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Diseases, Emerging and Infectious

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Glossary

Antimicrobial resistance (AMR)/Drug-resistant disease Is said to have occurred when microorganisms including bacteria, viruses, and some parasites are able to stop an antimicrobial such as antibiotics, antivirals, and antimalarials from effectively working against it when administered.

Emerging disease Constitutes all those infectious diseases that have recently surfaced. They are characterized by a rapid expansion in incidence beyond the population and geographic range of their first emergence and pose serious public health threats to the global population in the near future. They may also be viewed as all those infectious diseases whose incidence has increased within the past 2 years.

Infectious diseases Are caused by pathogenic microorganisms including bacteria, viruses, parasites, or fungi that can spread directly from one person to another.

Reemerging disease As suggested by the name, reemerging infectious diseases were once classified or seen as major public health threats to countries and regions, but were eventually contained and substantially reduced, only to resurface in recent times posing similar challenges to public health. Examples include Tuberculosis and Malaria.

Vector-borne disease Are diseases that are transmitted by vectors. Most commonly, these vectors are bloodsucking insects which ingest disease-producing microorganisms and then inject them into their new host.

Zoonotic diseases Comprise diseases that originate from animals with the potential to be transmitted to humans through viruses, bacteria, parasites, and fungi. According to the Centers for Disease Control and Prevention, six out of every ten infectious diseases are zoonotic, and another three out of every four emerging diseases are contracted through animals.

Infectious diseases are illnesses, which are spread directly or indirectly, from person to person. Infectious diseases can be classified under one of the following origins: zoonotic, vector-borne, or drug-resistant. The majority (over 60%) of emerging and reemerging infectious diseases are caused by bacteria, viruses, parasites, or fungi, which were passed from animals to humans, known as zoonotic pathogens. Zoonotic pathogens, which originated in wild life, are the causative agents for diseases such as Severe Acute Respiratory Syndrome (SARS) and Ebola. As a result, zoonotic infectious diseases have led to epidemics that drew attention to the interactions between humans and wildlife, including the domestication of animals, food production and intensive farming, moving animals and plants to foreign environments, urban sprawl and migration, and climate change and deforestation.

Vector-borne infectious diseases are spread between humans and animals by vectors such as mosquitoes and ticks. These diseases, including Malaria and Lyme disease, impact specific geographic regions. Tropical and subtropical areas are disproportionately affected, and the poorest and most vulnerable tend to face the highest burden of these diseases.

The history of these diseases includes widespread illness and high mortality rates affecting populations on a global scale. The history of infectious diseases goes back as far as Smallpox being found on Egyptian mummies and the Plague infecting and killing 20–45% of the world's population in the 14th Century. However, by the end of the 1960s, most infectious diseases were considered a health issue of the past. With improved public health measures including sanitation processes and sewage treatments, as well as improved healthcare services and the introduction of antibiotics and vaccination protocols, the prevalence of infectious diseases appeared to be declining. As a result, health care professionals and researchers turned their attention and available resources toward the rising issue of chronic disease. Yet, during the last quarter of the 20th Century, infectious diseases began to reemerge with new and resurgent diseases cited as causes of morbidity and mortality for large populations. Since this time, infectious disease rates have continued to rise, new diseases have emerged, and previously eradicated diseases have reemerged. The emergence and reemergence of infectious diseases has mostly been attributed to the unintentional consequences of human behavior, activities, and development.

The threat of emerging and infectious diseases (EIDs) to human health, society, and the global economy is increasing as infectious diseases continue to evolve and spread. To illustrate, in 2016 alone over 1 million people died from HIV, and 216 million people contracted Malaria. Furthermore, the SARS outbreak in 2002 resulted in death for 700 out of the 8000 infected patients within 6 months, with the survivors experiencing ill health and, in some cases, disability. Clearly, infectious diseases such as SARS place added stress on healthcare systems in affected countries as these systems must mobilize resources to effectively deal with the epidemics. They also create tensions within communities and decrease economic prosperity. For example, travel, tourism, and retail sales dropped dramatically during the SARS epidemic, especially in Asia where the disease originated and was most prevalent. Globally, the economic impact of SARS was estimated to be \$30–100 billion USD. Emerging and reemerging infectious diseases are largely preventable, and yet with their profound impact and increasing prevalence, they remain a threat to global health, which must be addressed.

