SYNOPSIS

KEY POINT SUMMARY

OBJECTIVES

The study aimed at investigating the causes of a varicella outbreak on a pediatric care floor and how air pressure between patient room and corridor impacted the risk of varicella infection.

An Outbreak of Airborne Nosocomial Varicella

Gustafson T. L., Lavely G. B., Brawner Jr., E. R., Hutcheson Jr., R. H., Wright, P. F., Schaffner, W.

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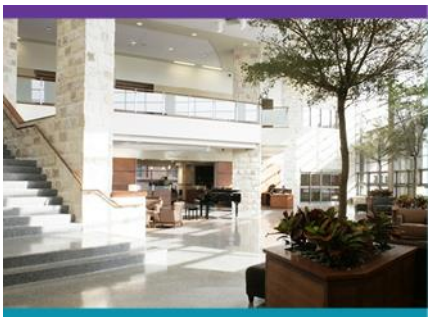
Key Concepts/Context

Varicella or chickenpox is a highly infectious viral disease in children that involves itchy blisters all over the body. Nosocomial transmission of varicella is a serious problem in pediatric settings especially in immune-compromised children. The routes of transmission include direct person-to-person contact (vesicular fluids or droplets from respiratory tract secretions), indirect contact (discharges of vesicular lesions), and airborne (aerosolized droplet nuclei).

Air pressure difference between neighboring spaces is an important environmental factor in preventing airborne transmission of infections. A negative pressured room is a room where enough air is evacuated to prevent air from flowing out of the room and into neighboring spaces. A positive pressured room is a room where enough air is supplied to prevent air in neighboring spaces from entering the room.

Methods

Following an outbreak of varicella, a detailed investigation was conducted to identify why the patient isolation method was failed. Medical record review, telephone surveys, and interviews were conducted to explore the potential causes of outbreak. A floor plan indicating room locations of patients (infected or not infected) was used to identify the possible routes of transmission. Air flow and dilution studies were conducted by using sulfur hexafluoride (SF6) as tracer gas and continuously measuring SF6 concentration in the corridor out of the isolation room where the patient who was identified as the source of the outbreak stayed (i.e. index patient).



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Findings

Seventy patients who stayed on the pediatric floor were susceptible to varicella (excluding those considered immune to varicella). All eight infected patients stayed on the floor in one same afternoon during the duration of the index patient's stay when the isolation room was vacuumed. The room locations of the eight infected patients were closer to the isolation room where the index patient stayed than the rooms of other patients. The airflow study showed that the air pressure in the isolation room which lacked an exhaust vent was higher than in the corridor and the tracer gas released in the isolation room reached high concentration in the corridor even though the original design specified a negative pressure in the isolation room. Varicella infections happened in several other rooms with negative air pressure to the corridor. All the evidence consistently indicated that the pathogen was transmitted through airflow from isolation room to the corridor and the airborne transmission contributed to the varicella outbreak.

Limitations

There were several limitations of this study:

- One main part of the investigation was a retrospective observational study. Even though the suspected transmission route was confirmed by the airflow study, it could not be 100% ascertained because varicella cultures were not obtained in the study. It was stated in the article that, generally, varicella virus was difficult to be cultured.
- The airflow study used SF6 to simulate the flow pattern and the concentration of airborne varicella. The simulation might not be accurate.

Design Implications:

- The study was very compelling in identifying the inappropriate air pressure difference between healthcare spaces as the main cause of the varicella outbreak. Ventilation design is very important to prevent potential airborne transmission of varicella as well as other pathogens. Negative pressured isolation rooms should be used to house infectious patients for infection prevention.
- In addition to proper ventilation design (e.g. exhaust vents in negative pressured isolation rooms), periodical auditing and commissioning of the ventilation systems are important to make sure that the ventilation system is operated according to design specifications, especially in isolation rooms in units housing immune-compromised patients. Further, it is essential to identify any errors or weaknesses in ventilation design through auditing and commissioning.