Review of space application support for disaster and emergency medicine

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Basic definitions

Biological hazard	Processes of organic origin or those conveyed by biological vectors, including exposure to pathogenic micro-organisms, toxins and bioactive substances, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.
Disaster	A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources.
Disaster medicine	Branch of medicine involved with application of emergency medical services in a community, following a natural or man-made catastrophe
Disease Outbreak	Sudden increase in the incidence of a disease. The concept includes epidemics and pandemics
Ehealth	eHealth refers to the use of information and communications techniques including health-related activities, services and systems carried out over a distance for the purposes of global health promotion, disease control and healthcare, as well as education, management and research for health.
Emergency management	The organization and management of resources and responsibilities for dealing with all aspects of emergencies, in particularly preparedness, response and rehabilitation.
Endemic	disease that is constantly present to a greater or lesser degree in people of a certain class or in people living in a particular location
Epidemic	a widespread outbreak of an infectious disease; many people are infected at the same time
Geographic information systems (GIS)	Analysis that combine relational databases with spatial interpretation and outputs often in form of maps. A more elaborate definition is that of computer programms for capturing, storing, checking, integrating, analyzing and displaying data about the earth that is spatially referenced.
Global Positioning System (GPS)	satellite-based navigation system whichprovides exact position on the Earth anytime, anywhere, in any weather
Hazard	A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.
IVM(Integrated Vector Management)	Integrated vector management is a process for managing vector populations in such a way as to reduce or interrupt transmissionof disease
Mitigation	Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards

Natural hazards	Natural processes or phenomena occurring in the biosphere that may constitute a damaging event.
Pandemic	epidemic of infectious disease that spreads through human populations across a large region, like a continent, or even worldwide
Preparedness	Activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations
Prevention	Activities to provide outright avoidance of the adverse impact of hazards and means to minimize related environmental, technological and biological disasters.
Recovery	Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk.
Relief / response	The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration.
Risk	The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions.
Tele-epidemiology	Methodological area of epidemiology concern with the application of space-based systems (satellite image, remote-sensing data, etc...) in the study of the distribution of a health event or disease process in populations.
Telemedicine	Delivery of medical service via remote telecommunications
Telehealth	Delivery of health-related services and information via remote telecommunications
Vector-borne disease	A disease that is transmitted to humans or other animals by an insect or other arthropod is called a *vector-borne disease*
Vulnerability	The conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards.

1. Introduction

In these days, both Space technology and Medicine is the most rapidly developing field of science and also play a key role to control disaster. The collaboration between the space and medical fields can generate significant advances in disaster management. While space technologies have been successfully applied to a small number of health related matters over the last decade, there is neither a significant utilization of space elements nor a systematic analysis of needs for space assets in this sector yet.[1]

This document reviews current status of space technology used in disaster management in medical aspects. The contents focusing on the overlapping point of disaster, medicine, and space technology would help coherent efforts by related people in various field including government, space technology and medicine.

The overall structure of this document is generated by two axis, space technology and practical medical field use it . The contents include how space technologies including GIS, GPS and telecommunication can be adapted in epidemic control and disaster medicine each with some successful example program supported by WHO (World Health Organization) and ESA (European Space Agency)

[1] Report of the United Nations/ Burkina Faso/ European Space Agency/Centre National d'Etudes Spatiales Workshop on the Use of Space Technology for Human Health for the Benefit of the Countries in Africa

2. General concepts

2.1 Division of Space technology

Currently used space technology can divided in three parts, Earth observation, navigation and telecommunication though satellite. Earth observation and navigation is integrated in GIS (Geographic Information System) and GPS (Global positioning system).

2.2 What are GPS and GIS?

The Global Positioning System (GPS) is a satellite-based navigation system which provides exact position on the Earth anytime, anywhere, in any weather. A network of 24 satellites are orbiting in space and transmit signals that can be detected by anyone with a GPS receiver. With distance measurements from four satellites, the position on the earth is determined.[2]

Geographic Information System (GIS) is analysis that combines relational databases with spatial interpretation and outputs often in form of maps. *GIS* are increasingly being utilised for hazard and vulnerability mapping and analysis, as well as for the application of disaster risk management measures.

