International Journal of Medical Sciences And Clinical Research

VOLUME Vol.05 Issue12 2025
PAGE NO. 157-162
DOI 10.37547/ijmscr/Volume05Issue12-34

Measures To Combat Viral Diseases And Prospects For Their Improvement

Zukhra Nuruzova Abdukadirovna

Head of the Department of Microbiology, Virology and Immunology of Tashkent State Medical University, Doctor of Medical Sciences, Professor, Uzbekistan

Received: 30 October 2025; **Accepted:** 26 November 2025; **Published:** 31 December 2025

Abstract: The world has seen the rise and reemergence of numerous infectious diseases that were either nonexistent or reemerging in recent decades, for which there are few prompt and efficient prophylactic interventions. In order to develop efficient preventative and therapeutic measures, the WHO has released a list of priority infections that are likely to cause future epidemics. A thorough grasp of the aetiology, epidemiology, and pathophysiology of the target disorders serves as the foundation for the reasoning for these therapies. While it is crucial to recognize the critical role that evolutionary changes in pathogens play, it is just as important to recognize the impact of a complex interaction of circumstances on the emergence and recurrence of infectious diseases. These include shifts in the human population, exposure vectors and reservoirs, and environmental changes. The aetiology, epidemiology, and pathophysiology of the ten WHO priority diseases—including HIV/AIDS, TB, and malaria—as well as those with high epidemic potential that are already the subject of particular control program activities are summarized in this overview. Additionally, this evaluation focused on how public health surveillance and response systems may be used to combat these illnesses. In order to effectively control transmission, such systems must be built to quickly identify odd and unexpected illness patterns, track and communicate information in real time, and mobilize global reactions. In addition to the creation of particular vaccinations, the goal of this narrative review is to explore the literature for antiviral tactics that could slow the spread of infection chains. In the event of future viral pandemics, the suggested interventions—such as the use of TMPSSR2 inhibitors, antiviral mouthwashes, or high-affinity cholinergic ligands—may prevent and treat post-acute infection syndromes in addition to preventing the emergence of viral resistance to vaccines.

Keywords: Public health emergencies, priority diseases, pandemics, epidemics, infection control, mobilize global reactions.

Introduction: The evolution of humanity has been significantly impacted by infectious illnesses. The introduction of measures like better nutrition, sanitation, vaccines, and antimicrobials has created the false impression that infection risk is limited to developing countries or that humanity has definitively defeated microorganisms. However, given the permanence of both new and re-emerging infectious epidemics, the claim that the risk of infection is limited to developing countries is clearly false. Two types are referred to as "emerging and re-emerging infectious diseases." Novel pathogens are the cause of newly emerging illnesses. Microorganisms resurfacing after a period of decline are the source of reemerging infectious illnesses. The CDC defines infectious diseases as those that have either been more common among people in the last 20 years or are expected to do so in the future. From an epidemiological standpoint, the distribution of infectious diseases varies. An epidemic is characterized as the frequent, localized, but time-limited manifestation of an infectious disease that happens when the number of cases in a community increases—often abruptly—beyond what is typically expected [1-6]. The word "pandemic," on the other hand, comes from the Greek words pân, which means all, and dêmos, which means people. It refers to the extensive spread of a disease over several continents or, more broadly, over large geographic regions of the world. The World Health Organization (WHO) released a plan in 2018 that listed the following illnesses as the most significant in the world: Rift Valley fever (RVF), Zika, Ebola virus disease (EVD), malaria (MVD), Crimean–Congo hemorrhagic fever (CCHF), Middle East respiratory syndrome (MERS), severe acute respiratory syndrome (SARS), Nipah virus (Nipah), henipaviruses, and "Disease X," an unidentified illness. On March 11, 2020, the WHO proclaimed the most current pandemic due to a novel strain of coronavirus (SARS-CoV-2). The world community has seen multiple infectious disease outbreaks and resurgences in recent decades, which have presented serious threats to both the global economy and health security. Among the notable epidemics that have surfaced are the following: Middle East respiratory syndrome (MERS), which first appeared in Saudi Arabia in 2014; H1N1 swine flu, a pandemic that started in Mexico in 2009; and SARS (severe acute respiratory syndrome), which first appeared in China in 2002 [7-12]. The following illnesses have also raised serious concerns about world health in addition to the previously stated epidemics: Crimean–Congo hemorrhagic fever (2022), Rift Valley fever (2019), Zika virus (2015), Lassa virus (2018), Marburg virus disease (2018), and Ebola virus disease (2013–2016). Apart from the aforementioned illnesses, it is crucial to take into account additional fatal infectious diseases as hantavirus and monkeypox. Simultaneously, the worldwide availability of effective vaccines has made it easier to safely stop the spread of illness and lessen the severity of COVID-19 cases. However, an equally hazardous societal division quickly developed due to the limited time available to provide the public with sufficient psychoeducation and the widespread anxiety of the seemingly uncontrolled threat of infection. People who rejected the reality of infection, supported vaccination, refused to wear masks, or opposed vaccination were examples of the formation of social dissent. Previously secure social ties, including personal ones, were frequently unable to take the strain as a result of the swift escalation of this social turmoil, which led to the creation of hostile groups [13-19]. Furthermore, social contact limits had significant negative effects on both younger and older generations in retrospect, and they were often insufficiently effective to warrant their application. In conclusion, both supporters and opponents of the political, social, and medical systems have seen a significant decline in confidence as a result of the aforementioned circumstances. Our social systems and social cohesiveness have become unstable as a result of this mistrust. This article reviews recent research on the mechanistic routes of viral infection from a universal perspective. Opportunities to mitigate acute viral infections on an individual basis and to stop the spread of infections within human cohorts will be found that go beyond the creation of vaccinations. Many easily implementable interventions were found in the literature review. By lowering the rates of endemic pathogen transmission, investigating and putting these strategies into practice could be a crucial step in averting another pandemic [20-25].

