

Chapter 1 : Health impacts of floods.

With respect to health, it concluded that although there was little evidence of the long-term health effects and impact of flooding, the limited evidence available suggested that there are significant short- and long-term impacts on psychosocial health.

Health effects[edit] Studies have shown that people who are atopic sensitive , already suffer from allergies , asthma , or compromised immune systems [3] and occupy damp or moldy buildings are at an increased risk of health problems such as inflammatory and toxic responses to mold spores, metabolites and other components. Severe reactions are rare but possible. Some molds also produce mycotoxins that can pose serious health risks to humans and animals. The term "toxic mold" refers to molds that produce mycotoxins, such as *Stachybotrys chartarum* , not to all molds. The five most common genera of indoor molds are *Cladosporium* , *Penicillium* , *Aspergillus* , *Alternaria* and *Trichoderma*. Damp environments which allow mold to grow can also produce bacteria and help release volatile organic compounds. Symptoms of mold exposure[edit] Symptoms of mold exposure can include: Increased exposure increases the probability of developing respiratory symptoms during their first year of life. Studies have shown that a correlation exists between the probability of developing asthma and increased exposure to *Penicillium*. Some people are more sensitive to mold than others. Exposure to mold can cause a number of health issues such as; throat irritation, nasal stuffiness, eye irritation, cough and wheezing, as well as skin irritation in some cases. Exposure to mold may also cause heightened sensitivity depending on the time and nature of exposure. People at higher risk for mold allergies are people with chronic lung illnesses, which will result in more severe reactions when exposed to mold. There has been sufficient evidence that damp indoor environments are correlated with upper respiratory tract symptoms such as coughing, and wheezing in people with asthma. According to the Institute of Medicine, there is a significant association between dampness in the home and wheeze, cough, and upper respiratory symptoms. For example, residents of homes with mold are at an elevated risk for both respiratory infections and bronchitis. Also, mold may produce mycotoxins, either before or after exposure to humans, potentially causing toxicity. Mycosis A serious health threat from mold exposure for immunocompromised individuals is systemic fungal infection systemic mycosis. Immunocompromised individuals exposed to high levels of mold, or individuals with chronic exposure may become infected. Mycotoxins may or may not be produced by the invading mold. Most dermatophyte fungi take the form of a mold, as opposed to a yeast, with appearance when cultured that is similar to other molds. Mold-induced hypersensitivity[edit] The most common form of hypersensitivity is caused by the direct exposure to inhaled mold spores that can be dead or alive or hyphal fragments which can lead to allergic asthma or allergic rhinitis. Another form of hypersensitivity is hypersensitivity pneumonitis. Exposure can occur at home, at work or in other settings. Mycotoxin Molds excrete toxic compounds called mycotoxins , secondary metabolites produced by fungi under certain environmental conditions. These environmental conditions affect the production of mycotoxins at the transcription level. Temperature, water activity and pH, strongly influence mycotoxin biosynthesis by increasing the level of transcription within the fungal spore. It has also been found that low levels of fungicides can boost mycotoxin synthesis. Mycotoxins are not produced all the time, but only under specific growing conditions. Mycotoxins are harmful or lethal to humans and animals only when exposure is high enough, as with absolutely all other substances. Mycotoxins can be found on the mold spore and mold fragments, and therefore they can also be found on the substrate upon which the mold grows. Routes of entry for these insults can include ingestion, dermal exposure and inhalation. Some mycotoxins cause immune system responses that vary considerably, depending on the individual. The duration of exposure, the frequency of exposure and the concentration of the insult exposure are elements in triggering immune system response. Aflatoxin is an example of a mycotoxin. It is a cancer-causing poison produced by certain fungi in or on foods and feeds, especially in field corn and peanuts. However, studies are suggesting that the so-called toxic effects are actually the result of chronic activation of the immune system, leading to chronic inflammation. A 1994 case study based on cases of pulmonary hemorrhage in infants in Cleveland , Ohio originally concluded there was causal relationship between the

exposure and the disease. The investigators revisited the cases and established that there was no link to the exposure to S. Their toxicity is due to absorption into cells and production of nano-channels that obstruct vital ion channels that ferry potassium and sodium ions across the cell membrane. This affects in the cells action potential profile, as seen in cardiomyocytes , pneumocytes and neurons leading to conduction defects. Trilongins are highly resistant to heat and antimicrobials making primary prevention the only management option. Indoor air quality Prevention of mold exposure and its ensuing health issues begins with prevention of mold growth in the first place by avoiding a mold-supporting environment such as humid air. Extensive flooding and water damage can support extensive mold growth. Following hurricanes, homes with greater flood damage, especially those with more than 3 feet 0. It is useful to perform an assessment of the location and extent of the mold hazard in a structure. Various practices of remediation can be followed to mitigate mold issues in buildings, the most important of which is to reduce moisture levels. A common issue with mold hazards in the household is the placement of furniture, and the lack of ventilation which this causes to certain parts of the wall. The simplest method of avoiding mold in a home so affected is to move the furniture in question. Adverse respiratory health effects are associated with occupancy in buildings with moisture and mold damage. Sometimes these by-products are detectable by odor, in which case they are referred to as "ergonomic odors" meaning the odors are detectable, but do not indicate toxicologically significant exposures. Food[edit] Moldy nectarines that were in a refrigerator. The nectarine with black mold is also affecting the nectarine underneath. Molds that are often found on meat and poultry include members of the genera *Alternaria* , *Aspergillus* , *Botrytis* , *Cladosporium* , *Fusarium* , *Geotrichum* , *Mortierella* , *Mucor* , *Neurospora* , *Paecilomyces* , *Penicillium* , and *Rhizopus*. A number of common microfungi are important agents of post-harvest spoilage, notably members of the genera *Aspergillus*, *Fusarium*, and *Penicillium*. When ingested, inhaled, or absorbed through skin, mycotoxins may cause or contribute to a range of effects from reduced appetite and general malaise to acute illness or death in rare cases. Dietary exposure to the mycotoxin aflatoxin B1, commonly produced by growth of the fungus *Aspergillus flavus* on improperly stored ground nuts in many areas of the developing world, is known to independently and synergistically with Hepatitis B virus induce liver cancer. In addition, it is especially useful to clean the inside of the refrigerator, and to ensure dishcloths, towels, sponges and mops are clean.

Chapter 2 : Mold health issues - Wikipedia

Health risks also are associated with the evacuation of patients, loss of health workers, and loss of health infrastructure including essential drugs and supplies. In the medium-term, infected wounds, complications of injury, poisoning, poor mental health, communicable diseases, and starvation are indirect effects of flooding.

