

Infectious Diseases in Indian Sub-Continent

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ABSTRACT

The Indian subcontinent has a huge burden of infectious diseases due to its enormous and diversified population, growing urbanisation, climate unpredictability, socio-economic inequalities, and changing health care problems. Despite considerable advances in the control of disease through wider immunisation, improved sanitation and improved surveillance systems, infectious diseases continue to be a significant cause of morbidity and mortality in the region. Endemic diseases such as tuberculosis, malaria, dengue, typhoid fever and diarrhoeal diseases also persist, along with emerging and re-emerging infections such as COVID-19, Nipah virus disease, antibiotic resistance bacterial infections and zoonotic pathogens. Growing international travel, environmental changes and population mobility further magnify the spread and evolution of infectious hazards. This article gives an overview of epidemiology, determinants, clinical impact and public health significance of infectious illnesses in the Indian subcontinent. It also covers breakthroughs in diagnostics, vaccines, antimicrobial stewardship, genomic monitoring and integrated disease surveillance systems that are driving current infectious disease management. The article ends with the call for a multidisciplinary, One Health approach that includes governments, health care professionals, researchers and communities to boost preparedness, improve outbreak response and minimise the burden of infectious illnesses in the region.

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Introduction

The Indian sub-continent consisting of India, Pakistan, Bangladesh, Nepal, Bhutan, Sri Lanka and the Maldives is facing a significant challenge to its health-care system from the constant emergence of infectious diseases and their subsequent reappearance. These difficulties make Health maintenance also a primary focus of the region's administration. Surveillance, prevention and control of infectious illnesses are thus essential health objectives. The Indian sub-continent accounts for around 75 million instances of diarrhoeal illnesses, 23 million cases of tuberculosis and 9 million cases of malaria per year. Respiratory infections, vector-borne diseases, food- and waterborne diseases, HIV/AIDS and sexually transmitted infections are among the many infectious diseases present in this region that are of particular importance. Most of the deaths from infectious diseases occur in the less developed countries and mostly in children, the elderly and immunocompromised people. In recent years there has been a growing awareness of the seriousness of these diseases and the need for health-care systems to be able to monitor populations and respond rapidly.

There are several pathogens that cause infectious illnesses. There are about 1 million organisms that can be categorised as infectious. Of them a few hundred only are a serious risk to human health. The likelihood of getting it varies with age, sex, ethnicity, health, whether you've been immunised and other things. Transmission of

almost all communicable diseases occurs either directly through contact between infected and susceptible persons or indirectly via a vector or vehicle (e.g., food, drink, blood, or air). Geography, trade, tourism and military actions also play a vital influence in affecting incidence and spread. Vaccines, suitable medications and preventative efforts can considerably lessen the burden of infectious diseases, but often these are not available to the populations at risk.

Common Infectious Diseases

Streptococcus pneumoniae, *Pseudomonas aeruginosa*, *Haemophilus influenzae*, *Acinetobacter baumannii*, *Klebsiella pneumoniae* and *Staphylococcus aureus* are major respiratory tract infections with significant morbidity and mortality in the Indian Sub-Continent. Viruses in this group include representatives of the Influenza A/B, Parainfluenza, Adeno, Respiratory Syncytial, Enterovirus and Rhinovirus families. Infectious or carrier individuals disseminate surrogate agents via aerosols, droplets or touch [1].

Respiratory tract infections are a heavy burden on the healthcare system with high outpatient visits, hospitalisation and substantial mortality in all age groups. Different causative agents are responsible for different manifestations including airways, bronchi and pneumonia. Relapse and superinfection are common. In dry regions, the transmission of harmful family viruses happens between September and March [2].

Vector borne infections are a major public health problem in India and the world and affect millions of people every year. Mosquitoes and ticks transmit diseases. The major diseases include Japanese Encephalitis, Dengue Fever, Chikungunya, Rift Valley Fever and Crimean-Congo Hemorrhagic Fever. Together they account

for around 120 million cases every year. Changes in land use, rapid urbanisation, greater human movement, climate change and increased agricultural intensification further facilitate spread. Public worry over mosquito-borne diseases is rising in India, where most large cities have seen epidemics of Dengue Fever and Chikungunya in recent years, causing enormous disease burden and economic loss. The impacted states include up to Sikkim in the northeast and Gujarat in the west, with peaks in the wet monsoon season [3].