The main purpose of the presented manuscript is a brief analysis based on the results of reputable scientific research on the importance in medical practice of measures to combat viral diseases and the prospects for their improvement, as well as side effects and disadvantages associated with their use.

How and Why Infectious Diseases Emerge and Re-Emerge. In the perspective of human history, epidemics are a natural occurrence. Even though infectious diseases have had a significant influence on human history, there is still little communal recollection of these illnesses. This is because pandemics are uncommon. The Spanish flu pandemic of 1918–1920, which killed an estimated 40 million people worldwide, and the more recent pandemic, the global new coronavirus crisis (SARS-CoV-2), which is expected to kill over 6.7 million people between 2020 and 2022, are two prominent examples. According to historical research, most illnesses have developed over millennia in tandem with the growth and development of interactions between people, animals, and their surroundings. It has been demonstrated that infectious illness onset and reemergence are complex phenomena. Between 60% and 80% of newly discovered infections are thought to have animal origins, indicating that zoonotic origin is a major source of newly discovered diseases. Humans can contract a possibly developing pathogen through direct contact with sick animals[5-11]. As an alternative, indirect infection can happen via a vector or by consuming tainted food or water. In this regard, the methods used to obtain, store, or process food and water have a significant impact on the transmission process. A pathogen may undergo a variety of genetic changes during its evolutionary process, such as single nucleotide substitutions, gene acquisition from other organisms, and recombination and reassortment processes. Numerous epidemiological effects, including spillover and outbreaks, can be impacted by these evolutionary changes. Antimicrobial-resistant microorganisms and parasites have emerged as a result of the selection pressure these drugs exert. Moreover, rapid evolution of novel varieties might result from diseases with a high rate of mutation. This phenomenon is especially noticeable in RNA viruses, such as coronavirus, influenza, and flavivirus, which are characterized by their high genetic variability and consequent impact on vector and/or host competence, leading to significant consequences for their spread among human populations. The origin and reemergence of infectious diseases are driven by a complex interplay of elements that can be conceptualized as the human environment, in addition to the evolution of pathogens. Numerous elements, many of which are also impacted by other disorders, have a significant impact on the formation of such diseases. These include, but are not limited to, the processes of urbanization, population increase, globalization, and climate change, all of which can result in the concentration of people in unsanitary metropolitan areas. Demographic changes, such as an aging population and a rise in immunocompromised people, are other host-related factors that are noteworthy [13-21].

Infectious Diseases and Conflict. A concerning pattern in the recent outbreaks of several infectious pathogens on the continent is revealed by a new analysis of the European Centre for Disease Prevention and Control's (ECDC) Surveillance Atlas of Infectious Diseases. The atlas reveals a return of formerly circulating infections, some of which exhibit concerning tendencies in their prevalence. While some diseases, like tuberculosis, which is a major cause of death globally, do not appear to be declining, other diseases, including sexually transmitted infections, are resurfacing with an increase in incidence that has doubled or tripled in the post-COVID-19 era.For example, 41,051 cases of syphilis, 230,199 cases of chlamydia, 96,969 cases of gonorrhea, and 28,751 cases of hepatitis C virus infection were recorded in the European Union/European Economic Area (EU/EEA) in 2023. It is crucial to recognize the important but frequently disregarded feature of the many conflicts that have taken place and are now taking place in different parts of the world in light of the global spread of infectious illnesses [13-18]. The disastrous effects of the link between infectious diseases and warfare have a well-established and recorded history. Therefore, understanding the connection between these two events is crucial. The onset of war creates a number of circumstances that lead to the spread of infectious illnesses, mostly through altering the living conditions of the impacted people. Public health is severely impacted by war, and long-term hostilities can make infections that are normally avoidable by immunization challenging. The recent hepatitis B and measles outbreaks in Yemen and Syria, respectively, serve as prime examples of this phenomenon. We are more vulnerable to the spread of new or reemerging infections when sanitation facilities are destroyed or overcrowded, food and clean water are few, and sanitary conditions are subpar. Furthermore, infections can spread over a huge geographic area as a result of high-scale human movements, whether they be refugees or military forces. Epidemics have a major effect on how conflicts turn out, making impacted populations more vulnerable 21-25].

