Environmental Health Relief Efforts after the Tsunami in South East Asia
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World Health Organization
Regional Office for South-East Asia
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The tsunami that struck Asia on 26 December 2004 was one of the worst natural disasters in modern history. Although India, Indonesia, the Maldives, Sri Lanka and Thailand bore the brunt of this catastrophe, several other countries - including Myanmar, Somalia, Bangladesh, Kenya, Malaysia, Seychelles and Tanzania - were also affected.

Over 280,000 people are believed to have died and 500,000 people were injured. A considerable number needed urgent medical or surgical treatment. Over one million people were displaced from their homes. Overall, an estimated five million people were directly or indirectly affected. Damage and destruction to infrastructure left hundreds of thousands of people homeless and without adequate water/sanitation and healthcare facilities.

Indonesia - particularly the provinces of Aceh and North Sumatra - was the worst affected. With more than 130,000 people dead and another 93,000 missing, and 514,000 people displaced in 18 districts, Indonesia’s devastation was unprecedented. Twenty percent of the Acehnese population was rendered homeless, and not a single family in the region was untouched by the disaster. Hundreds of communities were totally washed away.

Health facilities collapsed, as the tsunami painted a line of destruction across cities and villages. A large number of health workers were also killed, injured or otherwise affected. The people of Aceh and North Sumatra, in particular, were severely traumatized by the scale of the tragedy. Rebuilding the region requires more than rebuilding roads and bridges; it will entail reviving lives and livelihoods and resurrecting entire communities.

In India, more than 2,000 kilometers of coastline along the southern states of Tamil Nadu, Andhra Pradesh and Kerala and the Union Territory of Pondicherry were damaged by the tsunami. The Andaman and Nicobar Islands were severely hit, with more than 215 aftershocks reported. Waves as high as 3 to 10 meters swept the islands, sometimes as far as 3 kilometers inland. Over 10,000 people were killed and several thousand were injured. More than 3.6 million people were affected.

Although the number of casualties in the tiny island nation of Maldives was low compared to the other affected countries, the impact was tremendous - one-third of the

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1 Jan Speets, Environmental Health Advisor, WHO — October 2006
population was affected. The death toll reached 82, the highest in the history of Maldives in a single disaster, with another 26 people missing and 2,214 people injured. Over 11,000 were left homeless, of which about 5,000 had to be evacuated. The entire population of 13 islands had to be shifted to other islands. Providing relief was logistically difficult, considering the fact that the country’s 200 inhabited islands stretch almost 900 kilometers across the Indian Ocean.

Sri Lanka, another island nation, was one of the worst affected countries. Around 550,000 people - a considerable percentage of the country’s 20 million population - were displaced in 10 districts. They moved into about 1,000 camps for Internally Displaced Populations (IDPs) within a very short time. Around 30,000 died. Almost all the drinking water supplies and sanitation facilities in the coastal belt were affected. The total cost of the rehabilitation and reconstruction of water and sanitation facilities was estimated at about USD 220 million.

In Thailand, six provinces - including popular tourist destinations like

\[ \text{Ismaaiill Ssaaiidd, island chief from Ggemendhoo} \]

I was in Malé for official work on the day of the tsunami, and heard of it the same day. The fishermen and walkie-talkies helped spread the news. Although I had heard that the damage was extensive, nothing prepared me for what I actually saw. At first, I saw people crying. Then, as I went further into the island, I panicked and was very sad. As the chief of the island, I felt responsible; it was very personal. After some time, we heard about the damage in the Maldives and the support we could get elsewhere. We realised we could not survive on a small island like this. So we took the decision to abandon the island and go to Burunee.

We left literally with what we stood in. Most of my family was in Malé. I wanted to be strong and show my people leadership. Two people died and 6 are still missing. Some people have gone back, but there is nothing for them.

Here we are overcrowded, which is difficult. There is no privacy. Also, the water is not good; it has a bad smell. I am convinced that we will be here for a year and a half more. We want to stay here in spite of all the difficulties. We realise that it is not feasible to go back to our island. We do appreciate what the government is doing for us.

Water supply is the priority, and then overcrowding. There are 2 extra units to be constructed, which should provide some relief from the overcrowding. The men are doing the same work as before, but for the women it is more difficult. The school has constructed 6 extra classrooms, which has helped enormously. This was good for the children. They have integrated very well into their new school.

There is no more counselling now. But I still feel there is a need for it. In 6 months time, I would like to see jobs for my community members. For me personally, I want to see permanent housing as soon as possible. The food, drinking water etc. is ok.

People often ask us why there were so few deaths in the Maldives compared to other countries affected by the tsunami. I believe it is because we are taught to swim in the sea from a very early age. We have the instinct to survive even in water.
Phuket, Ranong, Satun and Trang, Karbi and Phang Nga - were almost flattened by the giant waves. The tsunami affected 660,000 people, and claimed over 5,300 lives. Around 3,000 people were reported missing and more than 17,000 were injured.

Unlike other countries in the region, the tsunami had only a mild impact in Myanmar. About 5,000 people were estimated to have been affected along the southern coast of the country. Sixty-one people were reported killed and another 43 injured. Damage to the public health facilities was minimal.

**Loss of Infrastructure**
The unprecedented devastation that the tsunami brought to infrastructure in each one of the affected countries was unimaginable. Though the tsunami is not a new phenomenon, in many parts of the affected areas, people had never even heard the name before. Obviously, nobody - not even the governments - were prepared. Hundreds of thousands

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**Jan Speets, WHO Environmental Health Advisor, Jakarta**

Everybody was devastated by the news of the tragedy - such an enormous impact on a scale we have never seen before. Personally, I was overwhelmed by the pictures that we saw on television. It was a day after Christmas; everybody was in a holiday mood. Immediately we came to realize that we have a big role to play. We had no clue which way it would go. We didn’t have any information on the actual size of the disaster. Also the pre-tsunami situation in Aceh was sketchy because of the ongoing internal struggle there. Lack of information was an extra complication in designing any meaningful response. If you do not know the situation, what can you do? It is no exaggeration; we were pretty much taken aback, overwhelmed.

We, however, felt a heavy responsibility on our shoulders. At the same time we were helpless. We all sat together and discussed what we could do. Three persons from our office visited Aceh to set up a site office and decide on a possible course of action. The WHO office was also destroyed. Fortunately, no WHO staff was affected, because it was a holiday.

It became clear that it was a situation that we have never experienced before.
of houses were razed to ground or made unfit for living. Hospitals, water supply and sanitation systems, roads and communication links and other essential services were totally destroyed in several affected areas. This led to the displacement of a very large number of people. The tsunami also impacted the social infrastructure, affecting the availability of local government workers and trained professionals.

Almost all standing field crops died where agricultural land was flooded by seawater, shattering the economy of these areas. But the impact varied, depending on the nature of damage caused to the soil in various affected countries. In some areas of Aceh, for instance, there was reportedly sufficient rain to leach most of the imported salts and allow planting of rice in the latter half of 2005. But in other areas, farmers will have to wait for several seasons before they are able to decide on the fate of their land.

A year after the disaster, a large number of the affected people still need relief assistance. Their governments, with support from the World Bank, the UN, international donors and the private sector, are rebuilding settlements, basic services in water and sanitation and health care structures. New health facilities will be made earthquake- and tsunami-proof, and will be located in resettlement areas.

Substantial resources were mobilized in partnership with the government health authorities, and in collaboration with other UN agencies, the International Federation of Red Cross (IFRC) and NGOs. Thus, the rebuilding and recovery process provided an opportunity for the health sector in the affected countries, assisted by the World Health Organization, to strengthen their public health systems in the long-term.

"The aftermath of the tsunami presented a great public health challenge to WHO", said Dr Samlee Plianbangchang, Regional Director, WHO South-East Asia Region. "However, every disaster presents opportunities to both the countries and the international agencies to strengthen their capabilities and capacity."

**Damage to Health Facilities**

Damage to health facilities in Indonesia was particularly acute with 53 of the 244 health facilities (22%) destroyed or severely damaged. Fifty-seven of the 497 provincial health office staff died, while 59 were reported missing - a loss of almost a quarter.