What are the consequences of floods? Floods impact on both individuals and communities, and have social, economic, and environmental consequences. The consequences of floods, both negative and positive, vary greatly depending on the location and extent of flooding, and the vulnerability and value of the natural and constructed environments they affect. The consequences of floods, both negative and positive, vary greatly depending on their location, duration, depth and speed, as well as the vulnerability and value of the affected natural and constructed environments. Floods impact both individuals and communities, and have social, economic, and environmental consequences Table 1. Floods have large social consequences for communities and individuals As most people are well aware, the immediate impacts of flooding include loss of human life, damage to property, destruction of crops, loss of livestock, and deterioration of health conditions owing to waterborne diseases. As communication links and infrastructure such as power plants, roads and bridges are damaged and disrupted, some economic activities may come to a standstill, people are forced to leave their homes and normal life is disrupted. Similarly, disruption to industry can lead to loss of livelihoods. Damage to infrastructure also causes long-term impacts, such as disruptions to supplies of clean water, wastewater treatment, electricity, transport, communication, education and health care. Loss of livelihoods, reduction in purchasing power and loss of land value in the floodplains can leave communities economically vulnerable. Floods can also traumatise victims and their families for long periods of time. The loss of loved ones has deep impacts, especially on children. For some people the psychological impacts can be long lasting. Types of loss from floods. Loss from contact with flood water Indirect loss: No contact " loss as a consequence of flood water Yes " monetary tangible e. Buildings and contents, vehicles, livestock, crops, infrastructure e. Disruption to transport, loss of value added in commerce and business interruption, legal costs associated with lawsuits No " non-monetary intangible e. Lives and injuries, loss of memorabilia, damage to cultural or heritage sites, ecological damage e. Stress and anxiety, disruption to living , loss of community, loss of cultural and environmental sites, ecosystem resource loss Flooding in key agricultural production areas can lead to widespread damage to crops and fencing and loss of livestock. Crop losses through rain damage, waterlogged soils, and delays in harvesting are further intensified by transport problems due to flooded roads and damaged infrastructure. The flow-on effects of reduced agricultural production can often impact well outside the production area as food prices increase due to shortages in supply. On the other hand, flood events can result in long-term benefits to agricultural production by recharging water resource storages, especially in drier, inland areas, and by rejuvenating soil fertility by silt deposition. Damage to public infrastructure affects a far greater proportion of the population than those whose homes or businesses are directly inundated by the flood. In particular, flood damage to roads, rail networks and key transport hubs, such as shipping ports, can have significant impacts on regional and national economies. Short-term downturns in regional tourism are often experienced after a flooding event. While the impact on tourism infrastructure and the time needed to return to full operating capacity may be minimal, images of flood affected areas often lead to cancellations in bookings and a significant reduction in tourist numbers. Flooding of urban areas can result in significant damage to private property, including homes and businesses. Losses occur due to damage to both the structure and contents of buildings. Insurance of the structure and its contents against flooding can reduce the impacts of floods on individuals or companies. Floods have significant consequences for the environment In many natural systems, floods play an important role in maintaining key ecosystem functions and biodiversity. They link the river with the land surrounding it, recharge groundwater systems, fill wetlands, increase the connectivity between aquatic habitats, and move both sediment and nutrients around the landscape, and into the marine environment. For many species, floods trigger breeding events, migration, and dispersal. These natural systems are resilient to the effects of all but the largest floods. The environmental benefits of flooding

can also help the economy through things such as increased fish production, recharge of groundwater resources, and maintenance of recreational environments. Areas that have been highly modified by human activity tend to suffer more deleterious effects from flooding. Floods tend to further degrade already degraded systems. Removal of vegetation in and around rivers, increased channel size, dams, levee bank and catchment clearing all work to degrade the hill-slopes, rivers and floodplains, and increase the erosion and transfer of both sediment and nutrients. While cycling of sediments and nutrients is essential to a healthy system, too much sediment and nutrient entering a waterway has negative impacts on downstream water quality. Other negative effects include loss of habitat, dispersal of weed species, the release of pollutants, lower fish production, loss of wetlands function, and loss of recreational areas. Many of our coastal resources, including fish and other forms of marine production, are dependent on the nutrients supplied from the land during floods. The negative effects of floodwaters on coastal marine environments are mainly due to the introduction of excess sediment and nutrients, and pollutants such as chemicals, heavy metals and debris. These can degrade aquatic habitats, lower water quality, reduce coastal production, and contaminate coastal food resources.

Chapter 3 : Hurricane flooding: The hidden health dangers - CNN

As most people are well aware, the immediate impacts of flooding include loss of human life, damage to property, destruction of crops, loss of livestock, and deterioration of health conditions owing to waterborne diseases.

Their impacts on health vary between populations for reasons relating to population vulnerability and type of flood event 2 5. Under future climate change, altered patterns of precipitation and sea level rise are expected to increase the frequency and intensity of floods in many regions of the world 6. In this paper, we review the epidemiologic evidence of flood-related health impacts. The specific objectives were as follows: We excluded papers that addressed only population displacement, economic losses, and disruption of food supplies. The scientific quality of these papers was assessed on a case-by-case basis. In drawing inferences, we made no exclusions from these , but we gave greatest weight to studies based on epidemiologic designs with controlled comparisons. We report and reference the main findings in this review. View large Download slide Words used in search strategy in title, abstract, or keywords. Some search terms have been truncated e. The influence of flood characteristics on health impacts is discussed where appropriate. These databases include little epidemiologic information age, gender, cause , however. Flood-related mortality has been studied in both high- 7 17 and low-income 18 21 countries. The most readily identified flood deaths are those that occur acutely from drowning or trauma, such as being hit by objects in fast-flowing waters. The number of such deaths is determined by the characteristics of the flood, including its speed of onset flash floods are more hazardous than slow-onset ones , depth, and extent 3. Many drownings occur when vehicles are swept away by floodwaters 12 , 14 , 15 , Evidence relating to flash floods in high-income countries suggests that most deaths are due to drowning and, particularly in the United States, are vehicle related 9 , Information on risk factors for flood-related death remains limited, but men appear more at risk than women Those drowning in their own homes are largely the elderly. Although the risk of deaths is most obviously increased during the period of flooding, in a controlled study of the floods in Bristol, United Kingdom, Bennet 8 reported a 50 percent increase in all-cause deaths in the flooded population in the year after the flood, most pronounced among those aged 45 64 years. Few other studies have examined such a delayed increase in deaths, but it was also reported by Lorraine 11 in relation to the storm surge flood of Canvey Island, United Kingdom, but not in two Australian studies 7 , Inconclusive evidence for diarrheal deaths has been reported from several studies of floods in low-income countries. Surveillance data showed an apparent increase of mortality from diarrhea following the floods in Khartoum, Sudan, but a similar rise was also apparent in the same period May July of the preceding year Routine surveillance data and hospital admissions records similarly showed diarrhea to be the most frequent 27 percent cause of death following the severe Bangladesh floods, but again the effect of the flood was not separately quantified from seasonal influences Injuries Flood-related injuries may occur as individuals attempt to remove themselves, their family, or valued possessions from danger. There is also potential for injuries when people return to their homes and businesses and begin the clean-up operation e. In Missouri after the Midwest floods of , injuries were reported through the routine surveillance system. Between July 16 and September 3, , a total of flood-related conditions were reported, and of these 48 percent were injuries: Similar data were also reported from Iowa Surprisingly little information is available on the frequency of nonfatal flood injuries, as they are mostly not routinely reported or identified as flood related. Fecal-oral disease In flood conditions, there is potential for increased fecal-oral transmission of disease, especially in areas where the population does not have access to clean water and sanitation. Published studies case-control studies, cross-sectional surveys, outbreak investigations, analyses of routine data have reported postflood increases in cholera 25 , 26 , cryptosporidiosis 27 , nonspecific diarrhea 18 21 , 28 31 , poliomyelitis 32 , rotavirus 33 , and typhoid and paratyphoid 34 table 1. Some of the reported relative risks associated with flooding are substantial. In Indonesia, for example, Vollaard et al. Key studies that assess the relation between flooding and health Authors, year reference no.

