with COVID-19 had at least one family member with the disease
- **75–80%** of all clustered infections were within families

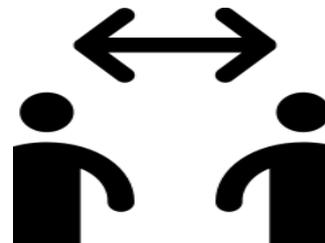


Outpatient Department – ensure safety for all Prevent spread of COVID-19

Screening point

All patients to keep 2 meter apart . All patients wash hands & wear masks; those with fever/cough (+ their caregivers) wear surgical masks. Instruct all patients on cough etiquette and hand hygiene

1.5-2 meters



Potentially Contaminated zone
Suspected COVID 19

Triage, assess & treat -
IMNCI/ETAT+

Severe pneumonia
admit respiratory
ward

Non-Severe
pneumonia admit
hoarding ward

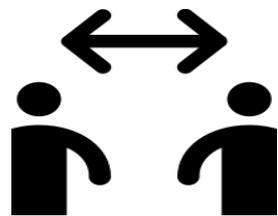
Clean zone
No fever/no cough/no
contact

Triage, assess & treat -
IMNCI/ETAT+

Admit general ward if
indicated



Preventing spread of COVID19 at outpatient department



All patients should be kept 1.5-2m apart



All patients with fever/cough(+ their caregivers) should wear surgical masks



Cough etiquette and hand hygiene for all patients



Healthcare workers should have appropriate PPE

STOP SPREAD OF VIRUS!

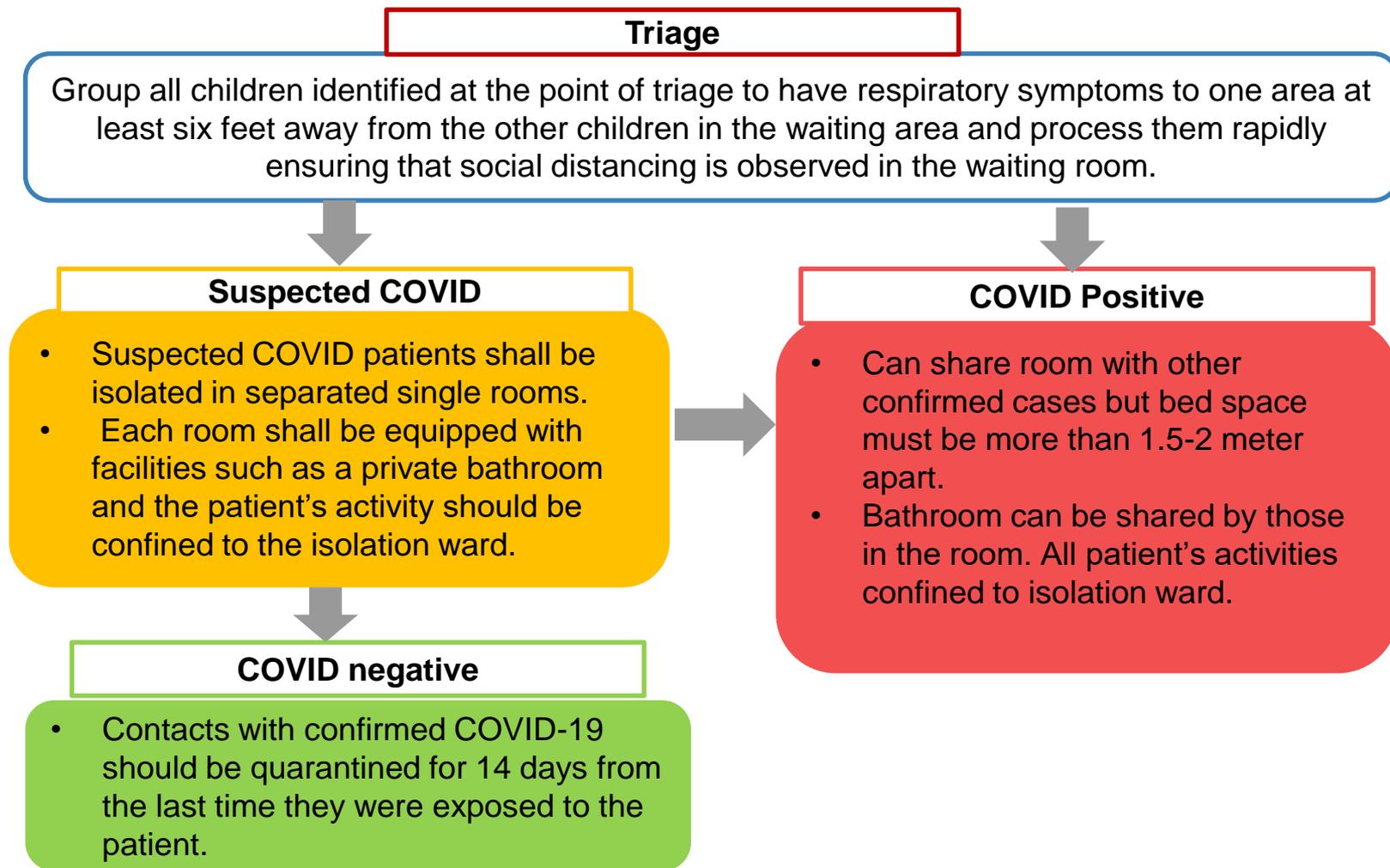
Protect others! Keep safe!

