

REVIEW ARTICLE

The 'One Health' Approach to an Epidemic Response

Vinu Cherian¹, Joel Philip²¹Assistant Professor, Department of Community Medicine, Sree Narayana Institute of Medical Sciences, Ernakulam, Kerala; ²Consultant Psychiatrist, Peejays @ Neurocenter Kochi, Kerala

Abstract	Introduction	Methodology	Results	Conclusion	References	Citation	Tables / Figures
--------------------------	------------------------------	-----------------------------	-------------------------	----------------------------	----------------------------	--------------------------	----------------------------------

Corresponding Author

Dr. Joel Philip, Peejays@Neurocenter, Ayesha Road, Vyttila, Kochi, Kerala - 682019
 E Mail ID: joelphilipmd@gmail.com



Citation

Cherian V, Philip J. The 'One Health' Approach to an Epidemic Response: the Kerala Model. Indian J Comm Health. 2020;32(3):472-478.

Source of Funding: Nil **Conflict of Interest:** None declared

Article Cycle

Received: 17/06/2020; **Revision:** 05/07/2020; **Accepted:** 30/07/2020; **Published:** 30/09/2020

This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/).

Abstract

The concept of 'one health' recognizes that there is an inextricable link between the health of people, animals, and the shared environment. With the rapid growth in population and the destruction of natural habitats, humans are coming into closer contact with wild and domesticated animals. This, in turn, creates ripe conditions for the movement of viruses and diseases between animals and people. The world is seeing frequent occurrences of epidemics caused by new pathogens, to which humans have little immunity, owing to this phenomenon. 'One Health' assumes global significance today when the world is in the grip of the COVID-19 pandemic.

The response of the state of Kerala to the COVID-19 crisis is guided by its prior experience with curbing the Nipah virus epidemic in 2018. The same core philosophy of 'one health' that was at the heart of the campaign to rein in the Nipah outbreak has spearheaded the state response to the COVID-19 pandemic. A review of available literature in Pubmed/Medline & Google scholar databases was carried out to study the impact of 'one health' on the epidemic response of Kerala state to the Nipah virus, and how it has been extrapolated in managing the current COVID-19 pandemic. The articles obtained were screened by title, abstract and full text to obtain the most relevant papers. Recommendations have also been proposed regarding the incorporation of 'one health' in public health strategy.

Keywords

One Health; Epidemic; Nipah; COVID-19

Introduction

The concept of 'one health' has been around for millennia, with references noted in the works of Hippocrates as far back as 400 BC. (1) Early Greek scholars spoke about the interdependence of human health, animal welfare and environmental stability, and the need to maintain a delicate balance between the three. (2) However, the unrestricted pilferage of natural resources and unchecked pollution in the modern age has taken a remarkable toll on the environment. With an ever-growing population and restricted living spaces, man has resorted to

encroaching upon forests, mangroves and other natural habitats to satisfy his needs. This in turn has brought humans in closer contact with species like bats and snakes, leading to new and distinct viruses crossing over from these host animals to man. (3) It follows that approximately 60% of the 1,461 diseases now recognized in humans are attributed to multi-host pathogens that have moved across species lines. (4) Moreover, nearly 75% of new human infectious diseases that have emerged over the last three decades are defined as zoonotic. (5)

'One Health' gained much-needed recognition in 1964 when the epidemiologist Calvin Schwabe

proposed that veterinary and human health professions unite to combat zoonotic disease. (6) Four decades later, the American Veterinary Medical Association, the American Medical Association (AMA), and the American Public Health Association took action to bring the animal and human medical communities together by forming the 'One Health Initiative Task Force'. This task force set out to tackle issues such as antimicrobial resistance and newly emerging zoonotic diseases, problems with significant repercussions that were gaining global recognition. (7,8) The ideology of 'one health' is hence very much in the limelight today, against the backdrop of more frequent and recurring epidemic outbreaks.