2.3 Telemedicine and satellite communication

Telemedicine is the use of medical information exchanged from one site to another via electronic communications to improve patients' health status. The important point is “via electronic communication “, meaning satellite communication is part of that. Some people have wrong concept that telemedicine is the medical field supported by satellite technology. Telemedicine via satellite is just a part of the space supports, especially satellite communication. Actually wide portion of telemedicine depends on the ground communication infrastructure. However, in disaster situation, on the ground telecommunication structure can be destroyed partially or totally. Then, communication via satellite would be only solution.

2.4 Medical aspects of disaster – Disaster medicine and epidemics

As regard disaster management, the medical field using the satellite technology is mainly focusing on two aspects. The first is as one of the catastrophe events such as flood, volcano, tsunami or something, epidemic crisis control. Epidemic crisis means widespread outbreak of an infectious disease; many people are infected at the same time. Another aspect is as a part of disaster management, health care problem in disaster cycle, namely disaster medicine. It is branch of medicine involved with application of

[2] Guidelines for data collection in the field using Global Positioning System (GPS)Technology ,WHO

emergency medical services in a community, following a natural or man-made catastrophe

2.5 Epidemic outbreaks after natural disaster

The important is epidemic outbreaks and another natural disasters are not separated, but in a sequence. Outbreaks of infectious diseases following hurricanes, cyclones, tsunamis and earthquakes are not uncommon. Ecological and environmental changes caused by natural disaster can lead epidemic outbreaks. For example, Malaria outbreaks in the wake of flooding are a well-known phenomenon.

An earthquake in Costa Rica's Atlantic Region in 1991 was associated with changes in habitat that were beneficial for breeding and preceded an extreme rise in malaria cases[3]. Moreover, Most of post-disaster infection is spawned by poor sanitation, a lack of safe drinking water and contaminated food. Therefore, epidemic control is also significant parts of disaster medicine and we'd better have a view to handle these fields in the integrated concepts, not only focusing on individual one.

[3] *Saenz R, Bissell RA, Paniagua F. Post-disaster malaria in Costa Rica. Prehospital Disaster Med. 1995;10:154–60*

3. Epidemic control based on space technology

3.1 Space supports for epidemic surveillance

Epidemic outbreak is one of the most fatal catastrophes, especially in developing or least developed countries[4]. Epidemics of weather and climate sensitive infectious diseases, including malaria, meningitis and cholera, cause massive disruption to societies and overburden nations. In developing countries, the vulnerability to climate and environmental change is likely to increase as demands on resources continue to rise in association with rapidly growing populations.

In these days, with the help of satellites currently in orbit, Space technology, including Geographic Information System (GIS), and Global Positioning System (GPS) technologies, now make it easier to integrate ecological, environmental and remotely sensed data for the purpose of predict and prevent deadly infectious disease outbreaks, such as Ebola, West Nile virus and Rift Valley Fever. By understanding the mixture of vegetation, rainfall and slope of an area, scientists can predict the food supply of disease transmitting vectors within the region and the threat they cause to humans. Because plague is also considered a bioterrorism agent, the surveillance systems enable scientists to decipher if an outbreak was caused by natural circumstances or was an act of bioterrorism.[5]

3.2 Early warning and response to epidemic threats

In recognition of the need for the improved understanding of current and likely future climate change, one important objective is the further development and integration of in situ ground measurement systems, remote sensing monitoring techniques and appropriate early warning systems, as the increasing trend in epidemics and natural disasters coincides with advances in weather and climate prediction and improved understanding of the relationships between human health and the environment.

New epidemic threats such as SARS, pandemic flu and bioterrorism pose challenges for countries and communities globally. These epidemic diseases can spread faster and further, aided by high-speed travel, increased trading of goods between countries, and social and environmental changes. In today's globalized world, an outbreak or an emerging infectious agent anywhere on earth must now be considered a threat to all. Therefore the immediate response and early warning in the risk area is key to limiting the spread of disease.

