



KEY POINT SUMMARY

OBJECTIVES

The study aimed at evaluating the effectiveness of UVGI lights in reducing the contamination of HVAC systems, and self-reported building-related illness and symptoms at three office buildings in Canada.

DESIGN IMPLICATIONS

The study showed that UVGI light was an effective method in maintaining cleanliness of HVAC system, reducing environmental contamination, and reducing building-related health symptoms in mechanically ventilated office buildings. Because patients are often immune-compromised, it is even more important to maintain environmental hygiene in healthcare settings through the use of appropriate devices for disinfection and filtration (e.g. HEPA filters, UVGI lights).

Effect of Ultraviolet Germicidal Lights Installed in Office Ventilation Systems on Workers' Health and Well-Being: Double-Blind, Multiple Crossover Trial

Menzies, D., Popa, J., Hanley, J.A., Rand, T., Milton, D. K.
 2003 / *The Lancet*
 Volume 362, Issue 9398, Pages 1785-1790

Key Concepts/Context

Most commercial buildings in North America are mechanically ventilated with sealed exterior shells. In this type of highly automatically controlled indoor environment, microbial contamination of the HVAC system often contributes to building-related illness and symptoms in building occupants, such as outbreaks of rhinitis, humidifier fever, asthma, hypersensitivity problems, and so on. Contamination of bacteria, fungi, and protozoa has been found on various parts of HVAC systems such as air cooling units, cooling coils, and drip pans.

Ultraviolet germicidal irradiation (UVGI) is a technology using ultraviolet light to inactivate a wide range of airborne pathogens, such as influenza, measles, and TB. In this study, UVGI lights were installed within the central HVAC system to reduce contamination of drip pans and cooling coils.

Methods

In this quasi-experimental study, UVGI lights designed to disinfect cooling coils and drip pans in the HVAC systems on 14 selected floors of three buildings were alternatively turned off for 12 weeks then turned on for 4 weeks for a total of three times (six data collection periods in 48 weeks). Participating building occupants completed questionnaires in the last week of each data collection period before the UVGI lights were switched on or off. On the questionnaire, participants reported ten specific health symptoms in two groups—systemic symptoms (headache, fatigue, and concentration difficulties) and mucosal symptoms (irritation of skin, eyes, nose, or throat, nasal congestion, musculoskeletal, and respiratory issues)—



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together with demographics and characteristics (personal, medical and work). Microbial contamination (fungi and bacteria) and endotoxin concentration (amount of toxins associated with certain bacteria) on irradiated surfaces in the ventilation system and in the air at selected locations on the floors were measured using surface and air sampling. Thermal condition (including temperature, humidity, and air velocity) and chemical concentration (including CO₂, total volatile organic compounds, formaldehyde, ozone, and nitrogen oxides) were measured at selected locations.

Findings

The use of UVGI lights was associated with significant (99%) reduction of microbial and endotoxin concentrations on irradiated cooling coils and drip pans in the HVAC system. The 771 participating office workers reported significant fewer building-related respiratory and mucosal symptoms under UVGI condition. Thermal condition and chemical concentration did not change between the two experimental conditions (UVGI on vs. off). UVGI was associated with reduction in airborne microbial and endotoxin concentration in supply air and at work locations and reduction in surface contamination at work locations.

Limitations

There were several limitations of this study:

- The study was conducted in three office buildings but not in healthcare buildings. Because of the limited number of buildings in the study and other potentially influential environmental factors (e.g. size, layout) presented in the buildings, the results may not be readily applied to other buildings.
- Different numbers (from 515 to 746) of workers participated in the surveys in the six data collection periods. There might be some biases due to the personal differences in slightly different groups.