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Learning from the history of airborne diseases: Understanding and applying health models as a guide for community-led outbreak prevention

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Abstract

The history of airborne disease outbreaks demonstrates that the community face similar repeated experiences that are disastrous and life-threatening. From the early years of the flu outbreak to the recent COVID-19 pandemic, public health responses have largely depended on top-down medical and policy measures. Although the role of communities was mentioned, it has received far less attention. This gap has led to inconsistent adherence to preventive guidelines, which is commonly referred to when needed, particularly in the event of an emerging outbreak. Hence, the application takes time, while outbreaks escalate. In response to this, this review examines the historical experiences of airborne diseases to understand how community involvement can be strengthened in outbreak prevention. Selected behavioural health models' theories and frameworks were studied for their suitability for application as a guide for community-led interventions. This review highlights the importance of historical awareness and established health models for a collective responsibility in shaping impactful health responses for outbreak prevention by bridging the gap between human behaviour and public health preventive responses expectations. Community-led outbreak prevention is the key to preventing future airborne disease outbreaks.

Keywords: infections, endemics, pandemics, epidemics, health models, public health.

1.0 INTRODUCTION

The COVID-19 pandemic has primarily reshaped numerous aspects of life. Similarly, with the past several airborne disease outbreaks that occurred and can recur at any time. Intuitively, airborne outbreaks have always been a sobering reminder of how vulnerable our society remains, despite our medical advancements. From 1918, the flu outbreak to 2019, the COVID-19 outbreak has caused many deaths (Piret & Boivin, 2020; Liang, 2023). An outbreak signifies that a pandemic demands a multi-dimensional response involving everyone. Everyone is involved in halting the spread of the organism causing the pandemic.

Expectedly, in an outbreak, there will be top-down instructions from the government to curb the progression and eradicate the threat. Urgent efforts to implement standardised public health protocols, centralised regulations, and national policies alignment, aiming to terminate the pandemic (WHO, 2020a). Internationally, there will be a universal regulatory framework by the World Health Organisation (WHO)

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and centralised international policy implementation (WHO,2020b). Nevertheless, all these repetitively occurs upon an unforeseen outbreak. Eventually, results in public health fatigue.

Therefore, empowering the community with knowledge and preparedness to face any unpredictable outbreak is the key to successful outbreak prevention and management. Although these efforts may have been done in the past, the sustainability, as suggested by some health models like the Self-Determination Theory (SDT), that emphasizes on motivation, is often overlooked. Consequently, educating the community, particularly by training health emissaries, will result in persistent behavioural change, hence averting an outbreak. The community must have a holistic understanding, repetitive reminders, and this is passed through generations, for instance, from parents to children, for an endless behavioural change. Therefore, educating behavioural health models to the community will make them understand their behaviour and take necessary targeted action that will result in persistent, impactful prevention.

In Malaysia, the effort of involving the ground-level leadership, like the local residents and village committees were seen upon the application of 'Standard Operating Procedures' (SOPs) during the COVID-19 outbreak (Azlan et al., 2020). This is where the Health Belief Model (HBM), that suggest 'cues to action' result in behavioural change, comes into action rather than just theories that were learned. But how about other health models that can be considered for a more impactful and persistent behavioural change, like the SDT model that emphasises sustainability? Other health models also help us to understand why people choose face masks, get vaccinated, improve ventilation, etc to protect themselves from infections.

Understanding these models is important to educate the community. Instead of directing the community on what to do, these models help the community to understand human behaviours and why humans change their behaviour. Hence, these models guide the community to build 'community-led' strategies that respect local culture, are consistent with daily life activities and are easily applicable. When the community takes the lead, prevention becomes a shared responsibility rather than a forced rule. This review highlights the description of airborne diseases that are commonly misunderstood, as well as the history of airborne diseases. From history, we learnt that our best defence for outbreak prevention is a well-informed, well-organised, and self-empowered community. Crucially, within Muslim-majority contexts such as Malaysia, this community empowerment finds its strongest foundation when human behavioral models are harmonized with Islamic legal and ethical imperatives. The preservation of community health fundamentally aligns with *Hifz al-Nafs* (the preservation of life), which is one of the five core objectives of *Maqasid al-Shariah*. By synthesizing the rational insights of behavioral health models (*Aqli*) with divine guidance on public safety (*Naqli*), community-led prevention shifts from a dry regulatory requirement into a profound moral and spiritual duty. This dual framework transforms top-down compliance into organically sustained, community-driven public health preservation.

2.0 METHODOLOGY

Literature reviews were applied to explore the history of airborne diseases, the prevention measures, and the related health models, theories, and frameworks for airborne infection control. Data was retrieved from multidisciplinary electronic databases including Google Scholar, Medline, PubMed, and ScienceDirect. To ensure a thorough search, additional sources such as official websites of health organisations and available textbooks on respiratory diseases were also included. Using a combination of Boolean operators of 'AND' and 'OR' and keywords such as 'airborne,' 'viruses,' 'bacteria,' 'parasites,' 'fungi,' 'infections,' 'disease(s),' 'prevention(s),' 'health,' 'model(s),' 'behaviour(s),' 'behaviour,' were used to identify literatures from 1991 to 2025. From the search results, a variety of peer-reviewed journals, articles, and clinical studies were identified. The chosen studies were reviewed by the researchers. Authorship, year of publication, and research methodology were carefully reviewed by researchers and pertinent data were extracted using a methodical and structured technique, focusing on the objectives of the review. The objectives are to review the history of airborne diseases, prevention, available health models, and study human behaviour for the prevention of future outbreaks. Several discussions were conducted to extract the data. The contents extracted were validated by three subject matter experts to ensure data quality and face validity for the arrangements to prevent confusion, which involved three other experts.

