PREVENTING THE RESURGENCE OF COVID-19 PANDEMIC AND SIMILAR EPIDEMICS: THE NEED FOR ONE HEALTH APPROACH

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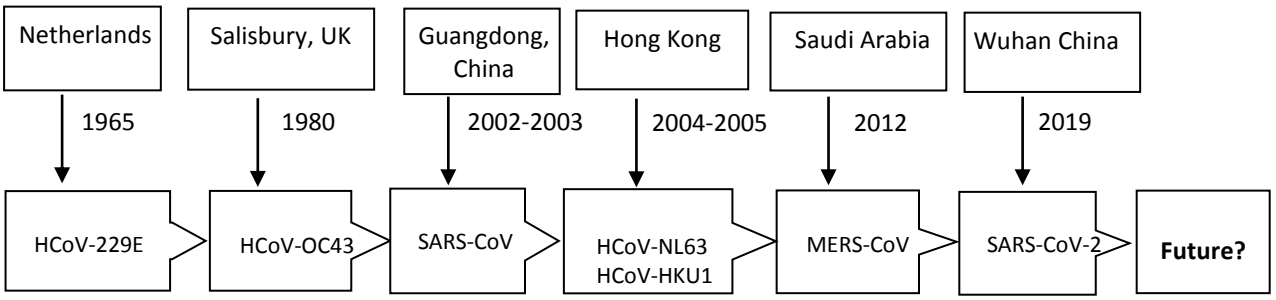
Abstract
Epidemiological evidences over the decades suggest that about 60% to 75% of emerging human infectious diseases are transmitted by animals, especially wildlife. This is as a result of the increasing interface between human, wild animals and environment caused by the destruction of natural habitats by human activities and climate change. The recent link of COVID-19 to the seafood and animals' market in Wuhan China, and the 98.99% shared resemblance of the virus to the genetic sequence of bat coronavirus holds a strong suspicion for zoonotic transmission. However, efforts towards controlling the pandemic have been centered on human health, with little or no attention on the animal and environment hosts. This paper proposes one health approach as a strategy that could control the resurgence of COVID-19 and similar zoonotic diseases outbreak.

Keywords: COVID-19, Coronavirus, COVID-19 Vaccine, SARS-CoV-2, One health approach

Introduction

Epidemiological evidences over the decades have shown that about 60% to 75% of emerging human infectious diseases are transmitted by animals, especially wildlife (1, 2). Among these diseases, the novel COVID-19 outbreak caused by severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2) currently dominates the public health priorities due to its rapid transmissibility, lethality and global adverse impacts; particularly on the economies and healthcare systems. Although no precise origin has been established for SARS-CoV-2, however, its link to the seafood and animals' market in Wuhan China, and the 98.99% genomic resemblance it shares with the genetic sequence of bat coronavirus holds a strong suspicion for zoonotic origin (**Error! Reference source not found.**, **Error! Reference source not found.**). Besides, this is not the first time a novel outbreak of disease has been linked to the interface between human, animals and environment. Various human coronaviruses that caused serious epidemics in the past such as HCoV-22E, HCoV-0C43, SARS, HCoV-NL63, HKU1, and MERS outbreaks were all traced to zoonotic origin (**Error! Reference source not found.**, **Error! Reference source not found.**). With the emergence of SARS-CoV-2 in December 2019, there are now seven known coronaviruses that affect human. Although epidemiological reports show that four (alpha coronaviruses) can only cause mild to moderate diseases among geographically bound population, however, beta coronaviruses such as MERS-CoV, SARS-CoV, and SARS-CoV-2 have been widely reported to cause more serious diseases (**Error! Reference source not found.**). For example, HCoV-229E and OC43 were studied between 1965 and 1980s to be responsible for 10-15% of common cold that mostly occur during winter (**Error! Reference source not found.**). In addition, HCoV-NL63 was identified in 2004 from a child with bronchitis in Netherlands (**Error! Reference source not found.**), while HCoV-HKU1 was first isolated in Hong Kong in 2005 in a patient with chronic pulmonary disease (**Error! Reference source not found.**). However, between 2002-2003, SARS-CoV emerged in Guangdong China through an outbreak from Civet cats and bats which ended with 8096 infections and 774 deaths (**Error! Reference source**

not found., **Error! Reference source not found.**). With the recent emergence of SARS-CoV-2 in China, it implies that five out of the seven known human coronaviruses emerged from Asia. The chronological order of emergence of human coronaviruses suggests the likelihood of either resurgence or emergence of new epidemics in future (Figure 1).