WHO's rapid assessment of Sri Lanka's affected areas, in collaboration with the Ministry of Health, highlighted substantial losses and difficulties. Several major hospitals were damaged, and many smaller health units and Ministry of Health offices, close to the coastline, were completely or partially destroyed. Sri Lanka's health service was stretched by the scale of the emergency, with medical and hospital supplies...
reported to be very limited. The Regional Medical Supplies Divisions (RMSD) of Kalmune and Matara were damaged, disrupting drug and vaccine distribution to the affected areas. Storage of vaccines became impossible because of damaged refrigerators. One of the major setbacks faced by the affected districts was lack of mobility. Since almost all vehicles were lost in the tsunami, it was difficult to reach out to those who were in temporary shelters scattered throughout the districts. Health teams, especially the field-level health care workers, such as Public Health Inspectors and Public Health Midwives, also faced the same problem. Loss of vehicles also made it impossible for district health authorities to coordinate, monitor and supervise the disrupted health services.

Lack of adequate health service personnel was another major obstacle in the initial stages of the emergency. Volunteers and NGOs played a major role in supporting essential health services.

In the case of Maldives, the tsunami proved to be a huge blow to the country’s public health infrastructure, damaging one regional hospital, two atoll hospitals, 14 health centers and 20 health posts. With 2,214 people confirmed injured, prompt access to adequate health facilities and treatment was logistically difficult, owing to the country’s geographical makeup - 200 inhabited islands stretching almost 900 kilometers. Initial health concerns also focused on the contamination of water and lack

As for my personal experience of the disaster, visiting these camps was a tremendous experience difficult to describe. All those who were working in the area were affected one way or the other. It was such a devastating scene that it was difficult to comprehend. Everyone had lost some one or the other. What can you say to them in a word of consolation? Here was a little boy, who lost the entire family and possessions. You say ‘hello’ to him he does not respond, he just stares into nothingness. He doesn’t know what his future would be! The affected people were completely crushed, mentally. Therefore, programmes pertaining to Mental Health were very important. I can say with confidence that all these issues were attended to and necessary steps were taken.

But it is not possible to meet each and every demand, and naturally, in some areas supply fell short of demand. Looking back now, I am still worried about what needs to be done. Some time ago, the UN Coordinator, the highest official coordinating the post-tsunami relief and rehabilitation operations, said, “the progress has been too slow”. It does not pertain only to WHO, but all agencies. Nine months after the disaster, people are still living in squalid camp conditions in many affected areas. Money was not a problem. In fact, there was too much money.
of adequate sanitation facilities, posing the threat of diarrheal diseases. There was also concern about vector-borne diseases.

In India, fortunately, the majority of health facilities were either intact or services could be extended to the affected areas without much delay, except in Andaman and Nicobar Islands.

Although seriously overstretched initially, in India and Thailand, government resources and, especially medical staff and professionals from other sectors could be mobilized to provide support in restoring basic services.
The impact on the affected countries was varied. In Aceh and the Andaman and Nicobar islands the damage was such that it took weeks to make a proper assessment, while South India, Sri Lanka, Thailand and Maldives managed to quickly assess damage and rapidly mobilize assistance. Waste management – i.e. safe disposal of human waste, solid waste and hospital waste – was a particular concern due to the volume and the absence of functioning landfill sites in many affected areas. Household and community wells were contaminated with salt water and dirt. Debris also posed a risk of injury and the threat of vector-borne disease. Some industrial facilities and a nuclear research plant, in Tamil Nadu, required certification of risk.

The tsunami led to a plethora of questions on the environmental health risks emanating from disasters of this magnitude. Environmental health status in any situation depends on several factors including quality and quantity of water, waste disposal facilities, food safety, health surveillance, sanitation and general hygiene.

**Indonesia**
Contamination of ground water reservoirs by saline intrusion was the most evident consequence of the tsunami. Water supply and sanitation infrastructures including treatment plants and their distribution network were seriously damaged.

**Contaminated Water Sources**
The tsunami caused major damage to the drinking water sources and supplies in the affected areas, contaminating hand-dug wells and production wells, breaking up piped water supplies and making surface water unfit as a water source.
The main challenge facing international agencies and aid workers was dealing with increased salinity along the coastal areas of Aceh. Some water sources had to be abandoned creating the need to rapidly find other sources, such as wells on higher land, deep boreholes, or springs. In Aceh, using protected springs in the hills was problematic due to the ongoing internal conflict.

**Sri Lanka**
As in Indonesia, drinking water sources were unusable due to excessive salinity. About 12,000 wells were damaged, particularly in the remote areas. Another 50,000 wells were abandoned. Distribution pipes along the coastal area were severely disrupted or totally washed away. Major bridge crossings were also shattered, taking along with them the trunk lines laid across them. Approximately 60,000 household latrines were destroyed.

**Maldives**
The hydrogeology of the Maldives poses a particular difficulty regarding access to safe drinking water, as they comprise small islands surrounded by large expanses of seawater. The freshwater aquifer lying beneath the islands is a shallow lens, no more than a few meters thick. This aquifer is normally exposed to pollution from poor wastewater practices as well as from badly constructed septic tanks.

The problem became worse after the tsunami, as ground water experienced high levels of salinity. Most wells were completely flooded with seawater. After the tsunami most affected islands had to rely on rainwater and desalinated water for drinking purposes.

**India**
In the southern Indian state of Tamil Nadu, the tsunami brought up titanium from the sea bed. It is not clear whether this will cause longer term environmental degeneration or water quality problems. The tsunami also had a detrimental impact on groundwater quality and sanitation, especially due to poorly-maintained septic tanks, which continue to pollute groundwater widely.

**Sanitation**
The sanitation challenge posed by the tsunami was much higher than water supply. In most of the affected areas, sanitation facilities were destroyed or rendered unusable. Proper disposal of human excreta from emergency and reconstructed locations of habitation is essential for protecting human health and the environment. Human faeces may contain a range of disease-causing organisms, including
viruses, bacteria and eggs or larvae of parasites. These microorganisms may enter the body through contaminated food, water, cooking utensils or by contact with contaminated objects. Various kinds of diarrhea are spread in this way and can be major causes of sickness and death in disasters and emergencies. When previously endemic in the affected populations, cholera and typhoid might also pose serious public health risks.

Intestinal worm infections are transmitted through contact with soil contaminated with faeces and may spread rapidly where open defecation occurs and people are barefoot. These infections contribute to anaemia and malnutrition, and therefore can render people more susceptible to other diseases. Children are especially vulnerable to all the above infections, particularly when they are under the stress of disaster relocation, high-density-camp living and malnutrition. While specific measures can be taken to prevent the spread of infection through human faeces (e.g. chlorinating the water supply, promoting hand-washing with soap), the first priority is to isolate and contain faeces.

**Risks from hazardous waste**

The tsunami posed a huge challenge to waste management. This was largely due to the vast geographical area affected and the extent of the damage. Aid organizations and government agencies found that the approach they had used in other large-scale emergencies had to be modified to deal with these circumstances.

Even in normal situations, accumulation of waste, especially in urban areas, creates public health risks through the proliferation of insect and rodent vectors of diseases. The debris left behind by the tsunami posed a threat on a much larger scale. Besides facilitating the breeding of vectors, inadequate waste management causes pollution of surface and groundwater, compromising the safety of drinking water.

The destruction caused by tsunami displaced hundreds of thousands of people who were then forced to live in temporary shelters. As the numbers were high, it was logistically difficult to maintain proper environmental health in the camps or shelters. Constructing toilets for such large numbers of people was a major challenge, considering their culture, traditions and practices.

In the first few days after the tsunami, the disposal of dead bodies posed a problem for the governments. International agencies and NGOs assisted the local authorities in disposing of the bodies as quickly as possible. The task was not easy, as the need for proper identification of the dead person and local customs and people’s sensitivities had to be taken into account before any body could be buried or cremated. On the other hand, people’s fear of outbreaks of diseases, due to decaying bodies, had to be taken into account. The widespread belief that corpses pose a risk of communicable disease is wrong. Especially if death resulted from trauma, bodies are unlikely to cause outbreaks of disease such as...
typhoid, cholera, or plague. However, corpses may transmit gastroenteritis to survivors if they contaminate streams, wells, or other water sources.

Since normal sanitation structures were damaged or destroyed in affected areas, disposal of human faeces was one of the main problems. It was important to prevent outbreaks of waterborne diseases, particularly among the displaced populations.

Disposal of hazardous waste, including clinical waste and chemical waste from factories or other sources, was another area that needed attention. Fortunately, in most affected areas, except in Aceh, chemical waste did not pose any serious threat. Disposal of clinical wastes posed a greater challenge than any other waste.

**Personal and General Hygiene**

An important issue following the tsunami was personal and general hygiene, especially in the IDP camps. The large numbers of people displaced from their homes, and thus living in temporary community shelters or camps, had little resources to address sanitation problems or maintain hygiene standards.