3.0 RESULT AND DISCUSSION

3.1 Airborne Diseases: An Overview

Description of Airborne Diseases

Airborne diseases are caused by pathogens transmitted through the air. The pathogens are commonly viruses and bacteria, but can also be fungi and parasites, particularly infecting those immunocompromised, such as HIV patients. The airborne transmission occurs when infectious respiratory particles (IRPs) from the exhaled breath of an infected person are in the air. Generally, the infectious particles in the environment enter the respiratory tract of another person through inhalation. It can also be released directly onto the exposed mucosal surfaces of another person, such as the eyes, nose, or mouth. Also known as direct deposition or direct contact. This is because the aerosols consist of small particles, <5 micrometres, and thus, are more likely to spread over long distances. It can also be suspended in the air for long periods of time (WHO, 2024). In addition, the method of pathogen transmission can be classified into 3 categories, namely obligate, preferential, and opportunistic (WHO, 2024). Obligate airborne infection is defined by its sole transmission through aerosols, whereas preferential infection may occur via multiple routes, but transmission via aerosols predominates. Opportunistic airborne infection may also be transmitted via multiple routes; however, under certain conditions that are favourable, such as with procedures that generate aerosols, e.g. intubation, transmission could occur. Opportunistic infections, for instance, are organisms such as A*spergillus fumigatus, a* fungus infecting immunocompromised individuals. Preferential airborne infection is like chickenpox, which is transmissible via multiple routes, but airborne transmission predominates (Seto, 2015). Furthermore, transmission through the air includes both airborne transmission and droplet transmission. But these two different methods of transmission are commonly misinterpreted.

Distinction Between Airborne Transmission and Droplet Transmission

Airborne transmission and droplet transmission are different. Airborne transmission occurs when there is a presence of pathogens within droplet nuclei with a diameter of <5 micrometres (aerosols), thus it could stay in the air for longer periods and be spread to others over a distance of more than 1m (WHO, 2020a). Droplet transmission, on the other hand, also involves the presence of pathogens within droplet nuclei. However, these particles that are expelled through coughing or sneezing are spread via direct deposition onto the exposed mucosae or conjunctiva of a person within close contact, with a distance of less than 1m. Droplet transmission could result in fomite transmission from the droplet nuclei landing on the surfaces in the immediate environment of an infected person, causing infection through indirect contact. For instance, if the droplet falls on the table and that surface is touched by another person, they could get infected.

Therefore, the community need to be educated on airborne diseases. The misconception that airborne infections are spread via air only, as most understand, needs refinement. The fact that the possibility of airborne transmissions is via multiple routes should be highlighted. The community also needs to understand that these infections are easily transmissible if individuals are exposed without any protective measures. Protective measures are not only face masks but also hygiene. Corresponding with frequent handwashing, bathing, and other self-care. Hence, educating the community is vital to prevent an outbreak. Neglecting this will result in the repetition of historical patterns and cycles with the evolution of new organisms. Thus, an outbreak is never an ending.

3.2 Timeline of Different Pandemics Throughout History

From Pandemic to Endemic: A Public Health Transition.

Throughout history, pandemics have significantly impacted human populations, with major outbreaks occurring at various intervals. The timeline of pandemics starts with the Plague of Justinian (541 – 543 AD), which originated in Egypt and spread across the Eastern Roman Empire, resulting in an estimated 100 million deaths (Cunha & Cunha, 2008). The highly developed structure of the Roman Empire facilitated the spread of the Justinian plague along its trade and military routes. Following this, the Black Death (1347-1351) emerged in East Asia and swept across Central Asia into Europe, killing approximately 200 million people until the early 19th century (Zietz & Dunkelberg, 2004). The Black Death was followed by successive outbreaks, including notable instances in Milan (1630), London (1665-1666), and Marseille (1720–1722), which led to the establishment of early public health approaches such as quarantine and isolation protocols (Seifert et al., 2016). The Third Plague Pandemic began in the mid-19th century in Yunnan, China, reached Canton, Hong Kong and then spread globally (Zietz & Dunkelberg, 2004). It was during this period that the

causative agent, *Yersinia pestis*, was detected. The pandemic lasted until the early 20th century, with plague becoming endemic in various areas.

In addition to the plague, cholera pandemics emerged, beginning with the First Cholera Pandemic (1817-1824) in India and continuing through several waves until the Sixth Cholera Pandemic (1899-1923) (Faruque et al., 1998). Cholera outbreaks were mainly associated with contaminated water sources, highlighting the importance of sanitation and safe water supply. Then, infectious diseases have continued to pose global health threats, including the Russian flu (1889–1893), Spanish Flu (1918-1919), Asian Flu (1957-1959), and Hong Kong Flu (1968–1970) that caused by influenza A with different subtypes of gene segments. In the 20th and 21st centuries, new pandemic occurred such as severe acute respiratory syndrome (SARS) (2002–2003) that is caused by SARS-CoV, Swine flu (2009–2010) by Influenza A, Middle East Respiratory Syndrome (MERS) (2015-current) by MERS-CoV, and the ongoing COVID-19 which started in 2019 by SARS-CoV-2 (Piret & Boivin, 2020). These pandemics have underscored the requirement for robust global surveillance systems and public health measures to detect and manage infectious diseases. The evolution of pathogens, driven by factors such as increased human-animal interactions and global travel, continues to challenge public health intervention, necessitating ongoing research and preparedness against future pandemics.

As early as the 13th century, leprosy epidemics have been reported, evidenced by the construction of leprosaria or leper colonies, with Paris alone having 45 of them by the year 1220. Leprosy was described to have been propagated by soldiers upon their return from Jerusalem to England, France and the Holy Roman Empire during the Third and Fourth Crusades (Spielman & Sunavala-Dossabhoy, 2021). Only in 1873, Gerhard Henrik Armauer Hansen identified the bacterium responsible for leprosy, which later became known as Hansen's disease in his honour. Before the development of effective antibiotics, leprosaria became a healing sanctuary for those afflicted with the disease, not unlike sanatoriums did for tuberculosis, providing care and isolated shelter when leprosy was strongly stigmatised and misunderstood to be highly contagious (Bennett et al., 2015).

The Evolution and Progression of History.