CoV= Coronavirus; HCoV= Human coronavirus; SARS= severe acute respiratory syndrome; MERS= Middle-East Respiratory Syndrome.

Figure 1: Chronological Sequence of Discoveries of Human Coronaviruses

Although the mortality rate of SARS-CoV-2 appears to be comparatively lower than some known beta coronaviruses, the rate of transmissibility remains a great concern. For instance, the middle-East respiratory syndrome coronavirus (MERS-CoV) emerged in Saudi Arabia in 2012 and showed much similar presentation to SARS-CoV but with higher mortality rate of 35% compared to 3.5% in SARS-CoV (**Error! Reference source not found.**). MERS-CoV is also geographically bound compared to SARS-CoV. A further comparative analysis of SARS-CoV-2 and the genomic sequences of MERS-CoV, SARS-CoV and bat coronavirus (SARSr-CoV-RaTG13) has shown close resemblances of 50%, 79.5% and 96% respectively (**Error! Reference source not found.**). Similarly, a recent study that used macro-genomic sequencing, molecular biological detection and electron microscopic analysis, reported 99.98% similarity between SARS-CoV-2 viral strains currently infecting humans and the isolated virus strain from pangolins (**Error! Reference source not found.**). These further supports the suspicion of zoonotic transmission of SARS-CoV-2.

In all, the key drivers to the emerging novel diseases remain the dynamism in global ecosystem caused by human activities and climate change. With rapidly growing population, urbanization, migration, agriculture, wildlife trade and consequent destruction of natural habitats, humans are increasingly coming in contact with wild and domestic animals (**Error! Reference source not found.**). This in turn, creates a pathway for cross-transmission of pathogens between humans and animals, resulting to new diseases in which humans may have little or no specific immunity to withstand. The emergence of new epidemics such as COVID-19 will continue to arise until a comprehensive strategy that addresses health in relation to human interaction with animal and environment is adopted. Although the epidemiological surveillance of COVID-19 pandemic suggests strong links with this ecological dynamism, prevention mechanisms so far have continued to give more priority to human health than animals and environment. Studies that assessed the roles of domestic pets in the transmission of COVID-19 infection have suggested that cats and ferrets infected by SARS-CoV-2 may be potential sources of the viral infection to human (**Error! Reference source not found.**-**Error! Reference source not found.**). Although more scientific evidences to this are needed, the epidemiological link of SARS-CoV-2 to seafood and animal market in Wuhan China suggests the need for one health approach in combating infectious diseases.

Furthermore, recent evidence demonstrates that older people (70 years and above) and individuals with co-morbidities are at higher risk of COVID-19 infection than others (**Error! Reference source not found.**). The interactions between human, animals and environment remain the cause of both low immunity and majority of transmissible diseases affecting human population (1). This interaction has promoted the endemicity and easy spread of numerous infectious diseases across regions of the world, especially in Africa and Asia. The concept of "One Health" approach could foster multi-disciplinary collaboration to reduce human infections, vulnerability and sufferings.

Global Situation of COVID-19 Pandemic

Cases of COVID-19 infection have been reported in more than 206 countries across the world with varying incidences and fatalities (**Error! Reference source not found.**). As at July 12, 2022, more than 552.4 million infections and over 6.5million deaths has been reported (3). Globally, Europe seems to be worst hit by the pandemic, with over 232.3 million cases and more than 2.1million COVID-19 related deaths (3). According to statistics, America also faces a considerably high prevalence of COVID-19 pandemic with contrary

mortality rate compared to Europe; with reported cases of more than 164.5 million and 2.8 million deaths. Besides this, sustained local and international responses has nearly reduced the spread of the virus to local transmissions. Currently, drugs that cure COVID-19 are lacking; however, researchers have developed vaccines which demonstrates high efficacy in preventing SARS-CoV-2 infections across populations (4). Clinical trials of the vaccine demonstrated that vaccinated individuals could develop immunity against the COVID-19 virus within seven days of administration (4-6). However, data on whether the vaccine-induced immunity against the virus is short or long term is still a subject of research. Regardless, vaccination against SARS-CoV-2 has increased in recent times both in developed and low resource countries.