Chapter 4 : WHO/Europe | How flooding affects health

Flooding can affect people of all ages and while most go on to recover with the support of their families, friends and local community, for others the longer-term, indirect effects on their health, relationships and welfare can be far reaching.

Flooding and communicable diseases fact sheet Risk assessment and preventive measures Risk assessment

Floods can potentially increase the transmission of the following communicable diseases: Of the 14 major floods which occurred globally between and , only one led to a major diarrhoeal disease outbreak - in Sudan, This was probably because the flood was complicated by population displacement. Floods in Mozambique in January-March led to an increase in the incidence of diarrhoea and in , floods in West Bengal led to a large cholera epidemic 01,El Tor, Ogawa. The major risk factor for outbreaks associated with flooding is the contamination of drinking-water facilities, and even when this happens, as in Iowa and Missouri in , the risk of outbreaks can be minimized if the risk is well recognized and disaster-response addresses the provision of clean water as a priority. In Tajikistan in , the flooding of sewage treatment plants led to the contamination of river water. Despite this risk factor, no significant increase in incidence of diarrhoeal diseases was reported. A typhoon in Truk District, Trust Territories of the Pacific in disrupted catchment water sources and forced people to use many different sources of groundwater that were heavily contaminated with pig faeces. As a result, there was an outbreak of balantidiasis, an intestinal protozoan. A cyclone and flooding in Mauritius in led to an outbreak of typhoid fever. There is an increased risk of infection of water-borne diseases contracted through direct contact with polluted waters, such as wound infections, dermatitis, conjunctivitis, and ear, nose and throat infections. However, these diseases are not epidemic-prone. The only epidemic-prone infection which can be transmitted directly from contaminated water is leptospirosis, a zoonotic bacterial disease. Transmission occurs through contact of the skin and mucous membranes with water, damp soil or vegetation such as sugarcane or mud contaminated with rodent urine. The occurrence of flooding after heavy rainfall facilitates the spread of the organism due to the proliferation of rodents which shed large amounts of leptospores in their urine. It is likely that environmental changes increased the vector rodent population which facilitated transmission. Vector-borne diseases Floods may indirectly lead to an increase in vector-borne diseases through the expansion in the number and range of vector habitats. Standing water caused by heavy rainfall or overflow of rivers can act as breeding sites for mosquitoes, and therefore enhance the potential for exposure of the disaster-affected population and emergency workers to infections such as dengue, malaria and West Nile fever. Flooding may initially flush out mosquito breeding, but it comes back when the waters recede. The lag time is usually around weeks before the onset of a malaria epidemic. Malaria epidemics in the wake of flooding are a well-known phenomenon in malaria-endemic areas world-wide. Periodic flooding linked to El Nino-Southern Oscillation ENSO is associated with malaria epidemics in the dry coastal region of northern Peru and with the resurgence of dengue in the past 10 years throughout the American continent. West Nile Fever has resurged in Europe subsequent to heavy rains and flooding, with outbreaks in Romania in , in the Czech Republic in and Italy in The risk of outbreaks is greatly increased by complicating factors, such as changes in human behaviour increased exposure to mosquitoes while sleeping outside, a temporary pause in disease control activities, overcrowding , or changes in the habitat which promote mosquito breeding landslide, deforestation, river damming, and rerouting. Risk posed by corpses Contrary to common belief, there is no evidence that corpses pose a risk of disease "epidemics" after natural disasters. Most agents do not survive long in the human body after death with the exception of HIV -which can be up to 6 days and the source of acute infections is more likely to be the survivors. Human remains only pose health risks in a few special cases requiring specific precautions, such as deaths from cholera or haemorrhagic fevers. Exposure to bloodborne viruses occurs due to direct contact with non-intact skin of blood or body fluid, injury from bone fragments and needles, or exposure to the mucous membranes from splashing of blood or body fluid. Gastrointestinal infections are more common as dead bodies commonly leak faeces. Transmission occurs via the faeco-oral route through direct contact with the body and soiled clothes or contaminated vehicles or equipment. Dead bodies contaminating the water supply may also cause gastrointestinal infections. The public

and emergency workers alike should be duly informed to avoid panic and inappropriate disposal of bodies, and to take adequate precautions in handling the dead see prevention below. Other health risks posed by flooding These include drowning and injuries or trauma. Tetanus is not common after injury from flooding, and mass tetanus vaccination programs are not indicated. However, tetanus boosters may be indicated for previously vaccinated people who sustain open wounds or for other injured people depending on their tetanus immunization history. Passive vaccination with tetanus immune globulin Hypertet is useful in treating wounded people who have not been actively vaccinated and those whose wounds are highly contaminated, as well as those with tetanus. Hypothermia may also be a problem, particularly in children, if trapped in floodwaters for lengthy periods. There may also be an increased risk of respiratory tract infections due to exposure loss of shelter, exposure to flood waters and rain. Power cuts related to floods may disrupt water treatment and supply plants thereby increasing the risk of water-borne diseases as described above but may also affect proper functioning of health facilities, including cold chain.

Chapter 5 : Health Effects of Hurricane and Flooding

The main health impacts are deaths, injuries and mental health illnesses during the flood event itself, during the restoration process, or from knock-on effects brought about by damage to major infrastructure including displacement of populations.

