Contribution ID: **66** Type: **Poster**

Advancing Worker Safety: Innovative Source Control Strategies and Spatial Performance Assessment for Bioaerosol Control in Healthcare Isolation Rooms

In the workplace, aerosols exposures are numerous and reported in various sectors. Bioaerosols are aerosols containing microorganisms. Healthcare workers are exposed to aerosols of different types and sizes during many occupational activities. Between 2008 and 2023, 100 workers were compensated for occupational acquired tuberculosis in the province of Québec. During the first year of COVID-19 pandemic more than 14 000 cases were established as occupationally acquired infections including twenty deaths of healthcare workers in the province of Québec. The pandemic has also highlighted the challenge over the dispersion and the purification of aerosols in enclosed spaces. Since bioaerosols can be dispersed over several meters, documentation and understanding of their dispersion becomes critical to protect the workers. Drawing up a global picture of exposure to bioaerosols by focusing on the main exposures in the near field, but also by characterizing the far field to prevent secondary exposures is crucial to protect all potentially exposed workers. The use of direct reading instruments (DRI) measuring numbers of particles can provide relevant information of aerosols contaminants. At the IRSST, a method has been developed and refined since 2017 to realistically evaluate the spatio-temporal dispersion of bioaerosols and their purification kinetics in workplaces. Assays with this method have shown that aerosols can spread over distances ranging from two meters to several tens of meters. At the beginning, only one DRI was use. However, sampling at a single point could not provide information on local deviations and sequential sampling does not allow simultaneous documentation of several points and is highly time consuming. Based on these findings, we start working on the development of a Spatio-Temporal Assessment Technique for Aerosol Dispersion based on a network of sensors and a data acquisition tool. This innovative method has awakened the interest of the medical community.

Isolation rooms use in hospital are in negative pressure to guarantee that when the door is opened, dangerous particles from inside the room will not flow outside into non-contaminated areas. However, their designs fail to consider the occupational risk of the workers going inside those rooms for treatment and interventions. To provide protection to the respiratory therapist during inducted expectoration (tuberculosis patients) a prototype room with source extraction was conceived in a hospital in Montréal. This room measure 6.0 by 3.3 and has a ceiling of 2.65 meter. The extraction duct is in the center back of the room and measure 1.125 by 0.515 meters. This extraction system has been designed to improve the source extraction of infectious particles. To evaluate the performances of this prototype room the network sensors including six OPS (TSI, USA) was deployed. This strategy alloys the documentation of both the dispersion of 1 um latex particles, serving as proxy of bacterial particles, and the measurement of the spatial decay rates provided by the extraction ventilation system.

To study the performance of the prototype room, a spatial interpolation was carried out. Spatial interpolation allows to use points with known concentrations to estimate unknown points concentrations. This mesh treatment of the room makes it possible to visualize the dispersion of 1 um latex particles and the variation of the concentrations overtime. Assay where performed with and without the ventilation system in function to visualize the differences of performances. The pic concentrations with the system in function varies from 0.05 #/cm3 to 0.17 #/cm3 close to the source compared to 1.5 #/cm3 in the back of the room to 3.0 #/cm3 closer to the door when the system is turn off. The equivalent air change per hour (EACH) measured with the system in function were between 14,8 and 18,1 and between as low as 0.33 and 2.6 #/cm3 when only the basic ventilation of the room was in function. The calculated EACH value are higher than the twelve air changes per hour recommended by Canadian guidelines for hospital isolation rooms and the dispersion results demonstrate

that the system performance is effective in reducing exposure to workers near the source inside the room. In addition to the prototype room, three rooms that meet the Canadian standard will be evaluated and their performance will be compared with the prototype. Isolation rooms are essential for controlling nosocomial infections, but they are not designed with occupational disease prevention in mind since capture at source is not required. This prototype room demonstrates that controlling nosocomial infections can also be done while considering worker protection.

Primary author: Mrs MARCHAND, Genevieve (IRSST)

Co-authors: Mr WINGERT, Loic (IRSST); Ms TERRIEN, Sophie (CIUSSS du Nord de l'île de Montréal)

Presenter: Mrs MARCHAND, Genevieve (IRSST)