Another one of the oldest recorded outbreaks caused by bacteria was Pertussis in the 15th century in Persia. This bacterium later caused another outbreak in Paris in 1578, resulting in the deaths of many infants and young children (Decker & Edwards, 2021).

Around three centuries later, in the 1870s, *Bacillus anthracis* was discovered by Robert Koch as the causative organism of anthrax, leading to the development of Koch's postulates and the germ theory of disease. The first live attenuated vaccine was also developed around the same time by Louis Pasteur using heat-treated *B. anthracis* in sheep. Southern Africa is presumed to be the geographical point of origin due to having the widest variety of strains in comparison to other areas, according to the identification of variable-number of tandem repeats (VNTRs). In Zimbabwe, the biggest anthrax epidemic was said to have lasted six years from the year 1979 to 1985, resulting in the loss of 182 lives, with circa 10,000 cases recorded. Almost all these cases were of the cutaneous form and were linked to cattle raising practices and veterinary mismanagement during the nation-forming civil war.

In the 19th century, during the industrial age, the invention of factories that processed wool and hides led to the deaths of German and British ragpickers and wool sorters from inhalational anthrax. The upside of this outbreak was the inception of the concept of occupational hazards of infectious diseases, bringing attention to the importance of protecting workers from health risks. Another highly significant outbreak occurred in 1979, in which a Soviet military facility dealing with microbiology inadvertently released anthrax spores and consequently afflicted 70 people with inhalational anthrax. Notably, these cases were initially falsely reported as gastrointestinal anthrax, only being corrected years later when the specifics of the cases were released. The revelation of inhalational anthrax being highly transmissible through the air, in addition to the deliberate production of anthrax spores by Iraq in 1991, increased the likelihood of anthrax being highly weaponizable. This became a reality when anthrax spores were spread via letters sent through the U.S. Postal Service in 2001, wherein 22 people were infected, and five died because of this attack (Bennett et al., 2015).

In 1881, *Streptococcus pneumoniae* was successfully isolated by George M. Sternberg in the US (Bittaye & Cash, 2015). This bacterium served as an important function in shaping the history of

microbiology, providing a strong groundwork for the concept of humoral immunity when Felix and Georg Klemperer made a pivotal discovery. They demonstrated that immunisation utilising killed pneumococci was able to protect rabbits from the following pneumococcal challenge, and this protection was transferable via the infusion of serum, also known as 'humoral substance,' from immunised rabbits into unknowing participants. This concept of humoral immunity was then applied in the immunisation program to confront the yearly lobar pneumonia epidemic that affected around 1 in 10 African miners during the first decade of the 20th century. Outbreaks of a large scale caused by this organism are not common; smaller outbreaks happen with crowded conditions, for instance, in military training sites, prisons, and nursing homes (Bennett et al., 2015).

A year later, the causative organism of tuberculosis, *Mycobacterium tuberculosis* complex, was discovered and isolated by Robert Koch (Pai et al., 2016). The genus *Mycobacterium,* however, was postulated to have originated 150 million years ago (Barberis et al., 2017). This is proven by the evidence found of spinal tuberculosis in the human remains from as early as the Neolithic, pre-Columbian, and early Egyptian era. Nevertheless, tuberculosis only started to pose a major threat during the Industrial Revolution owing to the crowded living conditions, causing one quarter of all adult deaths in Europe in the 1700s and 1800s (Bennett et al., 2015).

In 1883-1884, the bacterium causing diphtheria was termed Klebs-Loffler bacillus, named after Klebs, who first identified it and Loffler, who successfully cultured it. This bacterium, also known as *Corynebacterium diphtheria*, has caused several major outbreaks globally from 1921 to 2018 (Sharma et al., 2019). In 1884, *Neisseria meningitidis*, the causative organism of meningococcal disease, was first recorded by March and Celli, to be found in the cerebrospinal fluid. It was only isolated 3 years later by Weichselbaum (Gianchecchi et al., 2015). Around 80 years before the event, in 1805, a canton in Switzerland, Geneva, saw an epidemic outbreak of meningococcal disease, depicted as having a high mortality rate with "gross inflammation of the central nervous system." A year later, New Bedford in Massachusetts faced a similarly characterised epidemic, and since then and over the next several decades, regions in Europe and the United States encountered many occurrences of similar outbreaks (Bennett et al., 2015). The first attempt to produce a meningococcal vaccine was by Davis in 1907, using heat to kill the cultures isolated from the cerebrospinal fluid of patients (Hollingshead & Tang, 2019).

As a ubiquitous organism, it is unsurprising that *Streptococcus pyogenes* becomes the most common causative bacterium of acute pharyngitis, besides causing a wide array of cutaneous and systemic infections, thus serving an essential role in the field of microbiology (Bennett et al., 2015). A global pandemic of scarlet fever occurred from 1820 to 1880 owing to *Streptococcus pyogenes,* affecting many regions in North America and Europe. This disease, which is transmissible via respiratory droplets, through direct contact or fomite transmission, was easily distinguishable from diphtheria by the doctors at the time from the symptoms manifested. Specifically, scarlet fever exhibited exanthem, a rash characteristic of scarlet fever, in addition to the fever, sore throat, lymph nodes inflammation and tonsillar and throat abscesses (Swedlund & Donta, 2002). According to the spectral analysis of the registration details from 1847 to 1880 in England and Wales, the interval between the scarlet fever epidemics was around five to six years, leading to a significant increase in mortality rate (Duncan et al., 1996). In Philadelphia, in the year 1976, the discovery of the genus *Legionella* bacteria occurred during the investigation of a major pneumonia outbreak among the members of the American Legion (Cunha et al., 2016).

The patterns of the history above clearly describe the evolution of airborne infections and the frequent outbreaks. Therefore, addressing this issue would need community empowerment. To achieve this, the community requires knowledge enhancements on the airborne diseases to create continuous awareness, resulting in behavioural change.

