

# Logistical considerations for Emergency Response resources

**Abstract:** Resource management is a critical component of disaster preparedness and response. The type and quantity of resources and supplies needed by any particular community will be determined by several factors including the disasters affecting the community, existing resources within the community, resources available from neighboring communities, and the vulnerability assessment of a community. Ideally only needed resources should be requested and delivered. Unsolicited aid can often hamper an emergency response. The needs of a community will change during a disaster. Often the immediate need focuses on the medical sector. Issues such as hygiene, water and shelter will occur later. Disaster planning and logistical management of resources should not only consider the short-term needs of the community but also the long-term consequences of a disaster on the community.

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## Introduction

During the last three decades, natural disasters have resulted in the loss of over 4 million lives and have affected at least 1 billion more people worldwide.<sup>1-3</sup> During 1987-1997 in the Solomon Islands 8800 people were affected, more than 15,000 people were affected in Fiji, and 25,000 people were affected in Western Samoa.<sup>4</sup> As population density increases in urban areas and regions prone to earthquakes, hurricanes or floods, these numbers will most likely continue to increase. In addition to natural disasters, developing nations are becoming more prone to man-made or technologic disasters. These hazards include airplane and maritime crashes, oil-tanker spills or fires, and toxic chemical exposures from industrial manufactures. During 1987-1996, Oceania experienced an average of three technologic disasters every year. In 1997, four such disasters occurred in this region.<sup>4</sup>

### Most disasters create a predictable pattern of public health consequences.

## Public Health consequence of disasters

Disasters can affect a community in many ways ranging from the destruction of communication and transportation systems, to the loss of personal property, and by overwhelming the capacity of the health and medical systems. Most disasters create a predictable pattern of public health consequences. An understanding of the patterns of morbidity and mortality associated with different types of disasters is essential to successful disaster planning and response. Emergency health planners can use this knowledge to predict the needs of a community in terms of resources such as shelters, food and water, medical and health supplies, communication equipment, and other materials. Thus, the first step in planning for the potential needs involving disaster response equipment and supplies begins by identifying the specific types of disasters affecting a community as each disaster produces different injury and morbidity patterns.<sup>5</sup> The main hazards affecting populations in Oceania during recent history (1900-1994), included cyclones, earthquakes, floods and volcanic eruptions.<sup>6</sup> Following is a discussion of the public health implications that are commonly caused by these key hazards.

The most common natural disaster is flooding. Floods have caused more deaths than any other natural disaster worldwide.<sup>5</sup> Floods accounted for 41% of the economic losses secondary to disasters during 1990-1999 in Oceania.<sup>7</sup> The main cause of death from floods is drowning; other causes of death include trauma and hypothermia. Victims frequently seek medical treatment for minor lacerations, rashes and ulcers.<sup>5</sup> Water supplies or sewage systems may be disrupted.<sup>8</sup> Shelters or homes frequently are destroyed after floods.<sup>4</sup>

Tropical cyclones, typhoons or wind storms were the most frequent type of disaster in Oceania during 1990-1999.<sup>7</sup> Although high winds can significantly damage

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surrounding structures, the most frequent cause of injury and death during cyclones is drowning caused by flooding and storm surges.<sup>5</sup> Morbidity and mortality also result from entrapment of persons under collapsed structures and trauma such as lacerations or penetrating injuries caused by flying debris.<sup>9,10</sup> Analysis of previous cyclones indicate that most victims do not require high levels of trauma or surgical care and can therefore be treated outpatients in clinics. In fact, medical needs are often much less than the more drastic needs for basic essentials such as shelter, clothing, water, and hygiene.<sup>5,11-15</sup> Early warning and population protection are important actions for lessening the morbidity and mortality associated with floods.

Volcanic eruptions affected approximately 153,000 people in the Pacific region during 1990-1999.<sup>7</sup> In general, death associated with volcanic eruptions often occurs instantaneously secondary to suffocation from ash or deadly gases, as well as from burns or trauma. Immediate death often results from inhalation of large amounts of ash or deadly gases and blasts from superheated steam. Toxic gases can cause pulmonary edema, ocular irritation, muscle and joint pain, and blistering rashes.<sup>16-18</sup> Burn care and respiratory support for victims exposed to ash or gases should be considered a top priority.<sup>5</sup> Victims can experience circumferential burns of the extremities as they walk or work in the hot ashfall; these burns should be evaluated for circulatory compromise and escharotomies and/or fasciotomies should be considered early during treatment and care. Early warning and population protection is also an important factor for lessening the morbidity and mortality associated with volcanic eruptions.