Thirteen Hurricane landed over Florida and 12 over Louisiana. The Hurricane Harvey poured Financial Burden and Health Issues Linked to Hurricanes- Flooding results in huge financial losses and major health issues. The repair and reconstruction cost after devastation following Hurricane Katrina was over billion dollars. The structural damages caused by hurricane Harvey were far worse than Hurricane Katrina and cost to rebuild affected cities and town could be over billion dollars. The property damages, stoppage of industries and restricted transport system causes loss of job and income. The cost of health management post hurricane is also additional expenses. The most common medical problem observed in the past 3 decades following flooding in North America due to hurricanes were personal injuries, mental issues, diarrhea and upper respiratory tract infection. The flooding as observed following hurricane Harvey can create major health issues on top of structural damages of roads, bridges, sewer system, residential and commercial properties. Flooding and Health Issues Caused by Hurricanes- Flooding occurs when rain water is far more in volume than the capacity of sewer drainage system to remove the water. Excess water over the land initially soaks into the ground or passes through sewer system in to sea or river in most urban and rural areas. Once the ground is saturated and sewer system is flooded with water then the storm water or runoff water starts collecting over the ground. The level of water over the ground increases if volume of water falling by rain is much higher in volume than the water drained by sewer system. Collection of stagnant water over the land is known as flooding. Flooding is observed when the volume of rainfall is much higher as seen following Hurricane of category 2 or higher as in case of hurricane Katrina and hurricane Harvey. The drainage of water from sewer system is often restricted when level of sea or river is higher than the water level over the land. The restriction of water flow in to river or sea is further slowed down because of large volume of debris blocking the sewer system. Once rain stops, the water is drained out in few hours or days if drainage system is efficient and not blocked. The water level may remain high for several days if drainage pipes are inefficient because of debris covering the lumen and stuck to wall of the drainage system. The repair workers and technicians in most cases are often unable to locate the area of blockade for several hours or days. The diseases are less wide spread if flood water is drained out in 3 to 4 days once the rain stops. In USA the increase number of cases of diarrhea and respiratory infection were observed following prolonged flooding as in Louisiana after Hurricane Katrina and New York after hurricane Sandy. Epidemic Health Problems That Arise After Hurricanes The epidemic health problems are the major issues following flooding in tropical and subtropical areas. The mosquito carrying viral and protozoal infection become epidemic diseases in tropical countries following flooding. The endemic diseases in tropical as well as subtropical areas like malaria, zika virus infection, dengue fever, viral hemorrhagic fever, yellow fever and leishmaniasis spreads as an epidemic disease following floods as mosquito population increases. The communicable diseases are often seen in area where sanitation is of lower quality and population is dense resulting in crowding of houses. In USA the diseases that are carried by mosquitoes are rare and eradicated, thus epidemics of mosquito or tick carrying diseases were not observed during last 3 decades following hurricane and flooding. The most common health issues observed following previous hurricane in USA were personal injuries, mental illnesses, upper respiratory illnesses and few cases of diarrhea. The minor increase number of zika virus was observed in Florida and Louisiana after hurricane Katrina. The personal injuries in most cases are drowning, crush injuries and blunt trauma. Spread of communicable diseases are not observed following past flooding in USA. The waterborne diseases like diarrhea and upper respiratory tract infection were observed following previous flooding in USA. The published studies also suggest the mosquito breeding was observed over pocket of water left after flooding is drained. The breeding includes Culex mosquitoes and Aedes mosquitoes. Culex mosquitoes carry West Nile, as well as St. Louis encephalitis and Japanese encephalitis. Aedes aegypti are the primary carriers for Zika, as

well as dengue, chikungunya, and yellow fever. In USA during last 3 decades following several hurricanes epidemics of vector borne diseases were not recorded, though increased number of vector were observed. In few cases delayed increase in number of West Nile diseases were observed in areas affected by Katrina. Nuisance mosquitoes observed in Texas during transmission season were not found to carry any viruses or protozoa. Water Contamination and Health Problems Caused Due to Hurricanes- The human and animal discharges consisting viruses, bacteria and protozoa lies on dry ground in inactive dormant stage. The viruses, bacteria and parasites rapidly multiples in flooded water resulting in contamination of flood water. Stagnant flood water over the street and land causes rapid mixing of debris, soil, feces and urine. The flood water also mixes with solid content of sewer system. The soil and content of sewer system carries expectorant, sputum, feces, urine and purulent discharges which may be mixed with viruses, bacteria and protozoa from infected individual. Flood water may also mix with content of sewer treatment plant, which may also contain viruses, bacteria and parasites. The contaminated flood water eventually is discharged into river and sea. The efficient drainage system removes the contaminated water once the rain stops. Once the flood water level is removed then the pocket of water over the land may become a breeding ground for mosquitoes and ticks. Since the mosquito transmitted diseases are extremely rare in USA, the increased number of mosquitoes may not reflect increase number of vector borne diseases. The only health issue predominantly observed following flooding in USA were injuries, diarrhea, respiratory illnesses and psychological illnesses. Psychological illnesses observed after hurricanes were depression, anxiety, increased cases of substance abuse¹ and sleep deprivation because of financial crisis. In few countries, mold exposure were increased resulting in increased upper respiratory symptoms. Mold exposure and health effects following hurricanes Katrina and Rita.

Chapter 6 : What are the effects of flooding?

Worldwide, floods are the most common natural disaster and produce a broad array of health impacts. In Canada, it is difficult to quantify all of the health impacts associated with flooding. This data gap is salient because of the increasing risks floods are posing to society as a result of climate.