3.4 Health Behaviours Models: Approach for Airborne Diseases Prevention.

A change in health behaviour reduces transmission risks of disease-causing organisms. Therefore, it is important to educate the community on the transmission mode and prevention of these infections. However, this needs to be done systematically by identifying several factors, particularly on how the people perceive their risk for infections, the barriers to their actions for improvements, etc. By learning health models for behavioural change, the community will be enlightened to focus on targeted factors for behavioural change and plan actions that lead to continuous effort and improvement by the community members, for a long-

lasting behavioural change(Green et al., 2020).

The Health Behavioural Model (HBM) are commonly applied for behavioural change in medicine. However, other models can be applied for health behavioural improvements. They are the Protection Motivation Theory (PMT), the Theory of Planned Behaviour (TPB), and the Self-Determination Theory (SDT). HBM and PMT focus on perceived fear and threats about infections that lead to behavioural change. However, they differ as HBM, an earlier theory, focuses on 'cues to actions' by internal or external triggers. For example, advice from a doctor prompts an individual for vaccinations. PMT focuses on 'coping appraisal' whereby a threat (feeling scared) about infections makes individuals respond (take actions) for protection. Whereas TPB and SDT focus more on social pressure and personal identity for behavioural change. TPB focuses on intentions and on what others expect from them (social/peer pressure). SDT focuses on the sustainability of a behaviour that can be achieved by sustained motivation if psychological needs are met. The needs are individual autonomy (they choose to), competence (skill or capability to change) and relatedness (feeling connected) to the reasons of their behavioural change.

3.5 The Health Belief Model (HBM) In Health Behaviours Related to Airborne Diseases

The Health Belief Model (HBM) is a conceptual framework developed in the 1950s to explore the factors that influence one's behaviours with their health and well-being. This model has undergone various changes throughout the years in its application to different diseases. The four main aspects remain unchanged as the basis of these models. These aspects are: 1. Perceived susceptibility to ill health; 2. Perceived severity of ill health; 3. Perceived benefits of behaviour change: 4. Perceived barriers to action. However, the notion of self-efficacy to preventive behaviours, which result from 'cues to action', is the main component of this model. This model demonstrates that decision-making is largely determined by one's personal belief in their ability to fulfil a goal. In short, the HBM can be summarised as a relational model of a person's perceptions of "risks, benefits, and obstacles" which convert into "their readiness to act or lack of readiness" with respect to their behavioural change and decision-making in health (Green et al., 2020).

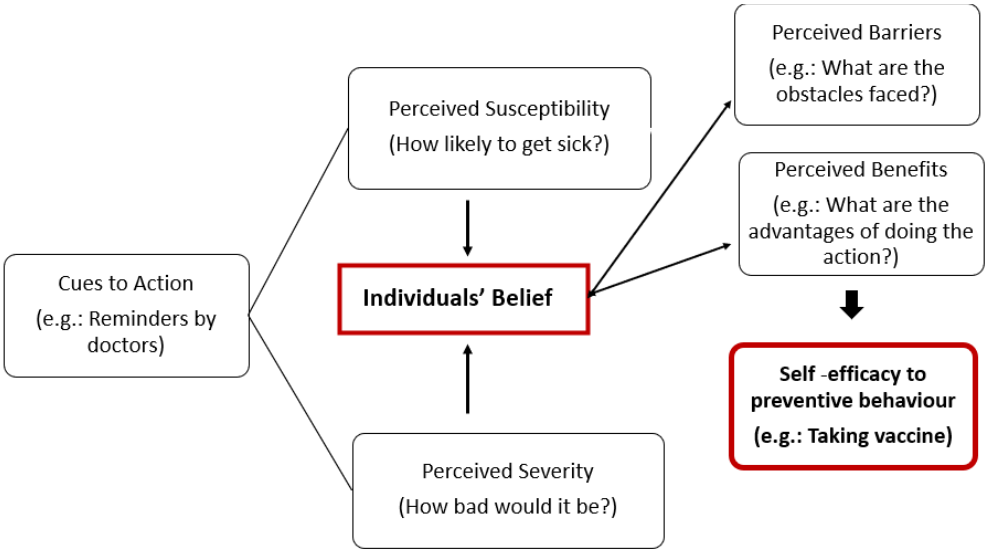

Fig 1. Health Belief Model (HBM) framework, in relation to airborne infectious disease control.

On the topic of airborne diseases, the application of the major aspects of HBM is shown in Figure 1. This usually begins in an individual when there are 'cues to action', perhaps symptoms, reminders or thoughts on airborne diseases. Therefore, HBM in application for airborne diseases can be explained as: 1. Perceived susceptibility to airborne disease, defined as the individual's perception of their likelihood of contracting the disease; 2. Perceived severity of airborne disease, defined as the individual's perception of the health threats inflicted by the disease; 3. Perceived benefits of behavioural change concerning the airborne disease, defined as the individual's perception of the benefits of committing changes in behaviour due to the disease; 4. Perceived barriers to taking action to mitigate the impacts or improve the situation surrounding the airborne disease. However, understanding this model for community-led intervention should focus on the highlighted boxes in Figure 1. Improving community knowledge, for instance, by frequent knowledge sharing and

reminders, improves individual beliefs for self-efficacy to adopt preventive behaviour.

Considering the recent COVID-19 pandemic, there have been multiple research projects exploring the effects of a pandemic on the individual and societal perceptions and behaviours towards health, utilising the HBM. A study conducted in India on the public perceptions towards the pandemic found that most of the participants heeded the recommendations by the government to combat COVID-19, with slightly more than half keeping themselves updated on COVID-19 several times a day. Those who perceived themselves to be more susceptible to COVID-19 were found to show better adherence to the recommendations; those who perceived themselves to be less susceptible to the infection also showed good adherence, albeit not to the extent of those with higher perceived susceptibility (Jose et al., 2021).