In regard to the 2 zones in outpatient the following should be observed:

- **Only patients** are allowed to enter waiting area to avoid overcrowding; for children, only one care giver. Patients must keep 1.5- 2 meter distance
- **All patients** must wear masks (surgical masks if they have fever and cough)
- **Instruct all patients** to cover nose and mouth during coughing or sneezing with tissue or flexed elbow and perform hand hygiene after contact with respiratory secretions
- **Educate patients and their families** about early identification of symptoms and essential preventative actions
- **Limited** duration in the examination room
- Clean and disinfect equipment (stethoscopes, blood pressure cuffs, pulse oximeters, and thermometers) between each patient use

All the two zones must have each independent examination room, lab, observation room and resuscitation room

Inpatient placement of patients with respiratory symptoms;



Inpatient placement of patients with respiratory symptoms

Severe pneumonia

Suspected case- admit respiratory ward
Test for COVID 19, repeat test in 24hrs if still symptomatic. Repeat test every 24hrs until asymptomatic OR PCR turns positive
stringent measures on infection prevention and control

Covid negative- admit general ward

Confirmed case- admit respiratory ward.
Repeat test on day 10 if asymptomatic.
Two negative confirmatory tests 24 hrs apart

Non- Severe pneumonia

Suspected case- test for Covid 19. Admit hoarding ward until confirmed negative

Covid negative quarantine for 2 weeks(test on day 14 of quarantine) discharge home

Confirmed case admit isolation ward- test on day 10 of admission if asymptomatic. Two negative confirmatory tests 24hrs apart

Personal Protective Equipment

Personal protective equipment

Three levels of precautions need to be handled:

1

Contact precautions: Use gloves, gowns or coveralls and aprons.

2

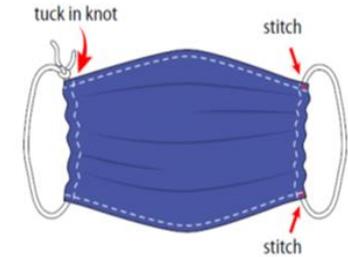
Droplet precautions: Use of surgical masks by the healthcare worker when attending to patients



3

Airborne precautions: Use of N95 masks or its equivalent especially when performing aerosol generating procedures

Cloth masks for use by the patients with no respiratory symptoms and the caregivers.



Fabric

Double layer of 100% cotton cloth, this is breathable and easy to use for making a mask at home.

Particle penetration

Reported to be high- study, 40–90% of particles penetrated the mask. Not appropriate for HCW.

Re use

Washed daily using hot water and soap and dried in the sun for approximately 5hrs

Utility

Use in public places e.g. Hospitals, supermarkets, shops, markets, matatu, buses and bodaboda



Caution

Not appropriate for use under 2 years of age, anyone who has trouble breathing ,or is unconscious and incapacitated or otherwise unable to remove mask without assistance.

