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Review Article

Public health interventions in the control of emerging diseases

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ABSTRACT

There has been an unprecedented increase in the burden of emerging diseases in the recent past. This has been attributed to changes in environment, human behavior, increased travel and human intrusion into the sylvatic cycle which has facilitated the emergence of novel and resistant strains of pathogens. A public health intervention is any effort or policy that is designed to improve mental and physical health of the population. This article focusses on the various public health interventions like vaccination, nutritional intervention, hygiene and sanitation, health awareness which has been and can contribute immensely to curb the rising threat of emerging diseases. Much research has been going on regarding the vaccines against new emerging diseases like SARS-CoV, Ebola, Lassa fever, Nipah, Chikungunya and Rift valley fever. Nutritional interventions has proven to be of much benefit in low and middle income countries because of its synergistic effect with infections. Quarantine and sanitation measures were highly effective strategies for control of COVID-19 pandemic. These preventive interventions along with a robust public health infrastructure can serve as an effective barrier in the spread of many emerging strains of diseases.

Keywords: Emerging, Diseases, Public Health, Interventions

INTRODUCTION

The present world has been witnessing a dramatic rise in new and emerging diseases along with a resurgence of many infectious diseases which were once controlled. These emerging and re-emerging diseases pose a significant threat to human health. Also, it puts considerable strain on the limited health infrastructure and resources of a country. There has been a drastic change in this 21st century with climate changes and environmental degradation, rapid and unplanned urbanization, antimicrobial resistance and increase in trade and travel across the globe. There looms a rising threat of emergence of novel strains of micro-organisms that may amplify into epidemics and pandemics. The burning example is the COVID-19 pandemic from which the world have been barely able to stretch its arms after a slow recovery. At the same time, new knowledge is constantly evolving around these infectious diseases.[1]

Emerging diseases are those diseases whose incidence has been found to be increased in the recent decades or which have threatened to increase in the future. Emerging diseases means either detection of a novel pathogen or detection in newer areas in which it was previously non-existent or even detection of an infectious aetiology in already detected diseases.[2] Unscrupulous use of antibiotics leading to emergence of new and resistant strains or genetic alterations in pathogens are primarily responsible for such emergence. It has been estimated that about 60% of infectious diseases and 70% of emerging infections among humans are zoonotic in origin. Most of the zoonotic diseases, approximately two thirds have their origins from the wild life.[3,4]A literature survey identified that among 1,407 species of human pathogens, 177 (13%) species are regarded as emerging or re-emerging. Distribution of emerging and re-emerging pathogens by groups shows that 37 per cent of emerging and re-emerging pathogens are viruses and prions followed by

protozoa (25%). This indicates that emerging and re-emerging pathogens are disproportionately viruses.[5]

There are five strategic elements that are needed to combat emerging diseases. These include: (1) Epidemic preparedness and rapid response (2) Public health infrastructure (3) Risk communication (4) Research and its utilization and (5) Advocacy for political commitment and partnership building.[6] Public health interventions has come a long way in the control of communicable diseases. A public health intervention is any effort or policy that is designed to improve mental and physical health of the population. Interventions can be either preventive or therapeutic.

LITERATURE SEARCH

In this article, we will be focussing on the preventive interventions that has or can play a critical role in the control of various emerging diseases. Preventive interventions are those interventions that are aimed at preventing the occurrence of a disease and reducing the incidence of a disease. In public health, these interventions should include primary prevention interventions which includes health promotion in terms of behaviour change communication, environmental modification, better health policies and specific protection which includes components like immunization, nutritional interventions or inclusion of preventive services in universal coverage packages.[7]

We did a systematic literature search by formulation our research question and exploring all the databases using MeSH terms and Boolean operators. The data bases looked into for finding relevant literature included EMBASE, web of science, Google scholar and Pub Med. Physical database of the library in terms of book chapters, journals and conference proceedings were also looked into for relevant literature as explained above.

VACCINATION

Vaccines are immunobiological substances that are administered to individuals, usually before they have encountered the infectious agent against which the vaccine is specifically targeted, in order to protect them when they are naturally exposed to the agent. They work by inducing a variety of immune mechanisms, through the humoral and/or cellular immune systems. Immunization is a global health and development success story, saving millions of lives every year. Presently, there are vaccines available against more than 20 life-threatening diseases, helping people of all ages live longer, healthier lives. Immunization currently prevents 3.5-5 million deaths every year from diseases like diphtheria, tetanus, pertussis, influenza and measles.[6] There are two preventive aspects derived from a vaccine-one is individual direct protection and the other at the population level is the herd immunity. Herd immunity implies that when a substantial proportion of the population is vaccinated, it interferes with the transmission of the infecting agent and acts a barrier to even those who are unvaccinated due to some or the other reasons.[8]

