Evolving Threats: A Review of Major Viral Pandemics from the Spanish Flu to COVID-19

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Abstract

Backgroud: Viral pandemics have historically posed significant challenges to global health, economies, and societal structures. This review meticulously synthesizes findings from scholarly articles that examine various viral pandemics, focusing on those caused by influenza viruses and coronaviruses, including notable examples such as SARS, MERS, and the COVID-19 outbreak.

Aim: The study aimed to review viral pandemics, examining their historical context, causes, transmission dynamics, and control measures, to provide a comprehensive understanding of their shared characteristics and the responses they elicited from health systems around the world

Methods: A comprehensive search was conducted using PubMed and Google Scholar databases, focusing on English-language articles published between 1990 and 2024. The search utilized specific keywords, including "pandemic," "respiratory viruses," "coronavirus," "covid pandemic" to identify relevant studies and reviews.

Results: The Spanish flu of 1918, known for being one of the most lethal pandemics in recorded history, serves as a powerful reminder of the severe consequences that can arise from poorly understood pathogens and underdeveloped healthcare infrastructure. This pandemic led to an estimated 50 million fatalities globally, highlighting the crucial need for preparedness. Subsequent pandemics, like the Asian flu in 1957, the Hong Kong flu in 1968, and the Swine flu in 2009, illustrated the importance of timely interventions, robust surveillance networks, and effective vaccination strategies to control viral transmission. The emergence of MERS and SARS in the last decades underlined the critical need for global health frameworks, as these viruses displayed a concerning propensity for cross-border transmission, escalating into worldwide health emergencies. The COVID-19 pandemic, which emerged in late 2019, dramatically shifted the focus of public health strategies, underlining one more time the necessity of clinical research into viral mutations and the importance of healthcare system preparedness. The unprecedented global collaboration to develop vaccines in record time showcased the power of international partnership in addressing such crises. The pandemic also underscored the necessity of equitable vaccine distribution to achieve global herd immunity.

Conclusion: Through a detailed analysis of past and present pandemics, this review underscores the vital importance of early detection systems, swift response mechanisms, and sustained global cooperation aimed at minimizing the public health, social, and economic ramifications of future viral outbreaks. The findings emphasize that continuous research, enhanced surveillance methodologies, and strategic emergency preparedness plans are essential to effectively combat emerging viral threats and safeguard public health worldwide. **(TCM-GMJ June 2025; 10 (1): P50-P56)**

Keywords: pandemic, respiratory viruses, coronavirus, covid pandemic

Introduction

Viral pandemics have presented substantial challenges to global health, economies, and societies throughout history (1). The rapid spread of infectious diseases caused by viruses has led to widespread morbidity and mortality, often overwhelming healthcare systems and disrupting daily life. Starting from Influenza pandemics in 1918 till last outbreaks of COVID-19, viral infections have demonstrated their ability to rapidly evolve, cross borders, and impact populations globally (2).

Understanding viral pandemics requires an interdisciplinary approach encompassing epidemiology, virology, public health policy, and medical interventions. The emergence of new viruses is often linked to factors such as globalization, urbanization, climate change, and human-animal interactions (3). Zoonotic viruses, which originate in animals and spill over into human populations, have been responsible for some of the most devastating pandemics, including SARS, MERS, and COVID-19 (4).

The impact of viral pandemics extends beyond health

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concerns, affecting economies, education systems, and mental well-being. Governments and health organizations have employed various strategies to control outbreaks, including quarantine measures, vaccination programs, and public health campaigns (5,6). However, challenges such as misinformation, vaccine hesitancy, and healthcare disparities continue to hinder effective pandemic response (7).

This article provides a comprehensive review of viral pandemics, examining their historical context, causes, transmission dynamics, and control measures. By analyzing past and present pandemics, we aim to highlight key lessons that can inform future pandemic preparedness and response efforts. The review also discusses the role of scientific advancements, international collaboration, and public health policies in mitigating the impact of emerging viral threats. Understanding abovementioned key points is crucial for developing more flexible strategies to detect, and respond to possible next pandemics, ultimately safeguarding global health.

