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STARTER

A Different Kind of Security: Public Healthcare in India

Anusha Krishnan[*]

1 Introduction

Healthcare is vital to all of us some of the time, but public health is vital to all of us all of the time

> *Everett Koop (pediatric surgeon, public health administrator, and 13th Surgeon General of the United States of America)*

As our world reeled under successive waves of the COVID-19 pandemic, Koop's words strike a deep chord. Over the last century, humans have seen three major pandemics unfold—the 1918 Spanish influenza (Spanish flu), which lasted 2 years and killed 17–100 million people; the 1981 HIV (Human Immunodeficiency Virus) pandemic which still persists; and most recently, the COVID-19 (Coronavirus Disease-19) pandemic that has hopefully ended.

There is little doubt that without the public health systems currently in place, COVID-19 could have been disastrous for us humans. Without such systems, diseases like the bubonic plague (fourteenth century) and Cocolitzli (sixteenth century) have wiped out more than 50% of a region's population.[1,2]

Although the COVID-19 pandemic has not caused the same devastation as these early diseases, it has nevertheless, highlighted many issues with current public health systems.

2 What is Public Health?

According to the World Health Organization (WHO), public health is *the art and science of preventing disease, prolonging life, and promoting health through the organized efforts of society*, a definition attributed to Donald Acheson, an Irish-born physician and epidemiologist.[3] Ideally, public health should focus on all factors that hierarchically affect the health of each individual, groups of people, and the human population as a whole.[3]

Keeping this in mind, the WHO has created ten Essential Public Health Operations (EPHO) listed as: (1) surveillance of population health and well-being; (2) monitoring and response to health hazards and emergencies; (3) health protection (environmental, occupational, food safety, etc.); (4) health promotion (addressing social/economic determinants of health and health inequity); (5) disease prevention (early detection of diseases); (6) assuring governance for health and wellbeing; (7) assuring sufficient and competent public health workforce; (8) assuring sustainable organizational structures and financing; (9) advocacy communication and social mobilization for health; (10) advancing public health research in informing policy and practice.[4]

In the United States of America, the Centers for Disease Control and Prevention (CDC), have a very similar system with their set of ten Essential Public Health Services (EPHS).[5] India's latest public health roadmap, outlined in the National Health Policy 2017, however, has a vastly different approach.[6]

3 How Does Public Healthcare Operate in India?

Rather than defining essential services and goals, India's policy outlines key objectives, principles, and initiatives that will be the focus of India's public health system between 2020–2025.[6] Within this framework, it addresses broad necessities such as achievement of universal health coverage, reinforcing trust in public healthcare, promoting the private healthcare sector to align with public healthcare goals, ensuring adequate investment in public healthcare, and improving delivery of public healthcare services. Following this, the focus shifts to outlining a series of 24 topics which the policy recognizes as being of utmost importance for public health improvement; these include national health programs, women's health, legal frameworks for healthcare, antimicrobial

[1] Bengaluru, India.
*anusha.krishnan@gmail.com

resistance, emergency care and disaster preparedness, human resource and financing of healthcare, and vaccine safety.

While India's National Health Policy 2017 has been praised for defining weak spots in the current public health system—especially its multi-stakeholder, consensus-based policy approach to address lacunae in access, affordability, and accountability—it has also been criticized on many accounts.[7] Critics point out that the NHP 2017 lacks structure and clarity in providing tangible action plants to tackle several issues, and are wary of the increasing the role played by the private sector in helping the government reach public health goals. [8,9]

The Indian public health system is organized into three tiers with primary, secondary, and tertiary levels.[10] At the primary level, are sub-centres (SCs; each of which serves 3000–5000 people) and primary health centres (PHCs; one per 20,000–30,000 people). SCs are tasked with spreading messages on behavioural changes for better health among the rural population, and also provide services related to maternal and child health, family welfare, nutrition, immunization, diarrhoea control, and control of communicable diseases. PHCs acts as referral units for 5–6 SCs, have in-patient facilities, and their activities include healthcare promotion and providing curative services. The second tier consists of sub-district hospitals and community health centres (CHCs; one per 80,000–120,000 people) that must have at least four medical specialists (surgeon, physician, gynaecologist/obstetrician, paediatrician) supported by paramedical and other staff. CHCs must also have 30 beds with an operating theatre, X-ray facility, labour room, and laboratory facilities to provide referral services to PHCs and specialist consultations. The third tier consists of medical colleges and district hospitals, which are referred to as 'first referral units', and must be equipped to provide 24-h emergency obstetric and new-born care along with a blood-storage facility.

