A National Epidemic Intelligence (NEI) Service for India

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Executive Summary

The COVID-19 outbreak has demonstrated the need for India to develop its own capacity to assess emerging biological threats. Reliance on foreign inputs led to delayed actions such as airport closures or screening/quarantine of incoming travelers.

We propose the formation of an Indian National Epidemic Intelligence Service to monitor emerging outbreaks of novel or existing diseases, assess the threat in an Indian context, and alert public health agencies to take actions to protect Indian citizens. This service builds on India's already existing intelligence and surveillance units, to create a network of trained personnel who can analyse incoming data, identify threats, secure biological samples and characterise pathogens.

Introduction

The need for an Indian service that could provide intelligence regarding the type and magnitude of a biological event became apparent during the COVID-19 pandemic. India relied on information from multi-national agencies like World Health Organisation (WHO) to take decisions regarding closure of airports and testing protocols. But reliance on data and analysis provided by such organisations have an inherent drawback, as they rely on the information submitted by host countries. During the COVID-19 pandemic, suppressed data on the extent of COVID-19 spread and nature of asymptomatic transmission led to uninformed decision-making such as late closures of international travel. Early, precise information and understanding of the COVID-19 threat in the India context may have led to a more tailored public health response. Hence, it would be advantageous for India to develop its own intelligence agency to make an assessment of emerging threats and inform public health organizations.

We propose the formation of an Indian National Epidemic Intelligence (NEI) agency, under the Ministry of Health and Family Welfare (MoHFW) staffed with individuals trained in epidemiology and intelligence gathering. The main function of this agency would be to collect and analyse comprehensive information on emerging pathogens, existing health threats, hygiene practices, and public health systems across the world. These data can feed into making informed decisions when a new health threat emerges.

This document covers existing agencies that monitor public health threats and recommends a roadmap for India's NEI agency.

Existing agencies involved in gathering intelligence regarding epidemic outbreaks

Co-ordinated by the WHO, a consortium of national and international agencies gathers and collates data on emerging biological threats. These data are analysed and, if a public

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health threat is identified, follow up action is initiated. Control measures can be put in place, alerts can be disseminated through partner organisations and further investigations of the threat can be set up as required. Figure 1 provides an overview of this intelligence flow.
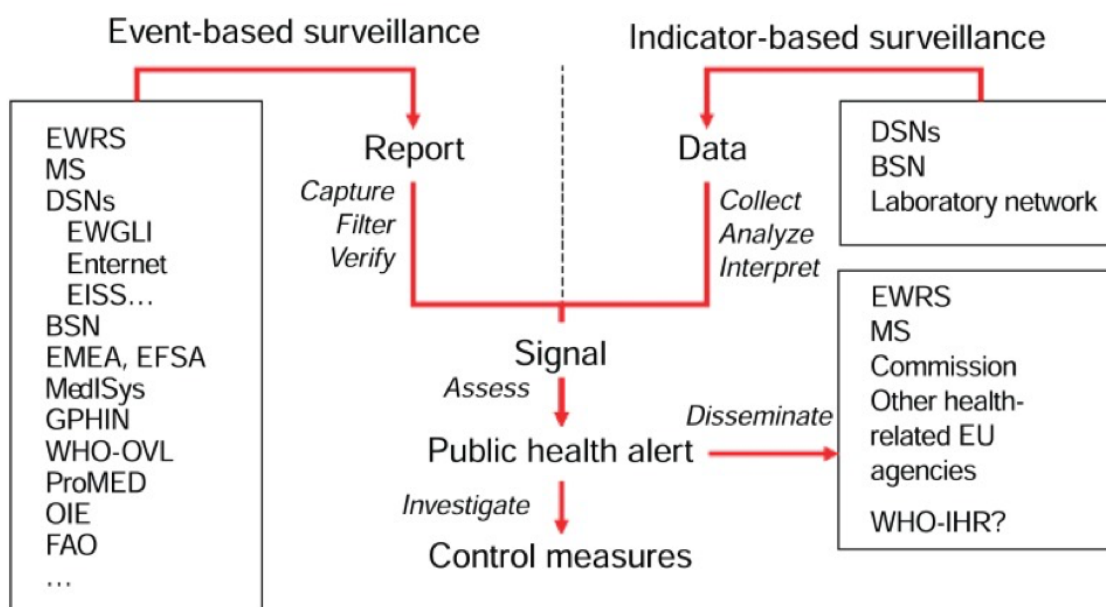