A similar study in Saudi Arabia showed different outcomes, with only 38% of the participants adhering to all COVID-19 preventative behaviours. The HBM constructs found to be significantly associated with adherence to preventative behaviours were perceived benefits, perceived barriers, and cues to action. Intriguingly, those with higher levels of income and education were less likely to follow COVID-19 preventative behaviours (Alagili & Bamashmous, 2021). Moreover, research investigating the extent of behavioural changes in exercise and nutrition during the pandemic in the USA found that those who reported a more substantial change in exercise had a higher likelihood of increased perceptions of susceptibility and severity with COVID-19, decreased perceptions of benefits and increased barriers to exercise. Overall, as a result, there had been a decrease in the levels of physical activities during the COVID-19 pandemic due to various reasons such as the closure of or operational limits in exercise facilities, orders to steer clear of social gatherings, or the fear of exposure to the infection in public settings. On the other hand, no link was found between the pandemic and behavioural changes in nutrition (Kiely et al., 2022).

A study in Iran aiming to ascertain the preventative behaviours against COVID-19 predicated on the HBM constructs showed that the correlation was strongest between perceived self-efficacy and preventative behaviours. This meant that one was more likely to carry out a preventative measure if they were confident in their ability to perform the act. The most commonly carried out preventative behaviour was "using a mask when leaving home," whereas the least commonly carried out preventative behaviour was found to be "immediate change of clothes when returning home." In terms of reliable sources of information on COVID-19, the study showed that the most reliable source was from the television, especially from the personnel of the Ministry of Health. When comparing the relationship between HBM constructs with demographic characteristics, the perceived severity of COVID-19 was shown to be significantly associated with gender, occupation and education (Heydari et al., 2023).

In the context of another airborne disease, influenza, the HBM has been widely applied in various studies to examine and enhance healthcare workers' (HCWs) attitudes and behaviours toward vaccination. A systematic review identified HBM as the most adopted theoretical model to explain influenza immunisation acceptance among health professionals, followed by the Theory of Planned Behaviour, the Risk Perception Attitude, and the Triandis Model of Interpersonal Behaviour. The analysis showed that the key HBM determinants of vaccination uptake were variables of the perceived benefits group, such as the HCWs' beliefs on the vaccine providing safety and protection to their family, and its effect of minimising their risk and the patients' risk of getting infected (Corace et al., 2016). Additionally, it became evident in another study employing HBM and the Theory of Planned Behaviour (TPB) that the HBM construct of perceived susceptibility to influenza virus infection was significantly linked to the HCWs' intention to receive vaccination (Ng et al., 2020).

3.6 The Protection Motivation Theory (PMT) in Health Behaviours Related to Airborne Diseases

Protection Motivation Theory (PMT) proposes that an individual's protective behaviours from threats are dependent on two major cognitive processes of appraisal, which are: 1. Threat appraisal, and 2. Coping appraisal. Threat appraisal is defined as one's assessment of the threat via its severity and one's susceptibility toward it. Coping appraisal refers to one's assessment of the protective behaviour effectiveness termed as 'response efficacy,' their ability to execute the protective behaviour known as 'self-efficacy,' and the costs required to execute it known as 'response costs.' Figure 2 illustrates in the context of airborne diseases, whereby a person is more inclined to perform an airborne preventative behaviour if he or she deems the threat of airborne diseases as posing a great magnitude of harmfulness to their health, and the airborne preventative behaviour is evaluated to be within their capabilities to execute effectively (Milne et al., 2000; Rogers et al.,

1983).

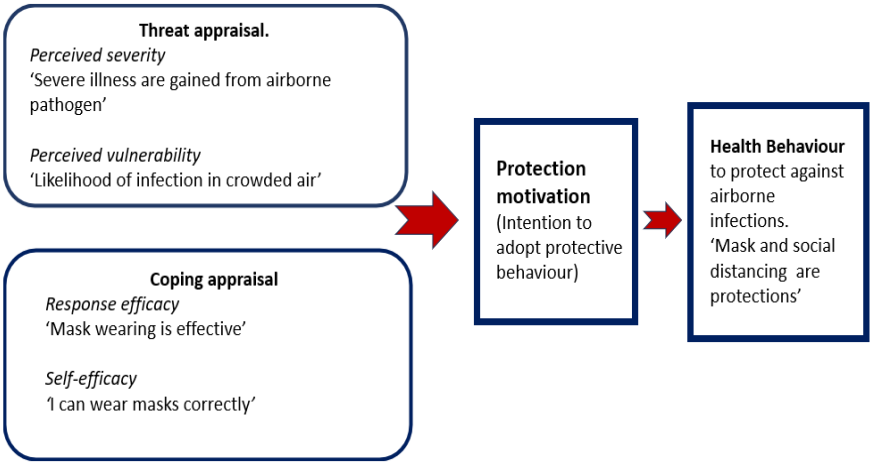

Fig 2. Protection Motivation Theory (PMT) framework in relation to airborne infectious disease control.

A quantitative study investigating the prevalence of COVID-19 preventative behaviours among adults in India employing the constructs of Protection Motivation Theory showed that self-efficacy for COVID-19 preventative behaviours and threat appraisal of COVID-19 disease were crucial drivers of COVID-19 preventative behaviours. Among the preventative practices documented were the usage of face masks (93.20%) and frequent handwashing with water and soap (84.90%). In addition, most of the participants held the right perceptions of COVID-19 symptoms, causes and method of transmission (Lahiri et al., 2021).

3.7 The Theory of Planned Behaviour (TPB) in Health Behaviours Related to Airborne Diseases

The Theory of Planned Behaviour (TPB) has three main themes in relation to airborne diseases. They are, namely: 1. Attitude toward airborne disease preventative behaviour, defined as one's evaluation of the behaviour as being either positive or negative; 2. Subjective norms, which refer to one's perceived social pressure to commit the airborne disease preventative behaviour; 3. Perceived behavioural control, defined as one's perception of the act of executing the airborne disease preventative behaviour as either easy or difficult. In Figure 3, these three constructs collectively form one's behavioural intention, the strongest indicator of the individual's behaviour in relation to airborne diseases (Ajzen, 1991).