Despite such a multi-tiered, well-planned public health organisation system, India's expenditure on public health spending is only around 1% of its GDP—one of the lowest even in Southeast Asia. The out-of-pocket expenditure for healthcare drives 7% of Indians into poverty, and about 23% of the population simply cannot afford healthcare.[11] Besides this, public health systems in India are severely understaffed and a strong workforce needs to be developed.[12]

Currently, the Indian public health system is not only highly fragmented and varied, but its governance is underdeveloped in both research and practice.[13] This has left India's population vulnerable to a host of health-related issues much like a computer with poor security against digital attacks.

4 Public Health as a Security System

Public health systems are similar to cybersecurity systems that protect digital networks, systems and programs from attacks. A cybersecurity framework consists of five core activities: (1) identifying potential weak points where attacks can occur, (2) building systems to monitor and protect weaknesses, (3) detecting attacks when they occur, (4) responding to attacks appropriately, and finally (5) recovering from the attack with minimal losses.[14]

As it turns out, several aspects of cybersecurity frameworks actually emulate public health systems.[15–17] This is not surprising given the amount of time and effort that public health programs invest in identifying, protecting against, detecting, responding to, and helping in recovering from disease outbreaks. Take for example the efforts of researchers and organizations to ensure that public health systems remain prepared to handle another wave of the Spanish flu—efforts that are like the *identification* step of cybersecurity.

Malcolm Gladwell illustrates this beautifully in a 1997 article in The New Yorker titled *The Deadliest Virus Ever Known*.[18] He begins the article with a description of seven graves in the local cemetery of a tiny mining town, Longyearbyen, in Norway, and a scientist's quest to obtain samples of the 1918 Spanish flu virus from the buried bodies. He proceeds to explain different research teams' experiences and efforts to understand the virus—how it originated and spread, what it did at a molecular level, and how it mutated. He also describes a yearly conference, informally referred to as the *Flu Conference* held by the Food and Drug Administration (FDA) in its efforts to prepare for future influenza outbreaks—parallel to a *surveillance and protection exercise* in cybersecurity terms. Public health officials from around the world, WHO and CDC representatives, and vaccine manufacturers attend the meeting for guidance on what influenza strains could be expected to hit humanity each year. During these conferences, surveillance data, vaccine and drug requirements, and healthcare strategies are discussed, akin to the *detection*, *response*, and *recovery* steps in a cybersecurity setup.

One of the best examples of public health action in the rapid detection, response, and

recovery from a disease outbreak in India was the containment of the Nipah virus that hit Kerala in 2018.

Occurring in the Kozhikode and Malappuram districts of Kerala in May 2018 this was the third Nipah outbreak in India (the first two occurred in West Bengal in 2001 and 2007).[19] During this outbreak, patient zero or the index case was reported in the first week of May; within 15 days, the causal agent was identified as Nipah, and nearly 2000 people were quarantined in the two districts while health advisories were issued for Northern Kerala and adjoining districts in Karnataka.[20,21] A total of 28 people tested positive for the Nipah virus, of which despite the medical teams' best efforts, 16 died before the outbreak was officially declared over on 10th June 2018.[19] According to the WHO, although the initial response to the outbreak relied heavily on improvisation, public health responses from both, public and private sectors, were swift, strong, and showed great commitment in dealing with the situation.[19]

Despite being declared a successful intervention, the containment of this Nipah outbreak in India also highlighted some major shortcomings of our public health system. Technical shortfalls and inexperienced surveillance personnel interfered with timely data collection on the extent of the outbreak, responses, and response efficiencies. Without this data, an opportunity to improve was lost.[19]

As Lord Kelvin, noted physicist and mathematician said, *what cannot be measured, cannot be improved*; therefore, measures of public health and public health data are essential for advances in not just healthcare, but many other aspects of life.

5 Public Health and Data

The COVID-19 pandemic has certainly driven home the fact that public health data are not just crucial for managing public health emergencies. Such data can also have grave consequences on economic policy decisions (such as those pertaining to shipping and travel) or seemingly innocuous guidelines (such as when schools could reopen after vacations).