The One Health Commission based in the United States of America currently defines 'one health' as a "collaborative, multi-sectoral, and trans-disciplinary approach - working at local, regional, national, and global levels - to achieve optimal health and well-being outcomes recognizing the interconnections between people, animals, plants and their shared environment." Their charter lays out the broad scope of the idea, one among the listed being 'disaster preparedness and response'. (9) Indeed, the South Indian state of Kerala utilized these principles effectively to conquer the outbreak of the Nipah virus in 2018. The close coordination between various departments and disciplines was instrumental in limiting the spread of the disease in the community. (10) With the state currently amid the COVID-19 pandemic, many of the same strategies have played a role in implementing the public health response to the pandemic in Kerala.

Aims & Objectives

In this review, we lay out the manner in which 'one health' was embedded in the state epidemic response to the Nipah virus two years ago, and how the same principles are being implemented today in limiting the fallout from the COVID-19 pandemic. We also put forward recommendations based on "One health' guidelines and plot out a roadmap for the future.

Material & Methods

A literature search of Pubmed/ Medline and Google Scholar databases was conducted using the terms 'one health', 'nipah', 'Kerala', 'COVID-19' etc. in varying permutations and combinations. The titles of the articles were screened to remove those that were irrelevant to the subject matter. The abstracts

of the remaining articles were scanned for narrowing the pool further to maintain relevance. Finally, the full texts of the articles that were remaining were screened to obtain the most suitable papers.

Results

'One Health' approach to the Nipah epidemic

On 19 May 2018, an outbreak of the Nipah virus (NiV) was reported from the district of Kozhikode in the South Indian state of Kerala. (11) A 28-year-old male had been admitted to a private hospital in the district two days before with features suggestive of an encephalitis-like illness. However, the treating team harbored suspicions regarding its etiology, owing to the presence of unusual clinical signs like tachycardia and hypertension. They were also aware that the patient's brother had died following a similar illness just a fortnight ago. The neurologist hence decided to send samples for analysis over to the Manipal Centre for Virus Research, nearly 300 kilometers away. This course of action led to the swift identification of the Nipah virus as the etiological agent, and prompted state public health machinery to swing into action to contain the spread. Samples were forwarded to the National Institute of Virology in Pune for a definitive diagnosis, which came on the 20th of May. (12)

The 'one health' approach was evident in the series of measures unveiled by the state on the public health front. Nipah being a rare virus of zoonotic origin, such an approach was adopted as it was the one most likely to reap the best dividends. Medical, veterinary, and animal husbandry departments joined hands in a rare feat of symbiotic collaboration to curtail community spread. [Table 1]

State officials and doctors from the animal husbandry department played a key role in trapping and testing the presumed host animal, the fruit bat (*Pteropus medius*), to ascertain the origin of the outbreak. Several bats from a well at the residence of the index case were tested; however, they yielded negative results. Virologists were well aware that this did not rule out bats as the source of the virus, as bats may harbor the virus only temporarily. Despite this, the work done by veterinarians was invaluable in tracing the virus back to its source. (13) The Animal Husbandry department officials were also at the forefront in spreading awareness surrounding bats and their role in the ecosystem. The spread of Nipah in the community led many locals to clean out their old wells that harbored bats

and instigated them to destroy their traditional roosting spots, in an ill-conceived effort to reduce their risk of infection. This was bound to worsen the situation by increasing contact between humans and bats, which were natural reservoirs of the virus. (14) Well-timed, clear and concise instructions from the department, in collaboration with the Department of Health, helped allay such fears amongst the public, which may have otherwise worsened an already precarious situation.