Methods

A comprehensive search was conducted using PubMed and Google Scholar databases, focusing on English-language articles published between 1990 and 2024. The search utilized specific keywords, including "pandemic," "respiratory viruses," "coronavirus," "covid pandemic" to identify relevant studies and reviews. This methodology ensured a thorough examination of the literature pertaining to various viral pandemics, such as the Spanish flu, Asian flu, Hong Kong flu, Swine flu, and the COVID-19 pandemic, as well as viruses like Influenza A subtypes (H1N1, H2N2), SARS-CoV, MERS-CoV, and SARS-CoV-2.

Results and discussion

In past 5 years, millions of people were profoundly affected by the widespread emergence of viral diseases. Among these, acute respiratory tract infections (ARTIs) stand out as the most prevalent, affecting individuals across all age groups and genders (9,10). These severe illnesses are triggered by a wide range of microorganisms, including various bacteria and viruses such as *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Moraxella catarrhalis*, along with well-recognized pathogens like Influenza A and B, respiratory syncytial virus (RSV), parainfluenza, adenovirus, and coronaviruses (11). Of particular concern are the highly contagious nature and potential for medical emergencies posed by respiratory syndrome viruses, influenza A and B, and coronaviruses (12).

Influenza Virus

Influenza is a highly transmissible respiratory infection caused by multiple virus strains belonging to the *Orthomyxoviridae* family. The impact of this condition extends beyond seasonal bouts, leading to widespread epidemics and notable morbidity and mortality rates across the globe (13). Certain groups, including children, the elderly, pregnant women, and individuals with preexisting health conditions such as chronic respiratory or cardiovascular diseases, are at increased risk of severe illness and complications (14). There are four main types of Influenza viruses: A, B, C, and D. Influenza A viruses are classified into subtypes based on variations in two surface proteins: hemagglutinin (HA) and neuraminidase (NA). With 18 identified HA subtypes and 11 NA subtypes, numerous possible combinations exist (15). This extensive diversity allows influenza A viruses to infect various animal species, including wild birds, domestic poultry, pigs, and humans, significantly contributing to their potential for causing pandemics. Influenza B viruses, in contrast, primarily infect humans and are mainly divided into two lineages: B/Yamagata and B/Victoria, rather than subtypes (16). Influenza C and D viruses are considered less clinically significant; Influenza C typically causes mild respiratory illness, whereas Influenza D primarily affects livestock and does not infect humans. Influenza types A and B usualy cause the seasonal influenza epidemics commonly observed in human populations. Influenza A strains, particularly those that acquire novel mutations or reassortments, have historically posed serious pandemic threats. The virus predominantly targets the epithelial cells of the respiratory tract, resulting in a range of symptoms and complications. The immune response to influenza comprises both innate and adaptive immunity. The innate immune system serves as the body's primary line of defense, utilizing mechanisms such as interferon production and natural killer cells to combat early infection. The adaptive immune response follows, B cells become activated, which produce antibodies against specific viral antigens, and T cells, which eradicate infected cells and provide long-lasting immunity (18). However, the rapid mutation rate of influenza allows the virus to change its surface proteins frequently, a phenomenon known as antigenic drift, enabling it to evade recognition by the immune system. This ability to mutate contributes to recurrent infections and seasonal epidemics, as the population's immunity from previous infections or vaccinations becomes less effective over time. Clinically, influenza typically presents with a sudden onset of symptoms such as fever, cough, sore throat, muscle aches, severe headache, and extreme fatigue. While most individuals recover within a week, the illness can lead to severe health complications, especially among high-risk groups. Potential complications from influenza include viral pneumonia, secondary bacterial pneumonia, acute respiratory distress syndrome (ARDS), and exacerbation of concomitant medical conditions such as asthma, diabetes, and cardiovascular disease (19). Young children are particularly vulnerable to severe illness due to their immature immune systems, while older adults may also experience complications due to age-related decline in immune function. Pregnancy is associated with higher risk for hospitalization and severe outcomes, as pregnancy induces physiological changes that affect the respiratory and immune systems (20). Severe cases of influenza may require hospitalization, with patients often needing intensive care, particularly if they experience respiratory failure or multi-organ dysfunction.