Advanced Search A recent visit to the city of New Orleans is enough to bring home the long-term effects of flooding and natural disasters on individuals and communities. This time the levees held, and there was no widespread flooding. New Orleans is still trying hard to rebuild itself after Hurricane Katrina. Although the Unified New Orleans Plan Citywide Strategic Recovery and Rebuilding Plan seeks to rebuild the damaged city, and deal with some of the chronic problems affecting the city before the hurricane, public services have struggled to cope few of the state primary schools are yet open, and public health services such as psychiatric beds are in short supply, many having failed to re-open after the Hurricane. Many houses are left uninhabitable and derelict. The disaster has taken its toll on health; one study has shown that death rates in New Orleans in were almost half as much again as their 2003 rates 1. There is evidence that damage to the infrastructure has reduced access to mental health services, both for existing patients with mental health disorders and for those with new conditions 2. And yet there has been a significant and continued rise in the prevalence of mental health disorders 2 years post-Katrina, with an increase in the prevalence of post-traumatic stress disorder, serious mental illness and suicide ideation 3. Evidence also shows that a fifth of those with chronic medical conditions cut back their treatment in the month period after the hurricane, with disruptions in treatment more common in the non-elderly, uninsured, socially isolated and those with relatively asymptomatic conditions 4. Reasons included problems accessing physicians, insurance and financial difficulties and transportation. In the UK, in summer of , floods affected communities, particularly in Hull, Worcestershire and Gloucestershire. A total of homes, owned by the council were flooded. The Pitt Review Learning Lessons from the floods 6 subsequently commissioned in the UK was published earlier this year. This comprehensive review examined all aspects of flood planning and management. With respect to health, it concluded that although there was little evidence of the long-term health effects and impact of flooding, the limited evidence available suggested that there are significant short- and long-term impacts on psychosocial health. Children moving out of their home were more likely to suffer emotional health problems. Debt related problems were common, leading to a large increase in calls to Citizens Advice Bureau. Preliminary findings from a research study funded by the ESRC and the Environment Agency and being undertaken by Lancaster University, following up in depth 45 residents of Hull affected by flooding have demonstrated many are suffering depression, with hardship in temporary accommodation, negotiating with insurance companies and mortgage companies while their houses are rebuilt, loss of social contact and strain on personal relationships. However, even those returning to their homes can experience ongoing anxiety, a lack of security, anxiety and loss of a sense of home. These impacts extend beyond individual families to the community, both in terms of damage and usability of existing community facilities and changes in traditional support networks because of displaced families. The Review has recommended that monitoring of the impact of flooding on the health and well being of the people and actions to mitigate and manage the effects should form a systematic part of the work of local Recovery Co-ordinating Groups, and that local responses need to ensure that health and well-being support is readily available to those affected by flooding. Additionally, it recommends that community networks, effective tools in reducing the psychosocial impact, need to be actively supported at local level. The Review specifically highlighted the need for consistent guidance about living or moving back into a damp home, given the psychological and physical ill health effects of having to stay out of ones home. Flooding has created significant health problems in both the USA and the UK, two of the wealthiest countries in the world. How much more challenging will it be to deal with the long-term effects of flooding on health on those in developing countries, such as Bihar, India, where an estimated 3 million people have been displaced by flooding in August ? Dealing with, and mitigating the short- and long-term health impacts of flooding is likely to be a key public health challenge for the 21st Century.

The long term effects of flooding on psychological health may perhaps be even more important than illness or injury. For most people the emotional trauma continues long after the water has receded. Making repairs, cleaning up, and dealing with insurance claims can be stressful.

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Extensive water damage after major hurricanes and floods increases the likelihood of mold contamination in buildings. This report provides information on how to limit exposure to mold and how to identify and prevent mold-related health effects. Evidence is included about assessing exposure, clean-up and prevention, personal protective equipment, health effects, and public health strategies and recommendations. For the majority of persons, undisturbed mold is not a substantial health hazard. Mold is a greater hazard for persons with conditions such as impaired host defenses or mold allergies. To prevent exposure that could result in adverse health effects from disturbed mold, persons should 1 avoid areas where mold contamination is obvious; 2 use environmental controls; 3 use personal protective equipment; and 4 keep hands, skin, and clothing clean and free from mold-contaminated dust. Clinical evaluation of suspected mold-related illness should follow conventional clinical guidelines. In addition, in the aftermath of extensive flooding, health-care providers should be watchful for unusual mold-related diseases. The development of a public health surveillance strategy among persons repopulating areas after extensive flooding is recommended to assess potential health effects and the effectiveness of prevention efforts. Such a surveillance program will help CDC and state and local public health officials refine the guidelines for exposure avoidance, personal protection, and clean-up and assist health departments to identify unrecognized hazards. After both storms, levees were breached, leading to massive flooding in New Orleans and surrounding parishes. The duration of flooding, the extent of flooding, and the number of structures flooded in New Orleans as a result of hurricanes Katrina and Rita in August and September made the likelihood of massive mold contamination a certainty. Many structures remained flooded for weeks after the hurricane and became saturated with water. The number of structures affected was much smaller in North Dakota than in New Orleans, and the population affected in North Carolina was much more dispersed than the population affected in New Orleans. In North Carolina, a reported increase in persons presenting with asthma symptoms was postulated to be caused by exposure to mold 2. In , flooding and subsequent mold growth on the Turtle Mountain reservation in Belcourt, North Dakota was associated with self-reports of rhinitis, rash, headaches, and asthma exacerbation 3. Methods This document was initially prepared by CDC as a guide for public health officials and the general public in response to the massive flooding and the anticipated mold contamination of homes and other structures along the U. Gulf Coast associated with hurricanes Katrina and Rita 4. A workgroup was convened of CDC staff with expertise in relevant subject areas. This included medical epidemiologists, environmental epidemiologists and occupational epidemiologists, industrial hygienists, infectious disease physicians and mycologists. The framework for the document was decided by consensus discussions, and workgroup members were assigned to research and to write different sections. The members produced individual written summaries, which formed the basis of the report. Wherever possible, recommendations were based on existing recommendations or guidelines. Where adequate guidelines did not exist, the guidelines were based on CDC experience and expertise. This revised version is intended to more broadly address public health concerns related to limiting exposure to mold and identifying, preventing, and managing mold-related health effects following any natural disasters or other occurrences that results in flooding or major water intrusion. Published guidelines, established standards, and the peer-reviewed literature were reviewed to ensure the accuracy and consistency of the recommendations. In addition, the document was sent for stakeholder review and external peer review by experts in the areas of worker protection, general public health, medical, environmental and occupational epidemiology, allergy, industrial hygiene, mycology, and pulmonology. A Definition Molds, mushrooms, mildews, and yeasts are all classified as fungi, a kingdom of organisms distinct from plants and animals. Fungi

