

## Acute encephalitis syndrome and Bihar health profile: Urgent need to revitalize primary health care

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### ABSTRACT

Acute encephalitis syndrome (AES) represents long term public health challenge with recurrent seasonal outbreak in many districts of Bihar for the past two decades. Multiple hypothesis has been postulated linking it as cause of acute encephalitis syndrome. Agrochemicals, lychee toxins, heat stroke, infectious causes and environmental factors have been postulated as AES cause. Although association have been found but no definite causation ascertained yet. Bihar health performance on various indicators have been poor for past many years. Health index 2019 released by Niti Ayog with ministry of health and family welfare ranked Bihar on 20th place out of 21 large states based on various health indicators. Early access to nearest PHC may significantly improve outcome. As most of the children are from rural areas it's imperative to strengthen rural health care. Rural urban disparity and inequitable distribution of resources, lack of well-trained health workforce has been widely reported. Primary healthcare is the essential foundation of emergencies outbreaks. PHC is the best strategy and most cost-effective investment to provide high quality care ensuring equitable access to all. PHC reduces morbidity and makes public health system resilient to absorb sudden increase in number of cases, rising health demands putting health workforce at stress and strain to available resources.

**Keywords:** Acute encephalitis syndrome, Bihar, family medicine primary, care, public health

### Introduction

Acute encephalitis syndrome (AES) represents long-term public health challenge with recurrent seasonal outbreak in many districts of Bihar for the past two decades. It's a clinical condition with multiple etiologies including Japanese encephalitis (JE), Herpes simplex virus, Influenza A virus, West Nile virus, Chandipura virus, Mumps, Measles, Dengue, Parvovirus B4, enteroviruses, and Epstein-Barr virus. Scrub typhus, *S. pneumoniae* are the other causes of AES in sporadic and outbreak form in India. Nipah virus and Zika virus have also been reported recently. Recently, H1N1 and SARS CoV2 causing COVID19 has also been reported causing AES.<sup>[1,2]</sup>

Acute toxic encephalopathy linked to lychee toxins or agrochemicals are being attributed to AES outbreaks, heat stroke also has similar presentation. What's common to above clinical conditions are seasonal outbreaks which peak during leech harvesting season in Bihar in the hot and dry months of June to August, and children from rural background with poor social determinants of health and low socioeconomic status compounded by profound illiteracy, overcrowding, hunger, and malnutrition.

Clinically, a case of AES is defined as a person of any age, at any time of year with the acute onset of fever and a change in mental status (including symptoms, such as confusion, disorientation, coma, or inability to talk) and/or new onset of seizures (excluding simple febrile seizures).<sup>[3]</sup> It's a broad term used for epidemiological surveillance and includes infectious and noninfectious causes.

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## Clinical Dilemma

Multiple hypothesis surrounding AES, acute toxic encephalopathy, and heat stroke have been put forward and debated.

Acute toxic encephalopathy (litchi deaths) outbreaks coincide with lychee harvesting period, which led to the assertion of lychee or lychee orchard-associated AES. Study by Shrivastav *A et al.* done in 2014 found that skipping the evening meals, MCPG and hypoglycin toxins as a major cause of toxic encephalopathy linked with hypoglycemia.<sup>[4]</sup> Study from Vietnam during seasonal outbreak suggested a role of hypoglycemic toxins among those with rapidly progressing acute encephalitis-like syndrome during litchi harvest season.<sup>[5]</sup> It recommended minimizing litchi consumption, ensuring receipt of an evening meal, and implementing rapid glucose correction for suspected illness.

