Principles of Environmental Health in the Operating room in the Coronavirus disease(COVID-19)

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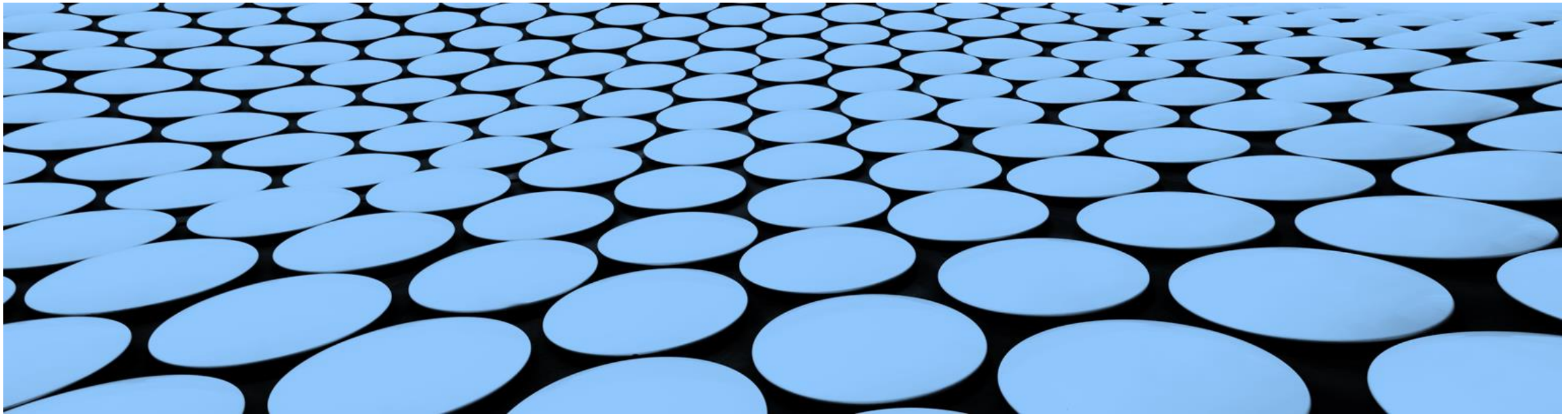

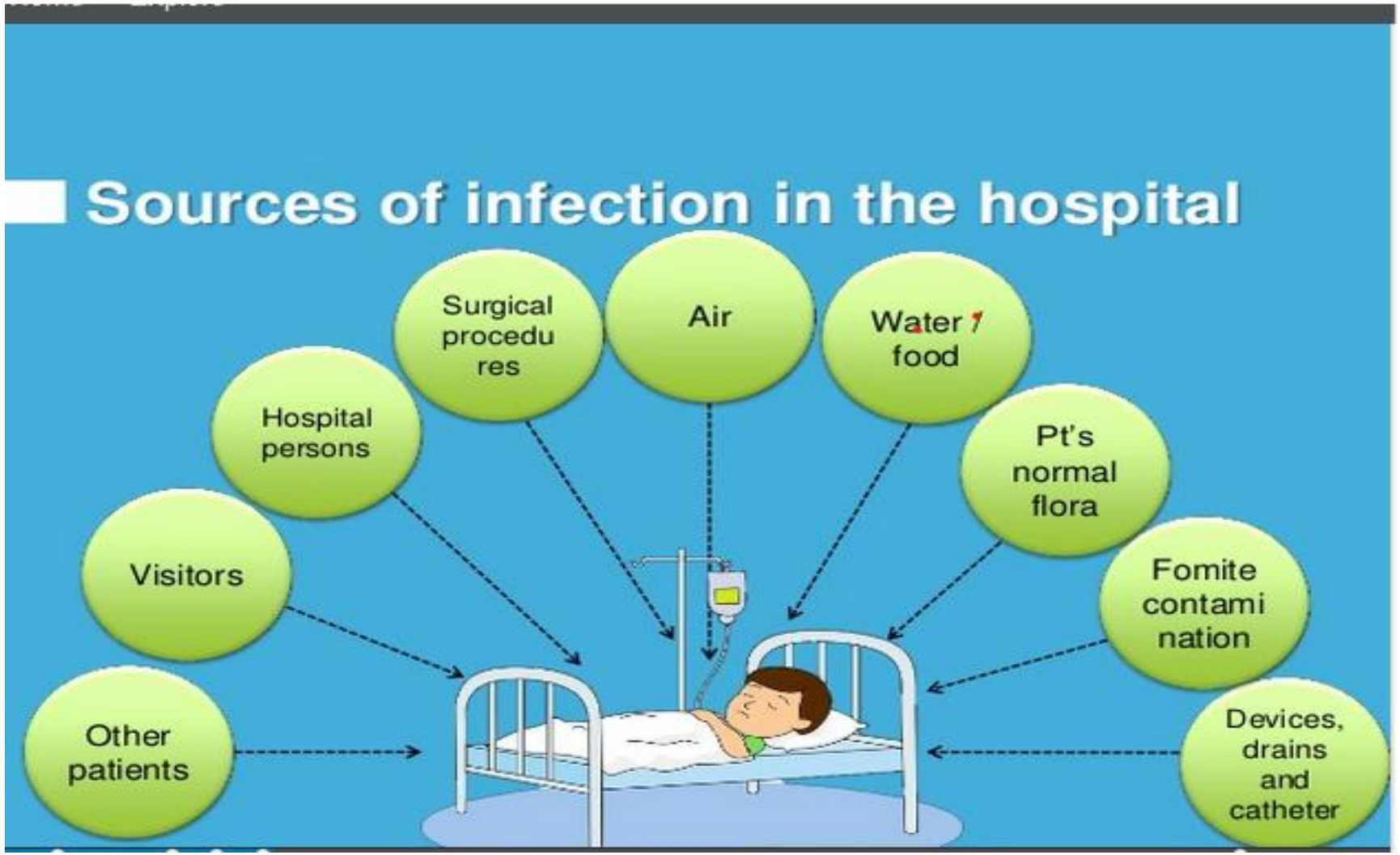
Sources of infection in the hospital
Surgical procedu res
Air
Water / food
Hospital persons
Pt's normal flora
Visitors
Fomite contami nation
Other patients
Devices, drains and catheter