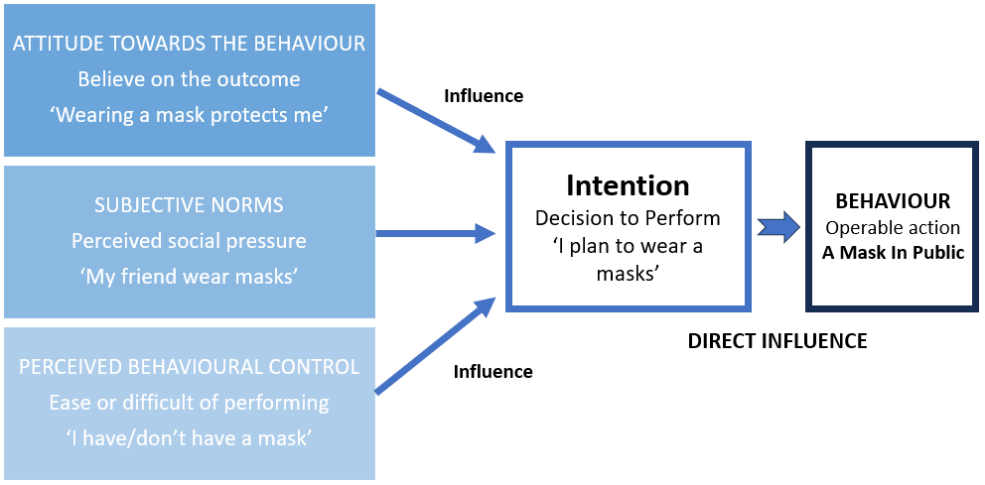

Fig 3. The Theory of Planned Behaviour (TPB) framework in relation to airborne infectious disease control.

According to a quantitative study in Pakistan deploying the extended TPB to perform analysis on the public motivating or demotivating factors to wear face masks during the COVID-19 pandemic, it became evident that attitude and subjective norms were major motivating factors, in addition to the following domains from the extended TPB, which were perceived risks of the pandemic and perceived benefits of the face masks. Demotivating factors were found to be the insufficient supply of face masks and the price of face masks (Irfan et al., 2021).

Similarly, another research focused on Hong Kong elderly usage of face masks to guard against seasonal influenza and employed an integration of TPB and the self-determination theory (SDT) framework. The path analysis results indicated that perceived autonomy support of workers in the senior centre, wherein the staff showed encouragement for the elderly's personal and voluntary choice, strongly led to autonomous motivation to wear face masks via their attitude, subjective norms and perceived behavioural control. Notably, however, possessing the intention to wear face masks did not significantly translate to the act of wearing face masks (Chung et al., 2017).

3.8 The Self-Determination Theory (SDT) in Health Behaviours Related to Airborne Diseases

The Self-Determination Theory (SDT) states that the satisfaction level of three foundational "psychological needs" determines the quality of motivation for an individual, namely "autonomy, relatedness, and competence." Autonomy refers to one's psychological necessity to experience the behaviour as voluntary and self-endorsed, while competence refers to one's psychological necessity to feel capable and have mastery over a goal. Relatedness is defined as one's psychological necessity to feel a sense of belonging and have social connections. Dissatisfaction in these three basic needs may be reflected in poorer motivation to perform a behaviour. Different types of motivation exist on a spectrum termed the "autonomy-control continuum," with intrinsic motivation that is autonomously regulated, producing a more self-determined behaviour as they understand the need for behavioural change, compared to extrinsic motivation (needing controlled regulations) that needs reinforcement for a sustained behavioural change. Similarly, amotivation (lacking regulations) may produce non-self-determined behaviour, whereby actions of prevention are done to avoid trouble, guilt or feeling of being judged (Ryan & Deci, 2018). This model is simplified in Figure 4 below.

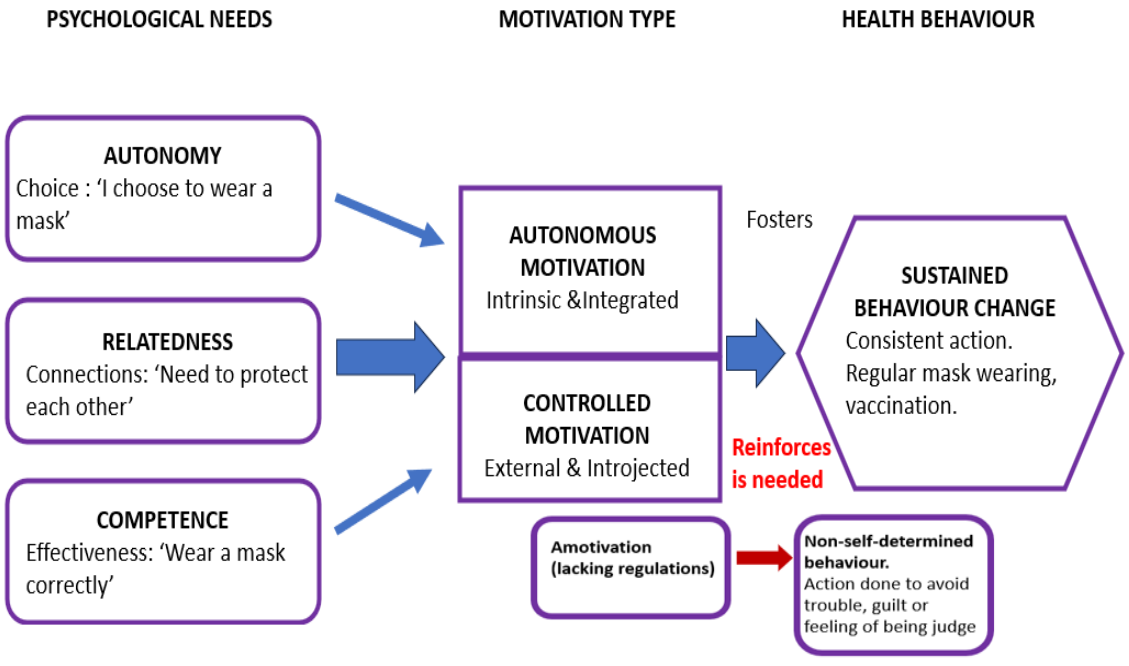

Fig 4. The Self-Determination Theory (SDT) framework in relation to airborne infectious disease control.