As public health systems of different countries began reporting rising or ebbing numbers of COVID-19 cases, they dictated changes in global mobility, with major economic consequences for shipping and aviation, which in turn also affected the spread of COVID-19.[22–24] Besides this, who would have thought that comparatively trifling decisions on whether, when, and how schools reopen would require guidelines and national-level decisions based on public health data?[25,26]

But it has happened; and the value of public health data has not escaped India, as proven by the intense coverage of the NITI Aayog Health Index Round IV, 2019–2020 in the Indian media.[27] The National Institution for Transforming India or NITI Aayog, which operates on the principle of *what gets measured gets done*, has computed the health index as a composite score of 24 indicators under 3 domains—health outcomes, governance and information, and key inputs and processes. Based on the health index, all Indian states and union territories have been ranked, and the key results indicate that while states like Kerala, Tamil Nadu, and Telangana have excellent health indices, several of the lowest ranked states like Uttar Pradesh and Bihar, have shown great improvements over the span of 1 year. When the NITI Aayog began tracking the health index across states in 2017 in collaboration with the Union Ministry of Health and Family Welfare (MoHFW) and the World Bank, it aimed to *measure and compare overall and incremental performance across states and union territories over time and nudge them to shift focus from inputs and outputs to outcomes*.[27] It is perhaps worth noting that while India is far from achieving an ideal public health system, the NITI Aayog's expectations were not entirely unrealistic.

An outstanding, albeit older example of how public health data can drive enormous change in healthcare comes from the efforts of the LV Prasad Eye Institute (LVPEI).[28] In the early 1990s, eye health programs in India focused on treating cataracts to combat blindness as a national survey (1986–1989) indicated that cataracts were responsible for 80% of blindness in India. However, Dr. Gullapalli Nageswara Rao, LVPEI's founder, realized that much more needed to be done to address eye health in India.

With this goal, he launched APEDS (Andhra Pradesh Eye Disease Study) to collect data on visual impairment and blindness in his home state. APEDS-1, as the first study was dubbed, turned out to be a literal eye opener; its results showed that nearly 86% of moderate visual impairment and 60% of blindness were due to a combination of cataracts and uncorrected refractive errors (short sightedness or long sightedness).[29] In addition, the study also found that 20–40% of eyes that underwent cataract surgery remained blind, and that rural areas bore a disproportionately high burden of eye diseases due to poverty and lack of access to quality care.[29] This data served as

the main basis for Dr. Rao's conceptualization of a rural eyecare system. This system, described as a *pyramidal model* of eye care, has a five-tier organization.[30] Basic eye care such as screening for short/long sightedness are available in rural areas, with progressively higher levels of care available via referrals based on disease complexity, clinical urgency, and population density of the area. All tiers are linked to each other via a robust health information system customized to eye care.[30]

As of 2020, this system has evolved into a highly efficient eye care delivery network offering quality eyecare at affordable rates to 150 million people in Telangana, Andhra Pradesh, Karnataka, and Odisha.[28] The network consists of a broad base of more than 200 *Vision Guardians* in rural areas trained in basic eye testing and care, tapering up to 160 *Vision Centers*, 19 *Service Centers*, 3 *Tertiary Care Centers*, and LVPEI as a *Quaternary Center of Excellence* in Hyderabad as the apex of the pyramid.

The system has been so effective that its practical applicability is being tested in Liberia, West Africa, where LVPEI began operating an eye care centre in 2017.[28] The success of LVPEI's public eye health program is largely attributed to its strong funding base (where affluent patients can choose to pay for extra non-medical services; the extra fees are used to offset eye care costs for poor patients), training programs, communication systems, and liberal digitization using their inhouse electronic record system EyeSmart™.[28]

With the advent of digitization in healthcare, it has now become easier than ever to collect, analyze and share healthcare data. Realizing that digital solutions can not only help cut healthcare costs, but also strengthen public health systems, many countries have begun investing in telemedicine, health apps for mobile phones and other devices, wearable health trackers, genomics, big data, etc.[31] The COVID-19 pandemic catapulted India's health system into adopting digital technologies with widespread usage of the Arogya Setu app, telemedicine services for outpatient consultation, and online medicine ordering services. The Health Heatmap of India is an open platform that curates, visualises, and analyses health data from various sources aid informed decision-making processes.[32,33]

6 Public Health Mistakes, Triumphs, and Room for Improvement

Despite the availability of abundant data and research insights, mistakes in public health decisions have been and will probably continue to be made. One of the most recent mistakes that affected every country in the world, was on precautionary measures to limit COVID-19 transmission.

Despite contemporary supporting work by several highly competent scientists who warned that SARS-CoV-2 (Severe Acute Respiratory Syndrome-Coronavirus-19) could be airborne, public health agencies like the WHO and CDC only declared this fact in April and May 2021, respectively.[34]

This was nearly one-and-a-half years after the initial outbreak, and nearly 1 year after researchers alerted WHO officials to the possibility that SARS-CoV-2 could be airborne.[34]

With this declaration, mask-wearing and ventilation, rather than social distancing and handwashing became the most effective ways to combat COVID-19 spread. Megan Molteni of *The Wire* wrote a compelling article titled *The 60-year-old scientific screwup that helped COVID-19 kill* chronicling how and why this happened.[34] In it, she describes the struggles of a group of researchers to convey their scientific conclusions to decision makers who were basing important public health decisions on a 60-year-old piece of erroneous data—that only infectious droplets smaller than 5 μm in diameter could be airborne aerosols.[35]

India's handling of the COVID-19 pandemic has also not been stellar.[36] The sudden lockdown in late March 2020 left millions of migrant workers without income and sparked a mass exodus of daily wage labourers from large cities to villages.[37] India's second COVID-19 wave was caused by lax public behaviour stemming from a false sense of security due to falling case numbers after the first wave. As political rallies and large public festivals such as the Kumbh mela were held, they turned into *superspreader events* that left the country's health system overwhelmed.[38,39] In addition, pseudoscientific cures and preventives touted by Indian ministries caused much confusion in the public's perceptions of the disease.[40] In spite of these problems, India's robust COVID-19 vaccination program was one of the world's largest and most successful programs.[41] This was likely responsible for largely asymptomatic or mild cases of COVID-19 with low death rates in the third wave that began in November 2021.[42,43]

Similarly, India has made incredible strides in many aspects of public health over the last 2 decades. One of the most notable triumphs in India's public health record is the eradication of polio. India's aggressive pulse polio campaign, begun in 1994, bore fruit after 2 decades, when

the country was declared polio-free by the WHO in 2014.[44] Another one of India's public health success stories lies in its 30-year battle against HIV.[45] India's neonatal mortality rates (NMR), infant mortality rates (IMR), and maternal mortality rates (MMR) have fallen by 57%, 58%, and 70%, to 22/1000 live births, 28/1000 live births, and 99/100,000 births, respectively, over 2 decades.[46–48] India also has one of the highest rates of COVID-19 vaccine acceptance in the world with 77% of respondents to a Facebook survey willing to take the vaccine.[49–51]

However, India's public health system does need to improve; the country's public health spending at just 1.2–1.6% of the Gross Domestic Product (GDP) is one of the lowest in the world. Most government hospitals and dispensaries, especially those in rural areas, are poorly stocked and lack basic infrastructure such as enough beds, medical equipment, working computer systems, and sometimes even water, sanitation, and electricity supplies.[31] India's doctor to patient ratio as of 2019 was 1:1457, which is lower than the 1:1000 ratio recommended by WHO.[52] For a population of 1.3 billion, India currently has around 1.9 million hospital beds, of which only 7.14 lakh are in government hospitals.[53,54] Worse, inequities in access to and affordability of healthcare are rampant, a situation, which left unaddressed can have grave consequences as history has demonstrated.[55]

7 A Re-Emerging Concept: One Health

One health is a system that recognizes that human health is closely tied to animals, plants, and local environments. It promotes multisectoral, collaborative, and transdisciplinary approaches to healthcare that must work at local, regional, national, and global levels to achieve optimal healthcare solutions.

Although it is a concept that has existed since the 1800s, when doctors noted similarities in diseases between humans and animals, it resurfaced in 2004 when the term *One Health* was coined.[56] This happened following a multidisciplinary conference of international experts hosted by the Wildlife Conservation Society to discuss preparedness and responses to diseases that could move between humans, domestic animals and wildlife.[57,58]

Over the past century, increasing human populations have caused people and livestock to live in increasingly close proximity to wildlife. This, compounded with climate change, altered land-use patterns, deforestation, and widespread international travel and trade, have caused existing zoonotic diseases (animal diseases that infect humans) to become more prevalent. Instances of *spillover events*, where pathogens such as rabies, anthrax, Ebola, HIV, and most recently, the coronaviruses, have jumped from animal reservoirs into new host populations, have been rising.[57]

To address these challenges, public health systems must adapt to changing needs and environments. New strategies of healthcare embracing the *One World One Health* approach interwoven with technological advances and digital solutions may herald a new era of inclusive public healthcare.[59]

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Anusha Krishnan is a bioscience writer based in Bangalore, India, with an interest in a wide range of biology-based topics, ranging from molecular biology and biochemistry to behavior and ecology. She has written for various online news sites such as Mongabay India, The Wire Science, and IndiaBioscience. Anusha has a PhD in Ecology from the Indian Institute of Science but abandoned a career in academia—despite a good publication list and strong research skills—in favor of communicating science. Now, she combines her research and scholarly skills with her love for storytelling to decode science for the general public.