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Chapter

Perspective Chapter: Hospital Disaster Management during Dengue Outbreak

Ashis Shrestha

Abstract

The outbreak of dengue results in surge of patient in the hospital. Dengue without warning signs are usually treated on outpatient basis while those with warning signs presents to emergency and are treated as inpatient basis. Severe dengue is treated in intensive care unit. This creates the challenge in managing the surge from outpatient to intensive care unit, often exceeding the capacity to treat. A hospital needs disaster management plan to cope with this surge of the patient. The disaster plan includes, hospital incident command system, networking plan, surge capacity, and emergency system. Beside this, a dynamic protocol needs to be implemented as sensitivity and specificity of the test kit remains same however, the predictive value of screening question increases as more and more population get affected. Therefore, primary or screening triage plays important during the surge of the patient.

Keywords: command system, dengue outbreak, disaster management, hospital, surge capacity

1. Introduction

Disasters are serious disruptions to the functioning of a community that exceeds its capacity to cope using its own resources [1]. Similarly United Nations International Strategy for Disaster Reduction (UNISDR) defined disaster as “a serious disruption of the functioning of a community or a society involving widespread human, material, economic, or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources” [2]. A similar definition is used by World Health Organization. These are universally accepted definitions, and it holds true for a country, community, and hospital as well. Hospital’s ability of cope using its resources is affected when the number of patient flowing in the emergency exceeds its capacity.

Disasters are caused by hazards which is “a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social, and economic disruption or environmental degradation” [3]. There are various type of hazards like environmental, technological, biological, etc. The risk of disaster is directly proportional to hazard and vulnerability. The vulnerability is “the condition determined by physical, social, economic and environmental factors or processed

which increase the susceptibility of an individual, a community, assets or system to the impacts of hazards” [4]. Hazard is not preventable; however, disaster can be prevented by managing vulnerability, known as risk management. The vulnerability of the hospital increases with poor hospital structure, uncoordinated patient flow and crowd control, absence of triage, inappropriate emergency management, and poor record-keeping system on normal days. Disaster is an escalation of normal day emergency; therefore, failing to manage daily emergency is failing to manage disaster.

There are four phases in disaster cycle, preparedness, prevention or mitigation, response, and recovery, **Figure 1** [5].

During the outbreak of dengue, the country, community, or a hospital responds to the event. The effort that is collectively put together in the response phase improves the response to some extent but not as desired. Therefore, for a good response, effort must be invested in the preparedness and prevention phases of disaster cycle. Similarly, recovery is an important phase after response.

The global burden of dengue has been rising in the last 30 years due to urbanization, climate change, and increased mobility. The rise is more in South-East Asia and South Asia [6]. A systematic review considering 262 outbreaks observed between 1990 and 2015 had 112 outbreaks after 2010, and the total number of patients since 1990 was 291,964 [7]. The patient with dengue presents with fever and myalgia and may require hospital admission for intravenous fluid. Out of patients visiting the hospital, nearly 40% require intravenous fluid [8]. This means an increase in the influx of patients visiting hospital and the number of admissions compared to normal days. This will cause a shortage of hospital beds, a shortage of medical supplies, and a risk of loss of revenue from cancellation of elective procedures. Moreover, the risk of nosocomial dengue has also been reported in health care workers [9, 10]. This surge will also cause exhaustion of health care worker. In a cross-sectional study, high burnout was observed in 15.9% of health care workers [11].