On the public health front, officials were tasked with meticulous contact tracing of confirmed cases. Exhaustive lists of contacts were prepared and susceptible individuals were followed up daily via telephone to determine their health status. If someone developed symptoms, ambulances were arranged to transport them to designated isolation facilities for clinical care and diagnostic confirmation. (15)

At the state administrative level, officials from the State and Central Departments of Health were actively involved at every step. The State Health Minister was especially hands-on in her approach, providing clear and decisive leadership at a time of crisis. Her public appearances were aimed at providing scientifically backed information regarding the epidemic and instructing people about the necessary preventive measures to be undertaken. She earned accolades for her measured tone, which instilled a sense of confidence in the general public about the management of the outbreak. (16)

At the central administrative level, a multi-disciplinary team was convened by the Union Minister of Health and Family Welfare, Government of India, to tackle the crisis. Such inter-departmental and inter-disciplinary alliances are, of course, at the heart of the 'One Health' approach. The team was led by the director of the National Centre for Disease Control. Other members were drawn from the National Institute of Virology (which confirmed the causative agent), the Department of Animal Husbandry, Dairying & Fisheries, the Division of Emergency Medical Relief as well as specialists from leading hospitals like the All India Institute of Medical Sciences and the Ram Manohar Lohia Hospital in New Delhi. This team provided much needed logistical support to the state health department in active case detection, contact tracing, observation, treatment, safe disposal of human remains, as well as training and use of personal protective equipment (PPE) by healthcare workers. (17)

The Final Report of the One Health Initiative Task Force convened by the American Veterinary Medical Association states that "partnership is critical to success" during an epidemic outbreak and calls for collaboration at the local, national, and global levels. (18) Such partnerships were facilitated at the highest levels in sourcing medication for the treatment of the afflicted. The Additional Chief Secretary of Health of Kerala set up a direct line of communication with the government in Queensland, Australia, where they had developed a monoclonal antibody found to be effective against similar viral strains. Further red tape in acquiring the medication was circumvented by close cooperation with the offices of the Drug Controller General of India (DCGI) and the Indian Council of Medical Research (ICMR) to hasten approval for use in a clinical setting in Kerala. (17)

Further international cooperation was solicited to develop a treatment protocol for the newly sourced medication. To this end, an expert committee called the 'Nipah Drugs Trial Group' was constituted in Geneva by an eminent deputy director-general at the World Health Organisation (WHO), who also happened to be an Indian national. The committee, comprising doctors, public health specialists, and infectious disease experts from different countries held several rounds of discussion via video-conferencing to formulate the requisite protocol. (17)

The epidemic outbreak also saw the rampant spread of rumors and misinformation via social media outlets. A technical committee was set up to filter and flag such incidences to avoid sowing seeds of panic in the population. (19) The government announced stringent punishment to those indulging in such malpractices as a counter-measure to this problem. Professionals from the information technology industry hence contributed their fair share to subduing the Nipah outbreak. (20)

The 'one health' approach was originally proposed to encourage the collaborative efforts of multiple disciplines working locally, nationally, and globally, to attain optimal health for people, animals, and our environment. (21) The state response to the Nipah outbreak sowed the seeds for developing a framework of epidemic control, that was firmly grounded in the core principles of 'one health'. Such an approach may indeed be the need of the hour in the current climate of the COVID-19 pandemic.

'One Health' approach to the COVID-19 pandemic

The experience of Kerala state in dealing with the Nipah epidemic gave it a distinct advantage in tackling the onslaught of COVID-19. Much of the public health machinery was already in place and primed for such an event, more so as the state had just identified and successfully dealt with an isolated case of Nipah in June 2019. Kerala was the first state to report a case of COVID-19 in January 2020, as it has a large expatriate population and a booming tourism sector. However, the state was able to quickly implement a slew of policies and public health measures to tackle the outbreak.

As soon as the first case of COVID-19 was reported on 30th January, the public health machinery remained on high alert. Rigorous tracing and screening of contacts were undertaken, right from the initial days of the outbreak. Communication was maintained daily with those under home quarantine to check for new-onset symptoms, and symptomatic cases were transported to earmarked isolation centers in ambulances. (22)

In contrast to the Nipah outbreak, the involvement of veterinary services was limited this time as the virus had already been transmitted to man from an animal reservoir, and the State was tackling the issue of human to human spread. However, as envisaged by the 'one health' directives, various disciplines began to work in tandem to promote the goal of good health, with public health experts once again at the forefront of the response.