Among university students in France, a study investigating their intention to be vaccinated and their influenza vaccine uptake employed the SDT by centring on the two main types of motivation, autonomous motivation (self-endorsed due to one's conviction of the behaviour being beneficial to health) and controlled motivation

(influenced by external pressure such as to follow family member's wishes or internal pressure such as to prevent feelings of guilt). This research found that autonomous motivation and self-efficacy were significantly associated with the intention to be vaccinated and their uptake of the influenza vaccine (Fall et al., 2018).

3.9 Health Behaviours Models: The bottom line for prevention

In short, all four health behaviour models should be combined for behavioural change. Combining their concepts leads to one most important outcome, that is, prevention. These models basically explain the perceived threats, the intention, and the coping mechanism to protect oneself from the infections and a sustained motivation for continuous self-efficacy. However, these models are not clearly highlighted to the community to guide them to come up with community-led airborne infection controls and outbreak prevention. This is due to the complexities of these theories, and providing exhaustive explanations is challenging at the community level for its understanding and applications.

Figure 5 below illustrates the different constructs of health behaviour theories related to airborne diseases that are combined to assist stakeholders in educating the community to come up with specific and targeted community-led interventions for airborne outbreak prevention.

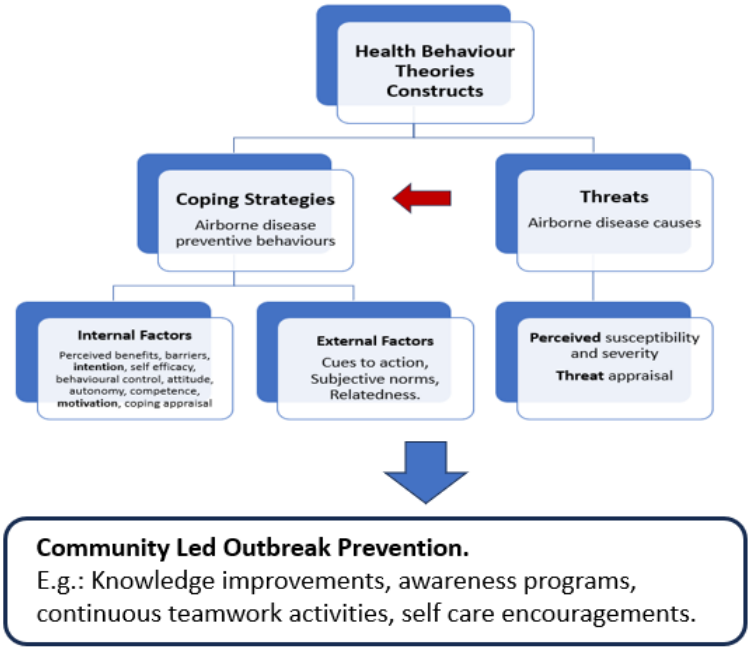

Fig 5. The different constructs of Health Behaviour Models related to airborne diseases, simplified for educating the community for community led preventions.

In summary, research during the COVID-19 pandemic and other airborne diseases demonstrates that health behaviour models provide valuable frameworks for understanding community responses. Collectively, these findings indicate that effective promotion of airborne disease preventive behaviours requires addressing both cognitive perceptions of risks and benefits, that is, by filling the gap of knowledge, as well as addressing motivational factors for sustainability of self-efficacy attitude for prevention. Integrating insights from these theoretical models may therefore enhance the design of public health interventions, but this time led by the community, by tailoring strategies that not only increase awareness of threat severity but also strengthen individuals' confidence, autonomy, and capacity to act, hence enhancing community empowerment for prevention.

3.10 The Intersection of Maqasid al-Shariah, Islamic Ethics, and Behavioral Health Models in Disease Prevention

The mobilization of communities to prevent airborne outbreaks relies heavily on modifying human behavior. In Islamic jurisprudence, this behavioral drive is codified under *Hifz al-Nafs* (preservation of life), a primary objective of *Maqasid al-Shariah*. When evaluating public health models through an Islamic lens, a powerful synergy emerges between empirical behavioral science (*Aqli*) and revealed values (*Naqli*). This intersection can be mapped across several foundational principles:

i) The Principle of Harm Reduction and Legal Responsibility

A main rule in Islamic bioethics is *La darar wa la dirar*, which means "do not harm others and do not harm them in return" (Ibn Majah, hadith 2341). This rule connects closely to health psychology models like the Health Belief Model (HBM) and Protection Motivation Theory (PMT). Usually, these models say that people will only protect themselves from a disease if they believe they are personally at risk and that the illness is severe. However, the rule of *La darar* changes this thinking. It turns a personal health choice into a deep religious duty. Because of this, skipping simple health habits like wearing masks or ignoring indoor air safety is no longer just a personal choice. Instead, it is seen as a moral wrong because it puts other people in danger (Zulfaqar Mamat, 2020).

According to the Theory of Planned Behavior (TPB), our choices are heavily shaped by social pressure from family, friends, and the community. If public health campaigns include the rule of *La darar wa la dirar*, then habits like improving air ventilation, keeping physical distance, and staying home when sick become proud signs of faith. This changes how the whole community thinks. It turns public health rules from annoying laws into shared community values that people follow willingly.

ii) Prophetic Guidance on Epidemics, Quarantine, and Isolation

Community-led disease prevention started very early in Islamic history. This is because the Prophet Muhammad gave clear rules on how to handle major disease outbreaks. His advice directly matches the quarantine and containment rules that modern health experts use today:
"If you hear of an outbreak of plague in a land, do not enter it; but if the plague breaks out in a place while you are in it, do not leave that place."(Sahih al-Bukhari, Hadith Number 5728)