GIS data from satellites can help workers clarify the contaminated region and separate it immediately. Early warning systems using satellite communication, GIS and GPS technology provide a fast and resilient way to distribute over geographical areas alarms and information to the population to facilitate adequate protective measures for the

[4] UN-ISDR, EM-DAT : The OFDA/CRED International Disaster Database.
[5] http://www.eurekalert.org/pub_releases/2007-11/asot-nth110607.php

safeguard of citizens' health in catastrophic events such as the tsunamis. No single institution or country has all the capacities to respond to international public health emergencies. In order to provide the most urgently required information for fast response, a focused communication must be organized where different actors bring in different perspectives.

Table1. Space supports and example for epidemic control

	Earth observation and Navigation	**Satellite communication**
Epidemic surveillance and prevention	Provide geographic information required to monitor the risks of epidemic outbreaks and create prediction models Support maps to monitor the risk of epidemic outbreak in ordinary times *Ex. WHO public health & GIS Earth observation technology for predicting malaria risk in Africa*	communications tools for data transmission with field-level epidemic surveillance teams in remote areas *Ex. SAFE(Satellite for Epidemiology)*
Early warning	Provide the essential geographic information to evaluate the risk of the reigion round primary disease area dangerous contaminated area from safe region in epidemic crisis Tracing the immigration route of vector animal *Ex. HEWS - Health Early Warning Systemas a source of infection (ESA)*	Urgent mobilization of Health security system in the levels of region, nation and world.
Response	Infection population and medical resource assessments Fast arrangements of medicine, human, decontamination facility to high risk area	Fast access to medical information to limit spread disease Rapid Communication between health center and high risk outbreak region

3.3 Space aid epidemic control program by International organization

- **WHO public health mapping and GIS**

Satellite technologies also contribute to the development of information systems for public health (PHIS), e.g. WHO HealthMapper and follow-up systems. The Public Health Mapping and Program developed by WHO and UNICEF allows the computer-assisted visualization of disease foci, the monitoring of newly infected or reinfected villages, the identification of at-risk populations, and the highly targeted, cost-effective distribution of interventions. It is an example of how space technologies developed to accelerate the control of one disease can expedite the control of others. WHO also provide useful tools and guideline to facilitate the use of satellites system in diseases surveillance for improving public health[6] (http://www.who.int/health_mapping/en/)

- **ESA (European space agency) supports for public health crisis**

ESA (European space agency) also supports the projects provide information through satellite to develop epidemic surveillance system. The Satellites for Epidemiology (SAFE) pilot project[7], for example, is part of that collaboration. According to SAFE coordinator Audrey Berthier, of the *Institut de Médecine et de Physiologie Spatiales* (MEDES) in Toulouse, France, the SAFE project attempts to answer the question: how good are satellites for providing early warning of disease outbreaks?

To explore this, SAFE conducted a training exercise in November 2007 on the Greek island of Crete (.The exercise assumed that damage from an earthquake was widespread and that the conventional, terrestrial communications infrastructure had been destroyed. The rescue operations had only one means at their disposal that had not been affected by the imaginary quake – a satellite. Response teams were tested on their reliance on the satellite for communications, but on the second day the satellite was also used by doctors to deal with an epidemiological threat that was also conjured up as part of the scenario.

As another example, the objective of this DUE project was to provide EO-derived information on the environment to epidemiologists working to study, monitor and predict threats to human health. User Requirements were provided by a group of epidemiologists (the User Group) who are enthusiastic to capitalise on the advantages that EO-derived information can provide for their work. A list of recent and current projects supported by ESA is given by linkage

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[6] *GIS and Global Positioning System (GPS) guidelines, WHO*

[7] *http://www.esa.int/esaMI/Space_for_health/SEMNVMB474F_0.html*

4. Space supports for medical care in disaster

4.1 Real-time medical care using satellite communication in disaster

When disaster occurs, the existing terrestrial communication infrastructures could be damaged. Then, telemedicine through satellite can play a key role in the diagnosis and treatment of urgent patients in the field. The rapid access to a wider range of specialists and medical procedures, better emergency triage of patients, the administration of overall medical systems and patient care through seamless delivery of services by satellites can provide chances for both patients and medical staff to fulfill various urgent medical care requirements. For example, Satellite connection brings surgeons in remote area into operating room oceans away. Especially, in trauma situation which occurred frequently in many disaster, fast care matters most, patient should be treated in golden –it means most critical- hour. In this urgent situation, telesurgery using satellite communication can be an answer[8]