The New Variant Strains of SARS-CoV-2

New variant strains of SARS-CoV-2 have evolved following the outbreak across countries. Apart from the prominent spike mutation D614G, researchers have reported the emergence of A701V variant in United Kingdom, Malaysia, Nigeria, Australia, South Africa, and Netherlands (7). The new A701V variant has the substitution of amino acid - Alanine with valine at the codon position 701 in the spike protein. Epidemiological reports demonstrate higher infectivity among these new variant strains, posing more challenge for prompt control; and largely responsible for the current global relapses in COVID-19 infections, particularly in countries that had recently made significant progresses in the control of the viral disease.

Global COVID-19 Outbreak Responses and Prevention Programs

Various measures have been employed to curtail the spread and impact of the viral disease, including the development of the COVID-19 prevention guidelines, vaccination, public awareness, epidemiological surveillance, development and scaling up of testing kits/protocol, stimulating researches through sponsorships and grants, and capacity building (3). Although these measures are coordinated by the global health body in collaboration with governments of various countries, non-governmental and private partners organizations, the guideline allows countries to develop and implement prevention policies in line with their peculiarities. The chronological sequence of events is demonstrated in Table 1.

Furthermore, the rapid spread of COVID-19 from China to more than 206 countries within a short time frame underscores the role of human migration in aiding the pandemic. This necessitated the policies of shutting down international borders by many countries. While this showed good results, international movements and trades were affected, particularly among countries who largely depend on international trades for their economic viability. While borders closure minimized the rate of imported cases, no mitigating effect was observed on community transmissions resulting to further domestication of local policies such as social distancing, contact tracing, movement restrictions, lockdowns, wearing of face masks in public places, among others. These policies have continued to undergo regular reviews in line with prevailing situations, and have no doubt demonstrated some level of efficacy in curbing the spread of COVID-19. Furthermore, continuous research in response to the outbreak has led to invention of COVID-19 vaccines.

Table 1: Responses to events of the COVID-19 pandemic

Date	Events
December 30, 2019	A cluster of pneumonia of unknown origin identified in Wuhan animal and sea food market, the Hubei province of China
December 30, 2019	Chinese national health commission issued an epidemiological alert and immediately shutdown the animal and sea food market
January 2, 2020	First COVID-19 virus was isolated in China
January 11, 2020	First COVID-19 fatality was recorded in China
January 13 2020	First case of COVID-19 infection outside China was reported in Thailand
February 2, 2020	First fatality outside China was reported in Philippine
January 30, 2020	World Health Organization declared COVID-19 a global health emergency
February 11, 2020.	World Health Organization named the disease COVID-19
March 11, 2020	World Health Organization declared COVID-19 a pandemic

Covid-19 Vaccine

Clinical trial by Pfizer COVID-19 vaccine candidate using a potentially revolutionary RNA technology has demonstrated 95% efficacy in preventing COVID-19 infection after seven days of completing the second dose (4, 5). The vaccine known as COVID-19 mRNA

Vaccine BNT162b2 is a highly purified single-stranded, 5-capped mRNA produced by cell-free in vitro transcription from the corresponding DNA templates encoding the viral spike protein (S) of SARS-CoV-2 (8). The vaccine contains polyethylene glycol/macrogol (PEG) as part of ALC-0159, cholesterol, potassium chloride, potassium dihydrogen phosphate, sodium chloride, sucrose, disodium hydrogen phosphate dihydrate,1,2-Distearoyl-sn-glycero-3-phosphocholine, ALC-0159 and ALC-0315 (5). Results from clinical trials conducted in the United States, Europe, Turkey, South Africa, and South America demonstrated that when COVID-19 mRNA Vaccine BNT162b2 is administered intramuscularly on individuals 16years and above, after dilution as a series of two doses (0.3mL each) 21 days apart, the efficacy from 7 days after second dose in participants without evidence of prior infection with SARS-CoV-2 would be 95.0% (95% credible interval of 90.3% to 97.6%) (8).