The hadith shows that people must temporarily give up some of their freedom and travel choices to save lives. When we look at this through a psychological framework called Self Determination Theory (SDT), this religious history changes how people view public health rules. SDT states that people will stick to a new habit if it satisfies three basic human needs such as autonomy (feeling in control), competence (feeling capable), and relatedness (feeling connected to others). If a community sees staying home or isolating as a direct way to follow the Prophet's instructions, they do not view quarantine as an annoying government rule that steals their freedom. Instead, they accept it deep down. They choose to isolate themselves willingly out of a personal desire to grow spiritually and protect their neighbors. This internal motivation keeps people following health guidelines for a long time, even after official laws stop being enforced. This stops the "rules fatigue" that usually causes top-down public health plans to fail.

iii) Islamic Ethical Perspectives on Vaccination and Preventive Therapeutics

Islamic law strongly supports vaccination and health precautions. These actions are seen as practical ways to practice *Tawakkul*, which means putting your trust in Allah. Islamic teachings explicitly reject passive fatalism (the belief that you should do nothing because everything is predetermined). Instead, Islam teaches that seeking medical help does not contradict divine decree but rather fulfills it. Proactive interventions like vaccination represent the practical execution of protecting life (*Hifz al-Nafs*) before a crisis occurs (Rizal, Nurdayana et al., 2025; Radhia Nedjai & Kamel Ouinez, 2021). Integrating this theological validation into community-led public health programs directly addresses the perceived barriers component of the Health Belief Model. Misinformation, safety anxieties, and anti-science conspiracy theories can be systematically dismantled when trusted religious scholars validate vaccine safety and efficacy using text-based rulings (*Fatwas*). This validation reinforces an individual's perceived benefits and bolsters self-efficacy, giving community members the confidence to seek out and accept preventive care.

iv) Individual and Collective Responsibility

Effective Good public health systems cannot depend only on individual actions. Instead, they require the whole community to work together. Islamic law matches this dual approach by dividing duties into two categories: *Fard 'Ayn* (individual duties) and *Fard Kifayah* (communal duties). Washing your hands, covering your mouth when you cough, and wearing a mask are individual duties (*Fard 'Ayn*). Every believer must do these things to keep from spreading germs. At the same time, building health monitoring networks, upgrading building ventilation systems, and handing out community aid are collective duties (*Fard Kifayah*) (Kasim, N.M & Rahman, A. A., 2021). If a town fails to set up these big protective systems, the whole community shares the blame for any harm that happens. This two-part structure strongly connects to a psychological idea called Protection Motivation Theory (PMT), specifically a part called coping efficacy. When people see both individual and communal systems working together, it gives them confidence. They feel reassured that their personal efforts are supported by a strong, well-coordinated community network.

v) The Strategic Role of Mosques, Imams, and Religious Leadership

To make local health programs successful, community centers must act as cues to action. In the Health Belief Model (HBM), a cue to action is an event or message that triggers a person to take a healthy step. In Muslim-majority countries like Malaysia, the mosque is a highly trusted information hub. It can quickly teach people how to stay safe during a health crisis. Instead of separating religion from science, mosques can show people how to follow health rules by practicing them during daily prayers. For example, mosques can model safe habits by opening windows for better air ventilation, cleaning surfaces, and asking people to wear masks (Kamarzaman, Mohd et al., 2024). Similarly, Imams and religious leaders have great influence and earn deep community trust. This makes them perfect messengers for public health. When these leaders talk about how airborne diseases spread, encourage vaccines, and explain cleanliness rules directly in their weekly sermons (Khutbah), they connect scientific policies with everyday life. This religious support turns health awareness into an active way to practice faith. As a result, community prevention stays strong and ready for future outbreaks (Mohamad, Shaaban et al., 2025).

4.0 Proposed community-led interventions

Community-led interventions teach communities to take ownership of their health and their surroundings. This will transform them from passive recipients of government aid to active guardians of public health safety. In Malaysia, the Ministry of Health has informed the community on airborne infection control via several methods. For instance, through news and social media. However, these reminders will be more impactful if each community members play their role. Therefore, moving from the theory to practical interventions for outbreak prevention should focus on health measures that are not just obeyed but embraced. Thus, the responsibility should be placed back into the hands of the community members, consequently, enhancing community empowerment. Expectedly, these grounded actions can eventually end outbreaks.

The six practical interventions are: 1. Training of trainers of health ambassadors, whereby educating the local leaders, like the religious leaders, for instance, the 'imam', priest, 'swami', to educate the community, on prevention, particularly in closed areas with high traffic that can be practised in any community area. 2. Most Malaysian loves crowded food stalls, shopping complexes, especially on the weekend, carrying their babies. Therefore, wearing a mask and frequent handwashing are necessary as they should be aware that these areas are a threat and self-protection is compulsory. 3. Structural improvements like exhaust fan installation or open window policies in the community crowded areas, like praying areas is needed as many COVID 19 outbreaks occurred in these areas. 4. 'Ketua kampung', 'Rukun Tetangga', active members or any other community leaders, like in Sabah and Sarawak, Rumah Panjang, should be selected as health ambassadors with close networking with the local government health clinics. 5. 'Neighbour helping neighbour' awareness campaign is necessary as reminders (cues for action) and for emergencies. 6. Vaccination uptake to prevent outbreak complications.

These six suggestions encourage shared responsibility, highlighting a stronger defence against any future airborne outbreak. An empowered community is aware of unexpected threats and has planned coping strategies for any airborne infections.

4.0 CONCLUSION

History has informed us that airborne infections are boundless. The outbreaks are recurrent and disastrous. Evocative community engagement is therefore important to improve responses to public health infection threats and to improve community lived experiences with outbreaks. Health models for behavioural change eloquently guide in understanding community behaviour and assist in moulding these behaviours for self-care and shared responsibilities in preventing inevitable future outbreaks. Stakeholders can implement these models to come up with training modules to train community emissaries for a persistent, impactful behavioural change in the community to prevent future outbreaks. The unrelenting advocacy by emissaries and other learned community members keeps the community's motivation sustained in preventing future airborne infection outbreaks.

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