It is evident that the outbreak of dengue has been increasing in the last 30 years, causing a surge of patient in health care facilities overwhelming the service and

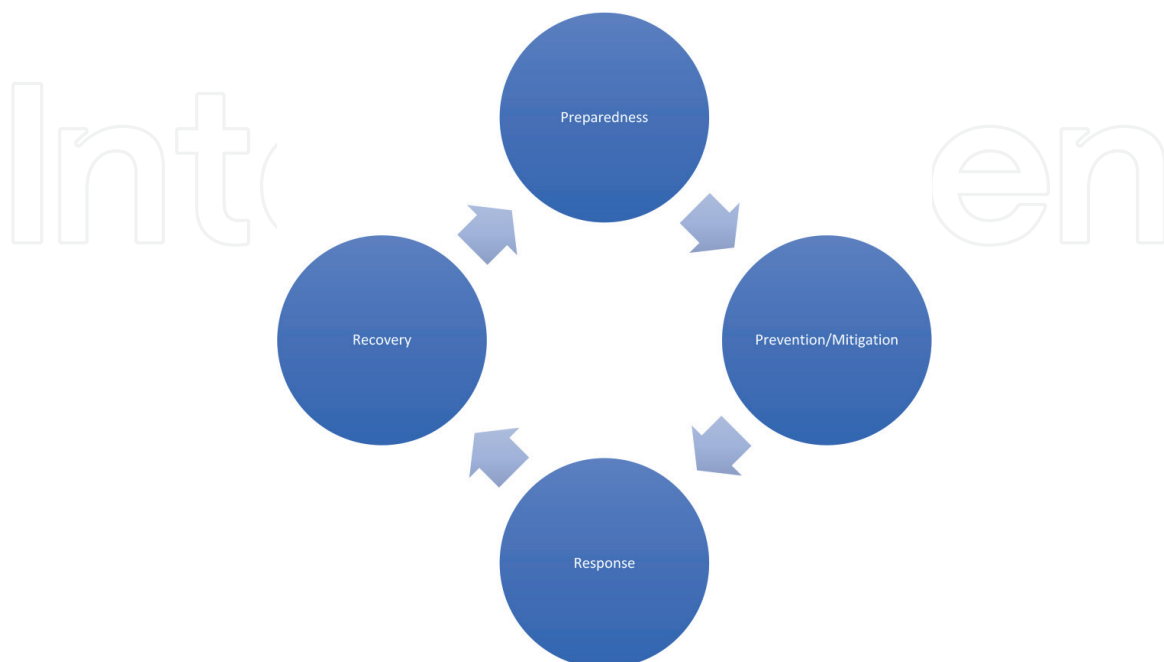


Figure 1.
Disaster cycle.

human resources. This is a hazard leading to a challenge for space management for the patients' surge. Furthermore, in such conditions, it takes a lot of effort to maintain the supplies of fluid, medicine and blood products and ensure adequate Intensive Care Unit (ICU) beds are available [12]. Patient safety is compromised due to the pressurized health care system of the hospital. Therefore, risk management requires improving the response, which further requires improving preparedness. Planning the response, developing strategies, tactics, and implementation planning is important to improve the response.

2. Hospital disaster preparedness and response plan

Sendai framework for disaster risk reduction (2015–2030) priority 4 emphasizes enhancing disaster preparedness for effective response [13]. Therefore, a hospital requires multi-hazard hospital disaster preparedness and response plan. This plan will be useful in any type of disaster, including the outbreak of dengue infection. The outbreak of dengue will result in a shortage of space, unavailability of beds in critical care units, increased workload of the staff, and decreased quality of care for the patients [14]. This needs to be addressed in disaster management plan. Important components of hospital disaster management plan are as follows.

2.1 Hospital incident command system

The outbreak of dengue will last for several weeks; at the same time, the hospital also needs to manage regular daily patients. The hospital incident command system is the pillar of disaster management in the hospital [15]. Activation of hospital incident command. **Figure 2** will help in prioritizing and executing the task. The role and responsibilities of the individual are designated. The incident command is controlled by incident commander, who is the chief of the hospital. Planning for the management of the dengue and regular patient is done by planning officer. This includes communicating, coordinating, and managing staffs and space. The operational officer will coordinate clinical management and protocols. The logistic officer is responsible for maintaining supply–demand chain, while finance officer is responsible for financial planning.