Since the inception of COVID-19 pandemic, we have witnessed that strategies like social distancing and periodic lock downs are not much sustainable in the long run. Much faith has therefore been placed on development of an effective vaccine to tackle the pandemic. In response to this need, multiple trials had been conducted in different countries to find out a safe and effective vaccine which had clearly demonstrated its effect in saving many lives during the pandemic. The WHO has identified several high priority pathogens that has the potential to cause large scale outbreaks in future. These necessitates the need for effective vaccines against several diseases like Zika, MERS (Middle East respiratory syndrome), Chikungunya, Plague, Rift Valley Fever, Ebola (Sudan and Zaire strains), Crimean-Congo haemorrhagic fever, Lassa fever, Nipah and recently the novel coronavirus SARS-CoV-2. The recent pandemic has brought to light the harsh reality that vaccines are the only way to curb the menace of emerging pathogens which at any moment can trigger a pandemic. There are many considerations in vaccine development like speed of development, cost, safety, ease of manufacture and feasibility in terms of storage conditions and administration and approval from regulatory authorities.[9] There needs to be a need based but sustainable approach with strong social and political will to develop vaccines against emerging diseases. While safety, efficacy and public trust are the three main success pillars for most vaccines, affordability is vital when formulating vaccines for neglected diseases in low- and middle-income countries. In addition, there has been increased focus in recent years on the development of vaccines against infectious agents that occur mostly in low- and middle-income countries, such as malaria or visceral leishmaniasis, tuberculosis (TB) or HIV infection. For vaccines against these agents, there is a need for major field trials to assess efficacy in countries where the disease burden is high.[10,11]

NUTRITIONAL INTERVENTIONS

Food and nutrition are major determinants of human health and disease. Under nutrition remains a major cause of morbidity and mortality in low-income countries and deprived populations in middle-income countries. Severe malnutrition, such as kwashiorkor or marasmus, is life-threatening, but milder forms of malnutrition are major risk factors that adversely influence the susceptibility to, and the outcome of, many infectious and other diseases, as well as cognitive development. In addition to calorie and protein deficiencies, specific deficiencies in micronutrients, such as iron, folate, zinc, iodine, and vitamin A, may be important determinants of severe diseases. Among young children, malnutrition remains as the major underlying cause of deaths from diarrhoea

(60%), pneumonia and malaria (50%) and measles (40%).[12] The relationship is synergistic; malnutrition compromises natural immunity leading to increased susceptibility to infection and more frequent and severe episodes of infectious diseases. Likewise, infection can aggravate or precipitate malnutrition through decreased appetite and intake, malabsorption, nutrient loss or increased metabolic needs. Thus, this vicious cycle continues unless deliberate nutritional intervention becomes imperative to bring out the child from this gamut of malnutrition and infection. Several studies in developing countries has established that health and nutritional interventions are indeed effective in populations and helped children to thrive and survive better. These interventions include the regular provision of high protein/calorie diets or supplementation with specific micronutrients under the government programs or food fortification at the community level. Some interventions target on the awareness and practices to change eating or food preparation habits so as to increase the intake of particular food groups or micronutrients.[13]

It is very important that interventions to address nutritional and communicable disease issues must be integrated so as to address the overall impact of malnutrition on mortality from communicable diseases. One of the huge successes of nutritional interventions is the control of tuberculosis in populations with improved nutritional status. Similarly, measles and HIV/AIDS seem to have a preponderance in malnourished people. The efficacy of health and nutrition interventions in developing countries has been established for decades. Prospective studies in several settings showed that health interventions with or without supplementary foods caused children to thrive and survive better. Studies in Narangwal, India by Kielmann and Others, in Jamaica by Waterlow and in the Gambia are examples.[14-16]

HYGIENE AND SANITATION

A number of infectious diseases particularly in low-and middle-income countries are attributable to poor hygiene and sanitation. Diarrhoea is one of the major preventable causes of under 5 deaths globally and accounts for almost 19% of under five deaths in low-income settings.[17] Sanitation is considered to be a primary barrier which can segregate the infectious agents and helps to keep these infectious diseases at bay.

Alterations to the environment directed at reducing the transmission of infections are central to the control of many infectious diseases, particularly those that are transmitted through water or through the faecal-oral route such as many gastrointestinal infections. Environmental interventions to reduce human faecal and urine contamination include provision of sanitary latrines, provision of sewage systems, clean water supplies, and safe food practices. Other environmental interventions are tackling indoor or outdoor air pollution or involve the disposal of contaminants and vector control measures. Many of these interventions require substantial educational efforts and lifestyle changes. They are also interventions that typically have to be applied to whole communities, rather than to individuals in a community, so that, the interventions can easily percolate and benefit the larger population.