Surgical masks

A loose-fitting, disposable device that creates a physical barrier between the wearer and contaminated immediate environment.

- Filters out all air reaching the mouth and nose for particles $\geq 5 \mu\text{m}$.
- Prevents inhalation of droplets and larger particles.
- Reduces person-to-person transfer of respiratory droplets



Outer layer
(water
resistant)

Middle
layer
(Filter)

Inner layer
(water
absorbent)

- The **inner layer is water absorbent** and will absorb spit or moisture.
- The **outer layer is water resistant** and blocks blood and bodily fluids from reaching the wearer's mouth and nose.



N95 mask

A respiratory protective device designed to achieve *a close facial fit* and efficient filtration of airborne particles, requires fit testing to be fully effective.

Features

Design

Use a **melted polymer** that is air blasted into layers of very small fibers

How it works

When viruses, vapor, or silica particles are caught in the fibers, they get caught in the maze. 3M adds an electrostatic charge to the material, so even smaller particles get pulled in.

Advantages

Prevents inhalation of 95% of 0.3 μm particles. Reduces person-to-person transfer of respiratory droplets.

N95 mask vs surgical mask

Surgical masks are used by health workers in non contaminated zones and by sick COVID patients.

The N95 masks are used in areas with suspected/confirmed cases and while performing AGPs.

N95 respirator mask

- Designed to block 95 -99% of aerosol particles - very small (0.3 micron) particles.
- Hydrophobic feature.
- It achieves a close facial fit and a very efficient filtration of airborne particles.
- Are not for use by public.
- Are not designed for children or people with facial hair – no tight fit!

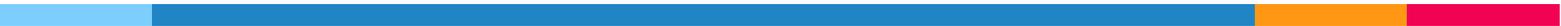


Surgical/medical mask

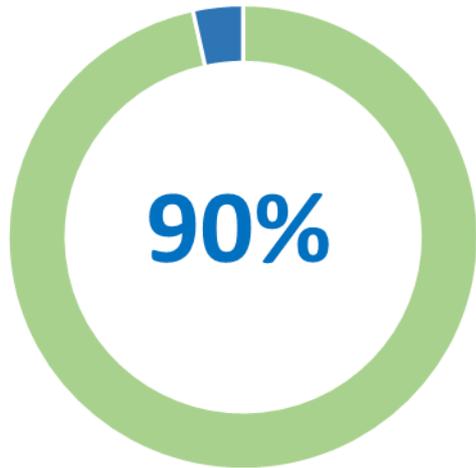
- Designed to block large particles, droplets and sprays ≥ 5 microns.
- Fluid resistant and provides the wearer protection against large droplets, splashes, or sprays of bodily or other hazardous fluids.
- The loose fitting allows leakage around the edge of the mask when user inhales.

All masks must be worn correctly and disposed correctly

Correct use and Sterilization of Personal Protective Equipment



Why should be PPEs be used correctly?



- Upto 90% of observed doffing was incorrect,
 - Doffing sequence
 - Doffing technique
 - Use of appropriate PPE.
- Common errors were
 - Doffing gown from the front,
 - Removing face shield of the mask.
 - Touching potentially contaminated surfaces and PPE during doffing.



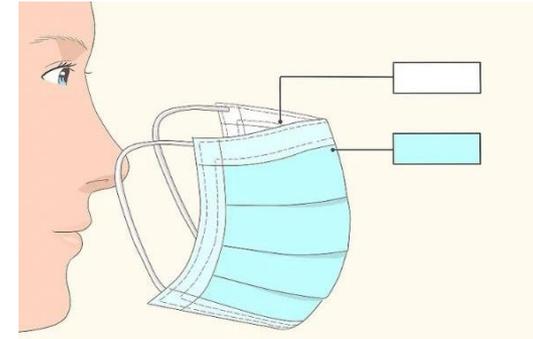
Errors during PPE doffing are common and can increase potential for contamination of the HCW's clothing or skin