The disaster management plan cannot cover all aspects of dengue management from the first to the last day. To manage the outbreak in a daily basis, incident action plan is prepared (IAP), **Figure 3** [16]. The action starts with incident notification and initial response, followed by incident command meeting. The incident command meeting prepares IAP, which is executed after operational briefing; this is called operational period. Once the operational period starts, preparation for next operation

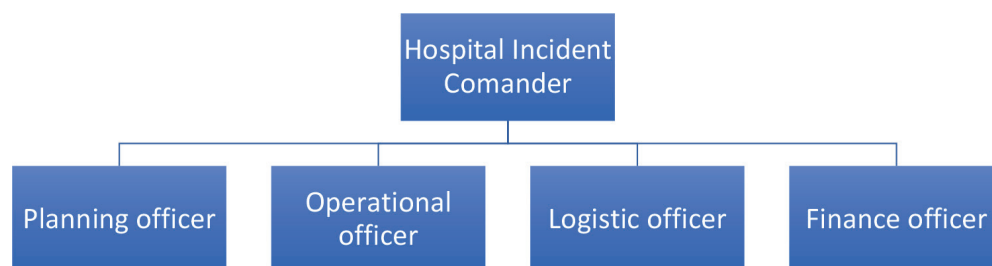


Figure 2.
Hospital incident command system.

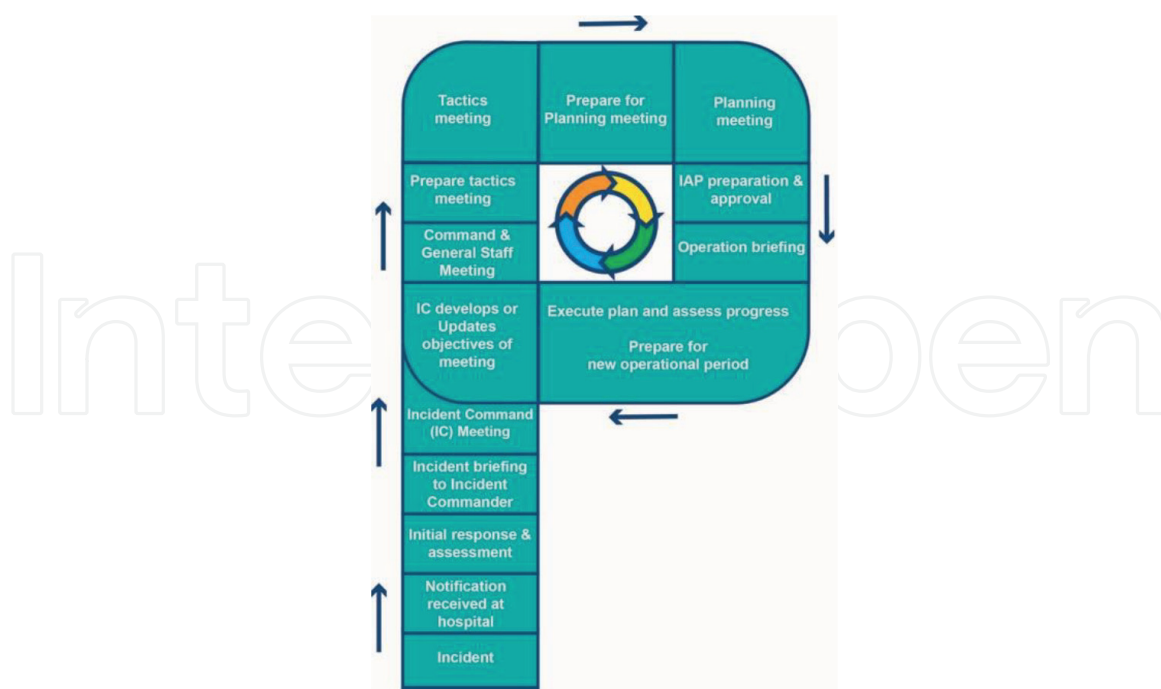


Figure 3.
P diagram of Incident Action Plan.

period is done considering the situation, information, and lesson learned during the preceding operational period.