Doctors at major hospitals started telephonic consultations to maintain continuity of care while maintaining social distance. Mental health specialists provided training to other doctors to help people deal with the psychological issues related to the epidemic and quarantine, such as anxiety, depression, and obsessive-compulsive symptoms. Telephone hotlines were initiated and manned by trained personnel to address these issues daily. (23) Owing to the propensity of the virus to spread easily through droplets, strict quarantines had to be imposed and enforced. The state police force and traffic personnel bore the responsibility to ensure that only essential workers and vehicles were allowed to ply. Local policemen even came up with an innovative 'hand-washing' dance, to educate the public about the proper technique of washing hands. (24)

Public information and broadcasting wings of the state government publicized inventive campaigns on social media such as "break the chain", which

focused on the importance of personal hygiene in preventing community spread. As part of the initiative, portable washbasins with running water and liquid soap were installed at strategic locations such as bus terminals. All shops were required to have such facilities or a bottle of hand sanitizer made available to customers. A second campaign was also put out in late April under the banner "Do not spit, we shall lose"; to stress the importance of hygienic practices in maintaining the gains that had been painstakingly made over the preceding months. (25) Prison authorities enlisted the help of incarcerated inmates to manufacture essential commodities like face masks and soap dispensers. Hundreds of liters of illicit spirit that had been seized by civic authorities in the preceding months were utilized to make hand sanitizer, which was then made available to the public at reasonable rates. (26)

Women's self-help groups, which have a strong foothold in the state, also pitched in to support the relief effort. The most prominent of these groups, the "Kudumbashree", has been providing gainful employment to thousands of women for over a decade. These women came forward to run community kitchens for migrant workers and provided packed lunches for children, the elderly and disabled who were confined to their homes. (27) Affordable takeaway meals were made available at Government-run canteens and enlisted restaurants. Telecom and broadband operators began to provide cheap data plans and extensions on currently active ones to facilitate working from home. They were also advised by the government to strengthen their networks to facilitate the additional load. (28)

'One Health' emphasizes interdisciplinary collaboration, training for health professionals and institutional support to minimize global health threats due to infectious diseases and epidemics. (29) The above-mentioned are some of the many instances of different departments, in both public and private sectors, working simultaneously and hand-in-hand to mitigate the effects of the COVID-19 outbreak on the populace. This coordinated multi-disciplinary effort was lauded by global media such as the British Broadcasting Corporation (BBC), as a sustainable blueprint that could be emulated in other parts of the world to address the epidemic. (30) Hence, an epidemic response with an underlying focus on 'one health' can contribute to the sort of public health result that may prove to be the light at the end of the tunnel.

Recommendation

1. The 'One Health' approach to tackling an epidemic has several benefits, as it encourages interdisciplinary collaboration and brings expertise from diverse fields to the table to attain a common goal.
2. We propose the following suggestions as a means of bolstering the epidemic response, based on the principles of 'one health'.
3. Constitute a 'One Health' Task Force with representation from the fields of medicine, infectious disease, public health, veterinary sciences, animal husbandry, virology etc., to share scientific information.
4. Develop evidence-based and region-specific guidelines to tackle the epidemic, taking into account the socio-cultural background, available health facilities, etc. of the affected area.
5. Convene a 'communications committee' to coordinate the dissemination of accurate information pertaining to the epidemic, as well as to manage media and public relations.
6. Involve researchers in basic sciences to develop mathematical models of infectious disease dynamics, in order to remain prepared and proactive.
7. Identify environments that bring people in close contact with animals in unhygienic conditions, such as live animal markets. Such settings can be hot-spots for the accidental transmission of zoonotic viruses to humans.
8. Support funding for 'one health' initiatives to study zoonotic diseases and the human-animal disease interface, to prevent future outbreaks of viral diseases originating in animal hosts.
9. Encourage a global agenda that reduces carbon emissions and global warming, besides promoting renewable energy sources. Such an outlook must recognize that the frequent occurrence of epidemics we are seeing today stems from the large-scale impact of destroying natural environments.