Levels of Protection

Level of Protection	Location	Which PPE to use
Level 1 (COVID-19 status Unknown or Negative)	<ul style="list-style-type: none"> Screening area Pre-examination Triage General Outpatient unit Labor ward and NBU screening area 	<ol style="list-style-type: none"> Disposable Surgical masks Disposable Latex gloves Clean Work Uniform/Scrubs Disposable Surgical cap***
Level 2 (COVID-19 status suspect or positive)	<ul style="list-style-type: none"> Fever isolation area Isolation ward including ICU Non respiratory specimen examination area Imaging examination Cleaning of instruments 	<ol style="list-style-type: none"> N95 mask Disposable Latex gloves Disposable Surgical cap Clean Work Uniform/Scrubs Plastic apron Impermeable coverall Googles/face shield
Level 3 (COVID-19 status positive)	<ul style="list-style-type: none"> When staff is testing for COVID-19 When performing procedures that may splash respiratory secretions/body fluids e.g. suctioning, intubation, tracheostomy, endoscopy, surgery, autopsy. 	<ol style="list-style-type: none"> N95 mask Disposable Latex gloves Disposable Surgical cap Clean Work Uniform/Scrubs Plastic apron Impermeable coverall Googles/face shield Full face respirator protective devices Powered air purifying respirators

Donning a Surgical Mask

1. Perform hand hygiene
2. Inspect the surgical mask for tears or holes
3. Identify inside part (white part) and outer part (blue)
4. Ensure metal nose band be on the top
5. Secure loose upper straps above the ears/on crown of the head with a knot and the lower straps below the ears
6. The top of the mask should extend **above your nose**, and the bottom should extend **below your chin**.
7. Pinch or press the nose band to conform with nose bridge
8. Avoid touching your face or even the mask in use



Doffing a Surgical Mask

1. Perform hand hygiene
2. Carefully untie (or unhook from the ears) and pull away from face without touching the front.
3. Start with lower strap, hold with one hand then remove the upper strap , while inclining forward pull it away from the face and discard it safely
4. Dispose off the mask when soiled or wet
5. Perform hand hygiene



Donning the N95 Mask

1. If the N95 has a nose piece, it should be fitted on the nose with both hands
2. If the N95 doesn't have a nose piece, ensure it covers the nose, mouth and under the chin.
3. Place top strap on the crown of head the bottom strap at the base of neck
4. Perform a user seal check (done each time you put on the N95 mask).



DO NOT;

- Pinch the nosepiece with one hand. Perform a seal test
- Wear the respirator/N95 under your chin or store in scrubs pocket between patients.



N95 Masks – The Seal Test

1. Put on the mask, position top strap high at the back of the head and bottom strap below ears lying on the neck and then mold nose piece.
2. Cover the front of the respirator with both hands being careful not to disturb the position of the respirator.
3. **Positive seal check:** Exhale sharply; A positive pressure inside the respirator = no leakage
4. **Negative seal check:** Inhale deeply; If no leakage, negative pressure will make respirator cling to your face



Doffing the N95 Mask



1. Wash your hands
2. Remove the bottom strap by touching only the strap and bring it carefully over the head.
3. With the other hand, grasp the top strap and bring it carefully over the head
4. Pull the respirator away from the face without touching the front of the respirator.
5. Discard the N95 or disinfect / sterilize before storing it well ready for next use
6. Wash your hands
7. Wear a surgical mask

Sterilization of N95 masks

Decontamination should preserve integrity and filtration properties, appropriately disinfect and not harm the user.

Compromise the physical integrity of respirator components

- Microwave irradiation
- Microwave-generated steam
- Moist heat incubation

Significant loss of filtration efficiency

- Autoclave,
- 160°C dry heat,
- 70% isopropyl alcohol
- Soaking in soap and water

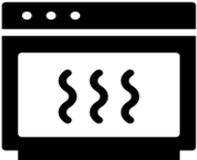
Promising

Ultraviolet germicidal irradiation (UVGI) has previously been shown to inactivate SARS-CoV-1 and preserve N95 performance after three cycles of exposure .

