

Indoor air quality in French hospitals: Physical-chemical results

Estelle Baurès^{1,2,*}, Fabien Mercier^{1,2}, Pierre Le Cann^{1,2}, Olivier Blanchard^{1,2}, Emilie Surget^{1,2}, Jean Pierre Gangneux^{3,4}, Arnaud Florentin^{5,6}

¹Research institute for environmental and occupational health (IRSET), Rennes, France

²School of Public Health (EHESP), Rennes, France

³Centre Hospitalier Universitaire de Rennes, France

⁴Parasitology-Mycology Laboratory, Centre Hospitalier Universitaire de Rennes, Rennes, France

⁵Centre Hospitalier Universitaire de Nancy, Nancy, France

⁶Lorraine University, Ingres, Nancy, France

Keywords: Indoor air, hospital, Pollutants, spatial and temporal variability.

Presenting author email: Estelle.baures@ehesp.fr

Indoor air quality in hospital is a very important issue. Currently, the biological indoor air quality monitoring and control in hospital are necessary and integrated in prevention strategy of hospital-acquired infections. However, the chemical contamination of indoor air in hospitals, although established, is little-known and rarely studied. This chemical contamination may be associated with a wide range of specific compounds emitted from various used products and building materials but also influenced by the outdoor environment. Finally some activities in link with practical in hospital may also lead to human exposure. The study aimed to assess the indoor air chemical contamination and spatio-temporal variability in two French hospitals.

Materials/Methods

This study was conducted in June 2014 and February 2015 (“summer” and “winter” sampling campaigns) during four consecutive days each in two hospitals in Rennes and in Nancy. For each hospital, air samples were collected in seven rooms (the reception hall, a patient room, a nursing care room, the parasitology mycology laboratory, a recovery room, a plaster room and the flexible endoscope disinfection unit) in order to estimate the spatial (related to the healthcare activities and between 2 hospitals) and temporal (daily, weekly and seasonal) variability of concentration. The reception hall was selected as a control site where the indoor air contamination is mainly due to sources not related to healthcare activities.

During these campaigns, 34 volatile organic compounds (VOCs) including aliphatic, aromatic and halogenated hydrocarbons, alcohols, ketones, ethers and terpenes, 7 aldehydes and 13 semi-volatile organic compounds (SVOCs) including phthalates, synthetic musks and pyrethroids were measured. PM10 and PM2.5 samples were collected in different rooms and gravimetric analysis was used to determine PM concentrations. In parallel, ambient parameters (temperature, relative humidity, pressure and carbon dioxide) and the number of particles (from 0.3 to 25 µm) were measured.

Results and discussion

First results showed that the main chemical compounds were found at meaningful concentrations in the French hospital indoor air. Mean concentrations were for alcohols (334 and 23 µg/m³ respectively for ethanol and isopropanol) but also several aromatic and halogenated hydrocarbons, aldehydes (4.5 µg/m³ for formaldehyde), ketones (17 µg/m³ for acetone), ethers (9.5 µg/m³ for ether) and terpenes (2.7 µg/m³ for limonene). The SVOCs were quantified in all the sampling rooms (mainly phthalates: 0.26 µg/m³ for diisobutylphthalate). The results are in the same order in two hospitals.

The temporal and spatial variability between sampling sites are correlated to information collected during the sampling campaigns such as the type of products used according to health activities, outdoor environment and building age and materials. For the different compounds a significant variability in concentrations levels was observed.

Conclusion

This study is a first integrated approach of the assessment of the nature of chemical contamination in hospitals, consisting in measuring simultaneously the compounds in seven sampling locations. Results showed that indoor air of sampling locations contains a complex mixture of physical-chemical compounds.

Acknowledgement

This work is part of the QAIHOSP project funded by the French environment and energy management agency (ADEME) under the national program of Environment-Health-Work research (PNRSET 2013) of the French National Agency of Sanitary Security (ANSES).