Table2. Telecommunication in disaster medicine [9]

Use of telecommunication in disaster medicine	Description
Telemedicine	The practice of medicine over distance with the use of telecommunications equipments
Telemanagement	The range of telecommunication activities designed to maintain control over disaster and emergency situation and to provide a frame work for helping at risk persons to avoid or recover from the impact of the disaster
Teleconsulation	A medical team or expert in a hospital gives assistance in diagnosis and treatment to a doctor or rescuers with victims using telecommunication facilities
Telediagnosis	Telediagnosis is involves the doctor making an assessment without physical exam, but rather based on data transmitted from a remote location using telecommunications.
Information for transportation	The use of telecommunications to request helicopters, ambulances and other mans of transportations, to assign patients to the proper treatment area and to establish maintain communication with medical facilities

Compare to on the ground communication infrastructure already widely used in telemedicine, Some drawbacks of satellite communication is higher initial costs of installing system, high cost of satellite bandwidth, restrictions on information flow. Therefore, it is desirable to consider the cost effectiveness before adapt satellite system to telemedicine. The proper cooperation between on the ground system and satellite can improve the potential of telemedicine in disaster situation.

[8] *Surgery via satellite, La Crosse Tribune, Jul 26, 2006 by Simmons, Dan*
[9] *In search of effective telecommunications tools for telemedicine in the disaster,Kiyoko magami, Hiroshi Juzoji, e-health international*

4.2 GIS for the efficient medical management in disaster

Health care is a critical part in all aspects of the disaster management cycle. Great advances have been made in space technology in the past decade become useful for addressing humanitarian crises[10]. The chief of these, as the Pakistan earthquake illustrates, is using satellites to obtain images of a disaster zone quickly, so that rescue workers can focus their efforts where they are needed. Individual patients and medical resource assessments at a disaster situation can be coupled with GIS to support decision-making. However, since actors in the medical field may be less familiar with space technology, there are still many obstacles to overcome in utilizing space-based technologies in disaster medicine.

Table3. Space supports for medical care in disaster

	Earth Observation & Navigation	**Satellite communication**
Improve Surge capacity	Find the location of isolated patient in hidden area Provide map and navigation tools for vehicle tracking system for transport urgent patient European Geostationary Navigation Overlay Service (EGNOS)	Field based patient registration and transportation between health care facilities
Medical resource Management	Monitor real time status of critical medical resources availabity by map data provided by satellite	Communication with health center to estimates of resource availability, including personnel, vehicles, hospital beds and/or specialized equipment for search and rescue or decontamination
Manage infection and Contamination	Mapping the area exposed to infection source or Toxic materials by GIS mapping	Just-in-time distance education—HEPA filters, PPE suits, sanitation rule, decontamination
Provide real time medical care	Global Positioning System (GPS) for navigating rescue helicopter, ambulance for any time medical rescue	Real time co-operated surgery by real-time communication tools Rapid patient data transmission for telediagnosis, teleconsualation, telemanagement
Provide situational awareness	Mapping the dangerous neighborhood area for warning and prevention	Direct feedback form field to remote disaster management center

[10] *http://www.who.int/bulletin/volumes/86/2/08-020208/en/index.html*

Table4. Example of satellite technologies used for medical care in disaster[11]

Year	Project	Infrastructure	Practical Use in the field
2004	Tsunami, India(I-DISCARE	GPS, Globarstar, Inmaster ,Eutelsat	Positioning the urgent patient who need immediate medical treatment and Provide vehicle tracking system Voice and low –medium rate data transmission between On-site rescue team and remote medical experts
	Tsunami, India(ISRO)	VSAT,INMARSAT,MSS(Mobile satellite service)	On-site medical information acquisition devices (audio,video,data) for immediate patient control in the field
1996	Primetime 3 Bosnia (military)	Orion satellites, ISDN	The medical information of patient including CT(Computer Tomography),still image, US(Ultra Sound), Doppler store and forward to doctor for rapid diagnose and medical treatment
	ACTS Montatna demonstration (civilian)	ACTS Satellite	On-site medical information acquisition devices (audio,video,data) for immediate patient control in the field