Respiratory Infections

The commonest pathogens causing respiratory infections in the Indian subcontinent are viruses (rhinovirus, respiratory syncytial virus, adenovirus, parainfluenza viruses, enteroviruses, influenza virus and coronaviruses) and bacteria (*Streptococcus pneumoniae*, *Mycobacterium tuberculosis* and *Mycoplasma pneumoniae*). Respiratory infections are spread via droplet and fomite transmission. They generally present with cough along with sore throat, fever, headache and myalgia. In temperate nations, winter is the season for respiratory infections, as cold and dry air leads to respiratory ailments. It is different in India. Respiratory infections are a substantial cause of disease burden in India with more than 42 million cases reported annually and accounting for more than 13% of the Total Disease Burden recorded. Proper hand hygiene instructions, usage of alcohol-based hand rub, wearing masks and covering nose and mouth when coughing and sneezing are all preventive measures that will aid in breaking the chain of transmission significantly [4].

Vector Borne Diseases

The Indian sub-continent is home to a range of vector borne diseases caused by arboviruses transmitted by mosquitoes and tick-borne viruses associated with tick vectors. Dengue virus, chikungunya virus, Japanese encephalitis virus, Zika virus and West-Nile virus are viral illnesses that are transmitted by mosquitoes. Chikungunya, Zika and West-Nile viruses are relative new entrants to the Indian viral horizon. Climate changes have affected the pattern of rainfall, changed the surface and ground water flow, increased the ground-water storage and increased the household water supply and therefore, vector-borne diseases are likely to increase in incidence where they have established themselves in the Indian sub-continent. Among tick-borne viruses, Crimean-Congo haemorrhagic fever virus and Kyasanur forest disease virus are already important public-health hazards in the region. The first few months of the year are conducive for transmission of these arboviral diseases owing to high total rainfall or contribution of spray irrigation, thereby creating plentiful breeding grounds for the vector mosquitoes. In addition, environmental, occupational and socio-economic factors also play a role in the ecology of these arboviruses in The Indian sub-continent. While arboviral infections are well established and actively circulating in The Indian sub-continent, viruses such as Tick-borne encephalitis virus (TBEV) have all the qualities for establishment of transmission cycles and thus pose a public health threat [5,6].

Water and Foodborne Illnesses

Waterborne and foodborne diseases are major public health hazards throughout the Indian Sub-Continent, including Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. The highest number of cases of waterborne diseases occur in the region in the globe. Similar concerns apply to outbreaks of foodborne diseases. Poor populations are the ones that are most affected by these diseases. Foodborne dangers are a relatively recent area of expertise, in contrast to the long-established vector-borne diseases

such as malaria and dengue (see below). As a result, there are few relevant studies and more research is urgently needed [7,8].

Water and foodborne infections often lead to diarrhoea, vomiting, fever, abdominal cramps, and other intestinal symptoms. If multiple complaints are reported from the same region this suggests a common source and outbreaks of either form of illness may arise. One of the root causes is poor sanitation and inadequate infrastructure.

Blood and Sexually Transmitted Diseases Particular Infectious Diseases

Viruses and germs that are transmitted by blood and sexual contact are a severe health hazard in the Indian Sub-Continent. The Human Immunodeficiency Virus (HIV) is transmitted through unsafe sex, blood transfusions, sharing infected needles or a mother to her kid. AIDS stands for Acquired Immunodeficiency Syndrome, and is the terminal condition caused by HIV. The immune system is so compromised that the patient dies of other diseases owing to lack of immunity. AIDS victims die of infections from a number of other micro-organisms that are harmless to healthy people because of their highly impaired immune system. The most common consequences include pulmonary TB, persistent candidiasis, CMV retinitis, herpes virus keratitis, and pneumocystis pneumonia.

HIV/AIDS, a disease of great susceptibility, continues to be a concern in the region. Miklavc and Ranjan argued that stigma continues to be a major barrier to care despite improved public awareness of HIV/AIDS. They proposed HIV-related stigma reduction programs as part of an urgent effort to reach at-risk groups with treatment and prevention. Hepatitis B and syphilis are also blood- and sexually transmitted illnesses. Hepatitis B causes more long-term damage than HIV and affects a lot more people (390 million versus 40 million). The virus that causes the liver illness can actually linger in the blood for up to a week, thus it can be transmitted other than by intercourse.

