POTENTIAL INFECTIOUS DISEASES FOLLOWING EARTHQUAKES AND THEIR SECONDARY ENVIRONMENTAL EFFECTS

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INTRODUCTION

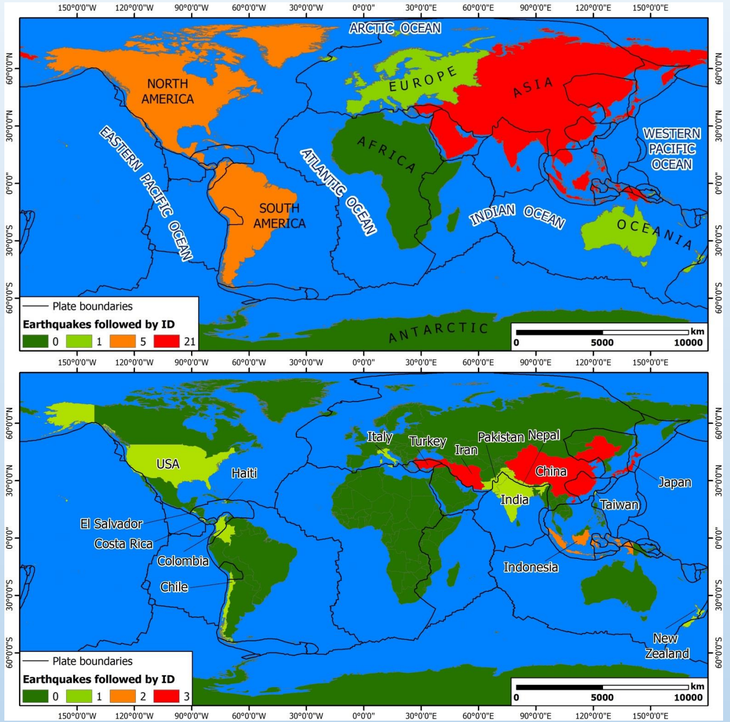
Earthquakes are among the most impressive geological processes with destructive effects on humans, nature and infrastructures. They set off a chain of events including secondary earthquake environmental effects (EEE). These effects lead to destruction of buildings and facilities that significantly affects public health resulting in casualties and injuries, effects on mental health as well as non-infectious and infectious diseases emerging during the post-earthquake period.

EARTHQUAKE ENVIRONMENTAL EFFECTS

- Primary EEE are directly linked to the earthquake energy and particular to the surface expression of the seismogenic source. They include surface faulting accompanied by landscape and geomorphological changes and permanent ground dislocation induced by tectonic uplift or subsidence.
- Secondary EEE are induced by the ground shaking. They are classified into ground cracks, slope movements, dust clouds, liquefaction phenomena, hydrological anomalies, tsunamis, trees shaking and jumping stones. Hydrological anomalies comprise changes in water discharge of springs, and rivers as well as changes in the chemical-physical properties of surface and groundwater, such as temperature and turbidity. Anomalous waves include seiches in closed basins, outpouring of water from pools and basins, and tsunami waves. Slope movements comprehend all types of mass movements including flows, slides, slumps, avalanches and falls. Liquefaction phenomena include sand volcanoes, water and sand fountains, some types of lateral spreading, ground compaction and subsidence.

METHODOLOGY

This study involved an extensive and systematic literature review of 121 research publications related to the public health impact of 28 earthquakes from 1980 to 2015 with moment magnitude (Mw) from 6.1 to 9.2 and their secondary EEE including landslides, liquefaction and tsunamis generated in various tectonic environments (extensional, transform, compressional) around the world (21 events in Asia, 5 in America and one each in Oceania and Europe). The inclusion criteria were the literature type comprising journal articles and official reports, the natural disaster type including earthquakes and their secondary EEE (landslides, liquefaction, tsunamis), the population type including humans and the outcome measures characterized by infectious disease (ID) incidence increase.



Spatial distribution of earthquakes followed by infectious diseases

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The potential post-earthquake ID are classified into 14 groups including respiratory (detected after 15 of 28 earthquakes, 53.57%), water-borne (15, 53.57%), skin (8, 28.57%), vector-borne (8, 28.57%) wound-related (6, 21.43%), blood-borne (4, 14.29%), pulmonary (4, 14.29%), fecal-oral (3, 10.71%), food-borne (3, 10.71%), fungal (3, 10.71%), parasitic (3, 10.71%), eye (1, 3.57%), mite-borne (1, 3.57%) and soil-borne (1, 3.57%) infections. Cholera, pneumonia and tetanus are the deadliest post-earthquake ID.

VULNERABLE AGE AND GENRE POPULATION GROUPS

Based on age and genre data available for 15 earthquakes, the most vulnerable population groups are males, young children (age ≤ 10 years) and adults (age ≥ 65 years).

Types of infectious diseases following 28 studied earthquakes and their earthquake environmental effects

Types of Infectious diseases	Number of earthquakes	Percentage
respiratory infections	15/28	53.57 %
water-borne infections	15/28	53.57 %
skin infections	8/28	28.57 %
vector-borne infections	8/28	28.57%
wound-related infections	6/28	21.43 %
blood-borne infections	4/28	14.29 %
pulmonary infections	4/28	14.29 %
fecal-oral infections	3/28	10.71 %
food-borne infections	3/28	10.71 %
fungal infections	3/28	10.71 %
parasitic infections	3/28	10.71 %
eye infections	1/28	3.57 %
mite-borne infections	1/28	3.57 %
soil-borne infections	1/28	3.57 %

RISK FACTORS FOR DISEASE EMERGENCE AND DISEASE INCIDENCE INCREASE

The risk factors leading not only to disease emergence but also to disease incidence increase include: (1) damage to infrastructures and health care systems that remained unfixed for a long time in the critical post-earthquake period, (2) aggravating weather conditions comprising immense and dramatic temperature changes, (3) prolonged physical exposure to large dust clouds generated by landslides and aspiration of contaminated tsunami water, (4) unfavorable conditions in overcrowded emergency shelters, (5) increased exposure to disease vectors population, (6) the weak immune system of elders, chronically ill individuals and young children, (7) large percentage of illiteracy and population living below the national poverty line (insufficient personal hygiene), (8) poor education and training on disease prevention, (9) sanitary deficiencies, (10) lack of screening for blood-borne diseases before emergency surgeries, blood transfusions and intravascular drug use, (11) use of unsterilized medical equipment, (12) insufficient or low vaccination coverage and (13) close contact with the affected local population.

CONCLUSIONS

In conclusion, our study referred to potential ID following strong, major and great earthquakes and their secondary EEE from 1980 to 2015. The establishment of a strong disaster preparedness plan following international guidelines and comprising adequate environmental and infrastructure planning and resilience of health facilities is fundamental for the enhancement of surveillance systems, the early detection of the emergence and spread of ID and their successful management.

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