4.3 Telemedicine via Satellite programs by ESA

ESA is collaborating with the World Health Organization (WHO) to establish a European user-driven Telemedicine via Satellite programs. The program will aim to provide telemedicine services, such as delivering medical care and treatment via satellite, and, for WHO, a key element is training health workers in how to use such health technologies in their work. WHO has already trained health workers in how to use satellite images in 20 countries.

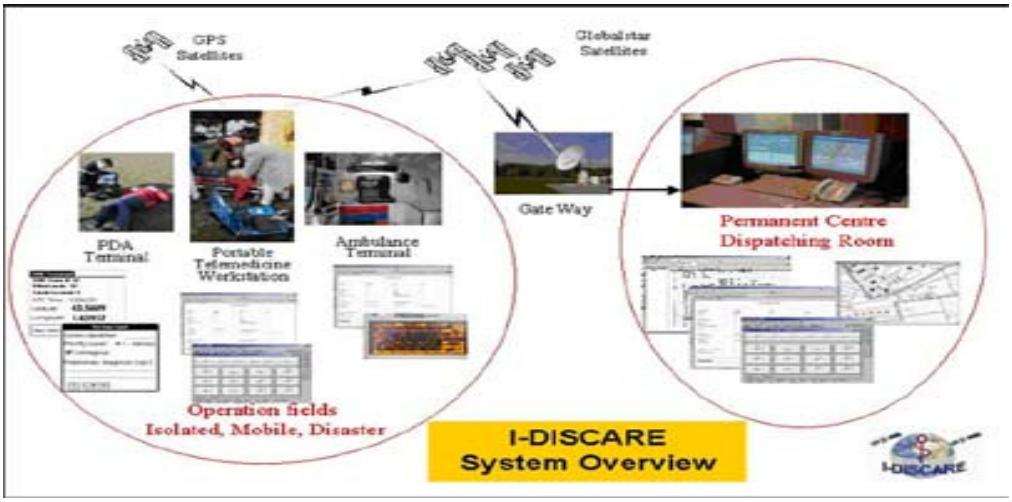
Ex1> SECOM - Satellite Enhanced Coverage of Mobimed[12]

Transmits of continuous patient data including vital signs, ECG, images and any relevant patient history from helicopter or ambulance though satellite to the hospital workstation where a Specialist can speak and command to paramedics with a patient

Ex2> I-DISCARE [13]

[11] *International journal of Medical infomatics61(2001), "Telemedicine and distance lerning after tsunami" The space review, Jan,1,2005*
[12] *http://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=932*
[13] *http://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=7564*

I-DISCARE system, using satellites systems, telecommunication and GPS system bringing links between field actors and their background organisation:



Following functions are supported by the I-DISCARE system

Victim *- Patient localization and identification*

First Medical Assistance *with localization and objective medical data transmission*

Medical monitoring *of the victims during evacuation on ambulance*

Management / co-ordination of the field operational actors from a dispatching room, thanks to a server and visualization consoles (including mapping capacity

Ex 3> DELTASS system (Disaster Emergency Logistic Telemedicine Advanced Satellite System) funded by ESA(European Space Agency)

DELTASS (Disaster Emergency Logistic Telemedicine Advanced Satellite System) is a space based system designed to improve the benefits and efficiency of the management of the rescue, first medical aid and emergency operations in disaster situations like earthquakes or explosions. In such situations, the existing terrestrial infrastructures could be damaged.

The space systems then suitably complement partly destroyed terrestrial infrastructures to answer to the requirements of emergency healthcare services such as fast deployment of the management of the logistic and medical means or remote medical expertise.