These diseases are important and must be constantly watched, but they are not at this moment the cause of epidemics of great concern to the public. Routine screening of the general population and high-risk groups, increased access to blood banks with well-screened blood, evaluation of transfusion history and promotion of condom use can control their spread.

Issues of the Region

The Indian sub-continent faces many obstacles in controlling infectious diseases. Poor health infrastructure, restricted access to timely care, low immunisation coverage and widespread antimicrobial resistance impede these efforts.

Health systems are behind the rest of the globe. Even when such facilities exist, they may lack laboratories, diagnostics, or qualified staff, thus official disease confirmation is rare. Access to care is hampered by poor roads and transport networks. Laboratory growth is limited by private sector rules. Disparities are driven by low governmental investment and dependence on out-of-pocket expenditure. Compliance is a hurdle to global standards [9-11].

Health Infrastructure (3)

Infectious illness control and prevention is a major problem to the Indian Sub-Continent. They result from weaknesses in public health infrastructure, such as a shortage of health facilities, competent staff, diagnostic laboratories, equipment and financial resources. The public health systems are very diverse, corresponding to the

physical diversity of the region, ranging from heavily populated urban areas to large rural areas far from hospitals and clinics [12,13].

The number of public health facilities available to residents of the Sub-Continent is estimated to be substantially lower than the WHO targets, leading to delayed diagnosis and treatment, ineffective prevention and control of diseases and contributing to the heavy burden of infectious diseases.

Access to Care

Health indicators are important to health care access. The rise in diverse infectious agents threatening human health and economic sustainability of the nations, the Indian sub-continent continues to see acute infectious disease concerns. Infectious diseases cause millions of fatalities per year, thousands of hospitalisations and loss of economic productivity amounting to millions of dollars. Even progress in one aspect of human development has not helped protect against infectious diseases. Socio-economic inequalities, rural-urban divide, capability gaps in government health infrastructures, widespread poverty, civil war and lack of focal interventions continue to fuel infectious disease burden in this part of the world. Outbreaks also continue to happen frequently calling for multi-pronged health interventions, fecal-oral vector-borne transmission disease causative agents like viruses, bacteria and viruses remain the principal challenge posed by infectious diseases, economic status of countries and regions continues to be the primary barrier to access to the preventive and curative measures to infectious agents [14,15].

Immunisation Coverage

India has one of the lowest vaccination coverage levels in the world. Only 44% of children 12–23 months of age are fully immunised. BCG, DPT and polio are vaccines with better coverage rates, with at least 76% of children receiving the initial doses, while coverage is lower than 50% from birth to the whole regimens. The coverage of measles immunisation is roughly 59%. Equally disturbing is the quality of vaccines given as 49% of children are partially vaccinated, 10% received ineffective vaccines and none were of >90% good quality. Low vaccination coverage causes large pockets of vulnerability, notably in urban slum communities where coverage rates decline to between around 25% and 64% and slum populations continue to increase. The problem has further worsened with the inclusion of new vaccines in India's national immunisation plan. These authors did not find any articles in India that particularly assessed vaccination coverage in urban slums, neither during the analysis nor before their independent studies. Despite significant efforts and investment, gaps exist at all geographic levels. National coverage does not ensure immunity for more than 500 million people or account for the reduced risk at which huge, susceptible populations are left [16-18].

Antimicrobial Resistance (AMR)

Poor sanitation and hygiene practices contribute to the spread of antibiotic resistance in the Indian subcontinent. Antimicrobial resistance in the region is driven by overuse of antimicrobials in the healthcare sector, agriculture and livestock. Low access to healthcare means self-medication is rampant. *Pseudomonas aeruginosa* and *Staphylococcus aureus* are major dangers among multidrug-resistant pathogens. Treatment options for multidrug-resistant tuberculosis are limited and spread of extended-spectrum β -lactamase-producing Enterobacteriaceae continues.

India is one of the primary hotspots for antimicrobial resistance. The two proposed alternatives are the One Health concept and the strict implementation of the National Action Plan. The use of

antibiotics in the healthcare sector encourages needless use as India is the highest global user of antibiotics in poultry [19,20].

Public Health Measures

The region has surveillance systems for infectious illnesses comprising different streams of data gathering such as clinical health care centres, laboratory testing, and serosurveys. Reports of infection occurrence are received from selected health-care facilities notified by a recognised authority and compiled and analysed in real time. Alerts are triggered when the situation calls for it, and fast reaction teams examine outbreaks. In addition to outbreak detection, assessing the presence or absence of a pathogen in the community and establishing early-warning systems, serosurveys are also valuable for evaluating vaccine-induced immunity.