With the onset of new emerging diseases such as the recent COVID-19 pandemic, the relevance of individual level sanitization has taken much precedence. The use of antimicrobial or virucidal agents to decontaminate objects/surfaces or body parts literally became an obsession among the general public. These measures have recently been found to be highly effective in reducing the mammoth spread of the virus. Masks and respiratory etiquettes have largely been promoted since the outbreak of the pandemic and have proven to be effective interventions.

The primary role of sanitation and hygiene is to cater to any health crisis and control the spread of emerging diseases which are highly communicable. Sanitization as an area of interdisciplinary research needs a central focus in the longer run. The role of hand sanitization and surface disinfection also cannot be undermined in the recent pandemic. Environmental disinfection policies should be evidence based and should have clear cut guidelines for different cleaning and disinfection measures in different contexts like home, hospital, institution etc.[18]

ISOLATION AND QUARANTINE

The practice of quarantine is ages old and began way back in the 14th century as a measure to protect the coastal cities from plague epidemics. One of the important public health measures to restrict the transmission of infectious diseases include quarantine which includes the restriction of movement of healthy persons who may have been exposed to the virus, with the objective of monitoring their symptoms and ensuring early detection of cases.[19] Many countries have the legal authority to impose quarantine. Quarantine should be implemented only as part of a comprehensive package of public health response and containment measures and, in accordance with article 3 of the international health regulations (2005), be fully respectful of the dignity, human rights and fundamental freedoms of persons. Introducing quarantine measures early in an outbreak may delay the introduction of the disease to a country or area or may delay the peak of an epidemic in an area where local transmission is ongoing, or both. This was also one of the major strategies adopted by countries to restrict the transmission of recent COVID-19 pandemic.[20] Studies undertaken by Nussbaumer Streit et al have consistently reported a benefit of simulated quarantine measures for reducing transmission of Corona virus in their modelling studies. Early implementation of quarantine in combination with other public health measures is

important for effective control of various communicable diseases.[21]

In contrast, isolation is separation of ill/infected persons from others to prevent spread of infection/contamination. A review conducted by Jefferson found that isolation of patients in hospital wards or at home is effective in reducing the spread of respiratory virus.[22] However another review conducted by Teasdale found that people were sceptical about adopting isolation because of its perceived adverse impact and social stigma.[23]

HEALTH AWARENESS

Preventing emerging infectious diseases is a multidisciplinary and multifaceted endeavour. These efforts can generate desired results only if the intended beneficiaries actively participate in mitigating the risk factors and in implementing the control strategies. A well-informed community can provide immense support to any public health intervention. Health awareness of the community at large through the public health system, mass media and other organisations helps in reaching the community at large.[24]

Emerging infectious diseases are the result of an interplay between diverse factors. It is therefore important to recognize these variables, including societal attributes and make the community aware of this. When a disease breaks out in a human population, changes in behaviour in response to the outbreak can alter the progression of the infectious agent. The individual behavioral responses to the presence of disease is a very important factor in containment of diseases. When people are aware about presence of a particular disease in their vicinity, they will generally take some steps to prevent it. Therein lies the importance of health awareness. It also implies that the health awareness programs should be strategically designed so as to address the needs of the community and should be context specific. Awareness and health promotion falls in the gamut of primary prevention which include actions to improve health through changing the impact of social and economic determinants on health; the provision of information on behavioural and medical health risks. Several studies have shown that well organized health awareness programs have a significant impact in reducing the burden of both communicable and non-communicable diseases in the community. [25]

CONCLUSION

Considering the rising and unpredictable threat of emerging diseases, the public health system must be strengthened to tackle such crisis. The surveillance and monitoring system should be robust for prompt detection and reporting of unusual outbreaks. Preventive Interventions in order to be effective should encompass various measures such as vaccines, vector control measures, health education, behaviour change strategies, injury prevention, and better health planning and management methods that improve a spectrum of health-related activities. Research involving a wide range of disciplines is needed to develop, deploy, and assess these interventions, ranging from molecular biology and immunology to social sciences, epidemiology, and statistics. Field trials are required to assess how interventions, both old and new, may be best applied in populations and to determine their impact on improving the health of the population.

