SYNOPSIS

KEY POINT SUMMARY

OBJECTIVES

The objectives of the study were to investigate the impact of window opening behavior on indoor temperature and relative humidity in relation to air conditioning use and seasonal changes, and indoor air quality as measured by indoor carbon dioxide (CO2) and outdoor fine particulate air pollution (PM2.5) concentrations.

Seasonal variation of window opening behaviors in two naturally ventilated hospital wards

Shi, Z., Qian, H., Zheng, X., Lv, Z., Li, Y., Liu, L., Nielsen, P. V.., 2018 | *Building and Environment*. Volume 130, Page 85-93

Key Concepts/Context

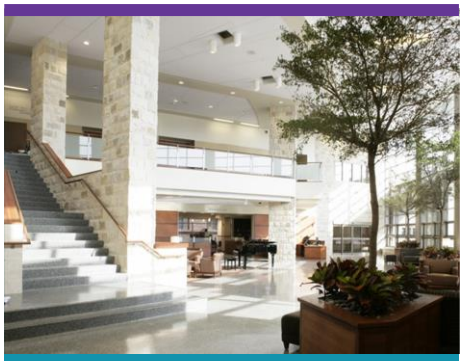
Natural ventilation is important in controlling indoor air temperature and quality. According to the authors, airborne infections can be reduced in hospitals among patients and staff when natural cross ventilation is used. Indoor air quality can be controlled by opening windows for faster air movement. This study was conducted at a hospital in Nanjing, China to analyze window opening behavior among the occupants.

Methods

During a one-year period data was collected at two adjacent wards on the third floor of the hospital building. The wards had doors opening from a corridor on one side and windows facing northwest on the other side. The air conditioning system was semi-central and was individually controlled in each ward. Monitors were installed at each ward to measure indoor temperature, relative humidity, and CO2 concentrations. The window opening state and size was recorded by a laser instrument. Restrictors were used to limit the opening size for safety. A weather station placed on the roof measured outdoor temperature, humidity, solar radiation, wind speed, and rainfall amounts. The PM2.5 concentration data was obtained from a local nearby monitoring station. Measuring time periods were categorized by season to understand the effect of summer air conditioning use. The data collected was analyzed and modeled using statistical software.

Findings

The data analysis showed a correlation between outside temperature and window opening. During the summer the windows were kept shut to take advantage of the air conditioning. In fall, winter, and spring the windows were kept open when the



The Center for Health Design: Moving Healthcare Forward

The Center for Health Design advances best practices and empowers healthcare leaders with quality research that demonstrates the value of design to improve health outcomes, patient experience of care, and provider/staff satisfaction and performance.

Learn more at www.healthdesign.org

outside temperature ranged between 20°C and 25°C. Opening the windows when the outside relative humidity was high was not desirable in the summer and winter but was more desirable during spring and fall, as the data analysis showed. There was no relationship between window use and the amount of PM2.5 in the air. When the CO2 levels were high in the wards the window opening probability was higher. The correlation between wind speed and window opening, according to the data collected, the windows were open at higher wind speeds in the summer but at lower wind speeds in the winter. The study found that the dominant factors in window opening probability were indoor air temperature and relative humidity.

Limitations

The sample size being only two wards was deemed small for the study, although patient turnover was relatively high. Other important factors not considered in the study were the number of occupants in the wards, the hospital department, floor height, and window direction. The patients in the wards and the patients' physical condition were not considered either. In addition, the significance of keeping the windows ajar requires further investigation. While the study referenced the relationship of air quality to infections, and suggested CO2 concentration was a good surrogate for airborne infection risks, no data was presented to support changes or correlations to actual HAIs.

Design Implications

Designers could take advantage of using operable windows to control cross ventilation and improve indoor air quality by reducing CO2 amounts and to reduce energy consumption. The study found that during the summer months it was better to keep the windows shut to control room temperature. Opening the windows would disrupt the operation of the AC system during hot summer days, so further studies are needed with a working prototype.