differ from plants and animals in several respects. Unlike animals, fungi have cell walls. However, unlike plants, which also have cell walls, fungal cell walls are made mostly of chitin and glucan. Fungi cannot produce their own nutrients as plants do through photosynthesis. Fungi secrete enzymes that digest the material in which the fungi are imbedded and absorb the released nutrients. Multicellular fungi do not differentiate into different organs or functional components the way plants and animals do 5. Approximately , species of fungi exists; fewer than fungal species have been described as human pathogens that can cause infections 5. Visible growth of multicellular fungi consisting of branching filamentous structures mycelia are known popularly as molds 5 and are referred to by that term in this report. Molds are ubiquitous in nature and grow almost anywhere indoors or outdoors. The overall diversity of fungi is considerable. For example, the genus *Aspergillus* has at least known species 6. Molds spread and reproduce by making spores, which are small and lightweight, able to travel through air, capable of resisting dry, adverse environmental conditions, and capable of surviving a long time. The filamentous parts of mold hyphae form a network called mycelium, which is observed when a mold is growing on a nutrient source. Although these mycelia are usually firmly attached to whatever the mold is growing on, they can break off, and persons can be exposed to fungal fragments. Molds also contain substances known as beta glucans; mVOCs and beta glucans might be useful as markers of exposure to molds 7. Some molds are capable of producing toxins sometimes called mycotoxins under specific environmental conditions, such as competition from other organisms or changes in the moisture or available nutrient supply. Molds capable of producing toxins are popularly known as toxigenic molds; however, use of this term is discouraged because even molds known to produce toxins can grow without producing them 6. Many fungi are capable of toxin production, and different fungi can produce the same toxin 6. Factors That Produce Mold Growth Although molds can be found almost anywhere, they need moisture and nutrients to grow. The exact specifications for optimal mold growth vary by the species of mold. However, mold grows best in damp, warm environments. The availability of nutrients in indoor environments rarely limits mold growth because wood, wallboard, wallpaper, upholstery, and dust can be nutrient sources. Similarly, the temperature of indoor environments, above freezing and below the temperature for denaturing proteins, can support mold growth, even if the actual temperature is not optimal 8. The primary factor that limits the growth of mold indoors is lack of moisture. Substantial indoor mold growth is virtually synonymous with the presence of moisture inside the building envelope. This intrusion of moisture might be from rainwater leaking through faulty gutters or a roof in disrepair, from a foundation leak, from condensation at an interface e. Water also can come from leaks in the plumbing or sewage system inside the structure. Studies of mold growth on building materials, such as plywood, have found that mold grows on materials that remain wet for hours 8. Flooding, particularly when floodwaters remain for days or weeks, provides an almost optimal opportunity for mold growth. Inhalation is usually presumed to be the most important mechanism of exposure to viable live or nonviable dead fungi, fungal fragments or components, and other dampness-related microbial agents in indoor environments. Inhalation exposure to a fungal spore requires that the spore be initially aerosolized at the site of growth. Aerosolization can happen in many ways, ranging from disturbance of contaminated materials by human activity to dispersal of fungi from contaminated surfaces in heating, ventilating, and air-conditioning HVAC systems. Fungal spores also can be transported indoors from outdoors. Overall, the process of fungal-spore aerosolization and related issues e. Persons can be exposed to mold through skin contact, inhalation, or ingestion. Because of the ubiquity of mold in the environment, some level of exposure is inevitable. Persons can be exposed to mold through contact with airborne spores or through contact with mycelial fragments. Exposure to high airborne concentrations of mold spores could occur when persons come into contact with a large mass of mold, such as might occur in a building that has been flooded for a long time. Exposure to mycelia fragments could occur when a person encounters a nutrient source for mold that has become disrupted, such as would occur during removal of mold-contaminated building material. Skin contact or exposure by inhalation to either spores or mycelial fragments also could occur in a dusty environment, if the components of dust include these fungal elements. For the majority of adverse health outcomes related to mold exposure, a higher level of exposure to living molds or a higher concentration of allergens on spores and mycelia results in a greater likelihood of illness. However, no standardized method

exists to measure the magnitude of exposure to molds. In addition, data are limited about the relation between the level of exposure to mold and how that causes adverse health effects and how this relation is affected by the interaction between molds and other microorganisms and chemicals in the environment. For this reason, it is not possible to sample an environment, measure the mold level in that sample, and make a determination as to whether the level is low enough to be safe or high enough to be associated with adverse health effects. Persons affected by major hurricanes or floods probably will have exposure to a wide variety of hazardous substances distributed by or contained within the floodwater. This report does not provide a comprehensive discussion of all such potential hazards; such situations will of necessity require case by case evaluation and assessment.

Factors That Cause Disease from Mold Numerous species of mold cause infection through respiratory exposure. In general, persons who are immunosuppressed are at increased risk for infection from mold. Immunosuppression can result from immunosuppressive medication, from medical conditions and diseases that cause immunosuppression, or from therapy for cancer that causes transient immunosuppression. Although certain species of mold cause infection 5,8,11, many mold species do not cause infection. Infections from mold might be localized to a specific organ or disseminated throughout the body. Many of the major noninfectious health effects of mold exposure have an immunologic i. Exposure to mold can sensitize persons, who then might experience symptoms when re-exposed to the same mold species. For sensitized persons, hay fever symptoms and asthma exacerbations are prominent manifestations of mold allergy 6. Although different mold species might have different propensities to cause allergy, available data do not permit a relative ranking of species by risk for creating or exacerbating allergy. In addition, exposure to beta glucans might have an inflammatory effect in the respiratory system. Prolonged exposure to high levels of mold and some bacterial species can produce an immune-mediated disease known as hypersensitivity pneumonitis. Clinically, hypersensitivity pneumonitis is known by the variety of exposures that can cause this disorder e. Ingesting toxins that molds produce can cause disease. Longterm ingestion of aflatoxins produced by *Aspergillus* species has been associated with hepatocellular cancer. In addition, ingestion of high doses of aflatoxin in contaminated food causes aflatoxicosis and can result in hepatic failure. Whether concentrations of airborne mold toxins are high enough to cause human disease through inhalation is unknown, and no health effects from airborne exposure to mold-related toxins are proven.

General Guidelines Assessing Exposure to Mold

Exposure Assessment Any structure flooded after hurricanes or major floods should be presumed to contain materials contaminated with mold if those materials were not thoroughly dried within 48 hours 15. In such cases, immediate steps to reduce the risk for exposure to mold are likely to be of greater importance than further exposure assessment steps presented below. Assessing the level of human exposure to mold in flooded buildings where mold contamination is not obvious is often a central and ongoing activity in recovery related to hurricanes and floods. Understanding the strengths and limitations of the approaches that are available to assess such exposures is important. Buildings that were not flooded could also have mold. For example, buildings with leaking roofs or pipes, which allows water to penetrate into biodegradable building materials, or excessive humidity, particularly buildings built with biodegradable materials, are susceptible to mold growth 2.

Chapter 8 : What are the consequences of floods? (Office of the Queensland Chief Scientist)

Health effects observed during and after floods include injuries, infections, poisoning and greater mental-health problems. Outbreaks of infectious disease are rare. The longer-term health effects result from displacement, shortages of safe water, injuries, disruption of access to health services and delayed recovery.