Wild aquatic birds, particularly migratory species such as ducks and geese, are the primary hosts for influenza

viruses. These birds can harbor various strains without exhibiting clinical signs of illness. When influenza viruses jump from these birds to mammalian species, various circumstances—including changes in the environment, genetic reassortment, and co-infection with other viruses—can support development of new strains that due the adaptation to new host species can persist for extended periods, sometimes even decades (21). Throughout history, different strains of influenza have caused numerous pandemics, leading to significant mortality and societal disruption. The earliest significant influenza pandemic emerged in Russia during the winter of 1729 and quickly spread across Europe and eventually reached the rest of the world. This outbreak occurred in two waves and resulted in considerable mortality, marking the beginning of the public's awareness of influenza as a serious health threat. The second pandemic in this timeline began in Southeast Asia in the late 18th century and quickly spread to Russia and Eastern Europe, characterized by a high transmission rate among younger populations, although its mortality rate was relatively low. In the 19th century, several pandemics were recorded, including the Great Pandemic of the winter of 1830. This pandemic similarly originated in Southeast Asia, spreading through Russia and Europe to other parts of the globe within a year. The infection rate surged, but the mortality rate remained manageable. Another significant outbreak occurred in 1889, beginning in Russia and subsequently spreading to Europe and North America, resulting in approximately 1 million estimated deaths worldwide (22). Today, influenza continues to be a major public health challenge. Seasonal epidemics impose considerable burdens on healthcare systems and economies, while the virus's high mutation rate and zoonotic potential—its ability to jump from animals to humans—pose ongoing risks for the emergence of new pandemic strains. As such, continual monitoring, vaccination efforts, and research into antiviral treatments remain critical components of public health strategies aimed at mitigating the impact of influenza (23).

Pandemics of Influenza pose significant challenges to global health, resulting in widespread illness and devastating mortality rates (23). Unlike seasonal flu, which strikes every year, pandemics only happen when novel influenza virus arises, rapidly spreading through populations that lack prior immunity. Historically, influenza pandemics have profoundly shaped societies, most notably the 1918 Spanish flu, with estimated 50 million deathes. Other significant events include the 1957 Asian flu, the 1968 Hong Kong flu, and the 2009 H1N1 pandemic (24) (Fig.1). The swift transmission of pandemic flu is fueled by mutations and genetic reassortment in influenza viruses, often stemming from zoonotic reservoirs like birds and pigs. Effective public health responses—including vaccination, antiviral treatments, social distancing and mask mandates—are vital to controlling the spread and minimizing impact.

Spanish Flu (1918)