This has been debated on circumstantial ground due to lack of definitive evidence like histopathological demonstration of toxins effects, robust methodology of epidemiological studies, and inability to perform analysis for any specific metabolite in the body fluids. Even the minimum lethal dose of hypoglycin A was found to be 98 mg/kg and in order to develop toxicity, a 10-kg child needs to consume 1.72 kg or 5.4 kg pulp of semi ripe or ripe litchi, respectively.<sup>[6]</sup> Absence of AES from other areas where lychee is being harvested has also contradicted the above point. According to vision 2050 document by Indian council on agricultural research and directorate of horticulture database, Muzaffarpur contributed to 9.6% of annual lychee harvest 56006 MT out of 585300MT in India.<sup>[7]</sup>

Similar outbreaks in Bangladesh indicated role of agrochemicals.<sup>[8]</sup> This outbreak ended following the onset of the monsoon, which suggested that the toxin associated with the lychees were on surface, rather than contained in the fruit. Acute exposure to organophosphate and carbamate pesticides in children accumulates acetylcholine at the autonomic ganglia resulting in hypertension, pallor, and hypoglycemia. This could explain why most of the case-patients fell ill between 2 am and 8 am when blood glucose reaches to its lowest levels. Similar concerns have been raised by farmers in Muzaffarpur district of state of Bihar.

Heat stroke is defined clinically as core temperature > 40°C accompanied by central nervous system dysfunction.<sup>[9]</sup> High temperature and humidity (28/40°C, 90% humidity) could lead to encephalopathy due to heat stroke. Sudden drop in cases coincide with decrease in temperature after rain suggested in favor of heat stroke as its etiology. But early morning presentation, habit of drinking plenty of water by inhabitants, and inconsistent hyperpyrexia goes against this hypothesis.<sup>[10]</sup>

## Encephalopathy vs Encephalitis

Encephalopathy may be caused by many diverse causes including infections, metabolic changes, inherited metabolic disorders, toxins, hypoxia, trauma, and vasculitis. Encephalitis

means inflammation of the brain, which is diagnosed through surrogate clinical presentation, and inflammatory changes in the cerebrospinal fluid or parenchymal inflammation on radio imaging.<sup>[3]</sup> This could be of various infectious etiology which include viruses, bacteria, parasites that directly infect the brain parenchyma. It can also occur without direct brain infection, for example in acute disseminated encephalomyelitis, or antibody-associated encephalitis. AES is a broader term used by WHO for syndromic surveillance in the context of JE.<sup>[4]</sup>

Globally JE is a viral disease with 20–30% case fatality rate and 30–50% residual neurological or psychiatric disability in survivors.<sup>[11]</sup> The case fatality rate of AES and JE ranges from 5% to 35% in Bihar. Compared to national average Bihar has recorded higher case fatality rate.

JE primarily is a zoonotic disease transmitted by culex mosquito with incubation period of 5–14 days where humans are an accidental dead-end host. Culex mosquito usually bites at night and prefers to stay in irrigated rice fields cultivated during same season and prefers cleaner water for breeding.

JE virus is neurotropic primarily affects central nervous system manifesting as febrile illness of variable severity associated with neurological symptoms ranging from headache to meningitis or encephalitis. Symptoms can also include headache, fever, neck stiffness, disorientation, coma, tremors, paralysis (generalized), hypertonia, loss of coordination, behavior changes, and altered sensorium.

Systemic review of acute encephalitis reports from India in the past decade suggested non-JE etiology in both outbreak investigations and surveillance studies.<sup>[12]</sup> Instead outbreaks were found to be due to a rhabdovirus (Chandipura virus) or water-borne enteroviruses. These outbreaks, which have also occurred in hot and humid seasons, have predominantly affected children, and have had a high case-fatality.

Several factors like JE vaccination campaign and thus unmasking other agents might account for enteroviruses replacing JEV as the major cause of AES. The emergence of non-JE etiologies in in AES outbreaks warrants to redesign our preventive strategy based on current evidence. This will need a multisectoral approach involving health, water resources, sanitation, vector control, vaccination, and rural development departments. Social determinants of health need to be at center of all healthcare strategies.