However one study found that increasing UVGI doses could compromise the strength of N95 respirator material and straps. Disinfection of straps may be incomplete.

Can N95 masks be disinfected for re-use?

Maintenance of filtration efficiency of N95 mask



70°Hot air oven:
96%



75%alcohol:
53%



UV C light 30min:
95%



Chlorine 5 min:
73%



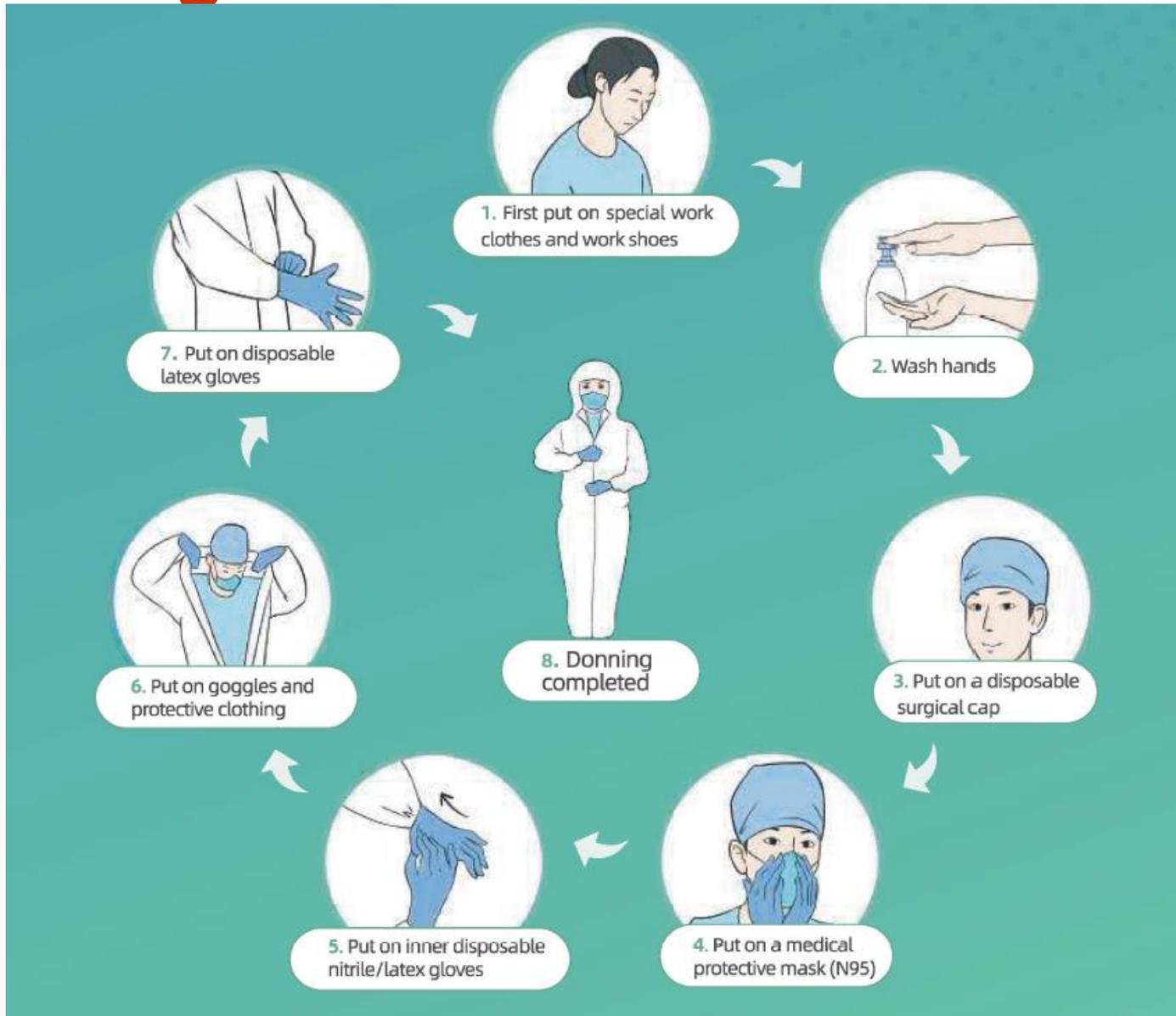
Hot water vapor
10min:
94%



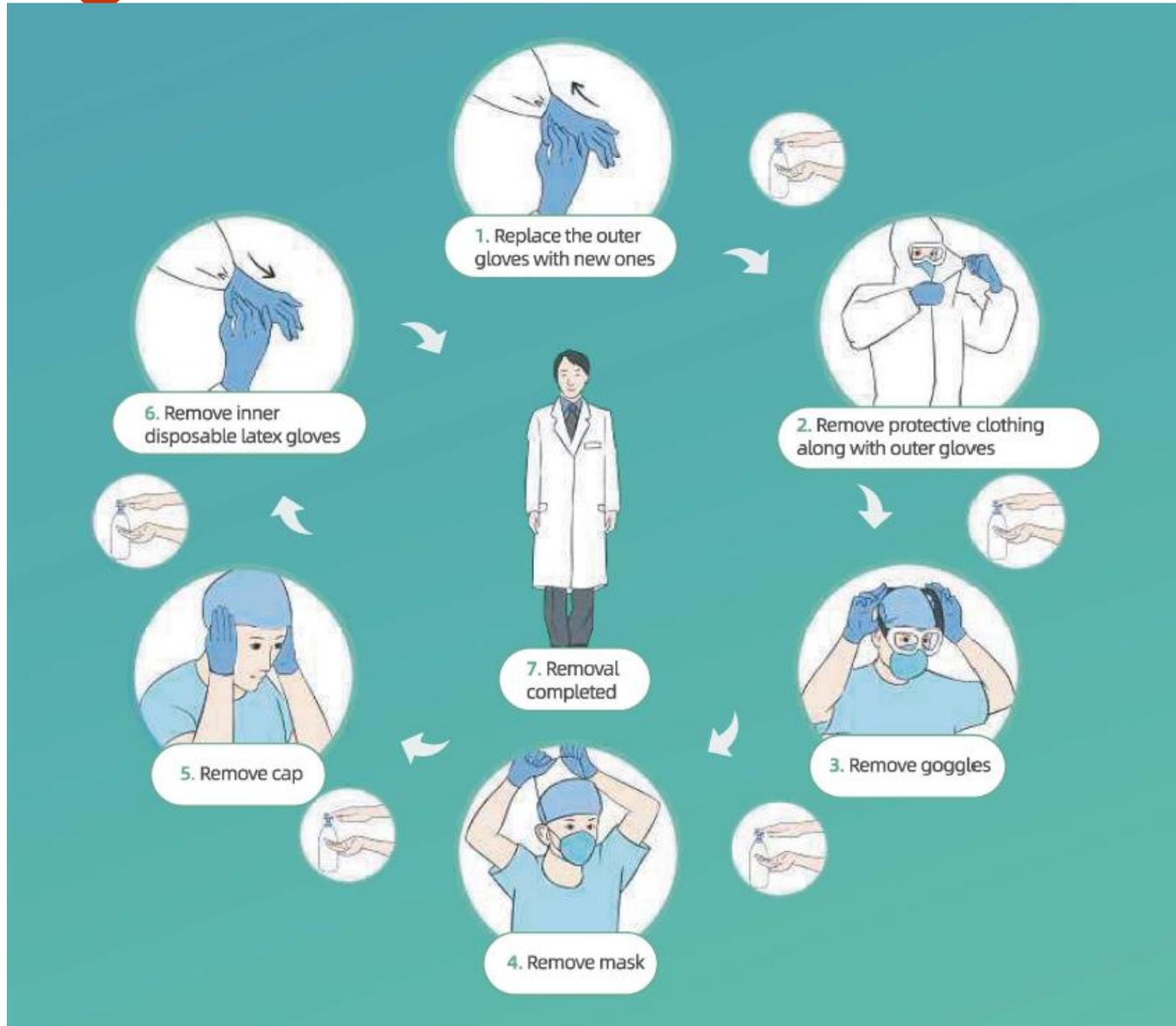
Vaporized H₂O₂:FDA
approved.