Earthquakes affected approximately 39,000 people in the Oceanic region during 1990-1999.<sup>7</sup> Death and injury from earthquakes usually result from trauma associated with collapse of buildings.<sup>19</sup> Death may be immediate, rapid or delayed depending on severity of injury, length of entrapment, or victim's ability to survive without proper medical attention.<sup>5</sup> Trapped victims survival rate significantly drops after the first 24 hours. One study showed that 93% of trapped victims survived if they were located within the first 24 hours and 95% of deaths occurred in victims trapped in the rubble.<sup>20</sup> The data suggest that if survival rates are to be improved, search and rescue of victims must occur within the first 48 hours.<sup>5</sup> Other victims may seek medical attention for minor lacerations and contusions, fractures, or crush injuries.<sup>21-23</sup> Early and aggressive search and rescue efforts are necessary to lessen mortality.

**A vulnerability assessment (also known as a hazard analysis) is a method for identifying the hazards and vulnerability and for determining their effect on a community.**

Concerns about disease outbreaks or epidemics always follow environmental disasters. Concerns for increase in communicable diseases arise when there is a breach in sanitation conditions such as fecal contamination of the water and insufficient sanitary facilities for large gatherings of individuals. Under most circumstances, disease outbreaks do not occur in the acute response phase of a disaster. Mass vaccinations are rarely indicated in the emergency response phase of a natural disaster.<sup>5</sup> Epidemics are significant public health emergencies and sometimes do progress to the proportions of a disaster. Therefore, planners should consider identifying equipment and supplies that may become necessary during the emergency response to epidemics that may be borne by water, food, vector, or personal contacts. These may include therapeutic and diagnostic medical supplies as well as materials necessary for outbreak investigation, epidemiologic analysis and reporting.

## Vulnerability and disaster assessments

Understanding the public health consequences of natural disasters is one step in organizing and developing a comprehensive "list" of resources, supplies, and equipment a community may require during a disaster. A vulnerability assessment (also known as a hazard analysis) is a method for identifying the hazards and vulnerability and for determining their effect on a community. Vulnerability of a community results from factors that limit the ability of a community to absorb and manage an emergency or disaster. Susceptibility refers to the factors that allow a hazard to become an emergency i.e. population living close to an active volcano. Resilience describes those factors that help a community withstand and recover from a hazard.<sup>24-25</sup> A vulnerability assessment is an important part of emergency or risk management.

Vulnerability assessments may include the following steps. First, identify the hazards that affect a community and the frequency, intensity, time frame (seasonal) and manageability of those hazards. Next, consider the community itself in terms of demographics, culture, economy, infrastructure, and environment. Indicators such as infant mortality and life expectancy can provide information about the overall health status of the population. Knowledge of disease patterns and natural history may be applied to analyze the risk of communicable disease outbreaks after an emergency. Vulnerability analysis should include the infrastructure of a community such as key facilities as telecommunications, electrical, and water services.<sup>24,26</sup> During the vulnerability analysis, communities may discover that not all parts of their communities are equally vulnerable to hazards and thus needs

and resources required may also differ. This may be particularly true in Oceania where many nations consist of multiple islands. The outer islands may be isolated secondary to accessibility, communication abilities, and limited medical resources. The CDC Pacific Emergency Health Initiative is now involved in a region-wide vulnerability assessment that is being offered for all Pacific island nations. Pacific health planners may use this resource when deciding on and prioritizing emergency response materials and resources.

Assessments should occur continuously throughout the disaster to determine ever-changing needs and priorities of the community as the event evolves. A needs or situation assessment provides accurate and timely information to disaster managers for decisions regarding resource allocation. An immediate assessment should take place within the first 24-48 hours. The assessment should identify the extent and types of emergency response needed, prioritize secondary health needs such as nutrition and identify possible post-disaster issues that will require surveillance. Information collected during a disaster assessment may include population affected, presence of continuing hazards, morbidity and mortality, access to water and shelter, and status of the infrastructure of a community. This information can then be used to prioritize the disaster response such that the most individuals in a community will benefit. Assessments and surveillance should continue throughout the disaster to monitor the effectiveness of the disaster response and its impact on the population at large.<sup>27-28</sup>

### **General principles in resource management**

Resources often are required most immediately that address critical medical needs of the affected victims. Water, food, shelter and equipment are needed next. Request for resources should be strictly limited to supplies that are unobtainable from the community. In most circumstances, relief supplies will not become available for 48-72 hours.<sup>5</sup> Additional time will be required to unload, sort, store, and distribute the supplies. Disaster managers should also expect that large quantities of unsolicited aid might be received. The usefulness, timeliness and quality of such donations are often questionable.<sup>29</sup> The ability to deliver the right supplies, in the right quantity, and to the right place is the goal of an effective emergency response operation.<sup>30</sup>

Effective resource management requires four basic actions: 1) determining which resources are needed and how to procure them; 2) identifying a means to transport

these resources where they are needed; 3) preparing an organized, safe and secure area for storage, with an inventory tracking system in place that is simple and able to anticipate future needs; 4) developing a system that distributes the assistance to affected persons. This system should ensure that the supplies and resources are distributed equitably and to the needed areas.<sup>29</sup>

### **Identify and maintain essential resources, supplies and equipment**

Equipment and supplies that are essential to the response capacity of a community can be generally categorized into five areas: direction and control, communications, warning and emergency public information, evacuation, mass care, and health and medical. Initial steps should be taken during a vulnerability assessment to identify and inventory existing resources, equipment, and supplies that are essential to health, medical and disaster management. These resources should be considered national assets. Resources could be managed and maintained using options that include vendor-managed inventory, a direct government warehousing, or an inventory or emergency requisition process that allows for on-going use in the private sector and with diversion to government use during disasters. Stockpiling supplies exclusively for disasters is not recommended because of the high costs involved in maintaining an efficient supply rotation.<sup>29</sup>

Equipment used for direction and control is usually non-specific. It includes administrative supplies. Inclusion of the following equipment should be considered:

- Charts or boards for tracking supplies and resource assignments
- Staff identifiers: vests, nametags, hats
- Disaster responder personnel equipment: flashlights, communication equipment, personal protective equipment
- Documents: reporting forms, maps, contact information, inventory lists

Disaster response is inextricably linked to the communication system. Communication failures can significantly impede an emergency response. A robust and redundant communication system are essential during a disaster response. It should allow for reliable and accurate transmission of information and communication between multiple services and the public. In addition to being reliable, the equipment should be low tech, easy to use, easy to repair, transportable, compact and mobile, and have a replaceable source of power.<sup>31</sup> Communication equipment may include a variety of technologies: two-way radios, pagers, broadcast radio, television, satellite,

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**Table 1. Common communication difficulties during a disaster response.**

1. Broadcast, microwave, and or repeater towers may be damaged or destroyed affecting telephones, pagers, radios, or television services
2. Telephone hard-lines may be down or disrupted affecting all telephone services
3. Widespread power outages may affect any number of electronic communication methods
4. Responders may use many different radio frequencies
5. Functional telephone lines to critical facilities such as hospitals, may be overloaded with calls
6. Existing radio frequencies may become saturated from increased amount of traffic or lack of radio control protocols
7. Battery-operated devices may run low on power as batteries become scarce or unavailable
8. Press media may interfere with emergency functions by using scarce lines of communications, or by eavesdropping on confidential radio transmissions from disaster responders
9. Handheld radios may not be heard over the noise level created by operation of heavy equipment.

telephones-cellular, hard-line telephone, satellite, fax machines, computer modems, public address systems, hospital intercoms, and sirens.

Each modality that could be used during a disaster has its own limitations. In addition, common problems tend to reoccur during disasters. Table 1 lists the most common of these problems.

For these and many other reasons, the following recommendations may be useful when strengthening a communication system intended for emergency response. (See Table 2)

Mass care or the shelter and feeding of displaced persons in response to disasters involves a wide variety of issues. This task is often the primary mission of a wide range of governmental and non-governmental organizations. Along with equipment and supplies needed to

provide of shelter, water, food, sanitation and environmental security, there are issues particular to displaced populations. Simple tasks may be extraordinarily complicated by logistical, political, financial and health-related factors. For this reason, planning efforts should be guided by careful consultation and reference. A few of the resources for additional information and technical support include the following organizations:

- United Nations High Commission for Refugees, Palais de Nations, CH-1211, Geneva-10, Switzerland. <http://www.unhcr.ch> Telephone: 41-22-739-8111
- OXFAM, 274 Banbury Road, Oxford OX2 7 DZ, United Kingdom. <http://www.oxfam.org.uk> Telephone 44-865-5677
- International Committee of the Red Cross, 17 avenue de la Paix. CH 1202, Geneva Switzerland. <http://www.irc.org> Telephone 41-22-734-6001
- World Health Organization, Avenue Appia, CH 1211, Geneva-27, Switzerland Geneva <http://www.who.org>

**Table 2: Recommendations for designing emergency response communication systems<sup>41</sup>**

1. Communications system design should provide alternative and back-up communication links, such as radio or microwave links. This redundant system should also allow for repair and replacement of parts.
2. Protocols should be in place to allow police, fire, and ambulance units from different agencies to communicate with each other during disaster operations.
3. Fixed communication facilities and hospitals should have adequate standby power sources that are independent.
4. Important locations such as hospitals in a service area should have more than one radio site.
5. The system's design should allow for enough telephone lines, radio channels, and operating positions or rapid expansion capability to handle heavy traffic generated by disasters.
6. Disaster communication procedures should be clearly defined, emphasizing an interagency coordination. These procedures should be straightforward expansion of day-to-day procedures rather than a radical change in standard operating procedures.
7. Communication paths should be established with military, amateur, air, public utility, and other radio operations outside of the public safety radio service.
8. Disaster communications should be tested regularly and the results of these tests should be reviewed so that failures can be corrected.

Telephone 41-22-791-2111

- American Red Cross, Attn: Public Inquiry Office, 431 18<sup>th</sup> Street NW, Washington D.C. <http://www.redcross.org> Telephone 01-703-206-6296

Equipment and supplies for health and medical care may be divided into two broad categories. The first category includes the drugs and medical equipment and supplies that are necessary for direct care of services. This should also include provisions for maintaining primary care services in addition to the medical and health needs created by the disaster. Many patients will seek medical care for chronic conditions because their pharmacies and primary clinics have been destroyed or have become nonoperational.<sup>5</sup> Communities should also prepare for the mental health needs of both victims and service providers. The second category includes logistical and occupational health supplies used to support the emergency caregivers and the facilities. Some examples of supplies include portable shelters, tents, water storage containers, patient stretchers, medical equipment and pharmaceuticals, communication equipment, personal protective equipment, fuel or generators for lighting, tools and latrines.

Several sources for lists of equipment and supplies exist

and can provide examples from which a community may select and begin developing an inventory of essential supplies and equipment that are appropriate for their population and hazard analysis. One such resource for identifying an inventory is offered in the *The New Emergency Health Kit* (World Health Organization, Avenue Appia, CH1211 Geneva-27, Switzerland). This publication offers a standard list of essential emergency health supplies that are widely accepted throughout the world. Contents are calculated to meet the needs of 10,000 persons for 3 months. The kit inventory itself is divided into 10 identical units that would treat 1000 persons, so it is also scalable to need. It is designed to meet the needs of a refugee camp and the priorities associated with austere conditions in developing nations.<sup>32</sup>

The US National Disaster Medical System (NDMS) has developed a list of disaster health and medical equipment. This model has been established for the deployment of emergency response teams known as disaster medical assistance teams (DMAT). These teams arrive at a disaster and deliver care onsite. They are expected to be self-sufficient for the first 72 hours and would also establish small-scale field treatment centers. This particular inventory is well suited to specialized field response teams in developed nations. The WHO New Emergency Health Kit and NDMS Equipment and Pharmaceutical caches may provide a starting point or reference for

community emergency or disaster managers in development of an appropriate "list" that will best serve their communities' needs.

## Problems encountered in resource management

Problems in disaster resource management can result from insufficient information or assessment of communities' health and other needs. A quickly organized response that is unfamiliar with local conditions and not designed to compliment and assist the community's effort only contributes to the chaos and strains already limited resources.<sup>33</sup> Countless examples exist of useless medical supplies and consumables sent to a disaster site such as: drugs are labeled in a foreign language, arrive after their expiration date or are not commonly used in a particular community.<sup>29,33-36</sup> Most unsolicited medical supplies arrive unsorted, unlabeled, mislabeled, or are not intended for emergency use, and time and effort must be expended to determine which resources are needed and which must be discarded.<sup>37</sup> Other examples include the arrival of specialized external medical teams that arrive too late or are inappropriate for the response. These personnel then require shelter, food,

and transportation.<sup>38</sup> At other times, clothing or shelter inappropriate for the local conditions arrive that are of little use to the community. Unfortunately excessive or inappropriate aid can complicate or hinder the disaster response efforts.<sup>39, 40</sup>

Inappropriate, unneeded, or excess aid can arrive for a variety of reasons, including the beliefs that any type of international assistance is useful and that the affected community is always incapable of handling the response.<sup>33, 40</sup> Resources and supplies may be delivered to a community even without specific requests. Furthermore, assigning personnel to be responsible for inventory control and assessing the overall resource needs is often not done.<sup>39</sup>

The Pan American Health Organization has developed an excellent management tool known as SUMA, an operational system comprising computer software, equipment, and trained personnel to assist countries affected by disasters in managing and distributing supplies. SUMA can be used to track and monitor inventories for all resources and supplies not just those related to the health and medical fields. SUMA was designed to help countries effectively manage the influx of humanitarian aid. More information about this operational system can be found on the PAHO website at [www.paho.org](http://www.paho.org).<sup>29</sup>

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## Special equipment or resources (search and rescue, external medical teams, heavy equipment, volunteers)

In certain situations, specialized equipment such as heavy earth-moving equipment, cranes, or search and rescue personnel may be needed. These resources may not be part of the routine disaster response procedures. Arrangements for obtaining special equipment and supplies should be considered in advance and a list of potential donors or vendors should be made.

External medical teams from a variety of organizations are often available to respond to disasters. The usefulness of these teams is based on the actual need of the population for the specific services of the team. Frequently, medical response in a disaster is limited to the provision of supplies and logistics but not personnel. If qualified personnel are available, request for assistance should include persons from neighboring communities or countries. The medical assistance should come from well-recognized organizations with disaster experience and appropriate medical qualifications. These medical assistance teams should be familiar with local customs, able to operate quickly when the need is required, and be self-sustaining (so they do not additionally drain limited local resources).<sup>33,38</sup>

Volunteers may arrive very early during the disaster to offer assistance in the disaster response. Coordination of volunteers is essential, as time and resources are consumed to organize and determine how to utilize these individuals. Foreign volunteers commonly have little specific training and lack knowledge of foreign languages or foreign customs.<sup>5,39,40</sup> A policy should be developed as part of the disaster response that specifically addresses the roles and responsibilities of volunteers. In addition, methods must be addressed to rapidly certify or license foreign medical volunteers. In small communities or countries in Oceania, one way to coordinate volunteers is to assign and develop volunteer teams in advance of the disaster event. Volunteers could potentially be assigned to a team leader such as a village leader, nurse, or Red Cross members in advance of a disaster. Their roles and responsibilities would be defined and regularly practiced before being needed or requested.

## Discussion

Resource management is a crucial component of disaster preparedness and response. The types and quantities of resources needed by any particular community will be determined by several factors, including understanding the public health consequences of disasters and the associated morbidity and mortality patterns along with completion of a vulnerability analysis for the community. Further information about resource needs is then col-

lected throughout the disaster as part of a disaster assessment that helps to prioritize resource allocation. By inventorying existing resources, basic needs and shortfalls may also be discovered. The process of developing and managing a community's resources also requires identifying potential sources of external aid, including neighboring communities. Only needed resources should be requested. Ideally the donated aid is one that meets a specific requested need and requires little or no processing on the part of the receiving community.<sup>37</sup> Individuals should be tasked with the responsibility for logistical management of resources. Disaster planning should also involve coordination among multiple agencies for distribution of the resources. During the immediate response phase of a disaster, resources often focus on and medical and health sectors. This situation then often changes to focus on environmental issues such as hygiene, shelter, and food and water safety.<sup>5</sup> Thus, disaster resource planning should consider not only the short-term needs but also the long-term consequences on the community.<sup>33</sup>

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I fear the power of the poets, to expose  
the tenderness of the soul  
**K. Helu-Thaman. From 'Salted Storms'**