Limitation of the study

The literature search pertaining to the application of the 'one health' concept in the state response to COVID-19 was limited to the early days of the pandemic, as the review was carried out at this time. It is possible that the dynamic and fluid nature of the

pandemic may have led to changes in the manner of response with the passage of time.

Relevance of the study

The study highlights the importance of the 'one health' approach in planning a strategic epidemic response, and in limiting the fall-out from future outbreaks.

Conclusion

The 'one health' concept holds promise and is indispensable to confront the public health challenges of an epidemic. The South Indian state of Kerala had successfully utilized this doctrine in managing the Nipah outbreak, and the same principles have guided its response to the current COVID-19 pandemic. Although it is still early days, there is much to be gained, in terms of lives saved, by indoctrinating the core principles of 'one health' in the epidemic response.

Authors Contribution

Both authors were equally invested in literature review, data collection and preparation of manuscript.

References

1. Haileamlak A. One Health Approach to Disease Prediction and Control. *Ethiop J Health Sci.* 2016 Jul;26(4):304. doi: 10.4314/ejhs.v26i4.1. PMID: 27587927; PMCID: PMC4992769. [[PubMed](#)].
2. Roncada P, Modesti A, Timperio AM, Bini L, Castagnola M, Fasano M, Urbani A. One medicine--one health--one biology and many proteins: proteomics on the verge of the One Health approach. *Mol Biosyst.* 2014 Jun;10(6):1226-7. doi: 10.1039/c4mb90011a. Epub 2014 Apr 29. PMID: 24777557. [[PubMed](#)].
3. Destoumieux-Garzón D, Mavingui P, Boetsch G, Boissier J, Darriet F, Duboz P, Fritsch C, Giraudoux P, Le Roux F, Morand S, Paillard C, Pontier D, Sueur C, Voituren Y. The One Health Concept: 10 Years Old and a Long Road Ahead. *Front Vet Sci.* 2018 Feb 12;5:14. doi: 10.3389/fvets.2018.00014. PMID: 29484301; PMCID: PMC5816263. [[PubMed](#)].
4. Torrey EF, Yolken RH. Beasts of the Earth: Animals, Humans, and Disease. *Emerging Infectious Diseases.* 2005;11(7):1162.
5. Taylor LH, Latham SM, Woolhouse ME. Risk factors for human disease emergence. *Philos Trans R Soc Lond B Biol Sci.* 2001 Jul 29;356(1411):983-9. doi: 10.1098/rstb.2001.0888. PMID: 11516376; PMCID: PMC1088493. [[PubMed](#)].
6. Atlas RM. One Health: its origins and future. *Curr Top Microbiol Immunol.* 2013;365:1-13. doi: 10.1007/82_2012_223. PMID: 22527177. [[PubMed](#)].
7. American Veterinary Association. One Health: A New Professional Imperative—One Health Initiative Task Force. 2008 [Internet]. Cited May 2, 2020. Available from:

- https://www.avma.org/sites/default/files/resources/onehealth_final.pdf
8. Nolen RS. AMA adopts one-health policy. *J Am Vet Med Assoc* 2007;231:353-357.
 9. One Health Commission. What is One Health?. 2020 [Internet]. Cited May 2, 2020. Available from: https://www.onehealthcommission.org/en/why_one_health/what_is_one_health/
 10. Chattu VK, Kumar R, Kumary S, Kajal F, David JK. Nipah virus epidemic in southern India and emphasizing "One Health" approach to ensure global health security. *J Family Med Prim Care*. 2018 Mar-Apr;7(2):275-283. doi: 10.4103/jfmpc.jfmpc_137_18. PMID: 30090764; PMCID: PMC6060941. [PubMed].
 11. World Health Organization. Nipah Virus Outbreak in Kerala [Internet] Cited May 2, 2020. Available from: <https://www.who.int/southeastasia/outbreaks-and-emergencies/health-emergency-information-risk-assessment/surveillance-and-risk-assessment/nipah-virus-outbreak-in-kerala>
 12. Taylor LH, Latham SM, Woolhouse ME. Risk factors for human disease emergence. *Philos Trans R Soc Lond B Biol Sci*. 2001 Jul 29;356(1411):983-9. doi: 10.1098/rstb.2001.0888. PMID: 11516376; PMCID: PMC1088493. [PubMed].
 13. 1: Sadanadan R, Arunkumar G, Laserson KF, Heretik KH, Singh S, Mourya DT, Gangakhedkar RR, Gupta N, Sharma R, Dhuria M, Jain SK, Nichol S, Gupta P, Bhargava B. Towards global health security: response to the May 2018 Nipah virus outbreak linked to *Pteropus* bats in Kerala, India. *BMJ Glob Health*. 2018 Nov 9;3(6):e001086. doi: 10.1136/bmjgh-2018-001086. PMID: 30483413; PMCID: PMC6231092. [PubMed].
 14. Ajith Kumar AK, Anoop Kumar AS. Deadly Nipah Outbreak in Kerala: Lessons Learned for the Future. *Indian J Crit Care Med*. 2018 Jul;22(7):475-476. doi: 10.4103/ijccm.IJCCM_282_18. PMID: 30111920; PMCID: PMC6069317. [PubMed].
 15. Thomas B, Chandran P, Lilabi MP, George B, Sivakumar CP, Jayadev VK, Bindu V, Rajasi RS, Vijayan B, Mohandas A, Hafeez N. Nipah Virus Infection in Kozhikode, Kerala, South India, in 2018: Epidemiology of an Outbreak of an Emerging Disease. *Indian J Community Med*. 2019 Oct-Dec;44(4):383-387. doi: 10.4103/ijcm.IJCM_198_19. PMID: 31802805; PMCID: PMC6881878. [PubMed].
 16. Aravindan K. How Kerala Passed the Tough Nipah Test. *The Wire* [Internet]. 2018 [cited 2 May 2020]. Available from: <https://thewire.in/health/how-kerala-passed-the-tough-nipah-test>
 17. Abraham J. Silently, additional chief secretary Rajeev Sadanandan gained the ammo to take on Nipah. *The Indian Express* [Internet]. 2018 [cited 2 May 2020]; Available from: <https://www.newindianexpress.com/states/kerala/2018/jun/10/silently-additional-chief-secretary-rajeev-sadanandan-gained-the-ammo-to-take-on-nipah-1826033.html>
 18. King LJ, Anderson LR, Blackmore CG, Blackwell MJ, Lautner EA, Marcus LC, Meyer TE, Monath TP, Nave JE, Ohle J, Pappaioanou M, Sobota J, Stokes WS, Davis RM, Glasser JH, Mahr RK. Executive summary of the AVMA One Health Initiative Task Force report. *J Am Vet Med Assoc*. 2008 Jul 15;233(2):259-61. doi: 10.2460/javma.233.2.259. PMID: 18627228. [PubMed].
 19. Pulla P. Nipah Virus: Anatomy of an outbreak. *The Hindu* [Internet]. 2018 [cited 2 May 2020]; Available from: <https://www.thehindu.com/news/national/kerala/anatomy-of-an-outbreak-how-kerala-handled-the-nipah-virus-outbreak/article24060538.ece>
 20. Lithin Z, Harikrishnan U, Jayakumar C, Sekar K. Psychosocial perspective of Nipah Virus Outbreak in Kerala, India. *International Journal of Scientific*. 2019;6(11):159-162.
 21. One Health Commission. Mission/Goals. 2020 [Internet]. Cited May 2, 2020. Available from: https://www.onehealthcommission.org/en/why_one_health/mission_goals/
 22. A 'Kerala Model' Worthy of Emulation. *Deccan Herald* [Internet]. 2020 [cited 2 May 2020]; Available from: <https://www.deccanherald.com/opinion/first-edit-a-kerala-model-worthy-of-emulation-823916.html>
 23. Telemedicine Unit Set Up for Home Quarantined People. *The Hindu* [Internet]. 2020 [cited 2 May 2020]; Available from: <https://www.thehindu.com/news/cities/Kochi/telemedicine-unit-set-up-for-home-quarantined-people/article31093989.ece>
 24. Faleiro S. What the World Can Learn From Kerala about How to Fight COVID-19. *MIT Technology Review* [Internet]. 2020 [Cited 2 May 2020]; Available from: <https://www.technologyreview.com/2020/04/13/999313/kerala-fight-covid-19-india-coronavirus/>
 25. Purayil MP, Malakar S. How a Tiny South Indian State Is Using Transmedia Storytelling to Fight COVID-19. *The diplomat* [Internet]. 2020 [Cited 2 May 2020]; Available from: <https://thediplomat.com/2020/04/how-a-tiny-south-indian-state-is-using-transmedia-storytelling-to-fight-covid-19/>
 26. Raghunath A. COVID-19: After face masks, Kerala prisoners to now make hand sanitisers. *Deccan Herald* [Internet]. 2020 [cited 2 May 2020]; Available from: <https://www.deccanherald.com/national/south/covid-19-after-face-masks-kerala-prisoners-to-now-make-hand-sanitisers-814911.html>
 27. Gilani I. India's densely populated state breaking coronavirus chain. *AA* [Internet]. 2020 [Cited 2 May 2020]; Available from: <https://www.aa.com.tr/en/asia-pacific/india-s-densely-populated-state-breaking-coronavirus-chain/1776936>
 28. Babu G. COVID-19 impact: Internet providers in Kerala to increase speed by 30-40%. *Business Standard* [Internet]. 2020 [Cited 2 May 2020] Available from: https://www.business-standard.com/article/current-affairs/covid-19-impact-internet-providers-in-kerala-to-increase-speed-by-30-40-120031200736_1.html
 29. Shrestha K, Acharya K, Shrestha S. One health: The interface between veterinary and human health. *International Journal of One Health*. 2018;4:8-14.
 30. Biswas S. Coronavirus: How India's Kerala State 'flattened the curve'. *BBC News* [Internet]. 2020 [Cited 2 May 2020] Available from: <https://www.bbc.com/news/world-asia-india-52283748>