Vaccination programmes are aimed at all those who are at a higher risk of infection, sickness, hospitalisation or fatal consequence. Vaccination services are offered through a broad network of public and private health care facilities across the Indian Sub-continent. But maintaining the cold chain is a challenge. Non-immunized pelagic shares in the poorest population groupings. The main causes of infectious illness and mortality are the absence of basic sanitation and hygiene. The policy priorities are to increase access to safe drinking water, improve sanitation and hygiene, especially hand washing and improve waste storage and disposal facilities. Most infectious diseases have fixed seasons; therefore clean-water-supply and sanitation initiatives, cluster hand-washing exercises and community cleanliness campaigns are more effective when planned and implemented before the commencement of the risk season.

CCTV Systems

Communicable disease surveillance systems work through a coordinated vertical reporting system including several laboratories and medical colleges around the country. Data are collected from many sources such as hospitals, private and public laboratories and animal health agencies. These sources provide communicable disease data to state health machinery which compiles and transmits information to central level. The National Centre for Disease Control compiles, analyses and publishes disease statistics in annual publication. Integrated Disease Surveillance Programme records endemic and epidemic data on important communicable illnesses. Monthly, the Integrated Disease Surveillance Programme forwards information to the World Health Organisation.

There is a web-based tool for real time reporting of infectious disease outbreaks and empowered clinicians and institutes. The data received from states is checked by the workers of the allocated Centres of the Indian Council of Medical Research, National Institute of Virology and National Centre for Disease Control. Various ministries flag abnormal or anomalous data and launch coordinated nationwide responses.

Immunisation Campaigns

Vaccination programs target various populations according to their risk of infection and disease load. Integration into routine health care ensures timely provision of immunisation. Efforts are focused on maintaining vaccination potency along the cold chain, avoiding stockouts and maximising adoption. Vaccine hesitancy and socio-political variables can sometimes impede acceptance, highlighting the need for adequate risk communication.

Two large-scale vaccination campaigns, against two deadly, communicable illnesses, poliovirus and diphtheria-tetanus-pertussis, have decreased morbidity and mortality. The neutrality of

vaccination in pregnant women gives passive immunity to babies against tetanus, maternal-HIV transmission, congenital rubella syndrome and Zika-associated birth abnormalities. Well-designed school-based vaccination initiatives for human papillomavirus and hepatitis B have proven to be successful.

Hygiene and Sanitation Projects

Basic needs for preventing many of these diseases include provision of clean drinking water, safe disposal of waste and sewage and maintenance of adequate hygiene. Essential preventative measures for such diseases include programmes aiming at development of hygienic practices such as washing of hands with soap, proper disposal of excreta and safe food preparation, handling and storage.

Waterborne infections are encouraged in communities without access to safe drinking-water supplies and adequate sanitation. Cholera and typhoid fever remain a concern in many parts of the region, typically spiking in incidence during outbreaks. They are caused by a mix of causes such as faecal pollution of the water supply, high population density and environmental deterioration. These disorders are associated with substantial morbidity and mortality notably in young children. Other prominent aquatic diseases are gastrointestinal infections caused by enteric bacteria, viruses and parasites.

The key to preventing foodborne illness is keeping food safe by preparing it properly and storing it at the right temperatures. Hygiene in food production and handling is important to limit the danger of food contamination with diseases. Finding clusters of gastrointestinal infections is an indication of possibly dangerous food handling or production practices. Food contamination with sewage is a key risk factor for giardiasis and cryptosporidiosis.

Response to Outbreak

In the case of outbreaks of infectious diseases, especially those representing a major threat to human health, a prompt reaction is needed. In principle, every scenario should be treated as an individual public health incident, requiring a specific method to achieve successful control. The specifics of the intervention may vary, but the general response should conform to the criteria provided below.

- **Alert** – We look at surveillance data, listen for unexpected reports, and respond to health worker suspicions. Take action based on the review of indicators of outbreak occurrence for the area.
- **Investigate:** Confirm the presence of an outbreak using health records, case detection and suitable laboratory tests. Identify the infectious agent, the population at risk, how it is transmitted, contributing variables, and when and where instances occurred.
- **Contain:** Alert the community and include important stakeholders. • Take necessary prevention measures and remedial activities to control the outbreak.
- **Communicate:** Deliver timely messages to the public, front-line health workers and the media on health hazards and control strategies. Keep the health authorities updated during the inquiry.
- **Review:** After the outbreak is contained, consider what went well, what may be improved and whether the incident will be included into future exercises.