The aim of any water and sanitation programme is to promote good personal and environmental hygiene in order to protect health. Hygiene promotion is defined in the SPHERE\(^2\) guidelines as a mixture of the people’s knowledge, practice and resources along with agency knowledge and resources.

Effective hygiene promotion relies on an exchange of information between the agency and the affected community. This can help identify key hygiene problems and enable the community to design, implement and monitor a programme to promote hygiene practices. Furthermore, it can encourage the optimal use of facilities to ensure the greatest impact on public health.

Proper washing of hands and the availability of soap is one of the most effective ways of preventing the spread of diarrhoeal diseases. Throughout the emergency stage and reconstruction activities, hygiene promotion had to be integrated into water supply and sanitation activities.

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\(^2\) The Sphere Project, Humanitarian Charter and Minimum Standards in Disaster response, 2004 edition (WWW.sphereproject.org)
Even experienced disaster management experts across the world were overwhelmed by the magnitude of the tsunami disaster. Never before had a natural disaster struck several countries across South and Southeast Asia and affected even areas in Africa. The world - both governments and people - responded with unprecedented generosity and solidarity to the affected communities and local and national authorities.

The first priority was to provide immediate relief to ease the sufferings of those who survived the disaster and restore their basic needs.

**Disease Surveillance**

The large number of displaced persons, crowded conditions, flooding and a vulnerable population posed an increased risk of communicable diseases following the tsunami. Thus, the immediate health concern was the identification and control of potentially widespread outbreaks of disease that could sweep across the region. Reacting without any loss of time, SEARO set up an Operations Room in New Delhi and sent out both general and technical guidelines to governments and regional and local civic authorities to deal with all aspects of the health sector, including information on disease surveillance, provision of safe water and food and sanitation facilities.

WHO staff, including the Global Outbreak Alert and Response Network (GOARN) were deployed to Aceh Province in Indonesia, Sri Lanka and Maldives to assist the ministries of health (MoH) with the establishment of supplemental surveillance, early warning alert and response systems (EWARN). The principal objective of these surveillance systems was to detect epidemic-prone diseases occurring in the population, based on symptomatic diagnosis followed
by laboratory confirmation, and to institute necessary interventions to contain further spread of disease and limit morbidity and mortality in affected populations.

No doubt the timely re-establishment of disease surveillance systems with assistance from WHO, helped prevent any major outbreak. These systems of epidemiological surveillance and outbreak response will now be used as part of the routine integrated disease surveillance.

**Safe Water**

Safe and adequate water supply is one of the pre-conditions for reducing environmental health risks and promoting good hygiene practices.

**Emergency Water Supply:** The most important immediate environmental health measure that must be implemented, after an emergency, is the provision of safe water for drinking and cooking along with facilities for excreta disposal. WHO, working in association with relief agencies during the emergency phase of the disaster, focused on ensuring that the population had access to all possible safe water sources. Activities included monitoring water quality, repairing damaged infrastructure and providing technical advice to relief agencies and government officials.

In water supply and sanitation, UNICEF is the lead-agency in the UN-family. WHO supports UNICEF in planning and coordination, and in water quality management. WHO water experts were able to start rapid assessments in the Maldives and Sri Lanka at the end of the first week, while in Aceh, WHO water and sanitation expertise was provided to the Inter-Agency Rapid Health Assessment Team operating from the USS Abraham Lincoln. Initially, WHO staff physically sat with UNICEF in Sri Lanka and Aceh, and thus contributed substantially to a coordinated effort by government, UN-agencies and NGOs. All affected countries have subsequently maintained a permanent WHO water and sanitation presence during 2005, with additional staff being assigned to Aceh, due to the complicated nature of the restoration of water and sanitation facilities.

**Water Supply Reconstruction:** The focus of the reconstruction activities was on ensuring the provision of sufficient safe water based on guidelines established by WHO, in conjunction with international, bilateral, and specialized agencies (i.e. Guidelines for Drinking Water Quality, Environmental Health in Emergencies and Disasters, etc.) Throughout the reconstruction phase, measures were taken to ensure, not only the provision of an adequate quantity of safe water in the short-term, but also that the water supply system would not be vulnerable to possible future disasters.

Wherever possible, WHO emphasized the principles outlined in Water Safety Plans (WSPs), as recommenced by the WHO Guidelines on Drinking-water Quality. These plans provide a preventive 'quality assurance framework' for a cost-effective and systematic means of ensuring an acceptable supply of safe drinking water. WSPs are also based on a 'Catchment to Consumer' approach for managing water safety from source to consumption by assessing hazards, identifying control measures, monitoring and verification; and by developing management plans for normal and disaster conditions.

Although a significant proportion of activities focused on working with communities and other partners in the reconstruction of
household and community based water systems, another major aspect of WHO work was on ensuring that hospitals, clinics and schools had access to safe water. These activities were directly funded by WHO, and involved assessing local medical and education facilities, determining priorities, and providing the necessary resources to ensure access to safe water.

India
In India, WHO initiated rigorous water quality monitoring and sanitation projects in the relief shelters in the worst affected district in Tamil Nadu. Assistance was provided for monitoring microbial contamination of water and laboratory surveillance of Shigella spp and cholera spp. WHO supplied 1,000 chloroscopes to monitor the quality of drinking water in the affected areas. In collaboration with the Gandhigram Rural Institute, WHO also provided technical assistance to district authorities to strengthen the monitoring of drinking water quality, hygiene education, and waste management in Nagapattinam, Kanyakumari and Karaikal.

In addition, a long term project to monitor the changes in ground water quality, following the disaster, was initiated in all the coastal districts of Tamil Nadu. A proposal is being developed with the Tamil Nadu Water and Drainage Board to assess changes in drinking water quality in the coastal areas after the tsunami.

Indonesia
WHO worked closely with the provincial health authorities, providing technical advice and support in assessing water quality in the affected areas. Assessments focused on evaluating the damage and resource requirements necessary to protect health. Short/medium and long-term needs were assessed. These included procurement of supplies and equipment for monitoring and testing, development of guidelines and promotion of good hygiene practices. These activities were complemented by practical water quality monitoring workshops organized in collaboration with UNICEF and MOH. WHO trained 21 agencies and NGOS in water monitoring and testing.

WHO further provided water and sanitation supplies and equipment (tankers, sludge pumps, and consumables, etc.) and assisted in emergency repairs to water treatment plants by providing supplies and equipment (silica bed and filter beds).

WHO guidelines were adapted to the Aceh conditions and translated into Indonesian. These included a water quality test manual, technical notes for emergencies and sanitary inspection forms.

In collaboration with the UNICEF and Australian emergency health experts, assessments of the water, sanitation and health situation in camps for internally displaced populations (IDPs) were carried...
out in Banda Aceh. These assessments suggested that the capacity for providing water through water tankers was insufficient and recommended that more tankers be supplied.

Though the transition from emergency to routine surveillance is now complete in Indonesia, there is still a need for more training and resources to strengthen the system. Water quality testing of some water tankers in Aceh continues to reveal serious problems. WHO is working with various stakeholders to improve water quality surveillance at critical points.

As a large number of shallow wells in the coastal areas were severely contaminated there was an urgent need to empty the wells of water and chlorinate the recharged water. This was the main source of drinking water for the affected population.

As supplies in the interior of Sri Lanka were often still functioning, water tankers were extensively used to supply IDP camps. At the request of the National Water Supply and Drainage Board, WHO developed a one-page good practice sheet for agencies who transported the water to the IDP camps to ensure that adequate residual chlorine remained in the water at the delivery point.

This and other interventions ensured that WHO had good and regular communication with all water and sanitation sector actors.

In Sri Lanka, WHO was able to make an initial assessment fairly quickly. The priorities were to provide clean water to relief camps and to health facilities, to ensure that water quality was systematically tested, to provide sanitation facilities in areas where communities were returning to their homes, and to complement all activities by hygiene education programs, particularly in relief camps.

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WHO also provided chlorine testing equipment (Chloroscopes), dewatering pumps, chlorine tablets and water storage tanks to the health department. Laboratory equipment was purchased to strengthen water testing laboratories in affected areas for the water board and the provincial health department.

These activities were complemented by hygiene promotion campaigns. Training programmes were organized at national, regional and district level, including practical demonstrations of water testing, hand hygiene and water quality surveillance. Sanitation kits were provided to relief camps to enable camp management to keep the public latrines serviceable.

Local water authorities confirmed that the water testing kits provided by WHO were very useful for spot testing.
WHO also supported the promotion of solar disinfection of water in its training courses to health staff and NGOs, using locally available promotion materials (SODIS).

