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Post-Cyclone Sidr illness patterns in coastal Bangladesh: an empirical study

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Abstract After the landfall of Cyclone Sidr along the southwestern coast of Bangladesh on November 15, 2007, emergency and public health personnel within and beyond Bangladesh anticipated a massive outbreak of water-borne and other diseases in most affected areas. Fortunately, such an outbreak did not occur. The objectives of this paper are to examine the extent and pattern of illnesses experienced by Cyclone Sidr survivors in the aftermath of its landfall and to investigate household and individual-level factors associated with such illnesses. Based on face-to-face interviews conducted among 277 randomly selected Sidr survivors living in the four most severely impacted coastal districts, this study found that the post-cyclone incidence of water-borne, respiratory, and other diseases was not unusually high. Only 52 persons suffered Sidr-related illnesses, and their illnesses were significantly associated with household income, and gender and age of the Sidr survivors. A major outbreak of such diseases was largely avoided because of the proper distribution of food and safe drinking water, as well as the timely implementation of health care intervention measures. This important finding will aid relevant authorities in successfully responding to outbreaks of diseases following a future extreme event in Bangladesh and perhaps elsewhere.

Keywords Cyclone Sidr · Coastal Bangladesh · Disaster myths · Epidemic · Illnesses · Emergency and public health personnel

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1 Introduction

Emergency managers, public health personnel, and members of the general populace fear large-scale epidemics in areas impacted by major disasters (de Goyet 2007). The presence of large numbers of dead bodies, both human and animal, and non-availability of pure drinking water are considered the main reasons for this prediction of post-disaster epidemics and diseases (Miller 2005; Paul 2007). The people/agencies who predict post-disaster epidemics do not consider the disaster aid factor. For this reason, the prediction proves false and becomes a myth. Several such myths exist in disaster literature, which often direct the focus of emergency workers and responders away from the needs of survivors and toward combating false realities (Fischer 1998, 2006; McEntire 2007).

Bangladesh experienced a Category 4 cyclone, named Sidr, on November 15, 2007. The cyclone caused 3,406 deaths and over 55,000 people sustained physical injuries (Paul 2009). Immediately after the cyclone, emergency and public health personnel both within Bangladesh and beyond its borders anticipated a massive outbreak of water-borne, respiratory tract infection (RTI), and other related diseases in impacted areas (GOB 2008a). According to the UN Rapid Initial Assessment, approximately 1.5 million people in the nine surveyed districts were at risk of communicable diseases—diarrhea, dysentery, acute respiratory infection, and pneumonia (GOB 2008a). This represents about 8.5% of the total population of these surveyed districts. A district, in Bangladesh, is the second largest administrative unit, with an average population of slightly over 2 million.

Fortunately, health and emergency officials were wrong in their prediction and no significant outbreak of water-borne and other related diseases did occur. In fact, morbidity in most cyclone-impacted areas remained near the level that existed prior to the landfall of Cyclone Sidr. The objectives of this paper are to examine the extent and pattern of illnesses experienced by Cyclone Sidr survivors and to identify the household and individual-level risk factors for such illnesses. Because of the absence of any systematic study dealing with illness patterns during the post-cyclone period, particularly after 2007 Cyclone Sidr, this empirical research will provide information useful to both public and private emergency management agencies and assist public health personnel in responding to future cyclone-related illnesses more effectively and efficiently.

The next section provides a general framework for a discussion of the health impacts of natural disasters. This is followed by a presentation of the reasons why the outbreaks of diseases were predicted after the landfall of Cyclone Sidr. These two sections provide essential background information for interpreting the data and results of this empirical study. The next two sections present the sources of data used in this study and study findings. The final section is devoted to a brief summary followed by concluding remarks and recommendations.

2 Health impacts of natural disasters: a framework

Natural disasters produce a range of impacts, which are often broadly classified as ‘direct’ and ‘indirect’ impacts (Green et al. 1983; Handmer 1988; Mileti 1999; Tierney et al. 2001; Tobin and Montz 1997; Ward 1978). Direct impacts are caused by physical contact of disaster with humans and/or property, whereas indirect impacts are caused by the ramifications of such physical contact during post-disaster period (Paul 2005). The latter impacts are often referred to as ‘second-round’ impacts or ‘second web of death and

destruction,' and these impacts also pose a significant threat to the lives, health, and well-being of disaster survivors.