## Bihar Public Health Scenario

### State health performance

Bihar health performance on various indicators has been poor for past many years. Health index 2019 released by Niti Ayog with ministry of health and family welfare ranked Bihar on 20<sup>th</sup> place out of 21 large states based on various health indicators. SRS bulletin 2017 revealed infant mortality rate of 35 per 1000

live births in Bihar compared to National average of 33 per 1000 live birth. Rural areas reported IMR of 36/1000 live birth with difference between male 32/1000 and female 36/1000 live births. IMR has significantly declined over past few years.<sup>[13]</sup>

Maternal health has direct bearing on child health; only 3.3% mothers had received full antenatal care compared to national average of 21%. 63.5% of children age 6–59 months were found to be anemic compared to 58.4% of national average.<sup>[14]</sup> Crude birth rate is 27.7 in rural Bihar which is highest in India due to poor adherence to contraception and family planning awareness. Frequent child birth without proper spacing also has deleterious effect on the health of mother and child.

### Health workforce shortage

One government allopathic doctor of Bihar serves an average population of 28,391 compared to the national average of 11,082 population. Average population served per government hospital is 10,0589 and per bed is 8645 compared to national average of 55,591 and 1844, respectively. At community health centre (CHC) only 82 specialists (Surgeons, Obstetrician & Gynecologist, Physicians & Pediatricians) are employed out of required 600 specialist doctors. At Primary health centre (PHC) out of 1899 required doctors only 1786 were available. Nursing staff required at PHC and CHC are 2949 but only 1211 are in position. There is also shortfall of 1438 out of 20,149 required posts of laboratory technicians and shortage of 1762 pharmacists out of required 20,149 posts.<sup>[14]</sup>

### Bihar health infrastructure

There is shortage of 8688 (47%) subcenter, 1200 (39%) PHCs and 624 (81%) CHC in Bihar as of 31<sup>st</sup> March 2018.<sup>[12]</sup> Out of the functioning PHCs only 41.9% function on 24\*7 basis, have a computer, have labor room, and at least four beds. None of PHCs function as per IPHS norms. Average rural population covered by SCs, PHCs, and CHCs (against norms) are 9281 (5000), 48,626 (30000), and 61,5610 (1,20,000), respectively.<sup>[15]</sup>

### Bihar disease profile

Looking at the disease profile based on global burden of disease study 1990–2016, malnutrition, air pollution, WaSH (unsafe water, sanitation, and handwashing), and dietary risks are top four risk factors attributable to total DALY. Malnutrition, WaSH, and air pollution have been top three risk factors unchanged from 1990 to 2016 driving most deaths and disability combined. Under 5 years of age most deaths and disability are attributed to communicable, maternal, neonatal, and nutritional diseases. Diarrheal disease has been leading cause of death and disability combined from 1990 to 2016.<sup>[16]</sup> Disease profile gives an insight that over past 16 years primary health care has not been prioritized. There is need of greater political commitments to invest in primary health care.

### Role of primary health care and family physicians

Primary health care is the essential foundation of emergencies outbreaks. Its role in prevention, preparation, planning, post emergency care, management of disability, and risk reduction is well established. PHC is the best strategy and most cost-effective investment to provide high-quality care ensuring equitable access to all. PHC reduces morbidity and makes public health system resilient to absorb sudden increase in number of cases, rising health demands putting health workforce at stress and strain to available resources.

WHO has defined role of primary health care in emergency outbreak through three synergistic components: primary care, multisectoral policy, action for health, empowered people, and communities.<sup>[17]</sup>

Primary care is the point of first contact where services provided are comprehensive, person centered with continuity of care and well-coordinated. Family doctors are well trained with skills to provide routine as well as emergency care to all age groups. In outbreak, there is need to have role of gate keeping to reduce burden on tertiary care and provide needed bidirectional referral facility and continuity of care. Their understanding of local context and community health profile is vital in providing earliest intervention to contain outbreak. Regular epidemiological surveillance and proactive communication with individual and community engagement keep a check on any outbreak.