The Spanish Flu, swept across the globe in 1918. This influenza pandemic resulted from a newly emerged strain of the influenza A virus, which is believed to have originated from an avian source (16). The first wave of infections emerged in early 1918, initially causing not severe illness. After in Fall 1918 the second wave emerged and that proved to be particularly catastrophic. This wave was marked by a sharp spike in mortality rates and the rapid progression of severe symptoms (25). It is estimated that the pandemic resulted in the deaths of between no less than 50 million people worldwide, a staggering toll that represented nearly from 3 to 5% of the world population in 1918 (26). In notable departure from typical seasonal influenza patterns, the Spanish Flu exhibited a particularly high fatality rate among young adults aged 20 to 40, a demographic usually associated with lower mortality in influenza cases. This unusual trend is thought to be linked to a phenomenon known as a cytokine storm, an Excessive immune response that can cause severe inflammation and tissue damage. This overwhelming immune response often led to acute respiratory failure and severe lung damage in otherwise healthy individuals, resulting in death in a matter of days (27). Clinically, the manifestations of the Spanish Flu mirrored those of standard influenza but were often more alarming and intense. Common symptoms included high fever, persistent cough, sore throat, debilitating headache, and extreme tiredness. In its more severe forms, the infection could lead to pneumonia, acute respiratory distress syndrome (ARDS), and cyanosis due to inadequate oxygenation, often culminating in death shortly after the onset of symptoms (28). The predominant causes of mortality during the Spanish Flu pandemic, beyond primary viral pneumonia, were secondary bacterial infections. This was particularly deadly due to the absence of effective antibiotics, as such treatments were not developed and widely available until later in the middle of past century (28). The precise virus origins remain a subject of debate among historians and scientists. Contrary to popular belief, it is unlikely that the virus emerged in Spain, despite its name. Instead, historical records suggest that the virus may have spread from the United States military camps during World War I, where crowded conditions and troop movements facilitated transmission. The first instances of the disease were reported in U.S. military camps, leading to subsequent outbreaks in Europe and around the world (29). Various theories have also proposed possible origins in China, France, or the United Kingdom. Spain was one of the few European nations to remain neutral throughout World War I, which allowed its press to operate without censorship. Consequently, Spanish media produced extensive coverage of the pandemic, detailing its spread and effects by late May 1918. As information flowed through global channels, many people erroneously linked the outbreak to Spain, solidifying the misconception that Spain was the source of the virus (30). Diagnostic capabilities during the pandemic were severely limited, as physicians relied heavily on clinical observations and the identification of symptoms rather than on laboratory testing and virology. Unfortunately, treatment options at the time were largely

ineffective, and the lack of effective antiviral medications or vaccines available led to an extraordinarily high mortality rate during this tragic and unprecedented public health crisis (30).

Asian Flu (1957)

The Asian flu, also referred to as the 1957–1958 influenza pandemic, was caused by the H2N2 subtype of the influenza A virus, marking it as one of the most significant influenza pandemics of the 20th century. The pandemic first emerged in East Asia, particularly in the southern provinces of China, and swiftly propagated worldwide, leading to significant illness and death. Especially vulnerable to the diseases were populations like the elderly and those with pre-existing medical conditions.

(31). Unlike the more catastrophic pandemics of 1889 and 1918, the Asian flu exhibited a notably lower number of deathes. This can be explained by various factors including advancements in medical understanding and public health responses. The scinetists suggest that the H2N2 virus emerged from reassortment of avian influenza viruses residing in wild ducks, which subsequently adapted to infect humans through various ecological and environmental factors (32). This reassortment allowed the virus to obtain genetic material from both avian and human sources, resulting in a novel strain capable of evading the human immune system. The antigenic distinctiveness of the H2N2 strain meant that the global population had minimal to no pre-existing immunity, facilitating its rapid and unchecked spread across continents. The extensive mobility of troops during the Korean War further accelerated this global transmission, as soldiers carried the virus to different regions. The H2N2 virus proved to be highly contagious among humans, with the World Health Organization (WHO) reporting that "the virus was primarily transmitted via respiratory droplets expelled during coughing and sneezing". This transmission method was particularly effective in densely populated urban areas, leading to swift outbreaks (29). The first wave of infections peaked in late 1957, driven by close contact in crowded environments, while a second wave followed in early 1958, further compounding its impact. The elderly—especially those above 65 years—along with individuals suffering from chronic diseases, faced heightened risks of severe illness and complications (30). By mid-1958, the virus had infiltrated most parts of the globe, resulting in an estimated 1 to 2 million deaths worldwide (30). These fatalities were mostly linked to secondary bacterial pneumonia, as well as exacerbation of chronic medical conditions such as asthma and heart disease (33). The clinical presentation of the Asian flu was akin to that of other influenza infections, Usually marked by the rapid appearance of symptoms including high fever, persistent cough, sore throat, profound malaise (33). Although most cases were mild to moderate, instances of severe complications, such as viral pneumonia and bacterial superinfections, were prevalent, particularly among the most vulnerable populations. The relatively low mortality rate associated with the Asian flu pandemic can also be linked to significant improvements in clinical medicine and public health infrastructure. Countries developed extensive networks of laboratories connected to major research institutions, such as the Influenza Research Centre in London, allowing for real-time monitoring and study of emerging influenza strains. Despite these advancements, the vaccine development process was initially sluggish. The creation of a vaccination technique for