Do not use alcohol and chlorine-based disinfection methods. This will remove static charge in the microfibres in N95, reducing filtration efficiency.

Donning PPE for Level 3 Protection



Doffing PPE for Level 3 Protection



Disinfecting agents

Alcohols (60-80%)

e.g. 70% Ethyl alcohol

Spectrum of activity

- Bactericidal
- Virucidal
- Fungicidal
- Mycobactericidal

Mechanism of action

The bactericidal/ virucidal mechanism of action is dissolution (dissolving) of the cell membrane (phospholipid bilayer)



- Broad spectrum (but not sporicidal)
- Rapid action
- Nontoxic
- Non-staining, no residue
- Noncorrosive
- Low cost
- Good for disinfecting small equipment or devices that can be immersed



- Slow acting against non-enveloped viruses
- Does not remain wet rapid evaporation makes contact time compliance difficult (on large environmental surfaces)
- Affected by environmental factors:** inactivated by organic material
- Material compatibility:** can damage materials (plastic tubing, silicone, rubber, deteriorate glues) Flammable

Disinfecting agents

Chlorine releasing agents

e.g. bleach/sodium hypochlorite

Dilution 1 part of 3.5%chlorine:7 parts water=0.5%chlorine

Spectrum of activity

Bactericidal

Virucidal

Fungicidal

Mycobactericidal

Sporicidal (hypochlorites only at 5000ppm or 0.5%)

Mechanism of action

Inhibits enzymatic reactions,
Denatures proteins and inactivates
nucleic acids.¹



Hypochlorites are broad spectrum (sporicidal)
Rapid action
Nonflammable
Low cost
Widely available
Can reduce biofilms



Affected by environmental factors:
inactivated by organic material
High toxicity: can release toxic chlorine if mixed with acids or ammonia
skin and mucous membrane irritant
Material compatibility: damages fabrics, carpets
Corrosive
Leaves residue, requires rinsing or neutralization
Offensive odors
Poor stability: subject to deterioration if exposed to heat and UV

Cleaning & Disinfecting

- Always prepare and plan procedures to be done.
- Discard single use equipment immediately after use.
- Follow the safety & cleaning instructions of each product and equipment based on the manufacturers recommendation
- Ensure clear instructions on dilution concentration, application method and contact time required for each PPE.
- Change gloves and sanitize before and after every patient and in between procedures

Cleaning & Disinfecting

- During cleaning;
 1. Observe hand hygiene before and after cleaning.
 2. Wear disposable gloves.
 3. Wear eye protection when there is a potential for splash or splatter to the face.
 4. Gowns or aprons are recommended to protect personal clothing.
 5. Store cleaning chemicals in labeled, closed containers. Keep them in a secure area away from children and food.
 6. Store cleaning chemicals in a manner that prevents tipping or spilling.

Cleaning and Disinfecting Agents

Items	Recommended Agent
Apron with blood splashes (PPE)	0.5% Chlorine
Gumboots/shoes (PPE)	0.5% Chlorine
Face shields, Goggles	0.5% Chlorine
Instruments (stethoscope, thermometer suction machine, laryngoscope, BVM, pulse oximeter, oxygen ports, oxygen cylinder)	70% Alcohol
Surfaces – door handles, power switches, Beds, trolleys, chairs	0.5% Chlorine
Equipment supporting patient care (oxygen concentrators, flowmeters)	70% Alcohol

Lessons from other Pandemics

1. Plan and ensure adequate stocking of supplies/consumables.
2. Always don appropriate PPE.
3. Work from clean to dirty/highly contaminated areas.
4. Follow instructions.
5. Communication and documentation.
6. Continuous CMEs.
7. Teamwork.
8. Buddy system.
9. Involving care givers and patients in their care.
10. Enroll in relaxation activities and rest enough when away from work.

Summary



Follow the 5 key steps to kick out Coronavirus and help flatten the curve



Optimize correct Oxygen therapy use in respiratory patients to improve outcomes for these patients.



Ensure proper use of correct PPE at all levels of protection to safeguard all healthcare workers.