Pathogens with the potential for pandemics and epidemics. The genus Flavivirus includes the Zika virus (ZIKV). In 1947, this encapsulated, single-stranded RNA arbovirus was discovered in a rhesus monkey in Uganda's Zika jungle. The next year, in 1948, the virus was discovered in Aedes africanum mosquitoes in the same area. Only occasional, moderate cases of infection were reported in Asia and Africa over the decades that followed its discovery. However, the first significant epidemic outside of Africa was in the Yap Islands in Micronesia (Pacific Islands) in 2007. Significant subsequent outbreaks in Brazil (2015) and French Polynesia (2013) confirmed the virus's capacity to arise and propagate among people. Most ZIKV infections are either mild, non-specific, or asymptomatic [7-11]. Fever, arthralgia, rash, and conjunctivitis are possible symptoms. These usually go away in two to seven days, although sometimes more serious symptoms may appear. The bite of an infected mosquito is how ZIKV is spread. On several continents, the Zika virus (ZIKV) is spread by mosquitoes belonging to the Aedes genus. There are two cycles in which mosquitoes spread ZIKV: the urban cycle and the sylvatic cycle. The Aedes aegypti and Aedes albopictus species are the primary ZIKV vectors in the latter cycle. The vector feeds on infected humans, which then spreads the virus to other people and mosquito populations, facilitating the spread of infection. The effectiveness of urban transmission between people and the virus's affinity for the urban vector, Aegypti, may have been influenced by an adaptive evolutionary process. This would account for the complete lack of a ZIKV outbreak prior to 2007. Planning is tough since it is hard to foresee how the virus will spread. Predicting future outbreaks and epidemics is extremely difficult due to the intricacy of the virus's epidemiology and transmission dynamics. The WHO has called on the world's research community to give the creation of vaccinations, better diagnostics, and creative vector control methods top priority [14-20].

The suggested actions in light of existing tactics. Evolutionary pressure on viral replication is always the driving force behind the formation of new viral clades. In other words, different antiviral drugs and vaccines also impose evolutionary pressure, which naturally leads to the establishment of resistant clades.It is highly improbable that viruses will become resistant to antiseptic mouthwashes since antiseptic substances come into contact with the virus even prior to its strictly intracellular reproduction. The decades of successful usage of antiseptic mouthwashes demonstrate how unlikely it is that viruses will develop resistance to them. This phenomena can be explained by the fact that these drugs work by attacking the virus before it has a chance to replicate, reducing the likelihood that resistance would emerge [2-8]. Similar to this, blocking SGP cleavage into S1 and S2 efficiently lowers viral affinity for the ACE2 receptor, hence reducing viral load through inhibition of intracellular SARS-CoV-2 replication. This makes blocking TMPSSR2 a promising preventive and therapeutic strategy. Concurrently, the decrease in intracellular viral RNA reduces SARS-CoV-2-related transmission and pathogenicity, which in turn causes the NF-κB transcription activity to slow down. Substances that block other NF-κB signaling accelerators, such as pathogen-associated molecular patterns (PAMPs), danger-associated molecular patterns (DAMPs), proinflammatory cytokines, and the spike glycoprotein (SGP) itself, may lessen the virus's excessively activated inflammatory cascade [15-19]. By activating toll-like receptors (TLRs), primarily TLR 2 and 4 but also TLR 3, 5, 7, 8, and 9, these NF-κB signaling accelerators initiate the NF-κB signaling pathway. TLR inhibitors, such as eritoran, resiquimod (R-848) (TLR7/8), chloroquine and hydroxychloroquine (TLR7/9), and resatorvid (TAK-242) (TLR4), are examples of such inhibitory drugs. Additionally, research has demonstrated that traditional non-steroidal anti-inflammatory medicines (NSAIDs), such as aspirin, celecoxib, ibuprofen, and diclofenac, block NF-κB and indirectly through cyclooxygenase 1 or 2 (COX1/2) reduction of TLR4 or TLR2 activation. Through the NF-κB signaling pathway, these compounds may also be used to prevent excessive viral replication and accelerated inflammatory cascades. Every action suggested in this paper is thought to be minimally intrusive. These strategies have a long history of effectiveness and have been used for many years. Furthermore, in terms of the expenses associated with their development and distribution to millions of people during a pandemic, these approaches are significantly superior to the majority of other prospective therapies or pharmacological classes (e.g., vaccinations, antiviral drugs, hyperbaric oxygen therapy, and plasma apheresis) [20-25].