the H2N2 virus represented a critical public health breakthrough during the pandemic. The first vaccines became available in late 1957, and mass production and distribution efforts were initiated shortly thereafter. These vaccination campaigns were instrumental in slowing the virus's proliferation and significantly reducing the mortality rate. By early 1958, the concerted efforts to immunize at-risk populations played a key role in the overall decline in infection rates, demonstrating the effectiveness of vaccination in managing infectious disease outbreaks (34).

Hong Kong Flu (1968)

The Hong Kong flu pandemic in years 1968–1969 is considered to be causative factor again influenza A virus but H3N2 strain, marked a significant global health crisis with far-reaching consequences. This strain arose from a genetic reassortment of the H2N2 strain that had previously led to the Asian flu pandemic of 1957. The H3N2 virus was notable for its rapid transmission and generally lower mortality rate compared to previous influenza pandemics, which enabled it to spread widely across various populations (35). The reassorted strain incorporated genetic material from both avian and human influenza viruses, allowing it to adapt and evade the pre-existing immunity in the humans, resulting in substantial outbreaks (24). Pandemic was less lethal compared to the Asian flu, however its rapid spread was significantly facilitated by the increase in international air travel, which was common during that era. Estimates suggest that the death toll from this pandemic ranged from 500,000 to two million people globally, comparable to the earlier Asian flu pandemic. The outbreak unfolded in two primary waves; it originated in Hong Kong in July 1968, before spreading quickly to the United States, primarily via returning U.S. Army soldiers from the Vietnam War. From the United States, it disseminated in dofferent countries. Emong them were the United Kingdom, Canada, Japan, France, Australia and numerous other countries. The virus also exhibited an alarming mortality rate among younger populations, with the highest fatalities recorded in children—a demographic often overlooked in influenza-related mortality statistics. Clinically, the symptoms of Hong Kong influenza resembled those of seasonal influenza. Most cases were mild, and patients typically recovered without complications within one to two weeks. Severe cases could escalate quickly, potentially leading to pneumonia, acute respiratory failure, and increased hospitalizations (36). Moreover, during the Hong Kong influenza pandemic, a significant proportion of the mortality was attributed to secondary bacterial infections, notably bacterial pneumonia, which compounded the effects of the viral infection. These secondary infections often led to severe illness and were a critical factor in the overall death toll associated with the

pandemic (30). The interplay between the influenza virus and these secondary infections highlighted the need for comprehensive public health strategies in managing influenza pandemics and safeguarding vulnerable populations.

Swine Flu (2009)

Swine flu, officially names as the 2009 H1N1 influenza pandemic, represented a significant global health crisis that emerged in the spring of 2009. This pandemic was triggered by a new strain of the influenza A virus (H1N1), which contained genetic material from avian, swine, and human influenza viruses.