COVID-19 virus be transmitted:

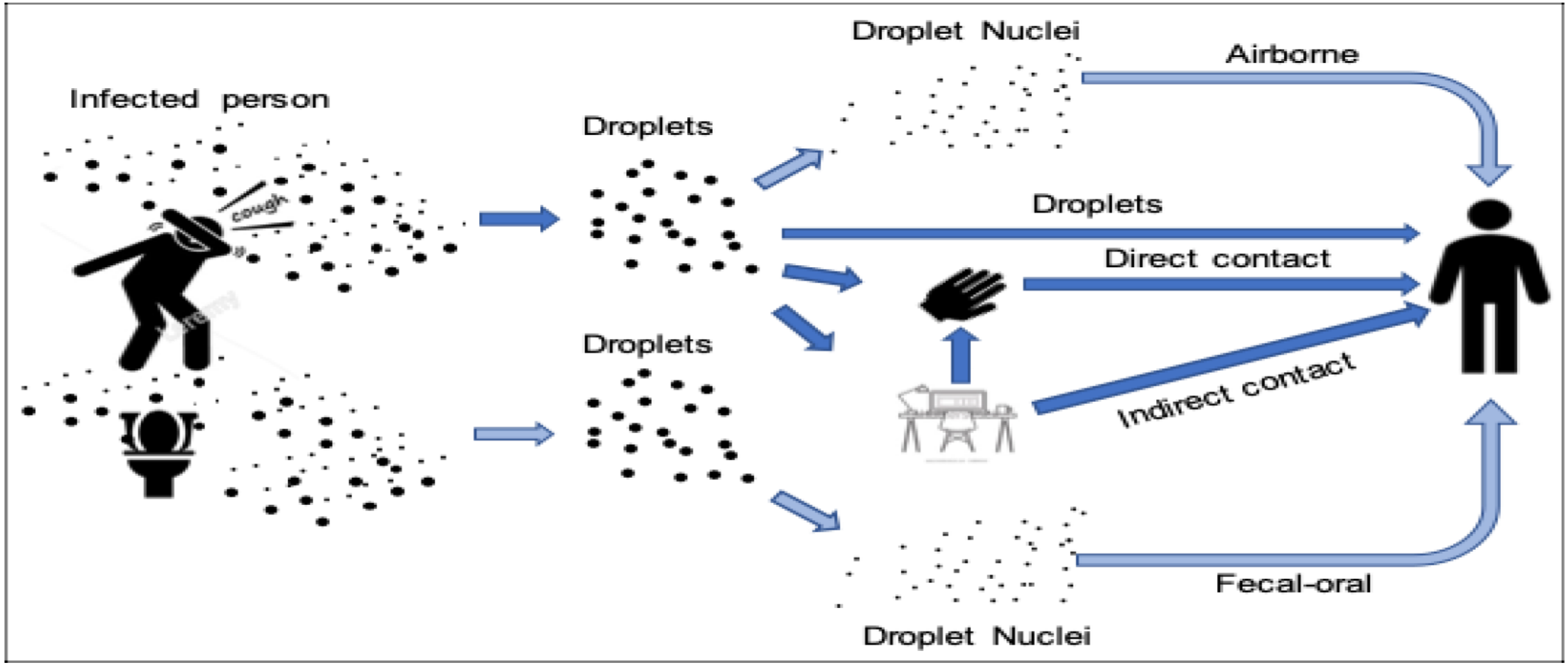

Figure 1. WHO reported exposure mechanisms of COVID-19 SARS-CoV-2 droplets (dark blue colour). Light blue colour: airborne mechanism that is known from SARS-CoV-1 and other flu, currently there is no reported evidence specifically for SARS-CoV-2 (figure: courtesy Francesco Franchimon).

COVID-19 virus be transmitted:

- **Droplets:**
- close contact (within 1 m) of someone with respiratory symptoms (e.g. coughing or sneezing)
- mucosae (mouth and nose) or conjunctiva (eyes) exposed to potentially infective respiratory
- **direct contact with infected people** and **indirect contact with surfaces** in the immediate environment or with objects used on the infected person (e.g. stethoscope or thermometer,….)

Airborne transmission is different from droplet transmission as it refers to the presence of microbes within droplet nuclei. Droplet nuclei are generally considered to be particles <5µm in diameter that can remain in the air for longer periods of time and can be transmitted to others over distances greater than 1 metre. Although Airborne transmission of the COVID-19 virus is possible under circumstances and settings where aerosol generating procedures (AGPs) are performed

AIRBORNE PRECAUTIONS

- Some AGPs (aerosol generating procedures)have been associated with an increased risk of transmission of coronaviruses (SARS-CoV-1, SARS-CoV-2 and MERS-CoV):

- open suctioning of airways
- sputum induction
- cardiopulmonary resuscitation((**CPR**))
- endotracheal intubation and extubation
- non-invasive ventilation (e.g., BiPAP, CPAP)
- bronchoscopy
- manual ventilation

The importance of prevention of transmission COVID 19 in the operating room

- Lei et al. studied 34 patients who underwent elective surgeries during the incubation period of COVID-19 at 3 hospitals.
- All their patients developed COVID-19 pneumonia shortly after surgery.
- 44% of patients needed intensive care postoperatively and the mortality rate was 20%. Five of these surgeries were conducted in orthopedic specialist areas.

- Guo X et al. showed that 26 orthopedic surgeons got infected with COVID-19 in 3 hospitals in Wuhan.
- It is important to understand that aerosols can be generated either by surgery or by the respiration of the patient
- ENT, Neurosurgery, and Ophthalmology surgeons are at risk from both types of aerosols while orthopedic surgeons are exposed to high levels of surgical aerosol but a lower risk of respiratory aerosol

The importance of prevention of transmission COVID 19 in the operating room

- Hart mentions that the operation room might be a viral lab in a wind tunnel
- Writing about orthopedic surgery. he mentions that power tools, hammers, and other instruments spread a lot of material around.

- Even though we do not know about the concentration of COVID 19 in blood and muscle, research into the airborne transmission of SARS and MERS makes it possible that transmission is likely

The importance of prevention of transmission COVID 19 in the operating room

Aerosols have been shown to spread from 5 to 7 m during orthopedic surgery. Hip replacement surgery can cause a spread of aerosol from 8 to 9 m

- In trauma and orthopedic surgical procedures, the use of power tools, such as electrocautery, bone saws, reamers, and drills, releases aerosols increasing the risk of virus spread.

IMPORTANCE OF VENTILATION IN COVID 19

IMPORTANCE OF VENTILATION IN COVID 19

- Environmental and engineering controls play a key role in aiming to reduce the concentration of infectious respiratory aerosols (i.e. droplet nuclei)

- Environmental and engineering controls include:
- standards for adequate ventilation according to specific areas in health-care facilities,
- adapted structural design,
- spatial separation,
- as well as adequate environmental cleaning.

- There are three basic criteria for the ventilation:

- • *ventilation rate:* the amount and quality of outdoor air provided into the space;
- • *airflow direction:* the overall airflow direction in a building and between spaces should be from clean-to-less clean zones;
- • *air distribution or airflow pattern:* the supply of air that should be delivered to each part of the space to improve dilution and removal of airborne pollutants generated in the space

IMPORTANCE OF VENTILATION IN COVID 19

- There are three methods that may be used to ventilate spaces within health-care facilities:
- natural, mechanical and hybrid (mixed-mode) ventilation.
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IMPORTANCE OF VENTILATION IN COVID 19

- When AGPs (aerosol generating procedures)are not performed, adequate ventilation is considered to be 60 litres/second per patient (L/s/patient) for naturally-ventilated areas or 6 air changes per hour (ACH) (equivalent to 40 L/s/patient for a 4x2x3 m3 room)
- For areas where AGPs(aerosol generating procedures) are performed:
- AGPs should be performed in rooms equipped with negative pressure ventilation systems, according to airborne precautions.

IMPORTANCE OF VENTILATION IN COVID 19

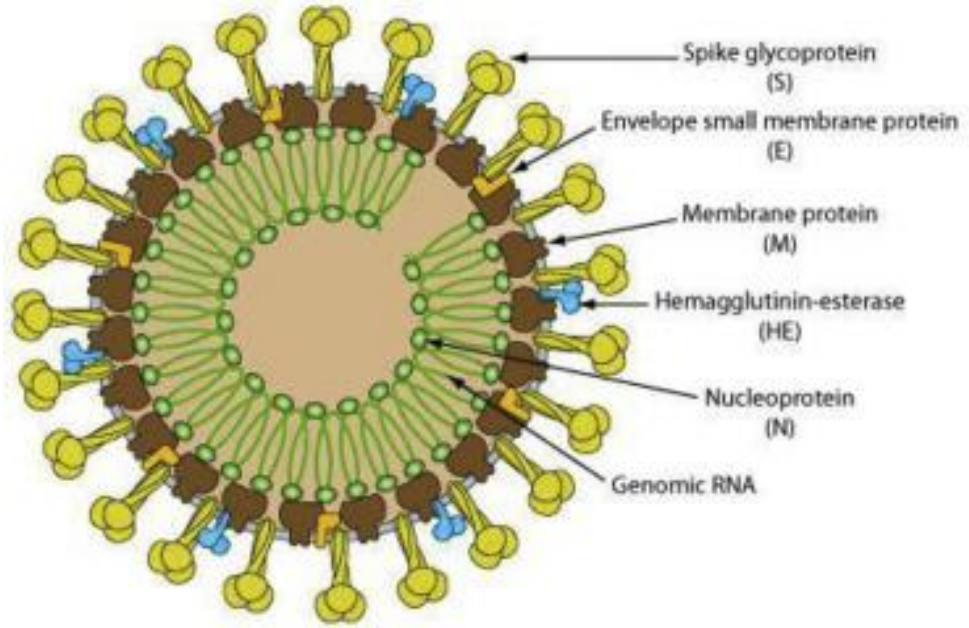
- Naturally ventilated areas Health-care facilities using natural ventilation systems should ensure that contaminated air exhaust directly outdoor, away from air-intake vents, clinical areas, and people.
- The recommended average natural ventilation rate is 160 L/s/patient.
- The application of natural ventilation depends on favorable climate conditions. When natural ventilation alone cannot satisfy the recommended ventilation requirements, alternative ventilation systems, such as a hybrid (mixed-mode) should be considered.

IMPORTANCE OF VENTILATION IN COVID 19

- Mechanically ventilated areas In health-care facilities where a mechanical ventilation system is available, negative pressure should be created to control the direction of airflow. The ventilation rate should be 6-12 ACH(**Air changes per hour**) (e.g. equivalent to 40-80 L/s/patient for a 4x2x3 m3 room), ideally 12 ACH for new constructions
- operating rooms that were built to applicable design code should already have a high ventilation rate (15-20 ACH) and their doors should always remain closed during procedures
- For health-care facilities without adequate natural or mechanical ventilation, the following approaches can be considered in consultation with an environmental engineer

Cleaning and disinfecting surfaces

CLEANING AND DISINFECTING SURFACES



- Like other coronaviruses, SARS-CoV-2 is an enveloped virus with a fragile outer lipid envelope that makes it more susceptible to disinfectants compared to non-enveloped viruses such as rotavirus, norovirus and poliovirus.

CLEANING AND DISINFECTING SURFACES

- Studies have evaluated the persistence of the COVID-19 virus on different surfaces.
- One study found that the COVID-19 virus remained viable up to 1 day on cloth and wood,
- up to 2 days on glass, 4 days on stainless steel and plastic, and up to 7 days on the outer layer of a medical mask. Another study found that the COVID-19 virus survived 4 hours on copper, 24 hours on cardboard and up to 72 hours on plastic and stainless steel.
- The COVID-19 virus also survives in a wide range of pH values and ambient temperatures but is susceptible to heat and standard disinfection methods.
- These studies, however, were conducted under laboratory conditions in absence of cleaning and disinfection practices and should be interpreted with caution in the real-world environment.

CLEANING AND DISINFECTING SURFACES

- the disinfectant concentration and contact time are also critical for effective surface disinfection. Therefore, a chemical disinfectant, such as chlorine or alcohol, should be applied after cleaning to kill any remaining microorganisms.

CLEANING AND DISINFECTING SURFACES

- **The use of chlorine-based products**
- Hypochlorite-based products include liquid (sodium hypochlorite), solid or powdered (calcium hypochlorite) hypochlorous acid (HOCl) is active as the antimicrobial compound. and is effective against several common pathogens at various concentrations
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HYPOCHLORITE EFFECTIVE

concentration	effective against
0.05% (500 ppm)	rotavirus
0.5% (5000 ppm)	*C. auris* and *C. difficile*
0.1% (1000 ppm)	COVID-19
0.5% (5000 ppm)	blood and body fluids large spills (i.e. more than about 10mL)

alcohol with 70%-90% concentration may be used for surface disinfection

contact time of a minimum of 1 minute is recommended for ethanol, chlorine-based products and hydrogen peroxide ≥0.5%

CLEANING AND DISINFECTING SURFACES

- In indoor spaces spraying or fogging (also known as fumigation or misting) is not recommended for COVID-19
- It is ineffective in removing contaminants outside of direct spray zones and due to adverse health effects
- If disinfectants are to be applied, this should be done with a cloth or wipe that has been soaked in disinfectant

REGARDING THE TYPE OF SURFACES AND FREQUENCY OF CLEANING

Table 3. Health-care setting: Recommended frequency of cleaning of environmental surfaces, according to the patient areas with suspected or confirmed COVID-19 patients.

Patient area	Frequency [a]	Additional guidance
Screening/triage area	At least twice daily	• Focus on high-touch surfaces, then floors (last)
Inpatient rooms / cohort – occupied	At least twice daily, preferably three times daily, in particular for high-touch surfaces	• Focus on high-touch surfaces, starting with shared/common surfaces, then move to each patient bed; use new cloth for each bed if possible; then floors (last)
Inpatient rooms – unoccupied (terminal cleaning)	Upon discharge/transfer	• Low-touch surfaces, high-touch surfaces, floors (in that order); waste and linens removed, bed thoroughly cleaned and disinfected
Outpatient / ambulatory care rooms	After each patient visit (in particular for high-touch surfaces) and at least once daily terminal clean	• High-touch surfaces to be disinfected after each patient visit • Once daily low-touch surfaces, high-touch surfaces, floors (in that order); waste and linens removed, examination bed thoroughly cleaned and disinfected
Hallways / corridors	At least twice daily [b]	• High-touch surfaces including railings and equipment in hallways, then floors (last)
Patient bathrooms/ toilets	Private patient room toilet: at least twice daily Shared toilets: at least three times daily	• High-touch surfaces, including door handles, light switches, counters, faucets, then sink bowls, then toilets and finally floor (in that order) • Avoid sharing toilets between staff and patients

[a] Environmental surfaces should also be cleaned and disinfected whenever visibly soiled or if contaminated by a body fluid (e.g., blood); [b] Frequency can be once a day if hallways are not frequently used.

ENVIRONMENTAL SURFACES IN HEALTH-CARE SETTINGS

- include furniture and other fixed items inside and outside of patient rooms and bathrooms, such as tables, chairs, walls, light switches and computer peripherals, electronic equipment, sinks, toilets as well as the surfaces of non-critical medical equipment, such as blood pressure cuffs, stethoscopes, wheelchairs and incubators .....
- Therefore, these surfaces, especially where patients with COVID-19 are being cared for, must be properly cleaned and disinfected to prevent further transmission.

The importance of prevention of transmission COVID 19 in the operating room

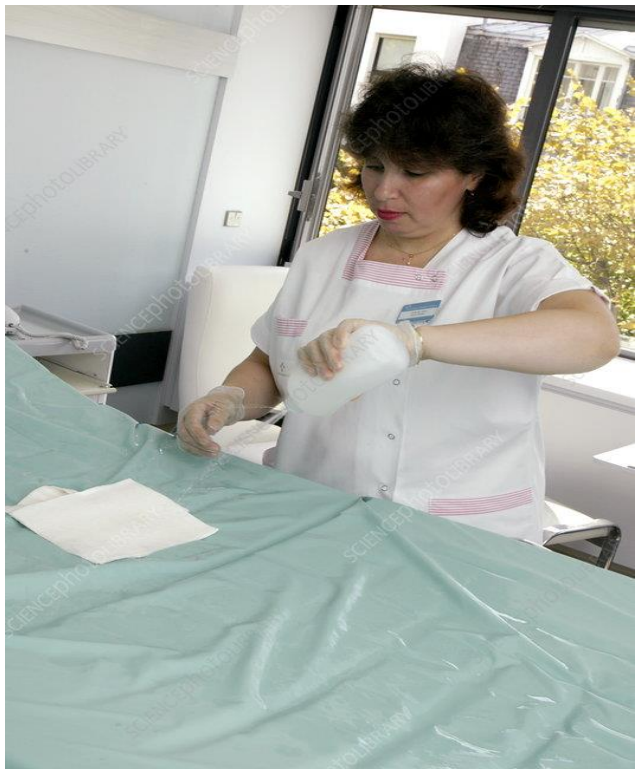
- Operating room must be disinfected between surgeries. But the disinfecting personnel should enter the Operating room only after enough air changes have occurred to remove infectious particles .
- If possible, no other surgery should be carried out in the same OR for the day, and Operating room disinfected with UV light. The instruments sent to the sterilization unit must be labeled and the staff in the unit must be made aware of the COVID status of the case, and must handle the instruments while wearing a full PPE

The importance of prevention of transmission COVID 19 in the operating room

- Provide one hour between procedures for patient transfer and cleaning and decontamination of all surfaces, screens, keyboard, computers, cables, monitors, anesthesia machines, and furniture
- Leave the room prepared for the next procedure.
- Change the whole circuit, the filter, the soda lime, and disinfect the anesthesia machine, as well as the soda lime compartment after each surgery
- Thorough cleaning of the equipment and furniture of the operating room, using PPE (n95 masks, face shield / goggles, aprons and gloves)

The importance of prevention of transmission COVID 19 in the operating room

- Discard all PPEs in the infectious waste.
- Discard all unused items from the medicine tray and airways car, since they should be considered contaminated.
- All materials and instruments should be sent to the purge inside large plastic boxes with the lid completely closed and with written identification that is easy to be seen by the team of the Material and Sterilization Center
- The soda-lime and filters are exchanged after each case. Disposable airway equipment is to be used.
- Air exchange cycles should be increased whenever possible to ≥ 25 exchanges/h between surgeries



use a new cloth to clean each patient bed

Use fresh cloths at the start of each cleaning session

Equipment used for isolation areas separated from other equipment.
detergent and/or disinfectant solutions must be discarded after each use in areas with suspected/confirmed patients with COVID-19.

- Ultraviolet germicidal irradiation (UVGI)UVGI has been proposed as a supplemental air-cleaning measure, however, currently there is limited evidence of its effectiveness in preventing respiratory pathogen transmission in health-care facilities.
- In addition, there are concerns about potential adverse effects because UVGI may be absorbed by the outer surfaces of the eyes and skin

THE LAST LETTER

- COVID-19 emphasizes the importance of accurate and reasonable use of financial and human resources. Maintaining manpower is vital. Efforts should be made to minimize infection among surgeons and hospital staffs.


Bright days are on the way
Thank you