**Maldives**

In Maldives, WHO assisted the government by procuring materials and equipment for water quality testing and monitoring, by assisting the Maldives Water and Sanitation Authority (MWSA) in developing guidelines on water safety risk management i.e. Water Safety Plans (WSPs), and by providing training to community health workers in setting up a surveillance system for water quality testing and reporting. Other agencies such as UNICEF provided testing equipment, rainwater harvesting tanks and materials and desalination plants.

The Public Health Laboratory (PHL), Regional Hospitals and atoll hospitals were provided with equipment to test water for chemical and microbiological contaminants. Workshops on water quality testing and monitoring were organized for Family Health Workers and Community Health Workers on tsunami affected islands. These workshops consisted of lectures and practical classes. Demonstrations covered the use of chlorine residual comparators, portable battery operated pH metres and the Oxfam-DelAgua Water Testing Kit.

A surveillance programme was designed with input from the island communities. Health workers were trained in data collection, data analysis, data interpretation and reporting to the central authority i.e MWSA. Participants were also trained in the design and implementation of Water Safety Plans (WSP). As stated previously these plans help identify parameters and processes to be monitored systematically, e.g. chemical contaminants, maintenance of pipes and storage tanks etc. WHO also helped design a "model" Water Safety Plan (WSP) for rainwater harvesting systems tailored for the Maldives.

To address long term sustainability of potable water supplies in Maldives, a geohydrologist, contracted by WHO, carried out detailed assessments of groundwater resources and existing water supply on selected islands. Assessments included...
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resistivity surveys, topographical surveys, household surveys and water quality surveys. Maldives Water Supply and Sanitation Authority (MWSA) staff was trained in geophysical surveying including topographic surveying. The objective of this activity is to arrive at an ecologically sound management of water resources available to island communities through improved harvesting of rainwater, protection of ground water by improving sanitation, and by developing appropriate solutions for waste water and waste management.

Water and sanitation issues have seen significant improvements, albeit by temporary measures, such as the provision of desalinated water in the islands, while long-term solutions for a sustainable water supply are being sought. The timely availability of technical experts in affected areas helped greatly in planning the recovery efforts.

**Safe Food**

In disaster situations, food safety is crucial because contaminated food in affected areas can lead to the risk of outbreaks of foodborne diseases such as dysentery, cholera, hepatitis-A and typhoid fever. Poor sanitation, including lack of safe water and toilet facilities and the lack of suitable conditions to prepare food, have led to outbreaks of food borne diseases in disaster areas in the past. The people suffering from the direct effects of a disaster may already be at increased risk because of malnutrition, exposure, shock and other traumas. It is, therefore, essential that the food they consume is safe. This is particularly important for infants, pregnant women and the elderly.

Following the tsunami, WHO was quick to send food safety experts to countries that requested support and issued guidelines for relief workers and officials in ensuring food safety at all stages—from procurement to transportation, storage, production, distribution and consumption.

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The need for strengthening Food safety communication was well recognized at the 1998 Regional Consultation on Food Safety in New Delhi.

A 10-Point Regional Strategy for Food Safety was formulated. One of the priority actions was the “development of advocacy materials for policy makers, training resource materials for implementers as well as education and training materials for producers, industry, trade, food handlers and the public [are necessary].

The Food Safety Units in WHO have since created materials for educating consumers on FOS risks and about safe food handling behaviours that can help minimize those risks. The FOS "Five Keys to Safer Food" Poster has made consumers become more aware and learn safe food handling habits.

Recently, SEARO translated the “5 keys” food safety poster in 18 languages and produced an accompanying guidance booklet for use by small and medium scale food and restaurant business owners/food vendors/ food & sanitary inspectors/ hospitality business students/ consumer organizations/ schoolteachers, etc.

The booklet: "Bringing Food Safety Home: First, Say it Right!", gives advice on how to adapt the food safety messages to local needs.
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The "Five keys to safer food" which are simple rules to promote safe food handling and preparation practices were reinforced in the local language for guiding public health officials / volunteers and donor agencies. This information was also used to educate food handlers and consumers about their responsibilities towards food safety.

**Maldives**
Most of the affected countries were able to provide relief supplies without much difficulty, except in the Maldives. Pre-tsunami Maldives was already dependent on the import of most food items, as agriculture accounts for only 20 percent of the GDP. The tsunami resulted in the destruction of hundreds of fishing boats, fishing equipment and the insulated storage facilities belonging to fishermen, crippling Maldives’ fish and seafood industry. After the tsunami, fruits and agricultural crops were swept away and most parts of the agricultural land covered with salty mud leaving it unusable for agricultural purposes in the immediate future.

Given this situation, WHO carried out an assessment of food safety, in the aftermath of the tsunami in January 2005. Recommendations in terms of immediate measures, short term measures and long-term measures were made to the Government for improving the food safety situation in the country.

Following this assessment, WHO assigned experts from the regional office to assist the Maldives Ministry of Health in implementing key measures to facilitate the capacity building in food safety in post-tsunami Maldives.

WHO began its task by assisting the Department of Public Health (DPH) in the identification of suitable food safety monitoring tools. Training

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3. *Keep Clean, Separate Raw and Cooked, Cook Thoroughly, Keep Food at Safe Temperatures, Use Safe Water and Raw Materials*
4. non-contact food thermometers, food probe thermometers, disposable swabs, thermolabels, chlorine concentration indicator strips and cold chain monitoring data loggers
of food inspectors was carried out in monitoring and compliance and auditing of food processing units, resorts, hotels and food establishments. Food safety advocacy sessions were also conducted for officials from various Ministries and statutory organizations as well as for food importers.

WHO also supported the Ministry of Health in upgrading the Public Health Laboratory for effective surveillance of foods. Suitable equipment for monitoring chemical and microbiological contaminants was identified and procured. Staff received training on using this equipment.

The country’s food safety guidelines for monitoring food processing units, resorts/hotels and food imports were reviewed and comprehensive food safety draft guidelines were developed. Guidelines were also developed for safe handling of fish at sea, fish market, storage and transport of food. The application of the food safety draft guidelines was also demonstrated during the field visits by personnel from Department of Public Health (DPH), Public Health Laboratory (PHL) and Water and Sanitation Authority (MWSA).

As part of the promotion of food safety measures among the population in general, efforts were also made to include schools and promote food safety as one more component of the ‘Healthy School Initiatives’ launched by the Government, with support from WHO and UNICEF.

WHO also helped the Maldives government to consider a National Food Safety Strategy. This strategy is primarily based on ‘Risk Analysis’ approach along with emphasis on self-regulation by the industry, consumer participation and selective enforcement by the government. The WHO recommendations emphasize the constitution of a National Food Safety Committee (NFSC) so as to provide a strong coordinating mechanism for uniform implementation of food safety activities and effective implementation of a Risk Analysis approach.

**Indonesia**

The earthquake and tsunami had a severe impact on food safety-related programs in the public health sector in Aceh and other areas, destroying or damaging local (district), provincial, and national offices. Many commercial establishments including markets, food and water processing facilities, and restaurants were also disrupted. In addition, IDP camps and resettlement centres created new challenges for maintaining food safety during storage, preparation and distribution.

The most pressing problems were present to a large extent before the tsunami. Food hygiene awareness, in general, was limited, and knowledge or concern about food safety was poor among the general population.

Most food safety-related activities in Aceh province, including food service and other inspections and most importantly education of food handlers and food processors, were carried out at the district or municipal level. While there were some dedicated public health workers with training in food safety and environmental health, their numbers were small, and tsunami-related staff shortages made things worse.

A mission to Aceh was undertaken by a WHO consultant together with an environmental health specialist from the Indonesian Ministry of Health and another from the University of Indonesia. These specialists worked with Provincial and district authorities to identify needs and develop plans of action in the affected districts. While the implementation part was carried out primarily by district level environmental health officers, WHO supported the technical aspects.
Appropriate infant and young child feeding was promoted. Responding to concerns about the large quantities of milk powder being sent into the region, WHO and UNICEF issued a joint statement on appropriate infant and young child feeding, cautioning caretakers and health staff about unnecessary use of milk powder and the need for monitoring the distribution of this product.

**Sanitation**
The provision of appropriate facilities for defecation is one of a number of emergency responses essential for people’s dignity, safety, health and well-being.