(37). Unlike previous influenza pandemics, which often had severe effects on the elderly, the 2009 H1N1 virus notably affected younger populations, particularly children and young adults, leading to substantial morbidity and mortality on a worldwide scale. Swine flu primarily spreads through respiratory droplets released when an infected person coughs, sneezes, or speaks. It can also be transmitted indirectly by touching virus-contaminated surfaces and then touching the face (38). This mode of transmission underscores the importance of individual hygiene practices and public health measures in controlling the outbreak. In contrast to seasonal influenza, which typically sees a higher mortality rate among older adults, swine flu exhibited an unusual age distribution pattern. This phenomenon may be attributed to pre-existing immunity in older individuals who had encountered similar strains of the virus earlier in life (39). The clinical presentation of swine flu was largely akin to that of seasonal influenza (40). Notably, some patients experienced gastrointestinal symptoms: vomiting and diarrhea, which are comparatively rare typical cases of influenza virus infection. While the majority of infections presented as mild, severe cases and complications occured more frequently among vulnerable populations—specifically pregnant women, patients with comorbidities nad those with weakened immune systems (41). Research utilizing animal models has revealed that the H1N1 virus demonstrates remarkable efficiency in replicating within both the upper and lower respiratory tracts. This replication capacity is associated with the development of severe respiratory symptoms in some individuals (42). The ability of the virus to infect the lower respiratory tract and induce widespread inflammation was critical in determining the disease's severity, as it led to significant respiratory compromise. Secondary bacterial infections, particularly pneumonia, emerged as a major cause of both morbidity and mortality during the swine flu pandemic (41). These secondary infections complicated the clinical picture and required careful management alongside antiviral treatments. Vaccination served as a cornerstone of the public health response to the swine flu pandemic. In record time, a monovalent H1N1 vaccine was developed, tested, and distributed to the public in the fall of 2009, just months following the virus's identification (41). The swift development of the vaccine was facilitated by previous research on related influenza viruses. In addition to vaccination efforts, antiviral medications such as oseltamivir and zanamivir were employed to treat infected individuals and reduce the likelihood of severe complications. Within months, swine flu spread to 122 countries, leading to an estimated infection rate of approximately 134,000 people and resulting in nearly 800,000 deaths. The pandemic exhibited a distinct wave-like pattern, with surges in cases occurring in waves globally. Alarmingly, this pandemic also highlighted particularly high mortality rates among young people, notably children and pregnant women. However, the outbreak was marked by a heightened global state of preparedness, with health authorities and governments implementing extensive public health measures to mitigate the impact of the virus. Ultimately, the overall death rate from swine flu was lower than initially projected, largely due to the relatively mild nature of many infections. Clinical diagnosis of swine flu was confirmed through laboratory tests, including PCR (polymerase chain reaction) testing, which is recognized as the gold standard for accurate diagnosis (43). The experience gained from the 2009 pandemic has significantly influenced ongoing research and preparedness for future influenza outbreaks.

Coronaviruses have been recognized as causative agents of human infections since the 1960s. Yet, it is only in the past two decades that their potential to trigger deadly epidemics has come into sharper focus. Four human coronaviruses (HCoVs)—HCoV-229E, HCoV-NL63, HCoV-OC43, and HCoV-HKU1— are usually linked to mild respiratory infections commonly referred to as the common cold. In the begining these viruses cause self-limiting upper respiratory tract infections, though they can lead to severe lower respiratory tract infections among susceptible populations like immunocompromised individuals, elderly people, infants (44). While the global impact of COVID-19 has been extraordinary, it is important to note that this is not the first instance of a zoonotic coronavirus spilling over to infect humans. Altogether, seven different human coronaviruses are known. Among these, three are particularly notorious for their high pathogenicity: severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome coronavirus (MERS-CoV), and SARS-CoV-2, responsible for coronavirus disease 2019 (COVID-19). The other four viruses, including HCoV-229E, HCoV-OC43, HCoV-NL63, and HCoV-HKU1, generally exhibit low pathogenicity. This ongoing evolution of coronaviruses highlights their genetic penchant for potentially becoming highly virulent in humans (45).

SARS-CoV

SARS-CoV first emerged in 2002 in Guangdong, China, sparking a global occurrence of severe acute respiratory syndrome (SARS). The virus spread like wildfire in dozens of countries, culminating in more than 8,000 cases and nearly 800 fatalities by 2003. The case fatality rate (CFR) for SARS-CoV reached an alarming approximate level of 10% , emphasizing its lethal potential (46).