- Mobile Teams , Permanent Center (PC), Mobile Field Hospital(MFH) and Reference Hospital (RH) are interconnected via several satellite systems with different bandwidths . Additionally terrestrial communication channels support the data exchange between PC and the RH [14]

[14] *Telemedical services for disaster emergencies Georgi GRASCHEW, Theo a. ROELOFS, Stefan RAKWSKY, Infromationi & security, an international Journal. 2005 vol 16*

5. Limitation of using space technology for medical parts in disaster

Satellites are obvious useful tools for assisting medical experts in disaster situation, but it's only in the past decade that they've really been useful. According to Norman Kerle, an assistant professor at the Netherlands' International Institute for Geo-Information Science and Earth Observation, The resolution of satellite imagery doesn't need to be too high to track and interpret details, such as land cover and temperature changes, especially when coupled with analytical, visualizing and reporting GIS software and restrictions on information flow is still problem. Other drawbacks are the high initial costs of installing system and high cost of satellite bandwidth, meaning they're either owned by governments or by companies that, naturally enough, want to make money from them.

That's why the Charter is so important – if agencies pool their satellites they can cut the response time down so their data are useful to people on the ground. But a rapid response is still counted in days rather than in hours, meaning that, today, initiatives like the Charter are only able to provide timely support for part of the emergency response actions that disaster management users are requesting. That hasn't stopped the Charter responding to more than 140 requests for help.

The last basic problem is that satellites, indeed, cannot always be counted on. Cloud cover, for example, prevented the CDC from getting images during the Ebola outbreak in Uganda in 2007. And whether good or bad, people have a touching faith in the all-seeing power of the satellite, if the Charter web site's logs are anything to go by[15]

Therefore, it is desirable to spread the burdens among a large user base, and such requirements and services must be identified by the community and taken into consideration when designing the disaster management system.

[15] *http://www.who.int/bulletin/volumes/86/2/08-020208/en/index.html*

Appendix1. List of Institutions and organizations to refer

Name	Webpage	Introduction
WHO- Epidemic and pandemic Alert and response	http://www.who.int/csr/en/	Integrated global alert and response system for epidemics and other public health emergencies based on strong national public health systems and capacity and an effective international system for coordinated response.
WHO- Public healthand GIS mapping	http://www.who.int/health_mapping/en/	Program leading a global partnership in the promotion and implementation of GIS to support decision-making for a wide range of infectious disease and public health programs.
WHO - Disaster preparedness and response	http://www.euro.who.int/emergencies	Responds to countries that need our help in preventing disasters, preparing for them and mitigating their consequences whenever or wherever they happen.
WHO-Public health mapping and GIS Map liblary	http://gamapserver.who.int/mapLibrary/default.aspx	Interactive map provide public health data divided in geographic region by WHO
WHO – Global Health atlas	http://www.who.int/globalatlas/	WHO's Communicable Disease Global Atlas is bringing together for analysis and comparison standardized data and statistics for infectious diseases at country, regional, and global levels
Geospatial Health	http://www.gnosisgis.org/	network of collaborating health workers and earth scientists dedicated to development of global computer-based models that can be used for improved control programs for infectious disease of medical and veterinary importance sponsored by the Rockefeller Foundation
TIE(Telemedicine Information Exchange)	http://tie.telemed.org/default.asp	Comprehensive, international, quality-filtered resource for information about telemedicine, telehealth, and telemedicine/ telehealth related activities supported and maintained by the Association of Telehealth Service Providers.
ESA(European Space Agency)- space for health	http://www.esa.int/esaMI/Space_for_health/SEMKXMB474F_0.html	An overview on recent, current, and planned projects on space supports to various aspects of health supported by ESA
Norwegian Centre for Telemedicine	http://www.telemed.no/	National competence centre for telemedicine research and development activity for the nation. World Health Organization (WHO)'s first Collaborating Centre for Telemedicine.
Télécoms Sans Frontières	http://www.tsfi.org/tsfispip/article.php3?id_article=227&lang=en	Company as emergency telecommunications centers to serve UN, government, and NGO humanitarian workers, and developed a reputation for being among the first to arrive after disasters.
European Center for Disease prevention and control	http://ecdc.europa.eu/	EU agency to identify, assess and communicate current and emerging threats to human health posed by infectious diseases.
American Center for Disease prevention and control	http://www.cdc.gov/	American National disease control center to promote health and quality of life by preventing and controlling disease, injury, and disability
German Institute for Disaster Medicine and Emergency Medicine	http://www.disastermedicine.de/index.php?lang=en	Institution improves Emergency and Disaster Medicine for the benefit of all people worldwide by providing a knowledge exchange.

