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Review Article

Aerobiology and Its Role in the Transmission of Infectious Diseases

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Aerobiology plays a fundamental role in the transmission of infectious diseases. As infectious disease and infection control practitioners continue employing contemporary techniques (e.g., computational fluid dynamics to study particle flow, polymerase chain reaction methodologies to quantify particle concentrations in various settings, and epidemiology to track the spread of disease), the central variables affecting the airborne transmission of pathogens are becoming better known. This paper reviews many of these aerobiological variables (e.g., particle size, particle type, the duration that particles can remain airborne, the distance that particles can travel, and meteorological and environmental factors), as well as the common origins of these infectious particles. We then review several real-world settings with known difficulties controlling the airborne transmission of infectious particles (e.g., office buildings, healthcare facilities, and commercial airplanes), while detailing the respective measures each of these industries is undertaking in its effort to ameliorate the transmission of airborne infectious diseases.

1. Introduction

Exposure to airborne pathogens is a common denominator of all human life [1]. With the improvement of research methods for studying airborne pathogens has come evidence indicating that microorganisms (e.g., viruses, bacteria, and fungal spores) from an infectious source may disperse over very great distances by air currents and ultimately be inhaled, ingested, or come into contact with individuals who have had no contact with the infectious source [2–5]. Airborne pathogens present a unique challenge in infectious disease and infection control, for a small percentage of infectious individuals appear to be responsible for disseminating the majority of infectious particles [6]. This paper begins by reviewing the crucial elements of aerobiology and physics that allow infectious particles to be transmitted via airborne and droplet means. Building on the basics of aerobiology, we then explore the common origins of droplet and airborne infections, as these are factors critical to understanding the epidemiology of diverse airborne pathogens. We then discuss several environmental considerations that influence the airborne transmission of disease, for these greatly impact particular environments in which airborne pathogens are commonly believed to be problematic. Finally, we discuss airborne pathogens in the context of several specific examples: healthcare facilities, office buildings, and travel and leisure settings (e.g., commercial airplanes, cruise ships, and hotels).

2. Aerobiology

Aerobiology is the study of the processes involved in the movement of microorganisms in the atmosphere from one geographical location to another [7], including the aerosolized transmission of disease. The aerosolized transmission of disease occurs through both "droplet" and "airborne" means. Droplet transmission is defined as the transmission of diseases by expelled particles that are likely to settle to a surface quickly, typically within three feet of the source [8–10]. Thus, for example, in order for an infection to be caused by droplet transmission, a susceptible individual must be close enough to the source of the infection (e.g., an infected individual) in order for the droplet (containing the infectious microorganism) to make contact with the