Besides, while hopes have heightened following this breakthrough by Pfizer and her German partner BioNTech, there is still insufficient data on how long the immunity triggered by the vaccine will last (6). This and more raises some concerns among researchers and the public regarding the benefits and safety of the vaccine. Furthermore, for optimal safety among recipients, health body in the United Kingdom has issued additional safety guidelines about the vaccine (9). In response to the above guidelines, reports from clinical trials have demonstrated that the vaccine may be relatively safe for all ages and status (7). Moreover, data is needed on the long-term side effects, and its interaction with other drugs used for long treatments. These limitations further suggest that a comprehensive approach that integrates the root of the disease in its prevention strategies may be beneficial and more reliable on a long term. Therefore, a multi-sectoral and multi-disciplinary approach in tackling the novel pandemic and similar future outbreaks should be prioritized (10).

One Health Approach

Factors that determine today's health have become more complex, multi-faceted and cut across species lines; thus, it is unlikely that sustainable mitigation strategies could be achieved if they are solely approached from the standpoints of pure medicine, veterinary or environmental sciences (2). The concept of one health centres on the consequences, responses, and actions on the animal–human and environmental ecosystems interfaces and the emerging endemic zoonoses. This is primarily responsible for a greater burden of global diseases and antimicrobial resistance that are causing serious impacts especially among low-resource countries (**Error! Reference source not found.**). The concept of one health approach recognizes the inextricable relationship between human health, animals and their shared environments (Figure 2). The ideology of one health evolved from the recognition that more than 60% of the 1,461 globally identified human diseases are attributed to multiple hosts that have passed across species lines (12). However, the concept gained more attention in 1964 through Calvin Schwabe, an epidemiologist who proposed that zoonotic diseases could only be eradicated by the collaboration of professionals from veterinary, human health and environment science (**Error! Reference source not found.**).

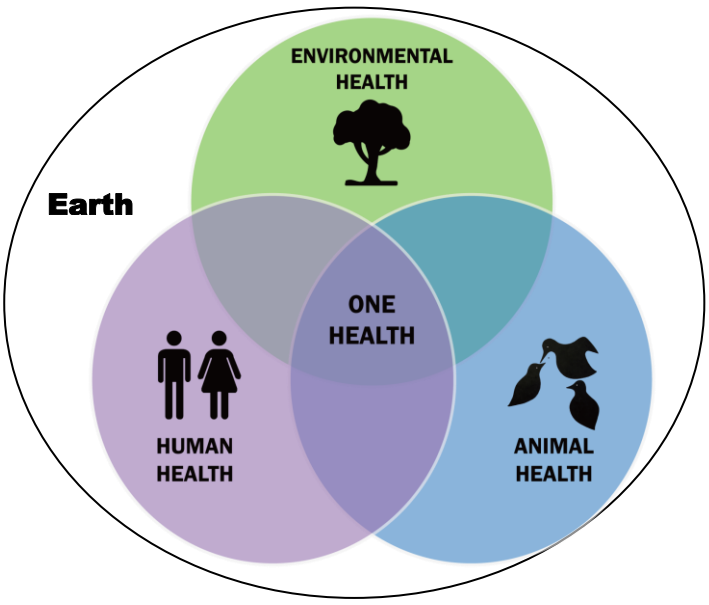


Figure 1: Concepts framework for One Health Approach (13)

One health approach is essential against the backdrop of frequent and recurring epidemics and the critical need for collaborative, cross-disciplinary approaches in responding to emerging and resurging diseases; and the threats these pose to human health, food supplies and economies (2,**Error! Reference source not found.**,13). The outbreak of SARS-CoV-2 has further demonstrated that new pathogens could emerge from a wild source at any time without warning and become a threat to public health and global economies (2). Responding to global pandemics require the basic principles of one health and the inclusion of wildlife health as an important component of global disease prevention, surveillance, control and prevention. These principles had been previously employed to curtail the outbreak of Avian influenza; which saw the collaboration of various international and national organizations, such as the World Health Organization, Food and Agriculture Organization, World Organization for Animal Health, United Nations Children's Fund, World Bank and other national health ministries, and the result was the development of the International Ministerial Conferences on Avian and Pandemic Influenza that served as the major driver in the surveillance and responses to influenza (2).