Figure 1: An overview of a global epidemic intelligence framework. Figure adapted from Global infectious disease surveillance and detection: Assessing the challenges—finding solutions.[i] EWRS = Early Warning Response System; MS = messaging system; DSN = disease surveillance network; EWGLI = European Working Group for Legionella Infections; EISS = European Influenza Surveillance Scheme; BSN = Basic Surveillance Network; EMEA = European Agency for the Evaluation of Medicinal Products; EFSA = European Food and Safety Authority; WHO-OVL = Outbreak Verification List; OIE = Office International des Epizooties (World Organization for Animal Health); FAO = Food and Agriculture Organization; EU = European Union. Enternet is an established and thriving EU-wide network for the laboratory-based surveillance of human Salmonella and Verocytotoxin-producing *Escherichia coli* (VTEC) infections.

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Below we discuss the structure and functions of select existing agencies involved in epidemic intelligence.

1. WHO; International Health Regulations (IHR)

The IHR treaty is the legal instrument which empowers WHO to be an international monitoring and advisory body for public health across the 196 signatory countries. The IHR Global Health Security Index (GSI) is a comprehensive assessment and benchmarking of health security and related capabilities across these countries. Data gathered from active surveillance efforts in host countries, information about past outbreaks, as well as the Joint External Evaluation (JEE) scores of countries part of the Global Health Security Agenda (GHSA) helps develop a medical intelligence profile for a country. JEE is a collaborative exercise by a country's public health experts and external evaluators from the Centers for Disease Control (CDC) of United States. The JEE examines capacities across 19 technical areas in the field of human health and prepares a report. This report is useful for the participant country to identify weaknesses in its public health machinery.[ii]

THE COUNTRY VOLUNTEERS FOR A JEE, and WHO establishes communication with the host country.

A JEE TEAM IS IDENTIFIED and participates in a 1-week visit to the country to validate the self-evaluation through multisectoral, interactive sessions and agrees to an assessment for each technical area.

THE REPORT IS POSTED on the WHO website (and on Global Health Security Agenda and JEE Alliance website).

THE HOST COUNTRY CONDUCTS A SELF-EVALUATION involving the relevant sectors using the JEE tool.

THE JEE TEAM DRAFTS A REPORT documenting the scores and priority actions as discussed during the visit. The host country reviews and comments.

Based on the final report, COUNTRIES DEVELOP A ROAD MAP to prioritize resources to address gaps.

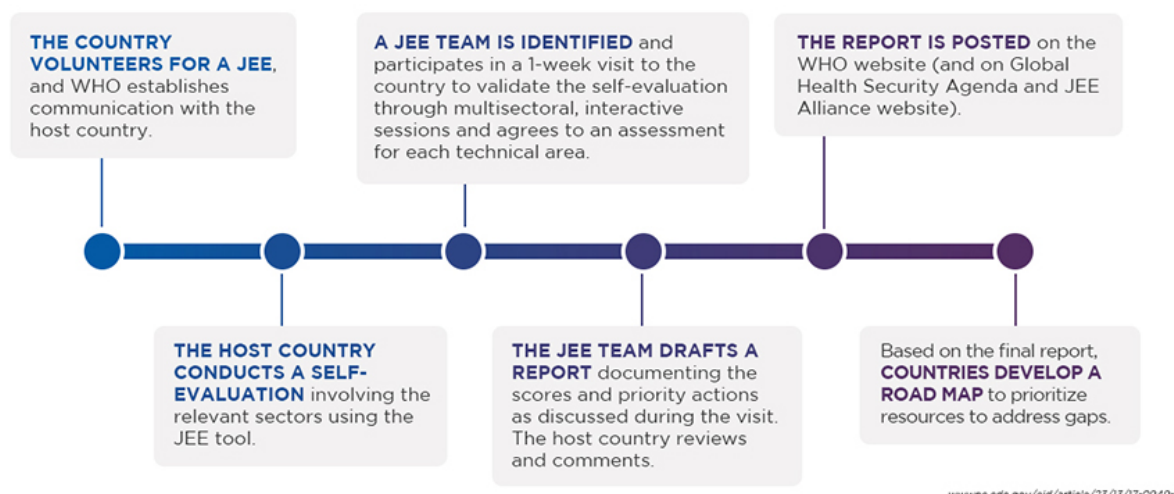wwwnc.cdc.gov/eid/article/23/13/17-0949-f1

Figure 2: The Joint External Evaluation Process. Image sourced from The Joint External Evaluation (JEE) Process: A Project to Assess and Build Global Health Security, CDC website.[iii]

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In 2012, WHO, along with its member states and partner organisations, created the ECO-NET, a global network of emergency operations and centres. The Strategic Health Operations Centre (SHOC) coordinates operations of the ECO-NET by providing a platform for information exchange and response coordination during public health crises of international proportions.