Tables**TABLE 1: MULTI-DISCIPLINARY RESPONSE TO THE NIPAH OUTBREAK (2018)**

Occupational group	Role
Healthcare professionals (Doctors, nurses, paramedical staff)	<ul style="list-style-type: none"> • Confirmation of suspected cases • Isolation of the virus from collected samples • Organizing effective isolation and quarantine of cases • Treatment of confirmed cases • Supervising burial of the deceased
Veterinarians	<ul style="list-style-type: none"> • Spreading community awareness about the role of bats in the ecosystem, and how to avoid acquiring the infection from these host organisms.
Animal Husbandry officials	<ul style="list-style-type: none"> • Trapping the fruit bat and obtaining samples for identification of the virus • Ensuring that roosting areas of bats are not destroyed by concerned residents
Public health experts	<ul style="list-style-type: none"> • Information, education and communication campaigns (IEC) • Tackling stigma by disseminating accurate information about the disease • Contact tracing of positive cases
Government officials	<ul style="list-style-type: none"> • Coordinating the efforts of different departments • Funding for the epidemic response • Sourcing medication • IEC efforts in press and other media • Keeping the public updated through press conferences and public appearances • Supply of PPE to frontline workers
Police cyber-security wing	<ul style="list-style-type: none"> • Preventing the spread of fake news