Like other disasters, direct health impacts of cyclones include deaths and injuries. Some of the important indirect health impacts include significant outbreaks of communicable, water-related, and other diseases, such as diarrhea, hepatitis, malaria, fever, pneumonia, eye infections, and skin diseases. Most of the communicable and water-borne diseases that occur during post-disaster period are often caused by a severe shortage of clean drinking water, non-hygienic living conditions, and lack of food, particularly in developing nations such as Bangladesh. Disaster survivors generally live in damp, dirty, and cramped conditions in their homes and/or temporary shelters. Such conditions facilitate spread of numerous adverse health effects from person to person within the household (Tapsell et al. 2002).

Illnesses are also caused by other indirect impacts of extreme events such as damaged infrastructure, population displacement, and reduced food production as well as the release of contaminates (e.g., from storage and waste disposal sites) into the waters and air in disaster impacted areas (Fig. 1). In the context of health impacts, damaged infrastructure primarily refers to health care facilities such as hospitals, medical clinics, and ambulatory services, but also to the electricity on which most of these facilities depend. Because of either complete or partial damage to such facilities caused by cyclones or other natural disasters, it is difficult to provide necessary care to the ill and injured. Lack of proper medical attention may also result from the absence of physicians and/or an insufficient supply of appropriate medicine. These indirect impacts not only prolong suffering, it also increases the probability of death from injuries and/or illnesses.

Damage to other infrastructure, such as roads, bridges, and culverts, may also impact health outcomes by causing serious delay (or even prevent) the provision of emergency medical supplies and personnel for treating acute injuries or for controlling disease outbreaks (Kuni et al. 2002; Siddique et al. 1991). Restricted access may also prevent the initiation of emergency immunization measures and other health interventions that may be required subsequent to a disaster. Cyclone Sidr completely destroyed some 1,145 miles (1,714 km) of roads and those that were at least partially damaged, an estimated 4,240

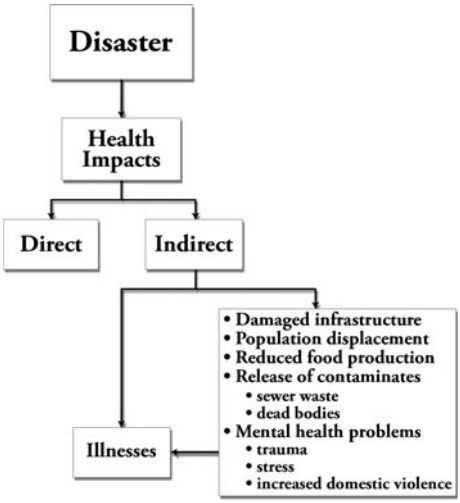

Fig. 1 Indirect health impacts of disasters

miles (6,361 km). Additionally, 1,850 bridges and culverts were damaged by Sidr (GOB 2008b).

Release of contaminates poses serious health risks, including cancer for survivors of several natural disasters, such as floods. Flood waters often mix with raw sewage, toxic chemicals, and fuel from ruptured underground tanks. These not only pollute the water and air but also cause dangerous levels of mold in homes located in flood-impacted areas (Godsil 2009). In one post-Katrina survey, 93% of all residents surveyed in New Orleans believed that mold in their homes could make them sick (Curtis and Mills 2009). Additionally, sediments of flood-affected areas often contaminate with toxic substances, such as arsenic, lead, diesel fuel, and polycyclic aromatic hydrocarbons (Godsil 2009).

Another indirect health impact of natural disasters, including cyclones, is associated with mental health (Fig. 1). In those areas affected by natural disasters, the related trauma tends to have a lengthy impact on the population's well-being, both directly and indirectly. Direct consequences may be seen in the form of lifetime disabilities. Indirect outcomes—perhaps less visible—manifest in society through individual breakdowns that lead to stress-related illness. Such stresses may become health problems months or even years after the event. Additionally, disasters may exacerbate existing stress or contribute to acute stress—a condition that can lead to chronic illness and mortality, if nor properly addressed (Curtis and Mills 2009).

There are several different measures that might be indicative of, or serve as an index assessing levels of stress. For example, suicide rates, coping mechanism behaviors including alcoholism, drug use, or even crime, increased spousal abuse, and even adverse pregnancy outcomes such as pre-term and low birth weight (LBW) babies (Buekens et al. 2006; Cordero 1993; Curtis and Mills 2009). All these tend to increase during the post-disaster period as a result of post-traumatic stress disorder and depression in the wake of death, destruction, and illness that usually accompany such catastrophes (Bromet and Dew 1995; Krug et al. 1998). Alexander (1998), however, urges caution in accepting these findings and states these are difficult to verify in both statistical and in causal terms.

Available evidence suggests that apart from stress, a pregnant woman is particularly vulnerable during the post-disaster period for a variety of reasons including healthcare availability concerns, and fears for the subsequent health of her baby in the event of a forced relocation due to a disaster (Curtis and Leitner 2006; Curtis and Mills 2009). This is also true for already ill persons. Although indirect health impacts of disasters may manifest months or even years after the event, this study focuses on illnesses that Sidr survivors experienced during its immediate aftermath—a period of approximately 54 days.

3 Reasons for post-Sidr outbreak of diseases

Post-Sidr outbreaks of water-borne and communicable diseases were anticipated for several reasons. First, available surface water (e.g., ponds, canals, and rivers), which are the main sources of drinking water in the coastal zone of Bangladesh, were highly contaminated by saline intrusion, carcasses of domestic animals, and dead fish. Trees uprooted by the cyclone also made surface water sources unusable for drinking and household purposes. More than four million trees were destroyed or damaged and almost two million head of livestock and poultry were killed by Cyclone Sidr (GOB 2008a).

Additionally, many tubewells in the cyclone-affected areas malfunctioned either because these tubewells were destroyed or damaged by the cyclone or were submerged under saline water. It was estimated that only about 1,500 out of a total of 18,000 tubewells

were functioning in cyclone-affected localities (GOB 2008a). Consequently, many drinking and domestic water sources were highly polluted. It is important to note that tubewells, which draw water from underground sources, also used as sources of drinking water in coastal areas of Bangladesh.

Besides an acute shortage of pure drinking water, another reason for the anticipated major outbreak of disease was that people in Sidr-affected areas were defecating everywhere indiscriminately. Physical damage to household latrines in some of the most severely affected areas was common, with one estimate putting the percentage of slab latrines damaged or destroyed as high as 70% (GOB 2008a). According to official information from the Department of Public Health Engineering (DPHE) of the Bangladesh government, as of January 21, 2008, as many as 55,279 latrines were partially damaged or fully destroyed in 12 severely impacted districts (GOB 2008a).

Among all sectors, the impact of Cyclone Sidr on the housing sector has perhaps been the most extreme with over 500,000 homes totally destroyed and more than 900,000 heavily damaged (SCG 2007). This means that the number of homes destroyed by Cyclone Sidr in Bangladesh was higher than the total number of homes completed destroyed by the 2004 Indian Ocean Tsunami—reported at 400,000 (Paul 2007). The total value of damage to the housing sector was estimated at US$ 839 million, a figure representing more than 50% of the total damage and losses from all sectors (GOB 2008a). An outbreak of RTI was suspected primarily because many Sidr survivors were living without shelter in cold winter weather and/or in make-shift temporary shelters, including tents (Fig. 2). Living in such crowded and non-hygienic conditions, and sleeping on damp floors may also cause several different illnesses such as fever and skin diseases. The most important reason for expecting an epidemic during the aftermath of Sidr was that Bangladesh had experienced two back-to-back floods in 2007—only 3 months prior to Cyclone Sidr. Although both monetary losses and the number of fatalities were much lower in these 2007 floods compared to the three most devastating floods (1987, 1988, and 1998) of the last century, the 2007 Bangladesh floods, particularly the first one, were seriously mismanaged by public authorities. This is primarily because the government in power at that time was not prepared for such an extreme event. People in flood-affected areas experienced an acute scarcity of safe drinking water, a shortage of food, and were exposed to various water-borne diseases, particularly diarrhea (Haque 2007).

4 Data and methods

4.1 Questionnaire survey

The primary source of data for this study was a questionnaire survey administered among Sidr survivors of four severely cyclone-affected districts (Bagerhat, Barguna, Patuakhali, and Pirojpur) approximately 3 months after the cyclone. Field visits, and formal and informal discussions with participating emergency responders, local leaders, government officials, and workers of non-governmental organizations (NGOs) were also used to collect relevant information. Unlike in developed countries, there is no provision in Bangladesh for keeping medical reports and/or records. For common illnesses, most people in rural Bangladesh either use wait-and-see approach or adopt self-care strategies rather than immediately seek medical intervention from physicians. When illnesses are perceived as life threatening, only then do many seek medical care either from traditional healers or modern physicians (Edgeworth and Collins 2006; Paul 2006). For this reason, relevant data

Fig. 2 Four examples of make-shift temporary shelters

were collected directly from sample households impacted by Cyclone Sidr. It is important to mention that no attempt was made to collect information on healthcare-seeking behavior of cyclone survivors.

The information used in this study is thus based on reported illness and not through direct observation of illness episodes unfolding. However, since the recall period for those individuals surveyed is less than 3 months, the chance of recall errors should not be an issue for this study. Questions regarding the validity of self-reports are also unlikely for this study because of the range of techniques implemented to limit the extent of variances, bias, and inaccuracies in the data. Every effort has been made to assure that the collected data is reliable and accurate. Data collection procedures utilized in this paper are discussed in another paper published online in this journal, so to avoid repetition, readers are referred to this publication (Paul 2010).

4.2 Selection of risk factors and data analysis

As indicated, few studies are available on post-disaster illness patterns. Based on these limited studies and existing hazard literature on disaster-induced deaths and human injuries (e.g., Ashley 2007; Bern et al. 1993; Kuni et al. 2002; Paul 2010; Siddique et al. 1991; Sommer and Mosley 1972), five risk factors (household income, landholding size, gender, educational level, and age) were selected to examine the relationship between each one of these factors and the illness status of individuals during the post-Sidr period. Review of the literature further suggests that the two household-level factors (income and landownership) should have an inverse relationship with illness status. It was also hypothesized that women, the illiterate, the elderly, and children would be more vulnerable to illnesses than male, literate, and adult. Pearson's chi-square test was used to determine the statistical significance of the five risk factors considered in this study.

5 Results

5.1 Extent and pattern of illnesses

A total of 277 individuals functioning as household heads were successfully interviewed from study villages through a structured questionnaire. Survey data reveal that 52 persons from 31 respondent households experienced Sidr-related illnesses (Table 1). This means that they suffered from illnesses acquired sometime between November 16, 2007, and January 8, 2008, when this questionnaire survey was initiated. This survey lasted for nearly 2 months. To maintain a study period equal for all the selected villages, any person(s) suffering illnesses from respondent households after January 8, 2008, was not included in this study. Data provided by this survey indicate that at the time of questionnaire survey, the average family size was 5.2 among respondent households. This family size is

Table 1 Number of deaths, injuries, and illnesses among respondent households

	Number of persons	Number of households	Average/ household
Death	69	48	1.44
Injury	132	124	1.07
Illness	52	31	1.68

consistent with the average family size of the four districts from which the 13 study villages were selected (GOB 2008b).

The total population of respondent households surveyed was calculated as 1,443. This means that, on average, only 3.6% of the people representing respondent households suffered illness during the study period considered here. This further suggests that morbidity was relatively low during the post-Sidr period. Information presented in Table 1 supports this contention. The number of Sidr-induced deaths and injuries was higher compared to the number of persons that suffered Sidr-related illnesses. This is also true at the household level. A higher number of households experienced death and injury caused by Cyclone Sidr among their family members than the number of households that experienced Sidr-related illnesses during the time period considered in this study. Survey data further reveal that only three households with Sidr-related illnesses among their members also experienced death and injuries caused by the cyclone.

Survey data reveal that 52 persons suffered Sidr-related illnesses. Of them, 20 (38%) suffered diarrheal diseases; 12 (23%) suffered RTI; 8 (15%) typhoid; 6 (12%) skin diseases; 4 (8%) fever; and 2 (4%) eye infection. Although all these diseases are reported in other cyclone-affected areas not included in this study, their relative ranking differs. According to an official government report, in terms of number of survivors with illness, fever ranks number one, followed by skin diseases and diarrheal diseases in all cyclone-affected districts—which includes both coastal and non-coastal districts (GOB 2008b). The study villages were selected from the four most severely impacted coastal districts, where surface water is the primary source of both drinking and household water. This fact might explain the difference in raking of illnesses between this study and the GOB report. Group interviews and informal discussions with local residents also confirmed the raking of illnesses obtained in this study.

No questions were formally asked of respondents any reasons they might have given as to why the illnesses did not reach expected epidemic proportions during the post-Sidr period. However, group interviews did provide several reasons for this. Diarrheal diseases did not reach epidemic levels because both government agencies and NGOs introduced appropriate measures and timely intervention programs. First, these organizations distributed water purification tablets and bottled water immediately following Cyclone Sidr and for more than 3 months afterward. NGOs along with the government, military, and relief agencies also cleansed the water supplies very quickly and efficiently. The Institute of Public Health of Bangladesh increased the manufacture of intravenous (IV) fluids, while the Health Education Bureau provided health education to create awareness of water-borne and communicable diseases among impacted coastal residents. Additionally, the government provided oral saline (ORS) to cyclone survivors (GOB 2008a).

To prevent and treat illnesses, the Bangladesh government sent more than 690 medical teams into cyclone-impacted areas. Each team consisted of a physician, a health assistant, and a paramedic. In addition, 92 medical teams from 26 private medical colleges were also working in impacted areas. In all, 1,189 medical teams provided medical aid in the areas devastated by Cyclone Sidr (GOB 2008a). The Health Ministry of Bangladesh provided life-saving drugs in the region while at the same time, officials of the Bangladesh government requested immediate medical supplies from UNICEF, WHO, UNFPA, and the Spanish government (GOB 2008a). Due to these unified, efficient efforts, almost all Sidr survivors received food, safe drinking water, and medical assistance in a timely manner and in adequate quantities. As a result, a major outbreak of diseases was avoided. The aforementioned relief efforts concentrated specifically on measures to prevent and control the outbreak of disease caused by Cyclone Sidr.

One member of a group interviewed claimed: "Many people initially feared outbreaks of cholera, dysentery, typhoid, malaria, and dengue fever. However, due to proper distribution of relief goods and timely implementation of health care intervention practices, anticipated large-scale epidemics and massive outbreak of water-borne and other diseases did not occur. This minimized the 'secondary loss of life'."

5.2 Risk factors of illnesses

The extent of Sidr-related illnesses is analyzed by two household (annual household income and landholding size) and three individual-level (gender, age, and level of education) risk factors. Table 2 shows that household income is categorized into three groups. Contrary to expectation, Table 2 shows a direct relationship between annual household income and the percentage of people affected by post-Sidr illnesses. The illness rate, as reflected by the percentage of people affected by diseases during post-Sidr period, is highest among households belonging to the highest income category. Further, the illness rate consistently decreases across lower income categories, leading to the lowest rate belonging to the lowest income category (Table 2).

Though unexpected, this relationship can be explained using the concept of vulnerability. Although poverty is the leading cause of vulnerability, poverty is not synonymous with vulnerability (Wisner et al. 2004). There is a need to de-construct poverty in order to understand why certain groups are more vulnerable and hence suffer more from a particular extreme event (Watts and Bohle 1993). For example, not all poor people are equally vulnerable to starvation, and it may not be the poorest who experience the greatest percentage of fatalities during a famine.

In the existing economic literature, a household is regarded as vulnerable in proportion to which income variations translate into consumption changes. For example, if two households have nearly the same consumption pattern, but the second household has more variability in income, then the second household is regarded as less vulnerable (Glewwe and Hall 1995 and 1998). Thus, vulnerability is defined as the ability to smooth consumption in response to shocks, measured by observed changes in consumption over time. As a result, people who are very poor may not be considered as vulnerable as others because they may not experience a large change in their consumption patterns in response to economic shocks. Almost paradoxically, non-poor people who face adverse shocks resulting in large consumption changes, may be considered more vulnerable (than the poor), even though they are affluent enough so as not to become poor after such shocks (Dercon and Krishanan 2000).

A similar argument can be made in the context of post-disaster illnesses and household income. Living conditions of the poor do not differ much (at least in developing countries such as Bangladesh) between pre- and post-disaster periods. This contrasts with the affluent—who are living in better hygienic conditions and always consume safe drinking water during the pre-disaster period. Therefore, they are likely to suffer more illnesses during post-disaster period compared to the poor.

It is generally thought that landholding size and annual household income are correlated. However, this is not the case in coastal Bangladesh. The incidence of landlessness is higher in coastal areas relative to non-coastal areas. As a result, agriculture is not the main source of income for most coastal residents. This is also true in the study area where nearly two-thirds of all respondents were employed, directly or indirectly, in fishing-related jobs. Information presented in Table 2 suggests that household income and landholding size are not strongly associated. Although consistent with household income, the incidence of

Table 2 Illness rate (%) by selected risk factors

Factor	Illness		Total	Illness rate (%)
	Yes	No		
Household-level factors ($n = 277$)				
Annual household income (in Taka; US $1 = 70 Takas.)				
<Tk. 36,000	5	74	79	6.33
Tk. 36,000–60,000	14	135	149	9.40
>Tk. 60,000	12	37	49	24.49
Total	31	246	277	11.19
$\chi^2 = 11.10^{**}$ ($df = 2$)				
Land ownership				
Yes	13	81	94	13.83
No	18	165	183	9.84
Total	31	246	277	11.19
$\chi^2 = 1.00$ ($df = 2$)				
Individual-level factors ($n = 1{,}443$)				
Gender				
Male	19	712	731	2.60
Female	33	679	712	4.63
Total	52	1,391	1,443	3.60
$\chi^2 = 4.31^{*}$ ($df = 1$)				
Education				
Literate	13	356	369	3.52
Illiterate	27	674	701	3.85
Total	40	1,030	1,070***	3.74
$\chi^2 = 0.06$ ($df = 1$)				
Age (year)				
0–14	27	466	493	5.48
15–49	14	777	791	1.78
50 and above	11	148	159	6.92
Total	52	1,391	1,443	3.60
$\chi^2 = 34.12^{**}$ ($df = 2$)				

* Significant at the 0.05 level

** Significant at the 0.01 level

*** Since the literacy rate in Bangladesh is defined for persons aged 7 years and above, the total number of cases for this risk factor was 1,070

illness is higher among households that owned land relative to households who did not, but the difference is not statistically significant (Table 2).

Consistent with expectations, Table 2 indicates that the percentage of females affected by disaster-related illnesses is higher than the percentage for male, and the gender difference, in terms of illnesses, is statistically significant at the 0.05 level. Table 2 further shows that the illness rate is slightly higher among the illiterate than the literate population, but the difference between these two groups is not statistically significant. As noted, age would be expected to exhibit a 'U-shaped' relationship with post-Sidr illnesses and Table 2 portrays that exact relationship. The illness rate (6.92%) is highest among persons 50 years or older, followed by the 0–14 age group (5.48%). As expected, the lowest rate (1.78%) is found among the 15–49 age group. This analysis of risk factors is consistent with the hazard literature focusing on disaster-induced illnesses.

6 Conclusion

This study examined the extent and pattern of illnesses experienced by Cyclone Sidr survivors in the aftermath of its landfall along the southwestern coast of Bangladesh on November 15, 2007. Attempts were also made to identify selected risk factors associated with such illnesses. In the 277 surveyed households, a total of 52 persons suffered disaster-related illnesses. The total population of these households was 1,443. This means, the illness rate was only 3.6%, which should not be considered high. An analysis of risk factors reveals that household income, gender, and age were significantly associated with incidence of illness in the study area.

The findings of this study clearly indicate that the prediction of a massive post-Sidr epidemic did not occur because of a number of factors. These factors include proper medical attention, adequate supply of appropriate medicine, the provision of safe drinking water and sanitation, and the initiation of immunization programs and other health interventions targeted for the Sidr survivors. Additionally, a considerable number of respondents believed that public health improved during the post-Sidr period due to the provision of humanitarian and medical assistance.

However, despite credible successes in stopping major epidemics and mobilization of medical resources and health personnel during the post-Sidr period, no comparative health survey was carried out to examine health impacts of this disaster. Lessons learned from this success story should be applied to future extreme events. The Government of Bangladesh also needs to initiate post-disaster health surveillance system in the impacted areas. Such a system will provide much-needed information that can be used to for further improvement of health status of disaster survivors.

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