Current Trends

Humans and pathogens have always been in a dynamic state of interaction; however, current trends reveal that this relationship has become unbalanced as human activities are causing pathogens to appear and spread at an increasingly alarming rate. As aforementioned, the 21st Century has seen a rise in infectious disease, largely due to the societal and global trends that are reinforced by an increasingly technological, globalized, and interconnected world. Between 1994 and 2004, 335 infectious diseases, such as Tuberculosis, SARS, and H1N1, emerged or reemerged in both the developed and developing world. These diseases caused the death of an estimated 17 million people per year, with 41% of these deaths occurring in the concentrated region of South-East Asia and the SARS outbreak in China affecting 32 other countries. By the end of April 2019, a Measles outbreak in the United States affected 704 people, 71% of whom were unvaccinated. Similarly, in the European Region, the WHO reported a total of 83,540 Measles cases by March 2019, with 74 related deaths in the preceding year. Additionally, the world is still battling with diseases such as HIV/AIDS, Malaria, Ebola, H1N1, and dengue fever.

Each year, approximately 600 million travelers transport pathogens between places and provide a means for infectious disease to spread across borders. The increased globalization of the world has resulted in travel and trade being facilitated on a global scale, which has caused infectious diseases to spread more easily to countries that were previously unaffected. Moreover, there is a higher prevalence of infectious diseases in low-income and developing countries due to increased poverty, social inequality, and conflict, leading to increased susceptibility and a decreased capacity to effectively provide sufficient treatment.

Additionally, environmental variability due to climate change has lengthened the season in which vectors are present and impacted agricultural practices, allowing for increased transmission. Furthermore, vectors have also become resistant to numerous pesticides making it harder to control the spread of the diseases, which they carry.

Another important issue that is feeding the emergence and reemergence of infectious diseases is the issue of drug resistance to treatment. Increasingly microorganisms are evolving and adapting which makes it difficult to treat these diseases, thus increasing their rate of transmission. Many factors lead to drug-resistant infectious diseases including antibiotic misuse (such as not finishing an entire dose of antibiotics), over-prescription of antibiotics, and the use of antibiotics for agriculture and animal production that can lead to antimicrobial resistance. Moreover, vaccinations not being kept up to date or not being administered to the majority of the population to maintain herd immunity has led to drug-resistant diseases, which have evolved and rendered current vaccines ineffective. Many infectious diseases are evolving more quickly than effective treatments can be created and tested, as a result, as drug-resistant diseases continue to increase in prevalence, their threat to human health continues to increase.

Other health trends have also contributed to the infectious disease epidemic. An aging population with a higher life expectancy has resulted in an increased proportion of the population being elderly, thus susceptible to infectious disease, and less likely to have the capacity to combat sickness. Much of the world also suffers from multimorbidities, with chronic diseases such as diabetes and heart disease on the rise, once again increasing susceptibility. Similarly, the HIV/AIDS epidemic has resulted in a large immunocompromised population who are vulnerable to contracting multiple infectious diseases. The prevalence of HIV/AIDS declined globally by 22% between 2010 and 2017. However, as of 2018, 37.9 million people were infected globally with HIV/AIDS, with Africa having the highest proportion of HIV/AIDS cases, a trend which like the general trend of emerging and reemerging infectious disease prevalence is not declining quickly or equitably enough.

Eradicating Emerging and Infectious Diseases

EIDs have been posited by researchers to persist as a global health concern for the next couple of decades particularly in poor and under-resourced settings in the Global South. However, efforts at the global level yield the potential to address incidences of EIDs. In line with these objectives, there have been proposed strategies to address current trends of EIDs. The Sustainable Development Goals (SDGs), created in 2015, identified infectious diseases as a priority area for health policy; SDG 3.3 set out to end numerous infectious disease epidemics, such as HIV/AIDS and Malaria by 2030. The SDGs posit that through increased surveillance and allocating more resources and funding to this health issue, diagnostic and treatment programs will be improved, and the epidemic of emerging and reemerging infectious diseases will once again begin to decline.