Personal Protection and Prevention

Getting rid of or lowering infectious diseases is only half of the answer. We need to stop people from passing it between each

other. Small acts make a big difference. Governments have to encourage and enable disease prevention behaviours. They can offer information, resources and incentives. Reliable and trusted information on the nature of the hazards and how to prevent them is key. The guidance needs to be culturally relevant. Engaging credible messengers trusted by the communities is crucial. Here are a few instances to illustrate. Strategies vary by agent groupings, routes of transmission, environments and target populations. Thus, adjustments at the national level should be advantageous.

Hygienic measures are the first line of defence. They include:

- 1) frequent hand washing with soap and water, especially after using public transport, before preparing food and before eating or drinking;
- 2) covering mouth and nose with tissue or handkerchief when sneezing or coughing;
- 3) cleaning and disinfecting frequently touched surfaces (e.g. door handles, table tops, computer keyboards);
- 4) engaging in personal protective behaviours such as wearing mask when feeling unwell in public transport setting.

Water and food safety is paramount. Water treatment measures:

- 1) disinfect by using chlorine or boiling for a minimum of 5 minutes; keep water in clean containers with lids to prevent recontamination;
- 2) raw foods such as lettuce, vegetables and fruits should be washed thoroughly either with safe water or by cooking;
- 3) cook food at a minimum temperature of 75 degrees Celsius;
- 4) separate raw food from ready-to-eat food.

Hygiene Practices

Hand hygiene, respiratory etiquette, environment sanitation and proper use of personal protective equipment are key preventive strategies for infectious diseases. Good hygiene habits help to minimise the transmission of diseases. People should wash their hands with soap and water often to decrease disease transmission. Cleaning and disinfecting surfaces lowers the overall level of contamination, especially on high-touch surfaces. 3. Avoid touching the face (eyes, nose and mouth). Cover your nose and mouth with a tissue when you cough or sneeze, and dispose of the tissue afterwards. A good maintained health care facility decreases the transmission of nosocomial infections [21].

Food and Water Safety

One of the main ways of preventing infectious diseases on the Indian sub-continent is access to safe water and safe food. Improved water, sanitation and hygiene can substantially lower the incidence of enteric fever and related disorders. The treatment policies should be continually monitored and changed to achieve the elimination of malaria. The consumption of safe and enough food is also important for physical well-being, allowing individuals to lead a healthy and productive life. Water is essential for cleanliness, food production and preservation, cleaning of dishes and utensils and for the production of cattle and poultry.

Immunity and vaccination

Vaccination, a vital preventative measure against infectious diseases, boosts the immunity of individuals and communities. The National Immunisation Schedule has recommended 12 vaccines in childhood: Bacillus Calmette–Guérin for tuberculosis; oral polio vaccine; pentavalent vaccine for diphtheria, tetanus, whooping cough, hepatitis B, and *Haemophilus influenzae* type B; measles-rubella vaccine; and rotavirus and Japanese encephalitis vaccines in selected states.

Additional age-appropriate immunisations are for those outside the national immunisation schedule. Rabies vaccination is suggested

if there is a history of exposure to a rabid animal. For adults, the indications are: varicella, influenza, herpes zoster, tetanus, adjuvant double vaccine diphtheria and tetanus. Vaccination is still important, especially for people at risk. Despite increased vaccination, reports of outbreaks show inadequate control. An estimated 6 per 1,000 instances of congenital rubella syndrome are due to rubella in 12-30% of women of reproductive age who are at risk.

As boosters become more important, rubella and hepatitis A continue to be important in preventing epidemics. Herd immunity and mass vaccination are therefore still important aspects of infectious disease prevention.

Community Engagement

Community involvement is essential to the successful design and delivery of health education programs that encourage informed decision-making and individual risk reduction. Building resiliency and facilitating outreach involves communicating the risk of infectious disease transmission with community members and local authorities. Community experts – those who live, work, pray and socialise in the impacted communities – are critical to answering community-specific concerns, worries and questions. Consistent communication with community leaders, local organisations and institutions, and families fosters trust and mutual support through continued discourse.

