

Is Oxygen Humidification with Sterile Water Essential to Prevent Risk of Infection?

The recent mucormycosis infection epidemic has raised an alarm about the risk of this fungal infection due to improper oxygen humidification and poor maintenance of humidifiers. Indian Council of Medical Research issued evidence-based guidelines for its management and recommended *the use of clean, sterile water for humidifier during oxygen therapy*.^[1] Furthermore, the Director of Public Health, Department of Health, Medical and Family Welfare, Government of Telangana, India, also issued a guideline for the prevention of mucormycosis in COVID-19 patients mentioning the use of clean, sterile water for humidifiers during oxygen therapy.^[2] A minister in Karnataka blamed the use of tap water in the humidifier for oxygen therapy as the main cause for the increasing number of mucormycosis infections during the COVID-19 pandemic.^[3] However, there is a pertinent question that do we have sufficient scientific evidence to mandate the use of sterile water for oxygen humidification in resource-constraint countries like India? Nevertheless, ultimately, this additional cost has to be borne by the poor patient only.

The Centers for Disease Control and Prevention (CDC) guidelines for the prevention of nosocomial pneumonia (1997) recommended a heated bubble humidifier for the prevention of nosocomial infection. However, the most recent CDC Advisory Committee Report (1997) recommends the use of sterile water (not distilled water) in bubbling humidifiers.^[4] Contrarily, a study conducted by Cahill and Heath with the aim to compare tap water and sterile water for bacterial contamination found that culture at the end of 5 days revealed higher microorganism growth in the sterile water reservoirs.^[5] Moreover, humidifiers other than bubble-through humidifiers to generate water vapors do not aerosolize solutes or microbiome contained in water to cause microbial transmission.^[6] Wenzel *et al.* also concluded that nonsterile tap water may be a safe alternative for sterile water in convection-type humidifiers, used in continuous positive airway pressure therapy.^[7]

The WHO-UNICEF, Manual on Oxygen Therapy (2016) recommends that the humidifier should be filled with safe and clean boiled tap water or distilled water, which must be changed regularly as chances of contamination may increase over time.^[8] Koss *et al.* reported that sterile water, distilled water, and saline were potentially less contaminated up to 72 h when used for oxygen humidification, but prefilled nebulizer units should be changed every 24 h.^[9]

Data revealed that only 20% of COVID-19 patients required hospitalization and the majority required a low-flow rate of oxygen delivery.^[10] Therefore, an important question arises;

is humidification beneficial in low-flow oxygen therapy? Wen *et al.* answered in their study that oxygen humidification was not essential at low-flow rates. Furthermore, literature supported that oxygen humidification is only essential when given at high-flow rates through the nasopharyngeal route.^[11,12] However, the heat and moisture exchanger method is more beneficial for ventilator patient because it reduces the chances of infection and reduces the cost by decreasing urgency to frequent change of breathing circuit.^[13]

Finally, it is inferred that there is a scarcity of sufficient evidence to support any particular method of oxygen humidification. However, sterile water may be a preferred solution in affordable healthcare settings; however, in nonavailability and resource-constraint healthcare settings, boiled tap water with a convection-type humidifier may also be a safe substitute. Nonetheless, it is more important to regularly change the humidifying solution and clear and disinfect the humidifier reservoir, which prevents the risk of microbial colonization and infection.

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Conflicts of interest

There are no conflicts of interest.

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REFERENCES

1. Indian Council of Medical Research. Evidence Based Advisory in the Time of Covid-19. (Screening, Diagnosis & Management of Mucormycosis); May, 2021. Available from: https://www.icmr.gov.in/pdf/covid/techdoc/Mucormycosis_ADVISORY_FROM_ICMR_In_COVID19_time.pdf. [Last accessed on 2021 Jun 25].
2. Health Ministry & Family Welfare Department COVID-19. Notification of Mucormycosis under Epidemic Diseases Act, 1897 – Issued; May 20, 2021. Available from: <https://www.cicovid19update.in/uploads/1/3/1/3/131362769/mucormycosis.pdf>. [Last accessed on 2021 Jun 25].
3. Minister Cities Possible Causes of Black Fungus. The Hindu. Karnataka;

- 2021 May 22, 18:33 IST. Available from: <https://www.thehindu.com/news/national/karnataka/minister-cites-possible-causes-for-black-fungus/article34622318.ece>. [Last accessed on 2021 Jun 26].
- Guidelines for prevention of nosocomial pneumonia. Centers for Disease Control and Prevention. *MMWR Recomm Rep* 1997;46:1-79.
 - Cahill CK, Heath J. Sterile water used for humidification in low-flow oxygen therapy: It is necessary? *Am J Infect Control* 1990;18:13-7.
 - Gilmour IJ, Boyle MJ, Streifel A, McComb RC. The effects of circuit and humidifier type on contamination potential during mechanical ventilation: A laboratory study. *Am J Infect Control* 1995;23:65-72.
 - Wenzel M, Klauke M, Gessenhardt F, Dellweg D, Haidl P, Schönhofer B, *et al.* Sterile water is unnecessary in a continuous positive airway pressure convection-type humidifier in the treatment of obstructive sleep apnea syndrome. *Chest* 2005;128:2138-40.
 - WHO-UNICEF Technical Specifications and Guidance for Oxygen Therapy Devices. Geneva: World Health Organization and the United Nations Children's Fund (UNICEF), 2019 (WHO Medical Device Technical Series). Licence: CC BY-NC-SA 3.0 IGO. Available from: <http://apps.who.int/iris>. [Last accessed on 2021 Jun 26].
 - Koss JA, Conine TA, Eitzen HE, LoSasso AM. Bacterial contamination potential of sterile, prefilled humidifiers and nebulizer reservoirs. *Heart Lung* 1979;8:1117-21.
 - Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW, *et al.* Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. *JAMA* 2020;323:2052-9.
 - Wen Z, Wang W, Zhang H, Wu C, Ding J, Shen M. Is humidified better than non-humidified low-flow oxygen therapy? A systematic review and meta-analysis. *J Adv Nurs* 2017;73:2522-33.
 - Poiroux L, Piquilloud L, Seegers V, Le Roy C, Colonval K, Agasse C, *et al.* Effect on comfort of administering bubble-humidified or dry oxygen: The Oxyrea non-inferiority randomized study. *Ann Intensive Care* 2018;8:126.
 - Gallagher J, Strangeways JE, Allt-Graham J. Contamination control in long-term ventilation. A clinical study using a heat- and moisture-exchanging filter. *Anaesthesia* 1987;42:476-81.

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