Best evidence from various fields needs to be shared among experts using the framework of one health. As a cultural component of pandemics, global institutionalization of one health approach in the fields of animal trades, food and agriculture, environmental, aquatic health and human health is important (**Error! Reference source not found.**). Furthermore, in many countries, one health approach has demonstrated high efficiency in the control of emerging tropical and infectious diseases. However, the commonest challenge is the sustainability. For instance, Kenya eradicated the recurrent rift valley fever epidemics through one health approach (**Error! Reference source not found.**). Similarly, the success of the 2003 SARS outbreak prevention strategies was largely due to the incorporation of one health approach which saw inter-disciplinary collaboration (15). Furthermore, case studies carried out in Nigeria, Uganda, and Tanzania to assess the efficiency of One Health approach to health policy have also demonstrated strong capacity for prevention of infectious diseases (16). While public health continues to respond appropriately as new diseases emerge, an approach that addresses the dynamics of disease outbreaks need to be adopted. It is believed that the growing dynamism in ecosystem contribute greatly to the emergence of new pathogens from wildlife, including SARS-CoV-2, suggesting of a deteriorating world. How we think and act about health requires a paradigm shift, and adopting one health framework is essential to achieving the global infections prevention goals.

Way forward

COVID-19 infection and similar future infectious outbreaks can be effectively controlled using multi-disciplinary collaborations. Tackling epidemics with one health approach encourages the collaboration of experts from diverse fields, and which could be more economical especially for low income developing countries. This paper recognizes the emergency need for short measures and proposes one health approach as a long-term strategy for the control of COVID-19 and probable future outbreaks.

Short term

We suggest among other short-term measures, the immediate vaccination of people across regions against COVID-19 infection. While efforts to unravel how long the immunity triggered against COVID-19 infection last and other salient issues surrounding the vaccine continues, any action capable of reducing the spread of the disease or generating human immunity against the virus should be welcomed. Efforts should be intensified to improve access and coverage of the vaccine (BNT162b2) to all vulnerable population, especially in low resource countries. There is also need to strengthen the current response mechanisms against the pandemic such as increased awareness, surveillance, movement control, social distancing, capacity building and scaling up of laboratories testing capacities. In addition, adequate coordination and communication among health experts is vital to overall success of COVID-19 prevention program.

Long term measures

One health approach as a long-term measure aims at the eradication of resurgence of infectious disease outbreaks that are linked to the human-animal-environment interface. Therefore, there are more comprehensive measures directed against multiple sources of infectious diseases to human. Although long term measures may take more time than acceptable in emergency situation created by COVID-19 outbreaks, these measures are considered to have less adverse impacts to human, more economical and could require legislation and efforts of all (Acharya, et al., 2020). These includes;

Animal and environmental welfare guidelines.

Adoption and domestication of best global animal and environmental welfare guidelines among countries could promote animal and environmental health, and reduce the chances of resurgence or emergence of possible future novel diseases from animals and environment. This requires multi-disciplinary collaboration of experts to develop guidelines that are evidence-based and region-specific in order to tackle the pandemic while taking into account the socio-cultural backgrounds and available infrastructures

across the regions. There is need for legislative provisions that would regulate pets' ownership and animal births to ensure closer monitoring of animals. The success of this may depends mainly on public participation and strong political commitments.

Establishment of One Health Commission

Establishment of one health commission that would be saddled with the responsibilities of promoting health and preventing infectious diseases associated with the activities of animals, human, environment, climatic changes and aquatic lives could help quell the incessant outbreaks of new infectious diseases. This may require legislations and enforcement of new human, environmental and animal health policies that would promote safety of the entire ecosystem. Members of the commission should be drawn from across the fields of medicine, environmental health sciences, infectious disease, veterinary sciences, public health, animal husbandry, community health, virology to share ideas and health information in line with the peculiarity of their environments. This would enhance adequate co-ordination and information sharing among human, animal and environmental health experts in order to timely identify risks and develop management strategies to forestall future outbreaks.