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REFERENCES

1. Neiderud CJ. How Urbanization affects the epidemiology of emerging infectious diseases. Infect E Col Epidemiol. 2015:5(10).
2. Emerging Infectious Diseases. CDC. Available at: Background and Goals (cdc.gov). Accessed on 12th Feb, 2023.
3. Dikid T, Jain SK, Sharma A, Kumar A, Narain JP. Emerging and Re emerging infections in India: An overview. Indian J Med Res. 2013;138(1):19-31.
4. Zoonotic Disease: Emerging public health threats in the region. WHO Document. Available at WHO EMRO | Zoonotic disease: emerging public health threats in the Region RC61 À propos de l'OMS. Accessed on 3rd March, 2023.
5. National Institute of Allergy and Infectious diseases. Emerging and Re-emerging Infectious Diseases. 2008. Available at: http://www.naid.nih.gov/factsheet/infectiou sdiseases.htm. Accessed on 12 February, 2023.
6. Asia Pacific Strategy for Emerging Diseases and Public Health emergencies. Advancing Implementation of International Health Regulations,2005. WHO Document;2017.
7. WHO. Combating Emerging Infectious Diseases in the South east Asia region. 2005. Available at: https://apps.who.int/iris/bitstream/handle/10665/204 878/B0005.pdf.WHO,Combating. Accessed on 28 January, 2023.
8. Field Trials for Health Interventions: A Toolbox. 3rd edition. In: Chapter 2: types of Intervention and their development. Smith PG, Morrow RH, Ross DA, editors. Oxford (UK): OUP Oxford. 2015.
9. Immunization Agenda 2030: A global strategy to Leave No one Behind. WHO Document. Available at: https://www.who.int/teams/ immunization-vaccines-and-biologicals/ strategies/ia2030. Accessed on 15 January, 2023.
10. Excler JL, Saville M, Berkley S, Kim JH. Vaccine development for emerging infectious diseases. Nat Med. 2001;27:591-600.
11. How Do vaccines work. WHO document. How do vaccines work? (who.int). Available at: https://www.who.int/news-room/feature-stories/ detail/how-do-vaccines-work#:~:text=Once%

20the%20antigen%2Dspecific%20antibodies,to%20each%20other%2C%20like%20cousins. Accessed on 10 January, 2023.
12. Archana M, Tanshi M, Pallavi S, Ankur M. Vaccines for neglected emerging and re-emerging diseases. Semin Immunol. 2020;50:101423.
13. Children. Improving Survival and Well-being. WHO. Children: improving survival and well-being (who.int). Available at: https://www.who.int/news-room/fact-sheets/detail/children-reducing-mortality. Accessed on 21 February, 2023.
14. Mason JB, Sanders D, Musgrove P, Soekirman, Galloway R. Disease control priorities in developing countries. 2nd edition. Chapter 56: Community Health and Nutrition Programs. Oxford University Press. 2006.
15. Kielmann AA, Taylor CE, DeSweemer C, Uberoi IS, Takulia HS, Masih N et al. The Narangwal Experiment: II. Morbidity and Mortality Effects. Indian J Med Res. 1978;68(1):42-54.
16. Waterlow JC. Protein Energy Malnutrition. London: Edward Arnold. 1992.
17. Whitehead RG, Rowland MG, Cole TJ. Infection, Nutrition, and Growth in a Rural African Environment. Proceedings Nutr Society. 1976;35(3):369-75.
18. Boschi P, Cynthia V, Lana S, Kenji. Estimating child mortality due to diarrhea in developing countries. Bull World Heal Organization. 2008;86:710-7.
19. Jurgen G. The role of surface disinfection in infection prevention. GMS Hyg Infect Control. 2013:8(1).
20. History of Quarantine. Quarantine. CDC Available at: https://www.cdc.gov/quarantine/historyquarantine.html. Accessed on 4 February, 2023.
21. Gabriela L, Ady P, Arne T, Yitzhak P, Martin AN. Evolution of resistance to COVID-19 vaccination with dynamic social distancing. Nature Human Behaviour. 2022;193-206.
22. Nussbaumer Streit B, Mayr V, Dobrescu AI. Quarantine alone or in combination with other public health measures to control COVID-19: a rapid review. Cochrane Database Systematic Rev. 2020;(4):CD013574.
23. Jefferson T, Del Mar CB, Dooley. Physical interventions to interrupt or reduce the spread of respiratory viruses. Cochrane Database Systematic Rev. 2011;(7):CD006207.
24. Teasdale E, Santer M, Geraghty AWA. Public perceptions of non-pharmaceutical interventions for reducing transmission of respiratory infection: systematic review and synthesis of qualitative studies. BMC Public Health. 2014;14:589
25. WHO. Combating Emerging Infectious Diseases in the South East Asia Region. Regional Office for South East Asia, New Delhi. 2005. Available at: https://apps.who.int/iris/bitstream/handle/10665/204878/B0005.pdf. Accessed on 10 February, 2023.
26. WHO, EMRO. Health promotion and disease prevention through population-based interventions, including action to address social determinants and health inequity. Available at: https://www.emro.who.int/about-who/public-health-functions/health-promotion-disease-prevention.html. Accessed on 23 February, 2023.

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