2. Global Health Security Agenda (GHSA)

GHSA is a multi-national body of 70 countries, international and non-government organisations, and private sector companies focussing on global infectious diseases. It has an event-based monitoring system/package in development. GHSA is supported by countries such as Georgia, Norway, Finland, Indonesia, Israel, Italy, Kenya, Mexico, United Kingdom, United States, and Yemen and international organisations like Food and Agriculture Organisation of the United Nations (FAO) and World Organisation for Animal Health (OIE). WHO is also part of this event-based monitoring package of GHSA.[iv]

3. Global Health Security Strategy (GHSS), USA

The USA's National Security Strategy (NSS) originally did not include biological threats. Initial work to develop a framework related to public health was done by the US Office of International Health and Biodefense (IHB), which comes under the Department of Homeland Security. In 2018, a National Biodefense Strategy (NBS) was formulated, expanding the NSS to encompass a comprehensive and integrated approach to address natural, accidental, and intentional biological threats domestically and internationally.[v] The vision for NBS was expanded to the global arena in May 2019 when the White House released the GHSS, which outlines the United States' government's approach to strengthen global health security, including improving the capacity of foreign countries to prevent, detect, and respond to infectious disease outbreaks. IHB engages the U.S. interagency and diverse stakeholders to implement these strategies.

The Centers for Disease Control and Prevention (CDC) is tasked with studying national and international public health threats. The agency runs the Epidemic Intelligence Service programme in epidemiology, creating a workforce of fellows that respond to health threats locally and globally.[vi] Since the inception of the programme in 1951, fellows have

investigated numerous health threats, including biological warfare during the Korean war, responding to Anthrax, SARS, and flu outbreaks, and providing on-ground response to Ebola and Zika virus outbreaks.[vii]

4. Global Outbreak Alert and Response Network (GOARN)

GOARN leverages the WHO network of over 250 several technical and public health institutions, laboratories, and NGOs, to observe and respond to threatening epidemics. It is not funded directly by the WHO, but derives funding from fundraising for each new incident it chooses to respond to.

5. Global Public Health Intelligence Network (GPHIN)

This is one of the most active and effective health monitoring systems in operation currently. It is a Canadian system that feeds into WHO. It has been the first to detect multiple Ebola outbreaks and other medical events around the world. GPHIN is an electronic monitoring system that uses news feeds from multiple languages to monitor any health related event in the world. It uses Natural Language Processing (NLP), weighted search words, automated translations etc. to analyse real time news feeds. Public health analysts and intelligence analysts perform a second level of analysis on the electronically collated data. GPHIN reports are forwarded by Canadian authorities to WHO. By some estimates, GPHIN reports form 20% of the health monitoring inputs to WHO.[viii]

6. Force Health Protection Agency (formerly, DHSC) for NATO[ix]

The Force Health Protection Agency was formed to monitor disease outbreaks in areas where NATO armed forces have been deployed to rule out biological warfare and provide an early warning system in the event of a local outbreak of a communicable disease.

7. MediSys

 The medical surveillance system of the EU is similar to GPHIN but only accessible to EU members.

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8. Blue dot[x]

Blue dot is one of the leading private entities in the realm of digital health monitoring systems in the world. Blue dot started as a private start-up relying on technology similar to GPHIN that makes use of NLP, auto-translations, etc. of global news feeds.

Limitations of current monitoring systems

The current surveillance systems, be they multi-national or national organizations have certain limitations made apparent by the emergence of COVID-19. The main problem with multi-national organisations like WHO is that they depend on the generosity of a 'host' country to access ground level as well as collated data from that country. The limitation of national systems is that domestic situations or budgetary constraints can influence the efficiency of monitoring systems. For example, GPHIN, arguably the best monitoring system, didn't detect COVID-19 outbreak due to Canadian government's priority to focus on domestic health issues.[xi] India has been relying on analysed data, warnings, advisories mainly from multi-national organisations. Additionally, it is important to assess these threats in the Indian context, taking into account India's geographical location, geostrategic ties, trade routes and capacity of health systems to respond to threats. It is therefore in India's national interest to create an Indian system capable of global monitoring and threat assessment.