Strengthening surveillance and laboratory capabilities

Reducing the interface between human, wild and domestic animals and environments could be vital to global control zoonotic diseases that threatens human health and existence. Due to the continuous destruction of natural ecosystem by human activities and climate change, an increasing threat is posed to human health. This could be effectively checked by developing a robust and sustainable surveillance and control programs with a tripod focuses on human, animal and environmental health (Figure 2). A sustainable surveillance system that generates primary data on one health is essential in continuous review of healthcare policies to safeguard both the environment, animals and human health (1). One possible way to control zoonotic diseases is to scale up animal campaigns for animal health and control. Animal health and control policies are already in full practice in many regions such as Europe, Canada and United States, however, many countries particularly in Africa and Asia continents are yet to embrace it.

Furthermore, effective surveillance could require the scaling up of diagnostic capacities of laboratories. In some countries, the locally available and sufficiently equipped diagnostic laboratories may be efficient in meeting the standard, however, improving the accessibility is important. In addition, development of rapid test kits for initial screening of COVID-19, including asymptomatic cases could lower the workload to these laboratories and reduce the spread of the virus. When merely clinical signs and symptoms are used as basis for disease diagnosis, the detection accuracy could be lowered. Therefore, control of the spread of COVID-19 virus requires easily accessible and affordable on-spot reliable diagnostic tests for enhanced identification and reporting (17).

Awareness

Continuous public awareness programs play vital role in wars against epidemics and COVID-19 is no exception. To some extent, community awareness is still low in many countries, particularly in Africa where information mistrust strongly exists between leaders and citizens due to corruption. In addition, misconception about COVID-19 due to low literacy rate, socio-economic issues, and cultural beliefs among communities are also hindrances to COVID-19 programs. Good knowledge of COVID-19, the environments that bring people in contact with animals in unhygienic conditions, and preventive measures could be helpful in ameliorating the situation (1). Such settings such as live animal markets could be routes for the accidental transmission of zoonotic diseases to humans.

Encouraging Research and funding

Epidemiology field research on COVID-19 in the communities might be helpful in identifying the associated risk factors, implications, and locality-based disease dynamics. This could be a starting point in formulating a multi-disciplinary management strategy for COVID-19 and other infectious diseases. Researchers from basic sciences could be involved to develop mathematical models of communities' infectious disease dynamics, that would engender preparedness and proactive preventive responses to epidemics. Further research funding for using 'one health approach' is important in order to assess zoonotic diseases and the human-animal disease interface, to forestall future outbreaks of diseases originating from animal hosts, and identify a global strategy to reduce carbon emissions and global warming. This is in line with the recognition that epidemics occur frequently from the large-scale impact of destabilization natural environments by human activities and climate change.

Relevance of the study

The paper highlights the relevance of one health approach in developing strategic response to epidemics and in preventing resurgence of COVID-19 and other future outbreaks. Limited literature on the application of one health concept in response to COVID-19 remains the key limitation in this study.

Conclusion

Both short and long-term measures should be employed in pandemics control such as COVID-19 and other probable future epidemics. A collaborative and

multi-disciplinary approach cutting across fields of animal, human, and environmental health disciplines could help to better understand the ecology of each emerging zoonotic disease in order to develop a better response strategies and control. One health approach to infectious diseases control holds a strong promise as an indispensable tool in eradicating the emerging epidemics occurring due to human interface with animals and environment. Indoctrinating the core principles of one health in response to epidemics could save more lives and resources.

Acknowledgment

This study was supported by Transdisciplinary Research Grant, Universiti Sains Malaysia (311.CIPPT.4119149). Authors acknowledge in special way Prof. C. O. Edeogu for his encouragement during this work.

Ethical Clearance

This study does not require ethical approval because it consists solely of a literature review and does not include human participants.

Competing Interests

The authors declare that there is no conflict of interest in this study.

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