DISCUSSION

Even before the identification of the infectious organisms responsible, the genesis of new infectious diseases has been acknowledged for millennia as an unpredictable process. The development of countermeasures (diagnostic, therapeutic, and preventative) has advanced significantly, but the establishment of the essential measures to contain such diseases has become much more difficult due to the ease of international travel and growing interdependence. These illnesses have the potential to impact both economic stability and human health. As seen by the recent 2019 new coronavirus (nCoV) pandemic and the following emergence and spread of additional infectious diseases, emerging and re-emerging illnesses represent a serious threat to global public health. The ability of these pathogens to spread rapidly and cause large-scale outbreaks is due to a number of interconnected factors, including globalisation, climate change, deforestation, and drug resistance. In the context of the ongoing emergence, resurgence, and spread of infectious diseases, human interaction with domestic and wild animals and environmental changes resulting from human activities have become pivotal elements in understanding the epidemiology of these diseases [3-8]. Furthermore, it is crucial to recognise the impact of these changes in terms of increasing opportunities for microbes to thrive. In light of the above, what efficacious strategies are currently available to combat these infections? In order to address these infections, it is imperative to employ a multifaceted approach that encompasses the following: (1) Rapidly detect unusual and unexplained disease outbreaks. (2) Track and exchange information in real time. (3) The mobilisation of a swift and decisive response effort that can rapidly extend on a global scale. (4) The containment of transmission with the objective of achieving rapid outcomes. Humanity has faced tremendous hurdles as a result of the coronavirus disease 2019 (COVID-19) pandemic, both in terms of managing the acute waves of infection medically and addressing the sociopolitical ramifications of the significant actions made to counter the viral threat. Our social and political institutions have been significantly impacted by the separation of societies into opposing factions—those who favor the measures and those who question the viral causality of the observed disease progression. Additionally, postvaccination syndrome and postviral syndrome (long COVID-19) are becoming more common [11-19]. The research of various viral infections has revealed numerous viral processes that have enabled the exponential spread of infection. For instance, the virus's affinity for the angiotensin-converting enzyme 2 (ACE2) receptor is dramatically increased when transmembrane serine protease 2 (TMPSSR2) cleaves the spike glycoprotein (SGP) into S1 and S2, greatly enhancing infectivity. The cholinergic anti-inflammatory system, the body's main anti-inflammatory mechanism, can also be severely compromised by the possible inhibition of α7n-acetylcholine receptors (α7nARs). Other viruses probably share the different mechanisms of SARS-CoV-2 infection, such as nonintrinsic high-affinity binding to cholinergic receptors and SGP cleavage to speed up viral entry. Incorporating techniques to combat future viral threats that target these pathways is crucial given the likelihood of the next viral pandemic and the ongoing development of antiviral vaccines. Given the increasing agreement that a pandemic in the future is not a question of if but rather when, it is critical to use the knowledge gathered from previous experiences to enhance medical and social readiness for similar situations. The presence of a highly transmissible viral disease and the lack of efficient mechanisms to stop its spread are prerequisites for the onset of a viral pandemic, in addition to high population density. The strong mutagenicity and exceptionally high pathogenicity of SARS-CoV-2 made these problems worse [20-25].

CONCLUSIONS

The aforementioned factors do not provide a conclusive answer to the question of whether the methods proposed can avoid the next pandemic. Nonetheless, these actions could significantly lessen the possibility of a worldwide outbreak of viral illnesses. Therefore, in addition to the crucial ongoing development of vaccination techniques, they should be given immediate consideration and additional study in anticipation of future pandemic virus threats. Given the low level of invasiveness and the low frequency of adverse effects linked to the treatments indicated, this urgent consideration is especially crucial. Furthermore, the significant long-term experience with these policies indicates that they will be largely embraced by society, resulting in less economic and sociopolitical harm.

By facilitating more efficient infection control and practical treatment alternatives in low-income nations with brittle social and medical institutions and relatively limited human, material, and financial resources, these interventions have the potential to increase global justice. Humanity would be far better prepared on a worldwide scale for a future pandemic if the suggested procedures were evaluated and put into practice in addition to the current strategies for preventing a new one, especially the utilization of national and international convergence. Retraining medical staff and improving diagnostics must be a top focus in any efforts to stop epidemics from happening again. This is essential for responding quickly and efficiently to clinical requests that are frequently vague.

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