SYNOPSIS

KEY POINT SUMMARY

OBJECTIVES

The study aimed at investigating relationship between the ventilation of patient care areas and tuberculin conversion among healthcare workers in 17 acute care hospitals in Canada.

Hospital Ventilation and Risk for Tuberculous Infection in Canadian Health Care Workers

Menzies, D., Fanning, A., Yuan, L., FitzGerald, J.M.
2000 | Annals of Internal Medicine
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Key Concepts/Context

Tuberculosis (TB) is an occupational hazard for healthcare workers. It is a bacterial infection of lungs and other body parts caused by strains of mycobacteria (Mycobacterium tuberculosis). Typical symptoms include chronic cough with bold-tinged sputum, fever, night sweats, and so on. Tuberculosis can cause significant morbidity and death. It is usually spread by air when infected people transmit their saliva through air by coughing and sneezing.

The tuberculin skin test is often used to screen people with high risk of tuberculosis infection. The test involves the injection of tuberculin and the measurement of the diameter of induration (palpable raised hardened area) on the forearm.

Research has revealed several aspects of ventilation design that may contribute to the transmission of tuberculosis, including inadequate air exchange rates, air recirculation, and wrong direction of air flow. However, questions remain in the feasibility and cost-effectiveness of certain ventilation design for preventing tuberculosis transmission

Methods

This observational study focused on about 1300 healthcare workers who had two skin tests more than 1 year apart at the same hospital and was tuberculin negative at the first test. Based on tuberculin skin test results, tuberculin conversion was identified as induration of >10mm with an at least 6mm increase more than one year after a previous negative result. The actual ventilation rates (i.e. air exchanges per hour) were measured using the tracer gas (CO_2) method (including the release of CO_2 in rooms with doors and windows closed, the measurement of CO_2 concentrations in the rooms overtime under normal ventilation, and the calculation

of ventilation rates using standard formula) in selected rooms in patient care units. Medical record review and self-administrated questionnaires were used to collect characteristics of hospitals and staff that may impact the risk of tuberculin conversion (such as community exposure, exposure to tuberculosis patient at work). Statistical analyses (i.e. survival analysis, proportional hazards regression) were conducted to evaluate the influence of ventilation rate on the risk of tuberculin conversion in healthcare workers.

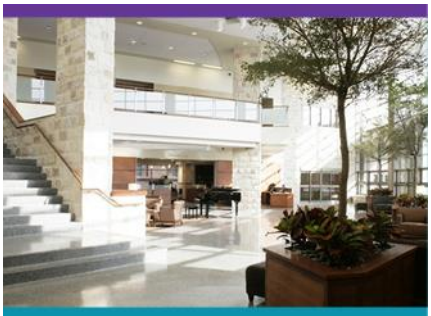
Findings

After adjusting for other risk factors, statistical analysis showed that healthcare workers working in units where the ventilation rate in non-isolation rooms was lower than two air exchanges per hour were significantly more likely (3.4 times higher) to have tuberculin conversion than healthcare workers in units with more than two air exchanges per hour in non-isolation rooms. The average ventilation rates at the units where staff without tuberculin conversion worked (4.2 air exchanges per hour for non-isolation rooms, 7.9 for isolation rooms) were higher than the ventilation rates units where staff with tuberculin conversion worked (2.2 for non-isolation rooms, 5.3 for isolation rooms). The risk of tuberculin conversion was also associated with the proportion of rooms not meeting design standards.

Limitations

There were several limitations of this study:

- The measurement of tuberculin conversion relied on the availability of previous tuberculin tests. Variation in the tuberculin testing (e.g. boosting phenomenon) at different hospitals and variation in tuberculin conversion definition might have skewed the results.
- The average ventilation rates on unit and hospital levels were used in data analysis. The average ventilation rates for one unit were calculated on the measurements from a subset of selected rooms. Aberrant results from a few unusual rooms might skew the average ventilation rates, which might not truly represent the ventilation rates of individual rooms where staff worked.
- The data collection of other risk factors relied on medical records and questionnaire responses, which might not be accurate. For example, some patients with tuberculosis might not be diagnosed and indicated in medical records. Because of this, the amount of occupational exposure in some staff might have underestimated.
- Further research is needed to identify the most cost-effective ventilation rate for areas with different levels of infection risk.



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Design Implications

The study showed the importance of ventilation in preventing airborne infections in healthcare workers. High ventilation rates may help reduce risks of airborne infections.

The study also showed that the actual ventilation rates at many patient rooms did not meet the design standards. Optimal ventilation rates should be achieved not only by design and construction but also through proper system maintenance and commissioning.