The authors made the decision to include hurricanes leading to flooding because of the difficulties in classifying disasters. We concluded that it was important to include the extensive data on the mental health of people affected by hurricanes because of the health impacts of the floods immediately following Hurricane Katrina. The majority of papers that the authors reviewed consider population samples of adults who are affected by a particular flood. A number of papers report research on samples taken from specific populations: The majority of the studies were cross-sectional. The timing of the studies, relative to the flood considered by the research, varied from data collected pre-event, to data collected after zero to two weeks, and up to eight years after flooding. However, the vast majority of the studies took place between six months and 24 months after the index event. The size of the population samples was also very diverse, ranging from 50 to 33, people. The intention was to identify documents in the public domain that outline, directly or by implication, models of care for responding to the psychosocial and mental health impacts of disasters in general and, if possible, flooding in particular. In this regard, we were greatly assisted by advice from experts. As a result, the authors analysed the content of guidance documents, research reports, and other papers. They include the current policy on psychosocial and mental health care in the set of contemporary emergency preparedness guidance published by the Department of Health for England 59 and a report on the research conducted by the University of Lancaster on the psychosocial and welfare impacts of the floods that occurred in England in . Each of the documents that the HPA reviewed offers practical guidance for policymakers, strategic and operational managers, public health services and clinical services. Flooding affects people of all ages and it can herald: Recovery from distress after disasters, including flooding, is characterised by adaptation to circumstances that have changed and by rebuilding communities. Many people experience distress that may be relatively transient after any disaster and being distressed temporarily is not antithetical to people also being resilient. Furthermore, the wider literature shows that the experiences of people who are distressed in the aftermath of all disasters including floods, are not always easy to distinguish from the symptoms of common mental disorders. On the other hand, the research suggests that the incidence and prevalence of common mental disorders after flooding is substantially increased and that these disorders can persist long after the flooding has passed. This stresses the importance of planning for and providing effective and timely public mental health and clinical responses. The threshold between what might be considered a common or anticipated response to an extreme event and what is indicative of a person developing a disorder are difficult to define. The authors found that the focus in the literature is on post-traumatic stress disorder PTSD. While that is valuable, it is also accompanied by a relative neglect of the crucial wider background morbidity that is found in all populations, including after disasters. For example, depression is a diagnosis that is under-represented in the published data. When considering PTSD, findings reveal that the symptoms may not decline over time as quickly as was thought previously. The authors found, though, that social cohesion has a significant effect on susceptibility to symptoms of PTSD and it, therefore, must be considered when developing public health strategies. As regards people who develop mental disorders, risk factors and co-variants did not have a constant association with poorer mental health across all the studies, partly due to methodological differences and partly because of the unique characteristics of each flood. However, as in general population studies, levels of exposure to the event s , gender, age, and socio-economic status were generally associated with mental ill health. There is a lack of studies which have investigated the impact of flooding on the mental health of children, young people and older people. There are, however, indications that both children and older people suffer PTSD after flooding and that the prevalence figures may well be greater than those that are found for adults of working age. Evidence-based guidance on the factors that could influence the course of an illness are valuable when developing tools to minimise the psychosocial and mental

health impacts of flooding. As an example, the extended timeframe of the impacts of flooding on people, their homes and their communities are such that the effects of secondary stressors are highly important because they prolong the welfare, physical and psychosocial impacts. Recognition of the longer timeframe in which adequate welfare, psychosocial and mental healthcare responses are required is an important lesson that has been learned from floods in the past, and that lesson is supported strongly by the findings from the review. In addition, other guidance 55 56 57 58 60 61 62 64 and research 63 which offers theoretical standpoints and outline, directly or by implication, models of care for responding to the psychosocial and mental health impacts of disasters were also reviewed. The documents offer access to practical guidance for managers, public health services and clinical services. The key themes that emerge from this guidance include: The Strategic Stepped Model of Care allows planners to take into account sources of personal and collective social support, and how responses to events are developed. It also allows psychosocial care and mental healthcare to be planned and delivered in integrated ways that follow the trajectories of the needs of people who require them. Thereby, the responsible authorities can create a dynamic, flexible and needs-led approach to mounting effective responses to flooding. Understanding the overlaps between the steps can be facilitated by incorporating knowledge of the: Nature of each flood and its consequences; Primary and secondary stressors; and Means of delivering care. Public health measures that are put in place after floods should include considering the social as well as psychological impacts of events, and especially because evidence suggests that good social support can act as a protective factor against negative psychological and psychiatric impacts of being flooded. Furthermore, recently published results from a randomized trial provide provisional evidence that psychosocial interventions, which target the resilience resources e. People who are affected need responding organisations to: Understanding flooding in these terms should aid and direct the responses from services as well as from communities. This applies not only to initial emergency responses, but also to support and reconstruction during recovery as many people and communities can experience continuing social and economic disruption after flooding. A multi-sector approach that involves communities and families as well as agencies is the best way to achieve these effects. It is important to recognise that family and community assets are vitally important to maintaining and promoting personal and collective psychosocial resilience. Everyone is likely to require continuing psychosocial support. However, some people require assessment by primary care services if their symptoms persist or are associated with dysfunction. A smaller proportion of people is likely to require referral for specialised mental healthcare. These findings support the requirement for a public mental health approach to flooding that comprises both universal and targeted plans and interventions, which are well coordinated with adequate, timely access for people in need as well as long-term availability of specialist care for a sizeable minority of affected people. It is important to understand stress, and the stressors that are inflicted upon people by floods and how they cause short-term distress in many people, influence their medium- and longer-term wellbeing, and affect the mental health of persons and populations. Primary stressors are inherent in all disasters and encompass any experiences that people have that are directly related to, or consequent on their exposure to disasters. A majority of people experience distress after disasters. But, personal and collective psychosocial resilience are inherent in each population, and families, communities and non-statutory and statutory services offer protection for people against psychosocial adversity during and after extreme events. Secondary stressors follow on from, or are consequential on primary stressors: Secondary stressors often arise during the responses to the clean up, recovery and rebuilding phases after flooding. Support networks may not provide enough support for a small proportion of people, or some people may not recover from distress even though stressors are removed. In this situation, more persistent problems, or mental disorders, can develop, or pre-existing ones are provoked. People who are affected in these ways should be assessed by the primary care services and some of them require treatment by the specialist mental health services. The lack of universally agreed definitions used when researching disasters. In addition to these inconsistencies, the recent literature on disasters, especially that on flooding, has tended to focus on the single and narrow concept of PTSD. The result is that, first, less research has been conducted on the psychosocial needs of people who are distressed rather than disordered. Second, the canon of research has tended to neglect the crucial wider and, sometimes, more prevalent morbidity that is found in all populations, including that