Appendix2. Terminology and source

	Definition	Source
Biological hazard	Processes of organic origin or those conveyed by biological vectors, including exposure to pathogenic micro-organisms, toxins and bioactive substances, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. *Examples of biological hazards: outbreaks of epidemic diseases, plant or animal contagion, insect plagues and extensive infestations*	UN ISDR http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm
Disaster	A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources. *A disaster is a function of the risk process. It results from the combination of hazards, conditions of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk.*	UN ISDR http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm
Disaster medicine	Branch of medicine involved with application of emergency medical services in a community, following a natural or man-made catastrophe	UN SPIDER
	Branch of medicine involved with management and organization of public health response to disasters and major events including the special health and medical needs of a community in a disaster.	U.S. National Library of Medicine http://www.nlm.nih.gov/mesh/MBrowser.html
Disease Outbreak	Sudden increase in the incidence of a disease. The concept includes epidemics and pandemics	U.S. National Library of Medicine http://www.nlm.nih.gov/mesh/MBrowser.html
Ehealth	eHealth refers to the use of information and communications techniques including health-related activities, services and systems carried out over a distance for the purposes of global health promotion, disease control and healthcare, as well as education, management and research for health.	Androuchko, ITU-D, ITU Workshop on Standardisation on eHealth, 2003
Emergency management	The organization and management of resources and responsibilities for dealing with all aspects of emergencies, in particularly preparedness, response and rehabilitation. *Emergency management involves plans, structures and arrangements established to engage the normal endeavours of government, voluntary and private agencies in a comprehensive and coordinated way to respond to the whole spectrum of emergency needs. This is also known as disaster management*	UN ISDR
Endemic	disease that is constantly present to a greater or lesser degree in people of a certain class or in people living in a particular location	wordnet.princeton.edu/perl/webwn
	(of a disease or condition) regularly found among particular people or in a certain area: areas where malaria is endemic. denoting an area in which a particular disease is regularly found	The Oxford Dictionary of Current English 2008, originally published by Oxford University Press 2008
Epidemic	a widespread outbreak of an infectious disease; many people are infected at the same time	The Oxford Dictionary of Current English 2008, originally published by Oxford University Press 2008
	widespread occurrence of an infectious disease in a community	wordnet.princeton.edu/perl/

	at a particular time	webwn
Geographic information systems (GIS)	Analysis that combine relational databases with spatial interpretation and outputs often in form of maps. A more elaborate definition is that of computer programmes for capturing, storing, checking, integrating, analysing and displaying data about the earth that is spatially referenced. *Geographical information systems are increasingly being utilised for hazard and vulnerability mapping and analysis, as well as for the application of disaster risk management measures.*	UN ISDR http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm
Geological hazard	Natural earth processes or phenomena that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. *Geological hazard includes internal earth processes or tectonic origin, such as earthquakes, geological fault activity, tsunamis, volcanic activity and emissions as well as external processes such as mass movements: landslides, rockslides, rock falls or avalanches, surfaces collapses, expansive soils and debris or mud flows.* *Geological hazards can be single, sequential or combined in their origin and effects.*	UN ISDR http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm
Global Positioning System (GPS)	satellite-based navigation system which provides exact position on the Earth anytime, anywhere, in any weather	Guidelines for data collection in the field using Global Positioning System (GPS) Technology, WHO 2003
Hazard	A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. *Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydrometeorological and biological) or induced by human processes (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterised by its location, intensity, frequency and probability*	UN ISDR http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm
IVM(Integrated Vector Management)	Integrated vector management is a process for managing vector populations in such a way as to reduce or interrupt transmission of disease	Global Strategic Framework forIntegrated Vector Management ,WHO http://whqlibdoc.who.int/hq/2004/WHO_CDS_CPE_PVC_2004_10.pdf
Mitigation	Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards	UN ISDR http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm
Natural hazards	Natural processes or phenomena occurring in the biosphere that may constitute a damaging event. *Natural hazards can be classified by origin namely: geological, hydrometeorological or biological. Hazardous events can vary in magnitude or intensity, frequency, duration, area of extent, speed of onset, spatial dispersion and temporal spacing*	UN ISDR http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm
Pandemic	epidemic of infectious disease that spreads through human populations across a large region, like a continent, or even worldwide	UN SPIDER

