COVID-19 - Considerations for Safe Chest Drain Management

General risks for cross-contamination in healthcare settings

Transmission of COVID-19 is primarily through droplet spread. Whether propelled by sneezing, coughing, talking, splashing, flushing or some other process[i] (Table 1), aerosols, an over-arching term, include a range of particle sizes. Those droplets larger than 5-10 millionths of a meter [µm] fall to the ground within seconds or impact on another surface, without evaporating. They can travel about 1m to 2m in the air, but do not stay suspended. The smaller droplets that remain suspended in the air evaporate very quickly (< 1/10 sec in dry air), leaving behind particles consisting of proteins, salts and other things left after the water is removed, including suspended viruses and bacteria. These airborne particles may travel greater distances and be inhaled, increasing the risk of transmission.[i] Droplets may cause direct transmission of coronavirus from close contact or contribute to surface contamination.

SARS-CoV-2 can survive in aerosols and on surfaces for several hours according to a new study from National Institutes of Health, CDC, UCLA and Princeton University published in the New England Journal of Medicine.[ii] The scientists found that the virus was detectable in aerosols for up to 3 hrs., up to 24 hrs. on cardboard and up to 48-72 hrs. on plastic and stainless steel. Noticeably, the virus titer/concentration was going down within hours significantly (from $10^{3.7}$ to $10^{0.6}$ $TCID_{50}$ per milliliter of medium, less than 0.1% of the starting virus material after 72 hrs. on plastic). "We still don't know how high a concentration of viable SARS-CoV-2 is needed in practice to infect a human being, though this is something we are looking to model in the future", co-author Dylan Morris said.[iii] The current scientific consensus is that most transmission via respiratory secretions happens in the form of large respiratory droplets rather than small aerosols.[iv]

Aerosol generating events
• Coughing/sneezing • NIV or positive pressure ventilation with inadequate seal* • High flow nasal oxygen (HFNO) • Delivery of nebulised/atomised medications via simple face mask • Cardiopulmonary resuscitation (prior to intubation) • Tracheal suction (without a closed system) • Tracheal extubation
Procedures vulnerable to aerosol generation
• Laryngoscopy • Tracheal intubation • Bronchoscopy/Gastroscopy • Front-of-neck airway (FONA) procedures (including tracheostomy, cricothyroidotomy)

*The reliability of seal is greatest with tracheal tube>supraglottic airway>face mask

Table 1: Aerosol generation during airway management[i]

The CDC recommends that all health care personnel, who enter the room of a patient with known or suspected COVID-19 (persons under investigation), should adhere to Standard, Contact, and Airborne Precautions.[v] See the CDC's Interim Infection Prevention and Control Recommendations for Patients with Confirmed 2019 Novel Coronavirus (2019-nCoV) or Persons Under Investigation for 2019-nCoV in Healthcare Settings for detailed recommendations.

Risks during application of chest drains

It cannot be ruled out that air or fluid drained from COVID-19 patients contains virus particles. However, it appears extremely unlikely that aerosols that could develop at pulmonary air leaks could travel over 2 meters through a chest drainage system (chest tube, chest drain tubing and the chest drain unit) without impacting the surrounding surface at some point. However, in case that virus particles make it to the chest drain unit, there is a possibility that they are delivered into the environment as all chest drain systems, conventional analogue and digital ones, have some sort of venting for positive pressure compensation. There are, however, differences how they release air into the environment.

Thopaz / Thopaz+

When the Thopaz⁺ pump is in use, surgical fluids, gases, bodily fluids or infectious materials are pulled through the chest tube via the suction tubing (Image 1, 1.1) directly into the canister. The pump is protected by a hydrophilic overflow and bacteria protection filter in the canister (Image 1, 2.1) to prevent cross contamination.

The 3D-structure Porex protection filter attracts aqueous solutions and swells immediately by closing the pores, when in contact with any liquid. It is made of Polyethylene (PE), with an average pore size between 18-40 µm. The pump draws filtered air from the canister and emits it to the ambient air via the exhaust (Image 1, 3.1).

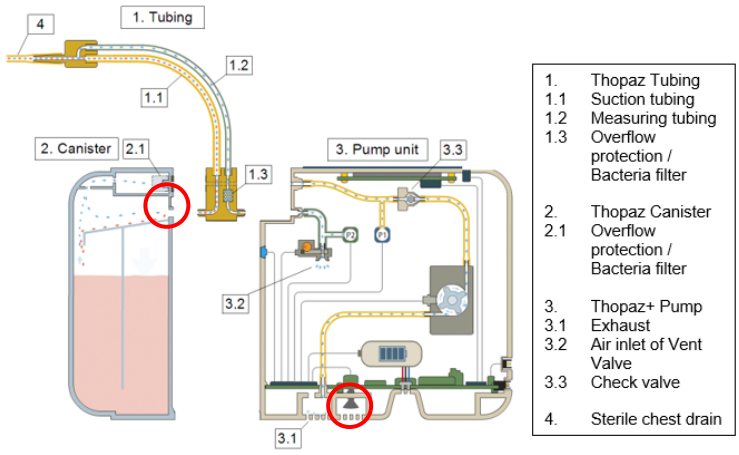


Image 1: Thopaz System

The Thopaz/ Thopaz+ system has been designed with the positive pressure valve located at the side of the canister facing the pump (Image 1, 2.), so that air will be directed towards the pump when a patient should cough.

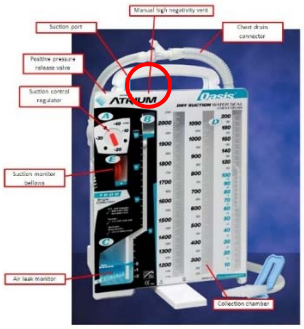
The combination of Thopaz tubing, Thopaz canister and protection filter prevents droplets and liquids from entering the device and subsequently the environment.[vi] However, filtering out of all virus particles is not guaranteed.

Recommendations for infection prevention

1. Follow standard hygiene guidelines.
2. After each use, Thopaz canister and tubing must be disposed, and the pump must be cleaned and disinfected. It is advised to pay close attention to the bottom part of the pump and the area below the exhaust port. Use disinfectant proven to be effective against viruses as SARS-CoV-2, e.g. recommended by EPA.[vii]
   After treating COVID-19 patients, a sensible precaution may be to wait for 3 days before applying the Thopaz+ device on the next patient, even though it seems highly unlikely that viable virus particles exit the device.

Traditional chest drains

On traditional analogue chest drain systems, the positive pressure valve is located on the top of the device. These valves are activated automatically when patients cough so that air, which might contain virus particles, is pushed directly in the environment.



[i] Consensus statement: Safe Airway Society principles of airway management and tracheal intubation specific to the COVID-19 adult patient group

[ii] Van Doremalen N, Bushmaker T, Morris DH, Holbrook MG, Gamble A, Williamson BN, et al. Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1. New England Journal of Medicine. 2020 Mar 17;0(0):null. https://www.nejm.org/doi/full/10.1056/NEJMc2004973

[iii] https://www.livescience.com/amp/coronavirus-can-spread-as-an-aerosol.html

[iv] https://www.livescience.com/how-long-coronavirus-last-surfaces.html

[v] https://www.cdc.gov/coronavirus/2019-ncov/infection-control/control-recommendations.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fhcp%2Finfection-control.html

[vi] Internal Validation Report, 2008

[vii] https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2
Of those, the following are recommended for use on plastics for Medela Healthcare products:

- Oxivir® TB, Oxivir® 1 from Sealed Air Diversey Care
- Virex® II 256, from Sealed Air Diversey Care
- Clorox Healthcare® Bleach Germicidal Cleaners and Wipes from Clorox

Non-EPA listed disinfectants recommended and tested by Medela are:

- mikrozid® AF wipes from Schülke&Mayr AG
- CaviWipes from Metrex
- Incidin® Foam from Ecolab Healthcare
- Hexaquart® plus and Meliseptol® rapid from B. Braun Melsungen AG
- perform® from Schülke&Mayr AG