Ensuring authority and accountability to family physicians led PHC team toward planning, preparation, response, and recovery. Flexible and transparent public health system to maintain adequate infrastructure, supply chain management, resources, capacity building, training, and health workforce recruitment.

Early intervention is known to save lives. AES report by John *et al.* suggests that if ill children are infused with 10% glucose within 4 h of onset of brain dysfunction, recovery is fast and complete.<sup>[18]</sup> Accessible health care should be central to all health reforms.

### Rural health care

Early access to nearest PHC may significantly improve outcome. As most of the children are from rural areas it's imperative to strengthen rural health care. Rural urban disparity and inequitable distribution of resources, lack of well-trained health workforce has been widely reported<sup>[19]</sup> which need immediate correction to prevent any future outbreaks. Strengthening PHCs could very well prevent what currently have to be treated in overburdened ICUs where in a two to three children have to be accommodated in a single bed.

Anticipatory preparedness is key to prevent such seasonal outbreak. Health workforce is central to emergency operations. Solution to this is recruitment and retention of doctor with proper incentive to work in rural areas. Capacity building, professional development, and regular training about standard

guidelines may improve quality of care. There have been various effective schemes incentivizing doctors to serve in rural areas.<sup>[20]</sup> Beyond incentive there must be focus on providing social security, law, and policy measures to curb workplace violence. Long-term reforms like shifting urban-based medical education to rural areas and community-based teaching may help inspire residents to practice in rural areas. There have been many research studies which show those with rural background and/or with exposure to rural practice are more likely to settle in rural areas.

Often due to poor perception, unreliability, low efficiency of primary health care due to various reasons like lack of medicine and other consumables, health workforce shortage, non-existent referral policy etc., tertiary centers are slowly becoming point of first contact. During any outbreak, thus they become overburdened and quality and efficiency gets severely compromised affecting patient outcome.

To prevent an outbreak information education and communication strategy can be executed by the primary health care team as there is better understanding of local context and acceptable interventions which are culturally appropriate and sustainable. Epidemiological surveillance, disease notifications, capacity building, and training of frontline health workers to identify and report such cases makes primary health care vital to minimize outbreak risk and hazards. Safe water, sanitation, nutrition, vaccination, and health education are cost-effective interventions which can be executed by PHC team.

Horizontal integration of various services and programs executed through PHC team would improve efficiency and reduce wastage of resources. Empowering people and community with partnership in codesigning emergency management models from planning, prevention, relief, recovery, and risk communication strategies. Promotion of self-care with such empowerment may help them take active decisions about their own health, a step forward in shared decision making.

Primary healthcare leadership to be promoted for dynamic and effective transformation of health care. Resilient health system has the capacity to absorb, accommodate, respond, and recover from any outbreak along with continuity of basic routine health care and also restore and preserve essential basic structure and function.

During emergency continuity of essential basic health services is equally important along with emergency response. Proactive communication, prioritize resources with community engagement may help to deal with emergency rise of healthcare demands.

Collection and analysis of good quality data is vital. Data gaps are huge concern which can be mitigated with ethical and appropriate use digital technologies. Electronic health records are now basic standards globally. Block chain and artificial intelligence are future which must be discussed, debated then implemented to improve trust, transparency and accountability.

Health workforce being point of first contact are exposed to various pathogens. During emergency health of providers is of utmost priority as any loss of working hours because of illness may severely hamper care delivery. Personal safety equipments should be available and their uses must be ensured. Extra working hours and hectic schedules may also be supervised to reduce care providers burnout which is important to ascertain quality of care and patient safety.

## Summary

AES is a long-term public health challenge which needs urgent attention and multisectoral support and coordination. There is immediate need to strengthen primary health care to improve access to regular as well as emergency care which is key to improve outcomes.

There is need at all levels to recognize central role of primary health care in plans and policy related with emergency operations. Government foresight is needed to ensure well-defined role of primary care in emergency prevention, preparedness, planning, and recovery operations. Primary care leaders must have representation at all levels during such policy development.

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## Conflicts of interest

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