Existing structures in India

India has few organisations involved in general monitoring, biosafety and biosecurity, but not systems involved in global, real-time data gathering pertaining to health. They are as follows:

1. National Centre for Disease Control (NCDC)

The National Centre for Disease Control is an institute under the Indian Directorate General of Health Services (DGHS), Ministry of Health and Family Welfare (MoHFW).

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NCDC is the nodal agency for the Integrated Disease Surveillance Programme (IDSP) and is the leading agency for implementation of the International Health Regulations (IHR) in India.

NCDC runs a program for doctors called Indian Epidemic Intelligence Service (EIS). It is a two-year programme in applied epidemiology in which trainee officers develop skills while working in Indian public health agencies and programs. Officers then return to their respective states or organisations. Since its conception in 2017, 33 Indians officers have been trained. They have investigated 121 outbreaks and evaluated 46 surveillance systems. Thus, the EIS is a training service and not an intelligence service.[xii,xiii]

2. Integrated Disease Surveillance Programme (IDSP)

The aim of IDSP is to develop human resources for domestic disease surveillance and integrate data gathered from decentralised surveillance and analysis. IDSP was set up in two phases using funding provided by the World Bank. NCDC is the reporting agency for IDSP.
IDSP has a media surveillance wing that was established in 2008. The Media Scanning and Verification Cell (MSVC) receives around 2-3 media alerts of unusual health events daily. A total of 2,925 health alerts have been detected till September 2014 since its establishment in July 2008.[xiv]

Additionally, 97% of Indian districts have mechanisms in place that provide data from government medical facilities including government laboratories to IDSP.[xv] However, not all laboratories are covered by IDSP due to budgetary constraints. Private medical establishments are not covered. Reporting centres are present at the Union, state, and district level. IDSP also runs the EIS programme for medical doctors wanting to pursue a career in field epidemiology and public health.

The data collected by IDSP is geotagged (GIS), has meteorological inputs and is in the 'S', syndromic; 'P', probable; & 'L', laboratory format. But currently IDSP data is not analysed using big-data tools.

3. DRDO laboratories

DRDO operates six laboratories under its life science cluster. These include Defence Bioengineering and Electromedical Laboratory (DEBEL), Bengaluru; Defence Institute of Bio-Energy Research (DIBER), Haldwani; Defence Food Research Laboratory (DFRL), Mysore; Defence Institute of Physiology and Allied Sciences (DIPAS), Delhi; Defence Institute of High Altitude Research (DIHAR); and Defence Institute of Psychological Research (DIPR), Delhi.[xvi]

These laboratories do not work in the area of monitoring but are geared towards solving technical problems related to life science that may or may not have applications in medical intelligence, biowarfare defence etc.

4. Medical Corps of Armed Forces

The medical corps has capabilities to identify a biowarfare attack and provide treatment but does not have monitoring/surveillance systems on a national/global level.

Lacunae in existing Indian monitoring systems

India's current epidemic monitoring systems need further strengthening to prepare for further disease outbreaks. Key areas that need to be included are:

1) Global, real-time news monitoring of biological events as the primary step.
2) Medical intelligence data of other countries
3) Medical data from private medical facilities under the IDSP format
4) Medical data from Medical Corps of Armed Forces under IDSP format
5) Include all government labs under IDSP format
6) Need for analysis of IDSP data using big-data tools
7) Need to include analysts versed in strategic studies at the Central office of IDSP

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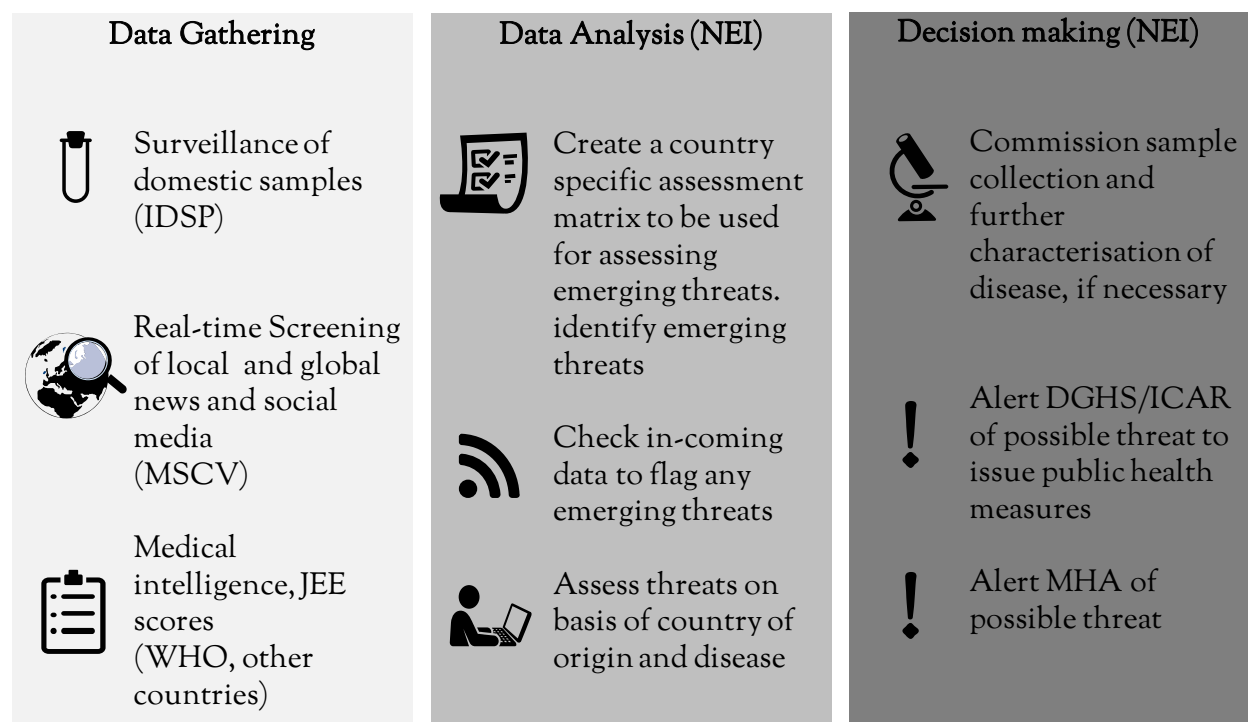
The proposed NEI

Data Gathering	Data Analysis (NEI)	Decision making (NEI)
Surveillance of domestic samples (IDSP)	Create a country specific assessment matrix to be used for assessing emerging threats. identify emerging threats	Commission sample collection and further characterisation of disease, if necessary
Real-time Screening of local and global news and social media (MSCV)	Check in-coming data to flag any emerging threats	Alert DGHS/ICAR of possible threat to issue public health measures
Medical intelligence, JEE scores (WHO, other countries)	Assess threats on basis of country of origin and disease	Alert MHA of possible threat

Figure 3: Data flow/decision making structure in proposed NEI system.

We propose a National Epidemic Intelligence (NEI) service for the primary function of assessing biological threats to India. For threats within India, the IDSP needs to be strengthened to ensure complete coverage of public and private hospitals in India. The sentinel centres need to be well-equipped to identify new diseases and characterise novel pathogens.

For threats originating in foreign countries, the NEI could have, as its first level, a global digital monitoring system on the lines of Canada's Global Public Health Intelligence Network and similar agencies. This monitoring system would involve expansion of the IDSP's current MSVC programme to include international events and active monitoring of news and social media. The monitoring system would use automated translations of news feeds from multiple languages, sentiment analysis, Natural Language Processing (NLP) etc.,

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to identify and locate an incident in the public health domain. Thess data can be analysed by public health experts and intelligence officers of the NEI and the threat assessed for the Indian context.

The second level of the proposed NEI could consist of personnel trained to analyse output of the first level. A mixed team of officers trained in epidemiology under the Indian EIS programme, statisticians and public health officials would be needed for informed analysis. The data gathered by IDSP can be used in conjunction with global digital monitoring at this level. Inclusion of analysts trained in strategic studies would also be required at this second level. The quality of analysis at this stage would improve if India has access to JEE scores from WHO as well as medical intelligence on countries. It will be critical for the NEI to develop an assessment matrix to judge an emerging threat – such a matrix can take into account the nature of the threat, distance from India, probability of the threat entering India, and transparency with which information about the threat is being shared.

The third level should consist of personnel trained to collect samples from distant locations and infrastructure consisting of laboratories capable of analysing these samples. The samples refer not only to biological specimens from individuals but can include environmental sampling of soil, water, sewage, construction material etc. Some of these laboratories might have to be located on foreign soil, as transporting samples contaminated with a pathogen or chemicals over long international distances is risky as well as governed by laws that prevent transport of certain biological entities across national borders. These personnel could be specially trained individuals from NEI or India's intelligence services. Once the samples are received, the NEI could work with existing governmental organisations to characterise the threat and get better understanding of the pathogen. This characterisation is important to take coherent public health measures - as seen in COVID-19, the suppression of the knowledge of asymptomatic transmission led to initial underestimation of the disease's spread. This step only requires to be done if the emerging threat is caused by a novel pathogen, such as SARS-CoV-2.

Once the assessment is done, concerned agencies can be notified about the emerging threat. This would include the MoHFW for public health measures, the Ministry of Home Affairs for internal security measures if required, and global organisations such as WHO.

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Data to be collected by NEI

The NEI's primary role will be to monitor for emerging threats by looking at real-time data on outbreaks. However, for assessing the threat in the Indian context, the NEI would also need to maintain data on various health parameters for all countries. The following categories of data are key inclusions for the NEI:

Medical intelligence - The knowledge of physical infrastructure, medical systems, and general health statistics of the target country/region. This category also includes data on life expectancy, disease burden, extent of vaccination etc. in a population of a country. This also includes cultural or societal norms that can feed into public health. For example, through COVID-19, countries which practiced mask wearing in public following previous SARS exposure fared better than others.

This intelligence can help form the basis for prediction models, in case there is an emerging public health threat in the target country. This intelligence can be gathered through publicly available data and on-site reconnaissance, but does not include near-real time information regarding an ongoing medical emergency.

Health system preparedness – this includes both, health monitoring systems – systems involved in gathering of information on the state of general medical status of a region/country and health surveillance systems – systems involved in gathering of information pertaining to a particular medical event.

Biosecurity measures – this includes procedures designed to protect the population against intentional exposure of harmful biological or biochemical substances. Measures such as regular monitoring for disease outbreaks, restricted access to pathogens, monitoring of supply chain of biological products and ratification of key international agreements to control bioweapon proliferation signal a country's preparedness to improve biosecurity.

Biosafety measures - procedures designed to protect the population against accidental exposure of harmful biological or biochemical substances. This includes laboratory safety

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measures, training of laboratory personnel and mechanisms of disposal of biological products. This can be assessed by reports of laboratory incidents, violations reported by institutions, and how strictly the country enforces its biosafety policies.

Data transparency - One key parameter that will influence the prediction of a biological threat is the transparent sharing of data amongst countries. China has been alleged to suppress the early dissemination of information on COVID-19, resulting in delayed public health response. Not only did they not share data openly, doctors who tried to raise alarm were censured.[xvii] Thus, the freedom of speech or state of transparency of media across various platforms in a country is a key determinant of its handling of a health threat. Countries with a history of information suppression should be treated with more caution than countries which openly share information. [xviii]

Functions of the NEI

International situations
Monitor emerging threats to human, animal or agriculture, originating outside India. The NEI would be responsible for flagging any emerging threats to the responsible agency in India. Functions would include monitoring for news updates, social media accounts and if required, retrieval of samples for further analysis in India. The NEI in collaboration with existing agencies can recommend steps to avoid the spread of the threat to India.

Domestic situations
The quality of public health infrastructure is vastly different across different states in India. The presence of both private and public medical facilities, concentration of medical facilities in urban areas, the poor quality of record keeping, and low rate of follow-up by patients makes it difficult to generate a situational picture of the medical state of the nation. NEI would play a role in monitoring for unusual disease outbreaks and collaborating with local governments to contain their spread.

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Non-biological events

Medical emergencies can arise due to chemical, radioactive, physical agents apart from biological agents. A monitoring system that is being proposed in this paper can be easily employed in such scenarios.

Conclusion

We propose the formation of a comprehensive National Epidemic Intelligence service for India that can monitor and assess emerging biological threats. Such a service can monitor both domestic and international situations to feed data to existing public health systems for preparing against potential biological outbreaks. We envision this data-based service to use digital data to identify potential hotspots of outbreak, and if required deploy field services to obtain samples for testing. An assessment based on the complete health and medical intelligence provided for the country of outbreak can help gauge the actual threat to India. Public health agencies can then make informed decisions to suspend travel or increase healthcare capacity in a timely manner to counter the emerging threat.

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