**Urban Flood**

**Overview**

Urban floods can arise from extreme thunderstorms or from river overflow. Both rapid rise and slow rise floods can have a significant impact on public health in an urban area.1 While the adverse health effects of flooding include direct impacts on human health, the pathways can be complicated and indirect.

**Health impacts**

**Disruption to essential health care.** Treatment for serious illnesses, such as cancer, can be disrupted by flooding, due to transport infrastructure being knocked out for prolonged periods of time.2 Health care practitioners may also become overwhelmed by the increased demand for services.1

**Drowning or physical trauma.** Rapid rise floods can cause sudden changes to the environment, increasing the risk of drowning and injuries.3 Slow rise floods can also be deadly when there is a lack of preparedness.1

**Illnesses.** Diseases can be spread from undisinfected groundwaters by the onset of flooding.4 Increased instances of cholera5, diarrheal diseases5, hepatitis A and E5, leptospirosis5, melioidosis6, respiratory infections7, and typhoid5 have been observed after floods in urban areas.

**Malaria.** Epidemics in the wake of flooding in tropical regions can occur due to clogging of storm water drains, causing stagnant water to allow genesis of vectors of malaria.7,8

**Malnutrition.** Damage to infrastructure caused by flood, and disruption to food systems can cause appropriate food to be unavailable for prolonged periods, with children and the elderly particularly vulnerable.9

**Psychological distress.** The mental health effects of a flood can last long after the flood itself, with reports of increased prevalence of psychological morbidity (including depression, anxiety, PTSD) in residents up to 1 year after floods, particularly if residents are displaced at short notice.10,11

**Deliverables**

**Clear messaging of probability, lead times and spatial scales.** Improving believability of flood forecasts can be improved by having clearer messaging on the predictability and processes of weather systems. The trustworthiness of flood forecasts can increase the changes of appropriate action and response by a vulnerable population .12,13

**‘Warn on forecast’.** Hurricane Sandy success in its pre-hurricane reporting (at x days before the event) enabled appropriate action to be taken in advance of landfall. If the forecast skill is significantly improved in a case such as Hurricane Sandy to advance to further days in advance, essential preparations, especially for those less able to move from place-to-place, would be easier and less disruptive. This would be especially true for trapped members of the populations, for example those who are stuck in a house to ensure that they have to appropriate amount of food and/or remote medical treatment.

**Improved downscaling of flood forecasts to improve early warning systems.** A study experiment set in Japan demonstrated the benefits improving resolution of flood forecasts for early warning systems.14 This demonstrated that a dramatic improvement in flood forecast downscaling could have significant returns in the preparedness of a population from flood early warning systems.

**Tolerance levels of buildings and drainage systems.** Overflowing sewers and storm drains can lead to flooding and collections of stagnant water, which will both have significant health impacts.1 Under climate change and increasing urbanization, the maximum flows resulting from floods can and should influence design capacity for tolerance of urban storm water. Designing the appropriate drainage system in urbanized areas will depend upon hydro-meteorological characteristics.15 Predictability of long-term maximum estimated flows is therefore an important input of future urban design.

**Preparedness for after the flood** Hurricane Sandy failures in the post-hurricane flood show that more understanding is required by authorities into how the flood will affect infrastructure in the weeks after the flood itself. Improving modelling of water flows after the flood will result in better infrastructure planning, potentially saving many more lives.

**Potential projects with improved forecasting**

**Wildfire**

**Overview**

Uncontrolled spread of wildfire can originate from bush, vegetation, forest, heath and grass. Wildfires predominantly occur in countries with warmer climates, they have been known to occur from uncontrolled burning of vegetation in temperature climates such as in the UK.16 Many health impacts result from the inhalation of burnt organic material, but other direct effects are evident.

**Health impacts**

**Burns.** Direct flame and thermal burns can result from a wildfire. The great increase in burns victims in a short time puts significant pressure on health care burns units, which can overwhelming these specialist centres.16

**Carbon monoxide poisoning.** This is mainly a risk to those who are in the immediate vicinity of the fire, such as firefighters. It can cause hypoxic injury, nervous system damage, and death.

**Eye irritation.** Those living close to the wild fires can experience eye irritation, as well as reduced general visibility due to ambient smoke, which can make vehicular accidents more likely.17 Corneal abrasions can also result from the eyes’ exposure to wildfire smoke.18

**Heat-induced illness.** Working in hot and humid conditions can cause many health issues (see ‘Urban Heat Waves and Pollution’). Firefighters can be particularly vulnerable when attempting to deal with the controlling the extent of the fires.

**Particulate matter inhalation.** Burning of organic material can produce several varieties of particulate matter. PM10 (particles under 10µm in diameter) can pass through the upper respiratory tract and are deposited in airways.16 PM2.5 (particles under 2.5 µm in diameter) can penetrate even deeper into the lungs and deposited where gaseous exchange takes place.16 Short-term exposure leads to increases in hospital admissions for respiratory conditions.19 Exposure to particulate matter will cause long-term health problems, and is a known risk factor for cardiopulmonary and lung cancer mortality.20,21

**Psychological distress.** Wildfires can cause the complete destruction of homes and livelihoods. This in turn can lead to depression, anxiety, and PTSD.22

**Respiratory complications.** Breathing in bushfire smoke will exacerbate breathing problems for both children and adults. [ref]

**Water and land contamination.** Large concentrations heavy metals (such as arsenic, cadmium, copper, and lead) have been found deposited in soil from ash debris after a wildfire, which can cause various long-term health effects.23

**Deliverables**

**Potential projects with improved forecasting**

**Example of Alberta, Canada.**

**Localised Extreme Wind**

**Overview**

24 **Health impacts**

**Injuries from debris** Buildings and trees

**Road accidents**

**Psychological distress**

**Sea spray**

**Deliverables**

**Potential projects with improved forecasting**

**Disruptive Winter Weather**

**Overview**

**Health impacts**

**Deliverables**

**Potential projects with improved forecasting**

**Urban Heat Waves and Air Pollution**

**Overview**

**Health impacts**

**Deliverables**

**Potential projects with improved forecasting**

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