In the meantime, there is urgency in building a global network consisting of a team of specialists in EIDs. This network will be hinged on improved communication surrounding risks of outbreaks in global hotspots that are difficult to access. This will be foundational to addressing outbreaks, as the WHO has observed that areas with more frequent outbreaks and endemic cases of reemerging infectious diseases such as HIV, HBV, and Ebola tend to be in low- and middle-income countries. Budget constraints in allocations for emergencies and laboratory research may therefore be undermining efforts at total eradication of EIDs in these areas. The lack of coordinated effort in understanding the nature and extent of outbreaks among specialists may be a major contributory factor where isolated cases of EIDs easily escalate to full-blown epidemics. Therefore, a global network of specialist and experts is key in designing future responses to EIDs.

The introduction of vaccines led to the eradication of major infectious disease such as Smallpox and Measles that plagued earlier centuries as leading causes of death. Currently, immunizations alone are estimated to avert two to three million global annual deaths. Targeting populations at increased risk, including high-density areas and those in the geographies of elevated risk of zoonosis, with vaccines will lead to a substantial decline in new outbreaks. The trial of Ebola vaccines marks a major milestone in reducing mortalities associated with the current perennial outbreak of the Ebola virus in West and Central Africa. As well, after

an initial trial of Malaria vaccines ended in 2015, the WHO has recommended an expanded trial in three countries in sub-Saharan Africa, based on this trial, deployment of this vaccine could be sanctioned across the globe to eradicate Malaria. Similarly, discussion on the deployment of preexposure prophylaxis (PrEP) and post exposure prophylaxis (PEP) for HIV in both endemic and non-endemic contexts in the Global South and North respectively, and among exposed populations, holds the key to achieving sections of the SDGs and the UNAIDS 90-90-90. It is worth noting that, an effective surveillance system of people and areas at risk, will lead to early detection of instances of microbial and drug resistance in vaccines and treatment of EIDs.

Particularly for EIDs that are asymptomatic, providing access to testing and screening services is desirable to obtain an early warning and to devise a response to outbreaks. This is largely dependent on available resources at the locale by way of laboratory or clinical technology that will be most effective in the timely detection of new incidences of EIDs. For instance, only 9% of people with Viral Hepatitis have been diagnosed due to limited access to testing services. Given that a large percentage of EIDs are concentrated in countries where governments are under-resourced in responding to outbreaks, well-equipped testing and screening facilities for the public at risk are needed. Currently in low-income settings where health infrastructure is under-developed, point-of-care (POC) diagnostics have emerged with the potential for inexpensive, effective, and timely diagnoses of infectious diseases. This also calls for the development and deployment of diagnostic techniques that are suitable for specific regions or geographies.

In view of the disproportionate global burden of infectious diseases where some regions are more prone relative to others, a key consideration in eradicating EIDs may be the reallocation of resources, including expertise and clinical technology to areas that are most impacted. Currently, areas least affected by EIDs receive a higher allocation and concentration of resources to respond to outbreaks. In this regard, in the context of developing countries, HBV, HIV, and Ebola have persisted largely due to the absence of funding to secure vaccines and treatment for populations at heightened risk of infection. This is in sharp contrast to the context of the Global North where EIDs are less prevalent but have control of global resources in eradicating infectious diseases.

Zoonotic pathogens account for 60.3% of all EIDs, of which an estimated 70.8% are contracted through contact with wildlife. In this context, understanding human contact with wildlife and how to minimize it in hotspots with highly biodiverse fauna can help contain new incidences. Moreover, the limited outbreak of EIDs in areas where conservation efforts have drastically reduced anthropogenic contacts with wildlife means more conservation efforts will lead to a substantial decline of EIDS. It is also crucial to institute smart surveillance in areas of high population density to avoid new strains of infection from reemerging.

See Also: Epidemiological Transition; Medical Geography.

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