Providing culturally relevant information is equally crucial so that the content is useful, accurate and understandable. Materials should address local beliefs, practices and circumstances, language, dialect and literacy levels, local dangers, and understanding of lived experience.

Special Populations

Some exposed at birth populations may be at elevated risk for specific infectious disease. Transmission of infection from mother to infant born may be vertical or horizontal transmission. Hepatitis B, syphilis, rubella and HIV can be transmitted vertically i.e. from mother to foetus across the placenta during pregnancy. Many bacterial and viral gastrointestinal pathogens may transmit from mother to infant in pregnancy. These diseases may be passed horizontally. Later in life, these infections can be spread, thus vaccination and early access to health care are important.

The access, awareness, infrastructure and official backing of public health efforts vary widely across the Indian subcontinent, in both urban and rural areas. Simple surface water delivery schemes, watershed development and rainfall harvesting can offer access to clean drinking water; urban capture and use initiatives provide source control benefits. City sanitation might consist of decentralised treatment systems, monitoring methods and recycling of trash. Simple low-cost community level safety solutions can help to prevent calamities such as the spread of illness in highly populated places.

Schools and Children

Children are very vulnerable population of the Indian Sub-Continent. According to the World Health Organization (WHO) recommendations, the children aged 0–14 years constitute around 32% of the entire population. Often, they contract infectious infections, many of which may be linked back to the school. Interventions in schools must therefore be adapted to students.

The association between diet and infection is widely documented. A number of studies have shown that infection affects nutritional intake and absorption and that malnutrition reduces a child's resistance to infection. Malnutrition is a risk factor for many disorders. Diarrhoeal diseases, malaria and respiratory infections are also among the most frequent ailments in this age range. Nutritional deficiency in schools is significant as the majority of Indian states have high prevalence of underweight children aged 0-5 years and low haemoglobin levels amongst school aged girls.

Schools are an efficient delivery mechanism for health information to children and immunisation programs during outbreaks of infectious illness. Being aware of health information, immunisation and normal hygiene practices can assist to reduce the severity of cases.

Variations Between Rural and Urban

The lack of infrastructure in rural areas, such as health care facilities and transportation systems, causes disparities in access. Less than 50% of villages in rural areas have adopted any type of latrine and districts with significant coverage do not correlate with urban wealth index. Tap water samples in rural schools with formal water supply often revealed significant faecal coliforms. Diarrhoea was epidemic in rural regions of Udaipur district, Rajasthan and Hernando et al. therefore advocate distinct public health policies in urban, peri urban and rural areas. The Government of India spends less on health care than any other country in the world with less than 19% being funded by government agencies compared to other countries that spend between 50% and 90%.

Pregnant Women and Infants

Pregnant women and newborns are vulnerable groups in India. The country has the highest number of births, around 25 million a year, exposing mothers and newborns to infectious pathogens. Health and mental health hazards have been compounded by the pandemic, which has also highlighted obstetric difficulties and decreased access to services. Pregnant women are at greater risk of severe illness and maternal death and there is a significant danger of infection to the foetus and newborn. India has witnessed several pandemics and epidemics (smallpox, H1N1, Zika, Ebola) affecting pregnant women and hence, initiatives to reduce disruptions and follow COVID-19 principles are vital for future outbreaks. Two thirds of mothers accessed antenatal care from a skilled provider and almost all delivered with skilled assistance. A large proportion of deliveries occurred in hospitals. However, no systematic investigation has examined perinatal and neonatal infection risks within the context of other concurrent national and local surveys.

The high birth rate in India and the clustering of babies in certain places warrants exploration of neonatal transmission and tracking of post-natal health. Pregnant women are at elevated risk for severe COVID-19 disease and maternal mortality with COVID-19 in India is 22 times higher than for non-pregnant women, similar to many other nations. Maternal infection does not change the clinical presentation in neonates, but the virus has been discovered in amniotic fluid, breast milk, placenta, and cord blood delivery, and vertical transmission is postulated. Most studies have shown negligible risk of bad outcomes with vertical transmission and no need to isolate sick neonates or separate breast-fed infants from their mothers. Hospitalised pregnant women or those with moderately symptomatic disease should be monitored for oxygen saturation, and daily temperature checks and other precautions should be taken to reduce the danger of horizontal transmission to newborns. The vaccination is best given before conception, in the early stages of pregnancy and after pregnancy.

