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Viral Abundance, Deposition and Atmospheric Recycling: Implications for Disease Outbreaks and Transmission

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Introduction

The COVID-19 pandemic has indeed been a significant global health crisis, resulting in substantial loss of life and societal disruptions. To effectively combat the virus and prevent future outbreaks, it is crucial to understand its multi-stage dynamics, including transmission routes and environmental conditions that facilitate its spread. This paper aims to provide a systematic review of the literature on virus-laden aerosols and their transmission into various environments, particularly built environments. Additionally, it examines state-of-the-art modelling tools that are relevant for studying the spread and transmission pathways of COVID-19. The influence of these environmental factors on COVID-19 spread is still equivocal because of other no pharmaceutical factors. The limitations of different modelling methods suggest the need for a multidisciplinary approach, including the 'One-Health' concept. Extended One-Health-based decision tools would assist policy makers in making informed decisions such as social gatherings, indoor environment improvement [1].

Description

Various modelling approaches have been employed to study the spread of COVID-19, and this paper discusses three prominent ones: GIS-based models, risk-based models, and artificial intelligence-based models. Geographic Information System (GIS) tools enable the visualization and analysis of spatial data, facilitating the surveillance and forecasting of COVID-19 by mapping its spread and identifying high-risk areas. Risk-based models incorporate factors such as population density, mobility patterns, and socioeconomic indicators to assess the likelihood of transmission and inform decision-making. Artificial intelligence-based tools, including machine learning and data-driven models, leverage large datasets to identify patterns, predict transmission rates, and support policy interventions. While environmental factors play a role in the spread of COVID-19, their exact influence is still uncertain due to the presence of other non-pharmaceutical factors. Some primary environmental factors that potentially contribute to virus transmission include meteorological variations, low air quality, high pollen abundance, and spatial-temporal variations. However, the interaction between these factors and the virus's spread is not yet fully understood.

The use of simulation models is indeed an effective approach for understanding the dynamics of infectious diseases. These models can be qualitative or quantitative, providing predictions for virus spread, risk assessment, and decision-making support. Process-based mathematical models, commonly referred to as compartmental models, have been widely used to predict the spread of diseases and estimate epidemiological parameters. These models consider the population divided into compartments, such as susceptible, infected, and recovered, and simulate the transitions between these compartments over time. Through these models, parameters like the reproduction number, total number of infected individuals, number of recoveries, and death rates can be estimated, In the context of infectious disease outbreaks, various factors come into play, including environmental drivers and climate change. These factors can modify the transmission dynamics of diseases. Changes in temperature, humidity, precipitation patterns, and other environmental variables can influence the survival and transmission of pathogens. For example, certain diseases may exhibit seasonality, with increased transmission during specific climatic conditions.

The limitations of existing modelling methods highlight the need for a multidisciplinary approach, particularly incorporating the 'One Health' concept. The One Health approach recognizes the interconnectedness of human, animal, and environmental health and emphasizes the collaborative efforts of various disciplines to address complex health challenges. By integrating One Health principles into decision-making tools, policymakers can make informed choices regarding social gatherings, indoor environment improvements, and COVID-19 risk mitigation. This adaptive approach ensures that control measures can be modified to align with the evolving nature of the pandemic. In summary, this paper highlights the importance of understanding the dynamics and transmission pathways of COVID-19. It provides a critical review of modelling tools, including GIS-based, risk-based, and artificial intelligence-based approaches, and emphasizes the need for a multidisciplinary, One Health-based approach. By incorporating environmental factors and considering non-pharmaceutical interventions, decision-makers can better navigate the challenges posed by COVID-19 and develop effective strategies for future pandemics [2-5].

Conclusion

In the context of infectious disease outbreaks, various factors come into play, including environmental drivers and climate change. These factors can modify the transmission dynamics of diseases. Changes in temperature, humidity, precipitation patterns, and other environmental variables can influence the survival and transmission of pathogens. For example, certain diseases may exhibit seasonality, with increased transmission during specific climatic conditions. COVID-19 is a deadly pandemic globally, which is currently in its fourth wave and possibly to enter the fifth wave because of a new variant. The assembling of data from various regions shows that COVID19 peak outbreak is observed in winter in most significant hot spots having an ambient temperature less than 15°C and 11– 22 (km/h) range of wind speed.

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