2.2 Networking plan: communication and coordination

Networking plan is an important component of surge management in dengue. There are two types of communication that needs to be planned in preparedness phase. External and internal communication: the external communication includes the communication with the local authorities of the country and local stakeholders. This communication is necessary for case reporting and advocacy of the preventive measure. The prevention and control of the outbreak is an effective measure for decreasing the surge of the patient in the hospital. Moreover, during the surge of patient as the space of hospital is overwhelmed, other hospitals in the region of outbreak, which do not have full bed occupancy, can be used. This coordination needs prior planning. One of the models tested during COVID-19 is the hub and satellite model [17]. Hospitals in the country are divided into hub according to the region and its resources; the hospitals that are near hub hospitals are categorized as satellite hospitals. A communication and coordination protocol for hub and satellite hospitals to support each other during the disaster is established during the preparedness phase [18]. Internal communication requires a communication officer with lists of contacts of all hospital staffs. Staffs needs to be informed about the communicable potential of dengue, the precaution to be taken, and the protocols of clinical case management and surge management needs to be informed to all hospital staffs.

2.3 Surge capacity

During the outbreak of dengue, most patients visiting outpatient department can be sent home, and some patients visit emergency and require fluid management along with

admission. In an observational study, outpatient treatment was needed in 82% of patient, and 18% required hospital admission. Intravenous fluid resuscitation was required in 3.2% of the patient [19]. A systemic review published in 2019 summarizes that the countries' dengue endemic has seasonal surges in the hospital; they have early warning system, therefore they cope with the surge by temporary expansion of the surge. The expansion includes, space, human resources, laboratory services, funds, and logistics. However, in non-endemic countries, surge are managed by reverse triaging. Therefore, context-specific planning will help hospitals cope with the surge of patient during dengue epidemics [12]. All hospitals face challenges in their ability to meet the surge demand. Larger hospitals in regional settings usually operate near capacity, while smaller hospitals at local level operate with limited availability of resources. Therefore, coping with surge is a challenge for all hospitals and needs to be planned during planning phase of disaster cycle [20].

Key components of surge planning include four S's: Structures, Staff, Stuff, and System [21]. Sub-acute units in the hospitals should be identified as it is much easier to manage the outbreak if it can be managed inside the facility. However, if the facility is unable to meet the demand of surge the spaces outside the facility need to be considered [22]. Expansion of the space requires effective management of staffs and stuffs. There should be interdepartmental coordination to manage the staffs from the department that does not have a patient load; moreover, hub and satellite [18, 23] mechanism is also helpful to mobilize staffs from the hospitals that are not expecting surge of patients. Moreover, equipment required to expand the capacity, needs to be planned. The equipment may include ward bed, ICU bed, medications, and logistic supplies [21]. An effective multi-hazard management plan must describe the system with a clear guiding policy in case of surge of patients.

2.4 Emergency system

Emergency system of the hospital needs to be functional on a daily basis because disaster is an escalation of everyday work. During disaster, it is not possible to implement a new system that has never been in practice. Therefore, hospital requires planning of outpatient services and emergency services. Management of the patient at triage, emergency and inpatient ward, and ICU must be well coordinated. The essential component of efficient management is a functional triage system. A primary and secondary triage is required to sort out and prioritize patients. Primary triaging is a system based on questionnaire. During the outbreak of dengue, the primary triage may contain questions like, "Do you have fever?" If the answer is yes, then the patient goes to dengue suspect zone, however, if the answer is no, then the patient goes to regular outpatient or the emergency. Once the patient is sent to the dengue suspect zone, secondary triaging is done, where patients are triaged based on symptoms and signs and labeled as critical or non-critical [24]. During the outbreak of dengue, the surge of the patient might interrupt the services for the patient with other clinical conditions presenting in outpatients, emergencies, and inpatient. Therefore, a separate unit consisting of dengue emergency, outpatient, inpatient, and critical care patient needs to be planned [25]. Even countries with infectious disease hospitals may be overwhelmed with the surge of the patient causing overflow of the patient to other hospitals.