MERS-CoV

Following the initial MERS outbreak in the Middle East

in 2012, two significant waves took place: Firs one occurred in 2015 in South Korea and another - in 2018 in Saudi Arabia, along with sporadic cases that surfaced intermittently. As of January 15, 2020, the World Health Organization documented 2,506 confirmed cases of MERS, with a staggering mortality rate of around 34%. Similar to SARS, MERS symptoms can include severe respiratory distress; however, it is particularly notorious for its higher incidence of acute respiratory distress syndrome (ARDS) and multi-organ failure (47).

SARS-CoV-2

The most devastating representative of this viral family - SARS-CoV-2, was first identified in Wuhan, China, in December 2019 amidst reports of unusual pneumonia cases. This virus, responsible for causing the global pandemic of coronavirus disease 2019 (COVID-19), resulted in far-reaching public health, economic, and social ramifications. Initially dubbed "Wuhan pneumonia" because of its symptoms, it was later confirmed through genomic sequencing that the causative agent was a novel coronavirus, designating it as the seventh member of the coronavirus family recognized to cause disease in humans.

This cunning virus evolved for several months prior to making its rapid ascent as a global threat. SARS-CoV-2 is distinguished by its remarkable transmissibility and its ability to manifest a wide spectrum of outcomes—from asymptomatic infections to life-threatening pneumonia, ARDS, and even death (48). The clinical signs of COVID -19 ate like the signs indetified in SARS, with common symptoms encompassing fever, sore throat, cough and shortness of breath. Approximately 80–90% of infected individuals experience mild symptoms, while around 20% require to be hospitalized (49). Notably, the number of deathes caused by COVID-19 is lower than that of SARS, however different data exist about the mortality rates in countries (49). The incidence of COVID-19 escalates significantly with advancing age. It is crucial to highlight that COVID-19 is far more contagious than SARS, and this can be attributed to several key factors. Firstly, the incubation period for SARS-CoV-2 varies from 4 to 12 days, considerably longer than the 2 to 7 days seen for SARS-CoV. Secondly, high viral loads for SARS-CoV-2 are often detected at the onset of symptoms and decline swiftly over the following week, while viral loads for SARS-CoV typically peak 1 to 2 weeks post-symptom onset. This difference complicates the processes of case isolation and contact tracing for COVID-19 (50). Finally, there can be indetified patients with infection of SARS-CoV-2, which exhibit no symptoms, can be presymptomatic, and even only show slight symptoms while still being capable of transmitting the virus, unlike SARS-CoV, which usually results in severe illness requiring hospitalization (49). On March 11, 2020 the World Health Organization declared COVID-19 a global pandemic. This pandemic has unleashed unprecedented challenges worldwide—affecting public health systems, economies, and social structures in ways previously unimaginable (51).

Conclusion

The history of viral pandemics, spanning from the Spanish flu to COVID-19, starkly reveals the persistent dangers posed by respiratory viruses. Each pandemic serves as a powerful reminder of the essential lessons in public health preparedness, the importance of vaccination, and the necessity for global cooperation. Despite remarkable advancements in medicine, we still face significant challenges in surveillance and response. It is imperative that we strengthen our healthcare systems, promote widespread vaccination, and invest in innovative research. Only by taking these critical steps can we effectively mitigate future outbreaks and safeguard global health against emerging infectious diseases.

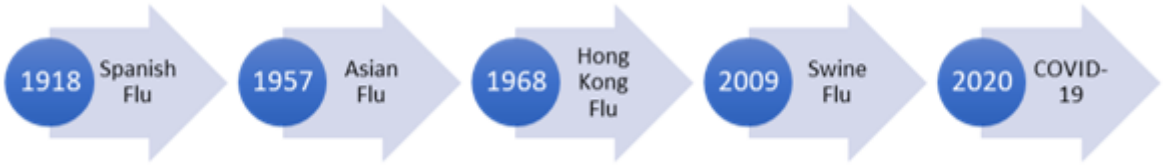

Fig. 1 Flu Pandemics in world history

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