The focus of the sanitation reconstruction activities was on ensuring the safe disposal of excreta, so that it did not contaminate the environment, water, food or hands. In addition, sanitation reconstruction attempted to prevent the proliferation of vectors. Certain species of flies and mosquitoes lay their eggs, breed, or feed on exposed material and can carry infection to people and domestic animals. Rodents and other vermin can also spread disease.

Measures were taken to ensure displaced people had a sufficient number of toilets, close to their shelters to allow them safe and acceptable access at all times of the day and night.

**Indonesia**
In some IDP camps the temporary facilities initially provided were inadequate or unsuitable. Sanitation needs were assessed for the camps assuming one toilet unit (with 2 cabins; one each for male and female users) per 50 people. However, sharing toilets by various social groups in society created major problems for the authorities. Inadequate knowledge of proper use of toilets, especially among the fishing community, and their unwillingness to use toilets, were major challenges. However, construction of separate urinal units helped reduce occupancy rate during peak hours in camps.

**India**
In India, WHO supported the Gandhigram Rural Institute in carrying out a post-tsunami public health project to extend basic facilities for water, sanitation and hygiene promotion in some of the affected areas. After an assessment of the environmental problems in the...
IDP camps, a campaign was designed to reach the affected people with tools to maintain appropriate sanitation and hygiene habits.

Target specific Information, Education and Communication programmes were prepared to promote better hygiene practices, and to encourage the community to use the sanitation facilities provided in the camps and avoid defecation in the open. To facilitate proper hygiene, locally specific toilets were constructed. Group discussions, public meetings, cultural programmes and rallies were organized to create awareness. Local volunteers and community members were trained in conducting cultural programmes on environmental health to effectively disseminate information to their own community members.

WHO also provided the affected districts in Tamil Nadu with insecticide-treated bed nets to prevent an outbreak of malaria and technical support for spraying and fogging to prevent vector-borne diseases.

**Sri Lanka**

Although Sri Lanka has quite a satisfactory sanitation coverage, this is low in the coastal areas, especially in fishing communities. Naturally, the problem became worse with the temporary settlement of affected communities in rehabilitation camps. Latrines were provided to IDP camps by aid agencies and NGOs. However, as in Indonesia, the people for whom these were intended did not use them or maintain them properly. Poor hygiene habits posed a health risk and WHO had to address this problem.

WHO enhanced local capacity by “training of trainers”, practical demonstrations, personal discussions, by motivating communities and by providing sanitation kits. Much technical literature including fact sheets, guiding notes, books and related articles were freely distributed.

WHO also agreed to support, two national level, 12 district level and 45 divisional level workshops for promotion of hygiene behaviour and practices, in tsunami affected areas. These programmes were conducted through the Health Education Bureau of the Health Ministry. A national level consultative workshop and review was held in Colombo in October 2005. The workshop was attended by 49 participants, mostly health education officers, from all the districts of the country. Fact sheets and reading material, developed by WHO, and a set of seven posters developed by UNICEF, were distributed to the participants.

**Waste Management**

The impact of the tsunami resulted in three fundamental challenges regarding the management of solid waste:

- The need to immediately remove and dispose of large amounts of rubble from blocked roads and from damaged buildings
- The total disruption and partial destruction of waste management systems and disposal sites, especially in health care facilities
- "Hot spots", where possible mixing of hazardous and non-hazardous materials had occurred, increasing human exposure to toxic substances.
WHO's focus in working with relief and reconstruction agencies, was to ensure that all solid waste recycling, removal and disposal operations were done in a safe and environmentally sound manner.

**Hazardous Waste**

Beyond the havoc left in affected health care facilities, the tsunami also resulted in localized releases of toxic and hazardous materials to terrestrial and marine environments. Emergency response activities such as uncontrolled disposal of infectious wastes from medical care facilities, significant donations of outdated pharmaceuticals, large amounts of plastic wrapping materials, and an accumulation of empty pesticide containers used for vector control, aggravated the problems of hazardous waste disposal. Far-reaching and long-term effects on the environment had to be assessed.

**Health Care Waste**

Special care had to be taken with refuse from any health care facility. The main categories of waste that can be produced in these settings are: infectious waste; pathological waste; sharps; pharmaceutical waste; genotoxic waste; chemical waste; waste with high heavy metal content; pressurized containers; radioactive waste and hazardous waste waters. Each type of waste requires specific "cradle to grave" management measure from the site of generation, throughout segregation, handling, storage, collection, recycling and final destruction. In emergency situations on-site burial may be appropriate, following segregation. In extreme situations, where large facilities produce significant quantities of infectious waste, incineration may also be considered a solution. Plastics should not be burned as their fumes may contain extremely toxic substances (dioxins). This waste should be separated and disinfected, if possible, for recycling purposes. Alternatively plastics should be buried properly.

When health facilities operate diagnostic laboratory services, radiological diagnosis and treatment facilities, pharmacies, etc., waste management is a specialized activity requiring trained and well-equipped staff.

WHO was requested to advise and support affected countries in the area of health care waste management. Expert consulting was shared with all the SEAR countries and substantial efforts on the ground were undertaken in Indonesia (Banda Aceh and Sumatra Provinces) and in the Maldives, through concrete projects.

**Indonesia**

Prior to the tsunami disaster, health care waste management in the affected areas was not well organized. The main problem was low awareness and knowledge among all health care personnel. This resulted in weak infection control practices and poor overall performance of the few treatment
systems. After the tsunami, most public health facilities became non-functional and many of the temporary health facilities did not have proper guidance or equipment to manage health care waste adequately.

There is no environmentally sound waste disposal capacity in Aceh. Disposal practices, where waste is collected, is to open dumps, where burning is the normal practice. In many areas, including most Temporarily Living Camps (TLCs) and IDP camps at present, waste is dumped in piles and burned on-site. Fly dumping is common throughout the province.

The only engineered landfill in the province was the Banda Aceh Gampong Jawa landfill, which was actually run as an open dump. It was heavily impacted by the tsunami and then was covered with tsunami waste. Reconstruction of a decent landfill at the site is essential to assure basic waste disposal capacity for Banda Aceh and the TLCs and IDP camps.

WHO staff assisted in developing the plan for construction of the Gampong Jawa landfill. They also assisted in the clinical waste assessment and provided technical oversight for disposal of 78 m³ of tsunami damaged medical waste at Z. Abidin hospital, which was becoming a public health concern due to scavengers.

At the request of the provincial health authorities, WHO Indonesia initiated a Health Care Waste Management project in the Nanggroe Aceh Darussalam Province across the 13 tsunami affected districts. After assessing the extent of the problem, training was organized on waste management. Materials and guidance were developed for over 500 health personnel, clinical waste managers and disposal workers.

Training included "training of trainers" to create a resource base in all tsunami affected districts. Training manuals and tools were developed on segregation of waste, storage, disposal and universal precautions. A committee was formed to effectively manage unwanted pharmaceuticals and expired drugs.

Equipment was supplied to 30 health care facilities to protect both health care workers and patients. This equipment included foot operated colour coded plastic bins for segregation at source, plastic liners, gloves, protective devices, needle cutters, bleaching powder for disinfection, and waste sharp containers for containment. District hospitals received autoclaves for disinfection before disposal, plastic shredders, and trolleys for safe transportation of waste. Some district hospitals received incinerators for final treatment of waste.

It is hoped that these efforts will help the government develop a National Training Plan and agenda for health care waste management.

**Maldives**

Early on after the tsunami struck, WHO carried out a national assessment of health care waste management practices. The assessment found that there was a general lack of awareness about inherent hazards caused by improper management of hazardous waste. Information on existing management and technology options for management of waste was also insufficient, and the country lacked a national policy, regulatory tools and operational guidelines to ensure sound management of medical wastes. Priority areas included the systematic introduction of basic waste segregation practices in all health care facilities, standardized sharps management in all health care facilities, waste reduction at source and specific capacity building.

In close collaboration with the regional hospitals, simple

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5 With substantial support from the European Commission
guidelines were developed on health care waste management, including a check list to help staff on a daily basis. Guidelines were also developed on the management of hazardous liquid wastes and management of mercury in the health care setting. Equipment and materials, to enable all hospitals to implement their waste action plans, were identified. These include two high performance incinerators, autoclaves, waste bins, autoclavable bags, cleaning carts, disinfectants, sharps’ containers, laboratory equipment and personal protective equipment.

As regards the purchase of the incinerators, a compromise was made between what was economically affordable and ecologically sound. Health care waste cannot be land filled on the islands or placed in a deep burial pit because of the possibility of leachate entering the aquifer. Transport capacity in the atolls is limited and frequent transport by boat is not a realistic option because of the costs of fuel, labour and equipment.

Capacity building in health care waste management was organized for over 50 health care workers from the regional and atoll hospitals, the Public Health Laboratory, MWSA and the Ministry of Environment, Energy and Water (MEEW). All trainees took a 10-day training course at the MS Ramaiah Medical College, Bangalore, India, in May, July and September 2005.

WHO also supported the country in determining the functions of a health care waste management coordinator to take the lead in developing a strategy for the country and in ensuring that regular training is organized for staff at all regional and atoll hospitals.

Guidelines for Relief Work
A significant part of WHO response to disasters, like tsunami, are WHO guidelines developed to aid those who are engaged in the relief operation. These are drafted and revised from time to time after lessons learnt from dealing with disaster situations in different parts of the world. In most disaster situations a large number of people engaged in the relief operation are not trained to deal with all aspects of such emergencies. Proper information instils confidence and helps them to handle the situation in a systematic way.

Immediately after the tsunami, WHO-SEARO sent out its standard guidelines for dealing with such emergencies to the governments, international agencies, NGOs and others engaged in relief operations in all the affected countries. These were also available in a dedicated WHO website in a downloadable format. Field response has indicated that these have been useful to many relief workers.

The guidelines included, among others, information on:
- General Management and Health Systems
- Disposal of Dead Bodies
- Management of Hazardous and Infectious waste
- Health Assessment
- Women and Children
- Psychological Support
- Safe Water
- Sanitation
- Communicable Diseases
- Vaccines and Immunization
All these documents were meant for field workers but some guidelines also had instructions for everyone including the victims.

**Good Practice Notes**

During 2004 four-page illustrated notes were prepared by WEDC\(^6\) for WHO to assist those working after an emergency to plan appropriate responses to the urgent and medium-term water and sanitation needs of affected populations. The notes are relevant to a wide range of emergency situations, including both natural and conflict-induced disasters. They are suitable for field technicians, engineers and hygiene promoters, as well as staff from agency headquarters.

The practice notes were revised immediately after the tsunami and published in early January 2005. They were also available on the Internet in a convenient downloadable format. They cover the following aspects of emergency operations:

1. Cleaning and disinfecting wells
2. Cleaning and disinfecting boreholes
3. Cleaning and disinfecting water storage tanks
4. Rehabilitating small-scale water distribution systems
5. Emergency treatment of drinking water
6. Rehabilitating water treatment works
7. Solid waste management in emergencies
8. Disposal of dead bodies
9. Minimum water quantity
10. Essential hygiene messages
11. How to measure chlorine residual
12. Delivering safe water by tanker
13. Emergency sanitation - planning
14. Emergency sanitation - technical options

Through the country level Watsan coordination mechanisms, WHO widely distributed the *Water, Sanitation and Health* CD-Rom Library, containing all current WHO publications in the field. Courtesy of WEDC, copies of the CD-Rom on *Emergency in WSH* and on *Civil Engineering Contracting* were also provided. At WHO’s request International Training Network ITN-Bangladesh contributed their publication *Water Supply and Sanitation in Rural and Low Income Urban Communities*, for use by Government organizations, NGOS and WHO field offices.

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\(^6\) The Water, Engineering and Development Centre (WEDC) is one of the world’s leading institutions concerned with education, training, research, and consultancy relating to the planning, provision, and management of infrastructure for development.
Delivering safe water by tanker

World Health Organization

When to use tankers
Moving water by tankers should be avoided if at all possible. It is expensive and difficult to organize. It should be seen as a temporary measure to allow for the development of a more sustainable solution. However, in the immediate aftermath of an emergency, it has happened more than once that tankers have been used as a stop-gap while more permanent measures are being put in place. Where the emergency is thought to be temporary, and where the situation will return to normal soon, and where the security and political climate makes it difficult to change to a more sustainable approach, in these circumstances, tankering may continue for long periods of time – sometimes for years.

Tankering is a major logistical operation. It requires the maintenance of a fleet of vehicles that require frequent maintenance and proper management. Tankers full of water are large vehicles and the operation may require regular resupply of fuel to the access routes if they are to remain operational.

The key to a successful tankering operation is proper management, and proper financing.

Types of tanker
Water can be carried in a variety of different tankers, some specifically designed for the task and others fabricated to meet an urgent need. Figure 1 shows a selection of different vehicles for carrying water.

If possible, try to use specially designed water tankers. They will be safer and more reliable. Temporary tankers are usually not suitable. It is important to ensure that the tankers are well maintained and equipped to handle the high demands of a disaster response.

Environmental Health Relief Efforts after the Tsunami in South East Asia

Essential hygiene messages in post-disaster emergencies

World Health Organization

This fact sheet outlines some of the key activities in dealing with hygiene promotion in post-disaster emergencies.

What is hygiene promotion?
The goal of hygiene promotion is to help people understand and adopt good hygiene practices to prevent disease and promote positive attitudes towards good health practices.

Focus of hygiene promotion in emergencies
Your aim in carrying out hygiene promotion in emergencies is to:
- Reduce high-risk hygiene behaviour;
- Sensitize your target population to the appropriate use and maintenance of facilities.

This latter point is important. Your efforts should be directed at encouraging people to take action to protect their health and make best use of the facilities and services provided.

Hygiene promotion is not simply a matter of providing information. It is more a dialogue with communities about hygiene and related health problems, to encourage improved hygiene practices.

Plan which good hygiene practices to promote
The understanding you gain from the above evaluation should be used to plan and prioritize assistance. The key is to identify the most harmful practices in user groups and focus on these.

Implement a health promotion programme that meets community needs and is understandable by every member of the community.
The need to rehabilitate and rebuild the areas affected by the tsunami presented a unique opportunity to address the institutional, political and economic barriers that have, in the past, complicated integrated responses.

Although awareness of the importance of environmental determinants of health exists, this awareness has so far been mainly outside mainstream health sector policy. Health sector thinking remains focused largely on curative approaches to diseases, rather than on the broader interactions between people and the surrounding eco-system. On the other hand, development and environment policies have also overlooked the links with health determinants.

Public health was a key concern following the tsunami destruction. WHO, as the agency leading on health, supported environmental health assessments and provided technical assistance for the immediate risks linked to water, sanitation and waste.

These assessments showed that there was a major need to scale up capacity to address environmental health issues on the ground. It was, thus, important to integrate environmental health considerations in the planning and implementation of the rehabilitation and reconstruction of settlements and communities, including choices in shelter, land use, and rebuilding of the local economy.

As the phase of emergency response moved into rehabilitation and reconstruction, the environmental health support refocused on a different set of issues raised by reconstruction. Opportunities arose to promote public health and reduce environmental health risks by collaborating with the development and reconstruction sectors at an early stage. Again, an environmental health presence in the field was essential for this to happen. It was backed up by existing knowledge and experience in addressing environmental health in the economic activities being redeveloped, such as coastal management, fisheries, forestry, tourism and coastal agriculture.

Resettling in a Healthier Environment

The aftermath of the tsunami provided an opportunity for the governments and the international agencies, including WHO, to design the rebuilding process in such a way as to improve quality of life of the people. It was possible to provide a more secure environment in many affected areas. As previously discussed, various activities were identified for action, particularly, clinical waste management, water quality protection, human and solid waste management, and integrated vector management.

For the medium and long-term rehabilitation period, various activities were proposed in shelter and settlement (re)development,
livelhood restoration and emergency preparedness. It is essential to undertake such activities in consultation with the communities and local authorities, and apply environmental health impact assessments. This ensures that optimum socio-economic and health gains can be achieved. For example, temporary shelters (tents) and block toilets provided by an international agency in Mullaitivu in Sri Lanka had to be dismantled to accommodate local conditions. The tents were rejected by the IDPs as they were very hot and did not prevent rainwater seeping into the floor area. These were replaced by temporary structures using locally available material.

The approaches developed in the context of healthy settings or healthy city programme, and the healthy environment for children initiative, offers guidance and tools that could readily be applied.

Greater attention to environmental health and to the restoration and maintenance of the engineering elements necessary to ensure a functioning physical environment, should go a long way to reduce the health risks associated with another disaster in the future.

Figure 3: Borehole Salinity Profiles July 2005

Strengthening Emergency Response Systems
Regardless of their cause or nature, disasters can disrupt health systems. Post-crisis settings are often characterized by great national expectations and intense international attention. Local and national authorities, often severely weakened, must absorb major influxes of external aid within a very short time frame. Indeed, these transitions have been described as periods when partnerships with the international community are crucial in underpinning fragile national processes.

Plans for rehabilitation and reconstruction demand an in-depth understanding of national realities and must be tailored to the specific local and national contexts. In any transition, rehabilitation and reconstruction starts with a needs assessment. The needs assessment is usually undertaken by national and other stakeholders: the UN agencies, humanitarian and development NGOs, civil society, the development banks and the private sector. In these contexts, WHO is generally called upon to perform the following functions:

1. To ensure links between health relief, rehabilitation and reconstruction.
2. To provide technical standards for a comprehensive needs assessment in the health sector.
3. To support national authorities with political and negotiating skills as well as high-quality leadership to manage all the aspects of the assessment and planning process in the health sector.
4. To serve as a bridge linking country health authorities and the development community.

Preparedness
Disasters occur without any warning and create havoc. The best way to minimize the impact is to be alert and prepared. In the aftermath of the tsunami, one of the lessons that emerged is that communities and agencies should be better organized to deal with these events.
Preparedness can reduce the impact in terms of fatalities and damage. Thus, there is an urgent need to establish disaster preparedness mechanisms in many countries and avail of early warning systems for cyclones, earthquakes, floods, famine etc. Preparedness plans are needed for the water and sanitation sector to facilitate emergency response and early restoration of essential services. Such plans would also help prevent serious epidemics. The best preparedness lies in good functioning systems during normal periods. It was clear from the aftermath of the tsunami that in areas where civil authorities and sector agencies where operating and communicating well, it was much easier to have basic services quickly restored.
The tsunami of December 26, 2004 caused major loss of infrastructure, destroying and damaging houses, hospitals, water supply and sanitation, roads and communication links. Very large numbers of people were displaced and many essential services disrupted.

The damage and the impact in the affected countries varied. In Aceh and the Andaman and Nicobar islands it took weeks to make a proper assessment, while South India and Sri Lanka managed a quick overview of the affected areas and could rapidly mobilize assistance. In the Maldives most islands experienced physical and environmental damage.

In all instances water supplies were damaged and community and household wells unusable due to salinity and dirt. Debris and damaged buildings posed a risk of injury and changed the vector borne disease risk potential. Displacement exposed the population to a new situation in which access to water, sanitation, food and shelter demanded adjustments that may have introduced exposure to health risks.

In May 2005, five months after the tsunami, WHO organized a conference on the “Health Aspects of the tsunami Disaster” in Phuket, Thailand. Conference participants included key personnel from local and national communities and international agencies. The conference findings, presented to the World Health Assembly in May 2005, influenced the adoption of a resolution, unanimously passed by WHO’s Member States, asking the Organization to increase its capacity to help them prepare for, and respond quickly to, health aspects of disasters and crises.

At the conference, there was consensus on a number of steps that would lead to stronger
national disaster management systems in order to reduce loss of life when disasters strike:

**Co-ordinating responses**
Governments of disaster-prone countries indicated that they need the UN system’s authoritative support with responding to (and, at times, directing and controlling) offers of human resources, equipment and materials made available through external assistance - with WHO serving as the health arm of the UN system. This is vital when numerous external groups offer assistance, creating major challenges for the planning and phasing of external inputs. When external assistance reaches a disaster-affected country, it should be managed through a participatory structure that involves representatives from both the recipient and donor communities.

A functioning coordination mechanism allows capacity building for emergency preparedness, including prior agreement on local standards and approaches for water and sanitation, taking into account national expertise and the SPHERE standards.

**Post-disaster needs assessments**
There are advantages in undertaking prompt assessments of people’s health situations and needs when a disaster strikes. The assessment techniques should be well tested in advance, take advantage of pre-existing data, be based on universally available GIS data, for example, and use standardized multi-stage methodologies. Techniques must yield population-based information (expressed as rates and not as absolute numbers).

Needs assessments should be undertaken by multidisciplinary teams that address a range of issues relevant to the emergency. The teams should at least have competencies in public health, water and sanitation, nutrition and food security; and if possible primary health care/maternal and child health. The team would consist of government officials to ensure adequate consideration of cultural conditions and feedback to local authorities. Duplicate assessments waste time and frustrate disaster-affected communities.

The environmental health component of the assessment concentrates on immediate relief in water supply and sanitation. The pre-disaster situation, with respect to water supply, should be taken into account. If at all possible, such information should be collected before the assessment.

For example, in Sri Lanka piped schemes in the towns and dug wells in the coastal belt were damaged. Plans of existing piped schemes helped to restore supplies quickly (a reasonable supply within 4 days) and allowed...
Lessons Learnt

Water distribution to communities, not linked up with a piped scheme, through tankering.

While the initial water and sanitation assessment reports were deemed adequate for the purpose of immediate relief, community consultation and sensitivity to cultural needs and expectations would allow for an improved response.

A consolidated post-disaster assessment should be conducted for a specific population. Further data collection will be needed over many years – particularly among vulnerable populations – to enable proper planning and management of support and assistance to track evolving health needs and access to services. Data should be disaggregated by location and gender.

WHO is working with NGOs, the Red Cross, other UN systems agencies and the IOM to develop standardized health assessment tools.

Effective Guidance in Disaster Response

Member countries called for up-dated and evidence-based guidance, and well-functioning professional networks, to help improve responses to specific problems faced by crisis-affected populations – including:

- psychological reactions to threats and losses and mental ill health,
- gender equity and the particular health and nutritional threats (including threats to reproductive health) faced by women,
- food, nutrition and health care needs of children,
- standard approaches for identifying dead bodies and the management of dead bodies,
- ways to involve volunteer health workers and manage in-kind donations during disaster response.

Strengthening Capacity

Participants from national governments confirmed that they were ready to be better prepared for
major disasters and that they want to strengthen their own capacity for disaster risk management and vulnerability reduction. Funding should be available to support national capacity building for disaster preparedness and vulnerability reduction.

Immediate relief

Water supply
Drinking water was not a very serious problem in most affected areas. In Aceh, water and firewood were available and as people normally boil water, most communities survived until aid arrived. The use of hypochlorite based disinfectants for water was cautioned against by the Government of Indonesia as it is not normally used i.e. people boil water after disinfection.

Adequate supplies of drinking water of reasonable quality were available in Sri Lanka in the affected areas within a few days. Most of the water was supplied by tankers. However, adequate chlorination of the water at the collection point or household level was a challenge. Residual chlorine at the distribution point was checked with chloroscopes, provided to public health inspectors and NGO field staff to facilitate water quality surveillance.

In this emergency, where displaced people lost nearly everything, provision of safe water containers or buckets with a lid, would be have been useful.

The tsunami crisis did however cause a mismatch between needs and long-term sustainability of supplies. For example, desalination plants were provided even though such equipment cannot be maintained long-term by the community, without external assistance. While there is a need for quick fixes that can produce large quantities of safe water, the final water supply option should meet community capabilities in operation and maintenance, management and affordability.

Limited attention seems to have been given to restoration or construction of institutional water supply and sanitation systems in health facilities and schools.

Sanitation
Sanitation in IDPs was a problem due to improper site design or location of latrines, as it was reported that women and children could not use the latrines during the night. Pit latrines were not acceptable in Aceh, as the population was used to anal cleansing using water. The inhabitants of former fishing villages in the affected coastal areas also did not have much experience with latrines.

The limited number of latrines caused problems with maintenance (regular cleaning and desludging). Suitable sites for discharging latrine waste were not easily available.

Some of the agencies that assisted did not have experience with the challenges in sanitation and the design of camps.

Hygiene
It is important to maintain hygiene standards by providing sufficient water, soap, hygiene
kits, etc. It is equally important not to take away from deeply traumatised people the last vestiges of dignity by assuming that they are not aware of the basic concepts of hygiene. Thus, hygiene promotion should be done with sensitive reference to the local cultural and socio-economic context.

**Lessons Learnt**

Restoration of water supply services, adequate and acceptable sanitation arrangements, proper shelter and ability to maintain personal hygiene are important instruments to restore physical and mental health in the household. Items such as plastic sheeting and a basic household kit support this effort as these items enable the households to flexibility look after their own affairs e.g. a plastic sheet is multi-functional as it provides a roof, can protect household assets, can help to collect rainwater, etc.

**Food Safety**

After the tsunami food safety was monitored, but no outbreaks of food-borne diseases were recorded. Hand-washing was identified as probably the most effective way of avoiding infectious disease in these circumstances.

In Aceh, due to the timely and significant response from the multi-national militaries, basic food staples, particularly rice and noodles, were distributed by helicopter to most locations on the west coast. However, in most areas, food supplies did not include protein, oil, sugar and vegetables. There was no targeting of food relief and little effort to get food to the most vulnerable populations (children under 5 years, elderly, pregnant and lactating women). Fortunately no acute, moderate or severe malnutrition was noted.

**Lessons Learnt**

- Food security has to be improved to meet the basic nutritional needs, in particular in infants, young children and pregnant women
- Distribution of food should be coordinated by a single agency and carried out through the civilian authorities (rather than the military)
- Each household should have access to cooking and eating utensils, and water storage facilities
- The tsunami experience also highlighted the need for food safety authorities to review all stages of the food supply, from procurement, processing, production, storage, transport, distribution, and sale, to preparation in food service, catering establishments and households. Good personal hygiene of food handlers and sound waste management are also important.

It is vital to monitor the quality and safety aspects of incoming food and ensure it is secure and hygienically stored. It is also important to reinforce guidelines for safe reconstitution of dried products given as food aid.

Food safety authorities should also ensure that salvageable foods are adequately protected and are not exposed to sources of microbial, chemical and physical
contamination. The extent and type of contamination should be assessed, and a decision made regarding the separation and reconditioning of salvageable food. Unsalvageable food should be disposed of properly, either by using it as animal feed, if appropriate, or by destroying it. In addition, before food businesses resume their activities, they should be monitored to ensure that they have regained the ability to ensure food safety.

**Institutional Capacity and Coordination**

Where the main government set-up was not seriously affected, or in areas that were not so remote, essential services were quickly restored. The local governments in Thailand, India and Sri Lanka basically remained in charge of the relief efforts. The existence of a decentralized structure of government and water supply agencies ensured quick and reasonably effective action (Tamil Nadu, Sri Lanka).

In Sri Lanka, sector coordination is institutionalized informally through a network of Government agencies, NGOs and sector support institutions, led by the National Water Supply and Drainage Board. The group meets quarterly, supports action-research, develops policies and exchanges sector experiences. This entity allowed for rapid coordination and networking, cooperative action and understanding of needs. An emerging effort in India with the existence of a roster of emergency-mitigation trained engineers under RedR-India, allowed rapid deployment of additional expertise to support relief efforts in water supply, sanitation and environmental health.

Pre-crisis existence of these mechanisms enhanced coordination and speeded up deployment of national experts. In Indonesia, a similar set-up was established during the tsunami crisis. These coordination mechanisms assisted Government and NGO development partners, who were already working in the country before the emergency, to guide the inputs of new humanitarian aid agencies. The existence of similar mechanisms in Bangladesh in both emergency response and in the water and sanitation sector, has, over the last few years, allowed for faster and more effective responses to emergencies.

**Lessons Learnt**

A functioning needs-based watsan sector network enhances preparedness, facilitates agreement on minimum standards for emergency and disaster response, speeds up initial response and assists in matching external support to local needs.

**Lessons of the first weeks**

With limited Environmental Health staff in countries (only Indonesia and India), WHO, in the first days, facilitated action by distributing straightforward 4-page technical guidance fact sheets on disinfection, source selection, sanitation, etc. to relevant field agencies.

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9 RedR: Registered Engineers for Disaster Relief: info@redrindia.org; www.redr.org
Provision of bleaching powder for piped supplies and tanker distribution and water quality testing equipment helped to maintain bacteriological water quality standards.

It is noted that many countries in the region are becoming sophisticated market economies where bottled water and water supply and sanitation equipment can locally be arranged quickly, at a local level.

- In addition to boiling water (Aceh, Sri Lanka), household water treatment options (disinfection by hypochlorite, SODIS) could be promoted through public information campaigns in emergency prone areas, as part of the emergency preparedness toolkit.

Providing an adequate quantity of water for hygiene and domestic use may have been a problem as provision of storage at the home and in the IDP camps took time to establish. This was noted in Aceh where scabies and conjunctivitis were reported, probably due to non-availability of soap and washing powder.

- For the next time, large distributions of soap, detergent, hygiene kits for women, all fitted in a bucket (OXFAM) or other water container, should be arranged.

When the overall sanitation situation is poor, or non-existent (e.g. no latrines, no drains) attention should be given to personal hygiene. Typically, water supply receives a lot of attention, but sanitation and hygiene promotion are also essential to avoid communicable disease outbreaks.

- Attention should be given to design of IDP camps, especially with respect to sanitation, including drainage, waste disposal and vector control.

**Capacity Building and Emergency Preparedness**
First of all, it should be emphasized that some capacity is always available in the country or in the affected area. However, for a variety of reasons, competence may have been eroded and personnel may need to be trained and updated on Standard Operating Procedures (including appropriate technical guidelines on water supply and sanitation in emergencies). Resources may also be available within the military and could be included in the Emergency Preparedness plan.

**Lessons Learnt**
A sector that functions well, under normal circumstances, will find that its infrastructure is easier to rehabilitate than a sector that has suffered from neglect. In Sri Lanka and Tamil Nadu, water supply services were up and running quite quickly, while in some areas in Aceh, it will still take time to rehabilitate the systems as the treatment plants were not functioning ever before the disaster.

At present, it may be possible to plan better, through the use of computerized scenarios, and ensure that agency assets are identified in such scenario planning and designated for
emergency duties (reservoirs, treatment plant, certain vehicles). This also means that annual disaster preparedness reviews need to include inspection of these assets and reconfirmation of their availability. Additional engineering and security protection measures will also ensure that water supplies and waste (water) management plants are not easily compromised in the event of a disaster.

**Lessons Learnt**

Emergency preparedness for disruptions in water and sanitation services, for hazardous waste spills and explosions, and other incidents that threaten to expose the population to environmental health risks, need to be strengthened urgently at national and local level, in a multi-disciplinary way. This should bring together local authorities, health and engineering competencies. A national/local framework of preparedness and response policies, strategies and SOPs should be formulated.

Now, at the end of 2005, reviewing the work that was done by the countries with the support of WHO, UNICEF and all partners in water, sanitation and environmental health, the following strengths and weaknesses were observed:

- **Strengths**
  - A well-built administrative set up armed with well-defined rules and regulations available at national and local levels.
  - International assistance with bilateral and multilateral cooperation.
  - The governments’ positive and proactive approach.

- **Weaknesses**
  - Limited resources in terms of finance and manpower
  - Procedural delays in implementation of project activities
  - Lack of professional skills and local technologies.

- **Opportunities**
  - Adversities could be converted in to developmental activities with the objective of improving the services.
  - National staff could be trained and motivated.
  - Long term planning could enhance sustainability of systems

- **Threats**
  - Civil unrest and ethnic conflicts
  - Lack of motivation and fatigue in staff
  - Poor community response.

This information leads us to formulate a set of actions that need to be considered in order for us to perform better the next time. This includes the following:

- Better coordination; more effective use of resources and less duplication
- Better pre-event intelligence to improve the quality of the needs assessments
- Better logistical management so that supplies and equipment are distributed quickly with agreement between agencies
- SPHERE guidelines or other agreed national standards to be known and applied by all actors including standards for the design of latrines, shelter and water provision/water disinfection
- Consistent provision of technical support to Government Agencies and NGOs
- WHO-wide preparedness, through attitudinal adjustment
complemented by general capacity building to fulfil its roles in emergencies and disasters.

- WHO’s ability to recruit and retain staff for longer assignment periods in emergency affected areas

Conclusion
The tsunami was an unprecedented catastrophe that affected millions of people. The way various agencies and governments worked together to support affected communities will influence generations to come - both those immediately affected by the tragedy, and those who provided help.

WHO staff at all levels of the organization contributed enormously to affected countries. While the immediate impact of the tsunami was catastrophic in terms of human suffering and physical losses, the subsequent health impacts seem to have been managed reasonably well by the combined efforts of all. No serious disease outbreaks were reported, and water, sanitation, food and shelter were provided to all in need.

The challenges with respect to restoring people’s lives, giving them - young and old - the mental strength to overcome their suffering and losses, will remain with us for quite a while. WHO through its policy guidance and country level support can hopefully continue to contribute to sustained improvements in water quality surveillance and water safety plans, food safety, hazardous and clinical waste management, and improvements in water supply and sanitation in health facilities and schools.

Primary health care and environmental health complement each other in promoting healthy villages and cities and this can further contribute to better settlement planning and an improved health future for all.

WHO’s response to the tsunami crisis, and the lessons learnt from it, will challenge the Organization to improve future response operations and work with Member States, their local authorities and civil society to ensure that we are all better prepared to reduce the impact of the next disaster.