3. Protocols

Protocols are important for the consistency of the service delivery. There is WHO management available for dengue management [26]; moreover, every

dengue-endemic country will have national guidelines. These guidelines are more static and are based on recently available evidence. Every healthcare institution needs to have a protocol based on these guidelines. These are operational, brief, and dynamic documents. During the dengue outbreak, the protocols are adjusted based on the clinical evidence for patient safety and surge of the patient. Therefore protocol needs to be dynamic and needs to be changed according to the situation [27].

Fever is the most common presentation of dengue followed by myalgia [19, 28]. For all patients with fever, the screening is done by rapid diagnostic kits that detect NS1 antigen and IgM antibodies. The NS1 antigen is detectable the most within the first 2–4 days, and IgM antibody after that. During this period, the sensitivity of the kit to detect NS1 ranges from 63% to 73%, while that of NS1 and IgM combine ranges from 90% to 98% [29–32]. The important phenomena, is that the sensitivity and specificity of the test kit remains same however, the predictive value of screening question increases as more and more population get affected [33]. As laboratories are overwhelmed with the surge of the investigation, it becomes very difficult to process the test in time, affecting sick patients whose clinical diagnosis is in a dilemma. Therefore, at the peak of outbreak, we may not need to send investigations for all patients who do not have warning signs. Hence, a small change in protocol for investigation or management will cause huge relief of workload to the hospital during an outbreak.

Dengue virus can present with severe cases and mortality in 1–5% of cases. The important laboratory finding of dengue fever is thrombocytopenia [34]. Platelet counts are useful in predictive and recovery parameters of dengue fever, dengue hemorrhagic fever, and dengue shock syndrome [35]. Studies suggest a high risk of bleeding below a platelet count of 20,000/cumm and a moderate risk below 21–40,000/cumm [36]. The cut-off value of less than 46,500/cumm has also been taken to stratify the risk of bleeding [37]. Platelets transfusion is found to be done in some literature [19], however, it has not been proven to be effective in preventing the development of severe bleeding or shortening the time to the cessation of bleeding [38]. Therefore, this type of information needs to be analyzed carefully and must be on the basis of the best available evidence before applying it to protocol. During the outbreak of dengue, the protocol must be customized so that it does good to maximum number of patients.

4. Capacity building in clinical case management

It is necessary that health care workers have a good knowledge of dengue infection. A health care worker in a hospital must know the screening criteria, treatment criteria, reporting procedures, and preventive knowledge. The knowledge does not always translate to the adoption of preventive measures [39].

Training on infection prevention and control are necessary while orientation on protocol is important to ensure that all staffs have uniformity in action. Moreover, during the outbreak of dengue, individual roles and responsibilities must be understood by each staff. This can be achieved by simulation exercises. There are various types of exercises that can be planned according to preparedness of the hospital [40]. Tabletop exercise can be done to test the dengue outbreak management plan. The plan is adjusted and finalized according to the lesson learned from the tabletop exercise. After finalization of the plan, functional components of the plan like primary and secondary triage can be tested by drill. Similarly, drill can also be done with clinical

case management and reporting system. The coordination and communication can be tested with functional exercise. Finally, full scale simulation exercise can be planned during the preparedness phase.

Besides this online learning has been one of the effective ways of learning following the COVID-19 crisis. Online learning is no more an option, but it is a necessity [41]. During the surge of dengue patient, the event will exhaust human resources. It will be difficult to manage health care workers' time for educational sessions. This method of learning can be adopted during time of crisis. However, inventing new methods during the crisis is not helpful; therefore, online sessions must be part of professional development for health care workers.

Social media is yet another powerful way of disseminating information. This platform can be used for short messages or updates. During disaster, there are three types of social media users: influential social media creators, followers, and social media inactive [42]. Social media is used as reporting system, distributed problem-solving, and digital volunteerism [43].

5. Database system

The surge of dengue outbreaks can be managed effectively by maintaining proper database system in the hospital. The real-time data will help in planning human resources and logistics. Moreover, predictive analysis can be done to anticipate the actions that need to be taken in future days. There are some important variables that will provide crucial information for patient management. For example, the number of cases per day will identify the trend of the dengue, and the address of the patient presenting will help identify the outbreak area. This will further help in the control of the disease. Likewise, the presenting symptom of the patient is helpful in understanding the pattern of presentation. This is important during the surge of the patient when the diagnostic facility is overwhelmed, and decisions have to be made on the basis of clinical findings for non-severe cases.

Data without analysis is not useful; therefore, a system of analyzing and providing the information to the concern in a useful and understandable way is important. This system must be in place prior to the crisis. The activities that are habitual and are in

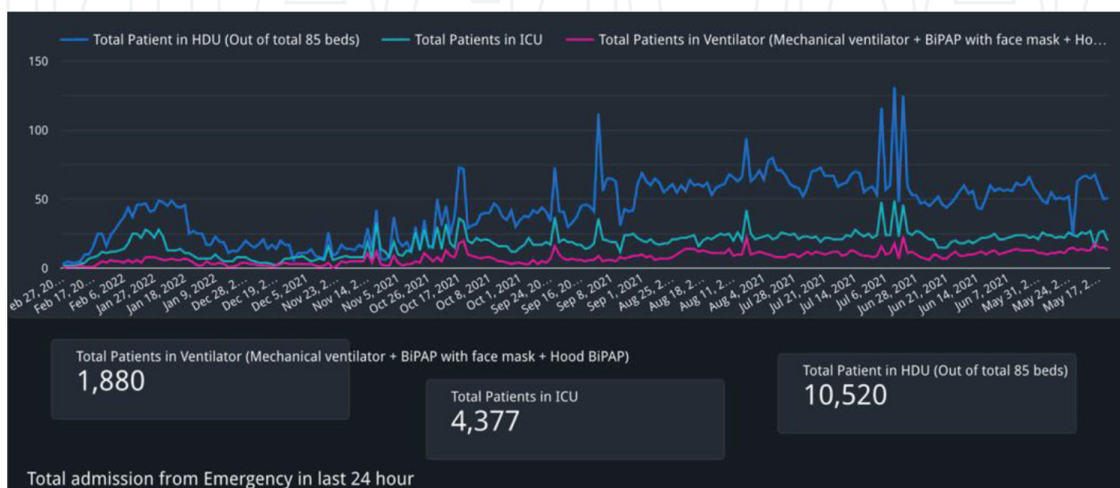


Figure 4.
Sample of dashboard used during COVID-19 pandemic.

daily practice work well during the crisis. One way of working is by using a dashboard that is visible to all clinicians, **Figure 4**. Moreover, hospitals should also have the capacity to collect data from external sources, which means the events that are being reported from other hospitals, recent advances, and updates. The process of acquisition of internal and external information, and its analysis to produce a meaningful information is an essential component of disaster management [44].

Research is another integral part of disaster management. Researches can be planned in two phases: during preparedness and response phases. In countries where dengue is endemic, response researches can be pre-planned. This will help prepare for subsequent outbreaks and improve the response.

6. Conclusions

Dengue is an infectious disease that can potentially exceed the hospital's capacity to provide the service. This surge of the patient can be managed by disaster management plan. Every hospital must have a disaster management plan including the hospital's outbreak management components. The four phases of disaster cycle need to be addressed well. An investment of effort in preparedness will improve the response phase of the disaster.

Conflict of interest

None.

Notes/thanks/other declarations

None.

Acronyms and abbreviations

COVID-19	Coronavirus disease 2019
ICU	Intensive Care Unit
IAP	Incident Action Plan
WHO	World Health Organization

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