which affects people who are involved in flooding. This is why much of the evidence relates to people who develop a narrow selection of mental disorders. There are two other groups of people about which healthcare services need to know more: In general terms, more research is required, which studies: When specific plans or protocols are developed for intervening with people who have particular disorders, they should reflect real situations in which co-morbidity is an important matter for treatment algorithms; The consequences and implications of diagnosing PTSD after people are flooded; and The mechanisms for people developing, and the consequences of them having, PTSD, including their rates and trajectories of recovery. The methodological variables and limitations that the HPA identifies in its report point to the importance of improving the quality of research. Further research should focus on: Using overt definitions of psychosocial need, mental health and mental ill health that are agreed, understood and used internationally and which include overt thresholds for caseness; Achieve development of systems for cross comparison of research findings; and Take forward findings to formal meta-analysis to identify better welfare and public health guidance and professional practice. We identify the requirement for more research on: This would help the research community to address: The authors did not explore in their report the secondary health impacts of disasters, the pathways from disasters to mental ill health, or the consequential impacts of developing a mental disorder. The authors considered one study that researched the somatic effects of mental ill health ⁹, another that researched substance misuse ⁵⁰, and others that have considered gender-based violence ^{27 28}. They conclude that clarification is required about what constitutes best practice in each of these areas. Together, the peer-reviewed research papers and guidance reported by the HPA allow the authors of that report to make recommendations for a variety of public agencies. They are presented here in general terms so that they can be interpreted and applied in all countries and jurisdictions. Policymakers It is clear that there is sufficient evidence available to show that the short- and long-term psychosocial and mental health consequences of flooding should be a high priority for policymakers. Development of evidence-based policy in this area should be a priority for people who are responsible for planning for and responding to emergencies, healthcare, social care, and mental healthcare services. Government organisations are advised to work with research funding agencies to identify priorities and to develop research evidence of increasing quality and relevance to policymakers. Emergency Planners People who have responsibilities for emergency preparedness within governmental, non-governmental, service planning, and delivery organisations, and within the commercial sector, should also consider the short- and long-term psychosocial and mental health consequences of flooding. They should work with the agencies that are responsible for managing the environments in which people live to achieve these aims because measures for preventing floods can reduce the health impacts on populations. Social Care Services The concept of psychosocial resilience, with its personal and collective components, points to the importance of mitigating the distressing effects as well as the social and health risks posed by flooding. These actions are important components of Psychological First Aid ⁶⁸, which is now agreed internationally to be an important set of principles for psychosocial care. Healthcare Services All healthcare agencies should be aware of the distress that flooding may cause people who are affected. The literature is not clear about the impact of floods in provoking more people than might otherwise do so to develop anxiety disorders, depression and PTSD. This is because of limited availability of population comparisons, and before and after evaluation studies. Local healthcare services should be aware that a substantial minority of people may develop mental disorders in the medium- and longer-terms after flooding. This health intelligence should inform the preparedness of healthcare agencies and their practical plans. Specialist mental healthcare agencies should be prepared to provide advice to emergency planners, community healthcare services, and social care organisations. They should also be available to deliver focused specialist services for people who may have mental disorders that are provoked or exacerbated by their involvement in floods. Conclusions The frequency of floods is increasing. The mortality relating to flooding is variable and depends on the enormity or otherwise of each extreme event and the capability of the rescue and recovery services. But, when compared with other types of disaster, the mortality may be interpreted as low when floods occur in well-prepared areas of the world. However, this should not blind policymakers, service designers and practitioners to the substantial morbidity that is posed by flooding. It identifies clearly the

requirement for more research that is of improved clarity of purpose and method. The need for greater discipline in defining and using terminology is another important message. The authors identify the implications of their review for policymakers, the responsible government agencies, and health and social care services.

The health dangers from Hurricane Harvey's floods and Houston's chemical plants. per the World Health there will be several competing effects on the population of mosquitoes and the.

What are the human health consequences of flooding and the strategies to reduce them? The issue Floods are the most common natural disaster causing loss of life and economic damage in Europe, which experiences three types of floods: Flash and riverine floods result from two main groups of meteorological events. In large- and medium-sized river basins in north and central Europe, flooding usually results either from wide-ranging and continuous precipitation or from snowmelt in connection with high antecedent soil saturation. Findings The adverse human health consequences of flooding are complex, far-reaching and difficult to attribute to the flood event itself. There is very limited quantitative evidence of the health impacts of floods. The main health impacts are deaths, injuries and mental health illnesses during the flood event itself, during the restoration process, or from knock-on effects brought about by damage to major infrastructure including displacement of populations. On average, the higher the water depth and the greater the flow velocity of a flood, the greater the damage to property. Most flood-related deaths can be attributed to rapid rise floods. Floods with fewer deaths and severe injuries were attributed to mild temperatures, government rescue plans, civilian rescue operations and disaster occurrence at times when most people were at home. Other health problems and injuries were reduced by measures taken by trained military personnel and by distribution of boots and gloves to other responders. Driving into flood waters is dangerous, as cars can become buoyant and swept away. The fatal effects of slow-rise river floods proved to be lower if people were aware of the risk of flooding and better prepared for a potential disaster. Sprains, strains, lacerations, abrasions and contusions are the most commonly reported injuries following floods. The risk of communicable disease outbreaks following flooding is small in industrialized countries excluding tropical regions of industrialized countries like Australia due to effective water treatment and sewage pumping, safe drinking-water, and public health infrastructure. However, national ministries and governments might need to take additional action on case-by-case bases. Providing accurate information on safe management of flood water during evacuation and clean-up and on the actual situation is essential. Chronic health effects followed by flooding were explained by exposure to human and animal viruses during evacuation, or substantial psychological or physical stress at the time of flooding. Furthermore, flooding is associated with increased rates of anxiety and depression stemming from the experience itself, troubles brought about by geographic displacement, damage to the home or loss of familiar possessions and stress in dealing with builders and other repair people in the aftermath. The persistence of flood-related health effects is directly related to flood intensity. A comprehensive surveillance of morbidity from floods is limited, however. Hospitals, ambulances, retirement homes, schools and kindergarten in flood-prone are at risk, and evacuation of patients and vulnerable groups might represent a further risk. Policy considerations There is a need to shift emphasis from disaster response to risk management; to improve flood forecasting; to establish early warning systems, and to include health actors in the communication flow. Risk management in this area must cover a broad field, including health impact assessment of flood structural measures, regulations concerning building in flood prone areas, insurance policies, etc. The harmful effects of flooding can be reduced by building codes, legislation to relocate structures away from flood-prone areas, planning appropriate land use and migration measures. The evidence, however, is inadequate concerning the effectiveness of comprehensive, risk-based emergency management programmes for reducing the adverse health effects of floods. The elderly, disabled, children, women, ethnic minorities and those on low incomes have been shown to be more vulnerable than others to the effects of flooding and may need special consideration during the response and recovery periods. However, more good-quality epidemiological data on these issues is still needed. Sources Hajat S, et al. The human health consequences of flooding in Europe and the implications for public health: Applied Environmental Science and Public Health, , 1 1: Accessed 10 December