Research Needs:

More data is needed in some places to determine the risk. Communicable illness notifications do not include all known hazards. Priority diseases for which incidence can be approximated from current mortality data are invasive bacterial infections, diphtheria, short-course tuberculosis and syphilis. (Estimates of years lost to disability from congenital syphilis should include appropriate rates of rheumatic heart disease. The importance of leprosy is declining, but increasing mortality from skin disease indicates a need for new data. Regional disease burden assessments should be based on local data for communicable diseases, except for enteric infections and tuberculosis, which should be stratified by region.)

Emerging illnesses of importance with animal reservoirs or vectors that may introduce the pathogen include Nipah virus, West Nile fever, yellow fever, Chikungunya and Bunyamwera fever. There are other illnesses that are not Zoonotic. Climate change may be associated with arboviral and rickettsial illnesses. Recent efforts have resulted in the foundation of the South Asian Network for the Scientific Study of Infectious Diseases, with the goal of improving early warning, providing trustworthy information on communicable illnesses and developing an adaptive knowledge framework for the South Asia region.

Data Gaps

Timely and reliable surveillance data are essential to inform public health policies and activities. But data on illness incidence and risk factors are limited for many of the prevalent infectious diseases. These inadequacies weaken estimates of disease burden, identification of trends, risk factors, and high-risk groups that would help target preventative measures and assess impact.

A recent example of the importance of timely availability of surveillance data for evidence-based interventions is the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection. However, for many other infections, including other viral and bacterial respiratory infections, H1N1 influenza virus, parainfluenza viruses, adenoviruses, respiratory syncytial virus, dengue, Japanese encephalitis, hepatitis A and others, the scope of surveillance is limited and does not cover all geographical areas. While noncommunicable diseases and associated risk factors have long been identified as emerging health problems in the Indian subcontinent, little attention has been given to the co-occurrence of infectious and noncommunicable diseases in the region.

Emerging Infections

Under conditions, circumstances and settings, there are tremendous powers that could multiply the emergence and intensification of infectious diseases. Microbial evolution and adaptability, ecological disruption, changes in land use and agricultural methods, fast and unplanned urbanisation in developing nations and poverty are important factors believed to enhance their formation. Scientific advances are continuously creating new fields for human adventurism. This, intolerable levels of corruption, and the availability of funds in significant amounts with no accountability, has led to biological research that has the potential to result in new calamities related to infectious diseases.

Historically, zoonoses have been the principal sources of new infectious illnesses and are typically thought to be likely to be the genesis of many infectious disease outbreaks. There are several ideas in this field and among them is the one that some researchers are advocating for, who think that zoonotic viruses that were previously host specific may extend their host range through

other closely related hosts before they may effectively infect widely varied host species. These concerns are not unfounded as several research reveal that viral zoonoses of mammalian and ornithological origin seem to have expanded their host range from lower mammals or birds to man via other species including domestic animals. Such an observation underscores the need for careful zoonotic disease surveillance to include all probable species of animals and birds and not just the obviously obvious reservoir and amplification hosts.

Policy and Funding

There are implementation gaps in response to infectious diseases in the Indian sub-continent. Strategies should be in line with national interests, and adequately and sustainably financed, especially through avenues for global support.

Most infectious diseases are known in the region and countries have the technical know-how to control them but execution is inadequate especially in rural areas. Approaches need to be in line with national plans, but national plans are not necessarily a reflection of the epidemiological reality. Follow-up and finance from external partners and development banks can be crucial to resolving epidemics, but should be phased out when countries gain the capacity to respond autonomously, bolstered by advancements in local capacity and pledges from regional organisations.

Emerging infectious diseases remain only partially addressed and warnings insufficiently converted into proactive responses. Funding, both at the outset and thereafter, has at times depended on outside donor support for specific, identified pockets of responsibility. Full integration of an emerging infectious disease program with resources and engagement with other national health programs could enhance the ability to respond.

Conclusion

Infectious diseases continue to be a major danger to countries of the Indian Sub-Continent. Established diseases can generate public health emergencies since they may re-emerge swiftly and behave differently than established dynamics. Factors influencing re-emergence of infectious illnesses Quarantine, vector control, immunisation, trace-back of food and water supply chains and control of environmental contamination should be the priorities (A. Hamburg, 2008). The epidemiology of existing illnesses can be significantly altered due to climate change, and novel infections can appear as another major danger [15-22].

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