	a pandemic can start when three conditions have been met: • the emergence of a disease new to the population. • the agent infects humans, causing serious illness. • the agent spreads easily and sustainably among humans.	WHO
Preparedness	Activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations	UN ISDR http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm
Prevention	Activities to provide outright avoidance of the adverse impact of hazards and means to minimize related environmental, technological and biological disasters. *Depending on social and technical feasibility and cost/benefit considerations, investing in preventive measures is justified in areas frequently affected by disasters. In the context of public awareness and education, related to disaster risk reduction changing attitudes and behaviour contribute to promoting a "culture of prevention".*	UN ISDR http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm
Recovery	Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk. *Recovery (rehabilitation and reconstruction) affords an opportunity to develop and apply disaster risk reduction measures.*	UN ISDR http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm
Relief / response	The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration.	UN ISDR http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm
Risk	The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions. *Conventionally risk is expressed by the notation Risk = Hazards x Vulnerability. Some disciplines also include the concept of exposure to refer particularly to the physical aspects of vulnerability.* *Beyond expressing a possibility of physical harm, it is crucial to recognize that risks are inherent or can be created or exist within social systems. It is important to consider the social contexts in which risks occur and that people therefore do not necessarily share the same perceptions of risk and their underlying causes.*	UN ISDR http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm
Technological hazards	Danger originating from technological or industrial accidents, dangerous procedures, infrastructure failures or certain human activities, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. *Some examples: industrial pollution, nuclear activities and radioactivity, toxic wastes, dam failures; transport, industrial or technological accidents (explosions, fires, spills.)*	UN ISDR http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm

Tele-epidemiology	Methodological area of epidemiology concern with the application of space-based systems (satellite image, remote-sensing data, etc...) in the study of the distribution of a health event or disease process in populations. study of environmental data to improve understanding of how epidemics spread. Tele-epidemiology is an approach that combines data from meteorological, Earth observation, scientific and telecommunications satellites to construct climatic, ecological and clinical models. Ultimately, this technique should allow to track the virulence and geographic distribution of epidemics and plan the measures necessary to prevent them spreading.	Victor Kotelnikov UNOOSA
Telemedicine	Delivery of medical service via remote telecommunications	UN SPIDER
	Delivery of health services via remote telecommunications	U.S. National Library of Medicine http://www.nlm.nih.gov/mesh/MBrowser.html
	The delivery of healthcare services, where distance is a critical factor, by healthcare professionals using information and communications technologies for the exchange of valid information for diagnosis, treatment and prevention of diseases and injuries, research and evaluation, and for the continuing education of healthcare providers, all in the interest of advancing the health and their communities, WHO 1997	http://www.esa.int/SPECIALS/Telemedicine_Alliance/ESA4428708D_0.html http://whqlibdoc.who.int/hq/1998/WHO_DGO_98.1.pdf
Telehealth	Delivery of health-related services and information via remote telecommunications	UN SPIDER
	Remote healthcare that does not always involve clinical services	America Telemedicine Association
Vector-borne disease	A disease that is transmitted to humans or other animals by an insect or other arthropod is called a *vector-borne disease*	Georgia Government- public health http://health.state.ga.us/epi/vbd/index.asp
	vector-borne disease is one in which the pathogenic microorganism is transmitted from an infected individual to another individual by an arthropod or other agent, sometimes with other animals serving as intermediary hosts	http://www.ciesin.columbia.edu/TG/HH/veclev2.htm
Vulnerability	The conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards. *For positive factors, which increase the ability of people to cope with hazards, see definition of capacity.* *Some examples: industrial pollution, nuclear activities and radioactivity, toxic wastes, dam failures; transport, industrial or technological accidents (explosions, fires, spills*	UN ISDR http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm