Public Health England

Protecting and improving the nation's health

Protocol for establishing a health register after a flood

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Preface

This protocol provides a framework for European countries to establish a health register after a flood event. National health authorities can adapt and incorporate this protocol in advance of a flood event according to their own national response arrangements. The protocol is based on Public Health England's *Major Incident Health Register Implementation Plan*, written by members of the HPA/PHE Health Register Project Group.

1. Background

Floods are the most common natural hazard in Europe and are likely to increase in frequency in the UK with changes in precipitation patterns; the impact of floods is also expected to get worse due to increased building on flood plains.[1] Across the WHO European region, 1000 people were killed and 3.4 million people were estimated to have been directly affected by flooding in the last 10 years[1]; but the exact number of those indirectly affected by the consequences of flooding is unknown. Floods can be associated with significant disease burden and may continue to affect the community and individuals involved for years after the floodwater recedes.

Public health has an important role to play in major incident preparedness, planning, response and recovery. The epidemiology of all types of floods should be described fully where possible in order to contribute to our understanding of the related burden of disease in different populations, locations and time periods. Epidemiology can be a useful tool to assess the health burden associated with a major incident even when the nature of the exposure is not entirely understood. One of the goals of the epidemiological investigation is to identify subgroups of the population who are at higher risk of disease and who will benefit most from targeted interventions. Epidemiological information can also be used to develop prevention strategies and should inform actions in flood management.

Gathering information about the types of flood exposure and health status among the affected population in a systematic and standardised way and using statistical and epidemiological methods to analyse the data allows health agencies to prioritise their response to an incident and rationalise the distribution of resources.[2]

1.1 Methods for evaluating the health effects of a flood

1.1.1 Routine data sources

Routine sources of health data, such as mortality data or prescription data, can be used to assess the health impacts of floods epidemiologically, for example by looking for statistical exceedances, comparing pre-flood data to post-flood data in the same area, or by comparing data between flooded and non-flooded areas. Interrogating existing health data sets can be useful as no special data collection or extra effort is required of people on the ground, allowing cheaper and more rapid assessment. However, most health data are only available at low geographical resolution, such as health authority administrative boundaries or hospital level, making it difficult to link health effects with individual exposure or establish causality. The best studies link flood exposure data with health data available at high geographical resolution. For example, Milojevic et al[3] linked detailed flood maps from the UK Environment Agency with mortality data geo-referenced by individual postcode of residence.

Other limitations associated with using routine health data sets include lack of sensitivity at ecological level to pick up rare health effects, dilution of effect due to displacement of flooded populations, and uncertainties in identifying long-term health effects.

A review of the summer 2007 floods in the UK stated that official statistics showed no significant increase in the number of people reporting to healthcare professionals with physical or mental health problems caused by flooding, but acknowledged that existing reporting methods may not identify these.[4] A survey of 647 households affected by these same floods showed that 39% and 67% of people did experience an effect on physical and emotional health respectively, with 39% of those with health problems reporting having been to see a doctor.[4] These two apparently contradictory results highlight how routine data may not be good enough to identify changes.

1.1.2 Retrospective surveys

Analytical epidemiology conducted post-flooding usually comprises cross-sectional community surveys and interviews, case-control studies and infectious disease outbreak investigations. These studies often have the benefit of measuring health impact and exposure at the individual level.

Whereas well-designed studies have improved accuracy in linking health and exposure data, experience shows that planning studies after a disaster has occurred – in some cases months or years post-incident - also has limitations, such as poor recruitment rates of affected individuals[5,6,7,8] or reporting bias in surveys where those with symptoms are more likely to respond.[9] One case-control survey achieved a response rate of 38% and 14% in two different flooded areas.[9] In addition, the delay in getting results is useful for research and future planning purposes, but does not provide assistance to the community who may be in need of immediate public health interventions.

1.1.3 Health registers

A health register is a way to collate details of individuals affected by or exposed to a specific incident. A health register is established to identify those affected in the immediate aftermath of an event, allowing rapid description of the population and their health needs in the acute phase of the disaster; ethical approval is not usually required during disaster response, further speeding data collection. Epidemiological rigour, including ethical approval, can then be applied later for follow up studies where required using contact details acquired during the initial recruitment of the cohort. The purpose of establishing a health register is:

- to enable appropriate advice on relevant immediate interventions to be provided
- to facilitate access to appropriate services
- to enable timely assessment of the health impact of the incident

- to identify longer-term health implications of the incident
- to provide reassurance to the public

Health registers have previously been used to identify and follow up people exposed to incidents such as the 1986 agrochemical contamination of the Rhine river in Switzerland10, a fireworks depot explosion in Enschede, Netherlands in 200011, the 2001 World Trade Center disaster12, and the 2005 London bombs.13,14 “Exposed” groups included not only those directly involved in the events, such as survivors of collapsed structures, but people psychologically affected, rescue workers and residents living nearby. Health registers have to date only been established after sudden, major industrial or technological incidents, with varying degrees of casualties.

1.2 Why establish a health register for a flood?

In establishing a health register, the aim is to ensure that individuals who are affected by the flood are subject to appropriate risk assessment and management and are offered health support services after the event. A register may be the only method to get robust individual level data for research purposes.

A flood event has some differences to the incidents listed in 1.1.3 where health registers have previously been used. Direct, immediate casualties tend to be few (with notable exceptions such as the New Orleans floods associated with Hurricane Katrina), with most of the disease burden associated with floodwater occurring in the days and weeks following the initial event.[1] Although floodwater usually recedes within a few days, exposure to damp and contamination, clean-up injuries and secondary stressors such as displacement can be sustained for many days or even years.[4,15]

In most cases, flood warnings allow the population time to evacuate or take precautions reducing immediate risk.[16] Sudden incidents such as explosions or accidents will often involve a proportion of transient populations (such as passers-by, those using transport systems or open public spaces), whereas the population affected by a flood tends to be those with more permanent links to the affected area (such as homes, workplaces or schools), making identification of those affected easier; however evacuated or displaced populations may be harder to contact.

In this section, the benefits of establishing a health register specifically for flood events are described.

1.2.1 Identifying the exposed population

Establishing a definition for the affected population is known to be difficult in response to any large-scale event.[11] A flood may result in many different types of exposure, such as being resident of a flooded home, being evacuated, loss of utilities (water/power), financial loss etc, all of which may lead to potential health impact. In summer 2007 in the UK, 55,000 properties were flooded, yet the floods resulted in loss of water supply to 350,000 people, loss of electricity for 42,000 people, and a further 10,000 people were trapped in their cars.[4] Recruiting an initially wide range of people to a health register allows epidemiologists to refine and stratify

their study population by exposure classification depending on their research area of interest. Analysis of subsets of the registered population was carried out in response to the World Trade Center disaster, for example.[12]

1.2.2 Long-term health effects

It is known that some of the health effects of floods vary over time and may continue for months or years, such as common mental disorders.[15,17] A complete register, including contact details, provides scope for more than one cross-sectional study of health impact to examine the time course of responses in the affected populations.

1.2.3 Unknown health effects

A register of people affected by a flood provides scope for investigating multiple health outcomes but also unknown outcomes of exposure. A register also informs our understanding of exposures and the indirect and direct stressors a flood event may have on an individual.

1.2.4 Population displacement

A significant proportion of households are temporarily displaced after a flood – up to 59% in one flooded English city[18], with some only being evacuated for safety during the event and other households being displaced for longer while repairs are made. Still others are displaced permanently, not returning to the area. Population displacement after a flood via evacuation and relocation is therefore complex and tools to facilitate capture and follow up of individuals would be beneficial both for the flood response phase and to fully quantify the impact. Epidemiological studies after a major explosion in France at the AZF factory showed that despite all efforts, a proportion of exposed victims had not been recruited nor had ever registered for insurance compensation and were thus lost to follow up.[6]

The effect of populations moving away from the flooded area (either temporarily or permanently) at the time of flooding or shortly after and before their subsequent death is postulated to be part of the reason one UK analysis of the long term population mortality in flood affected areas from 1994-2005 decreased by 10% in the six months after the event.[3]

By recruiting the affected population to a health register during or immediately after the flood and gathering contact details, it is more likely that these people will be included in future studies.

A register of contact details also facilitates communication with authorities, who want to provide practical advice, health advice, advocacy advice, and provide resources for emotional support. A database of flood-affected households and individuals was set up during the Carlisle floods of 2005 as a way to facilitate coping and promote resilience, as a way to map temporary addresses and contact details for families, friends and neighbours to stay in touch if they have been separated by evacuation.[19]

1.2.5 Health service consequences

A flood may affect health infrastructure such as hospitals and community health practices. According to the UK Environment Agency, 9% of surgeries and health centres are built in flood risk areas in England[20]; understanding health infrastructure at risk is particularly important for emergency planners when large scale floods are predicted. A primary care clinic in Morpeth, UK was flooded, and by linking flooded addresses with its patient register, it was possible to tell that the flooded surgery also had the highest proportion of its patient population affected in comparison with other practices. This intelligence allowed the local health board to plan for increased workloads.[21]

1.2.6 Targeted clinical advice

Registering individuals and understanding their location and type of exposure allows clinicians and public health staff to target clinical advice to those that may require it in a timely manner. For example, if chemical or sewage contamination of floodwater has occurred, contact could be made with those most likely to have been exposed for screening purposes. After two confirmed cases of leptospirosis were identified post-flooding in the US, a survey of those who had reported contact with floodwater showed that 90 of 271 (33%) responders had developed a febrile illness.[22]

Proactive screening and intervention by health providers may be particularly important for responding to mental health needs post-trauma.[14]

1.2.7 Targeted public health advice and psychosocial support

Profiling the flood-affected population based on location, age, vulnerabilities and health outcomes, allows local authorities and health providers to identify needs and tailor their interventions and support accordingly. Such demographic profiling enabled psychological support planning through the school system to affected children[21] and provision of specialist classes and employment support to communities in Yorkshire.[23]

1.3 Deciding to establish a health register

The decision to establish a health register should be taken by the local public health team and should be taken as soon as possible after the event in order to maximise completion rate of the register. A decision framework was developed by public health and other experts in the UK, suggesting the following should be considered:[24]

- nature and scale of the incident (including incidents with novel characteristics or unknown health impacts)
- poor knowledge of the type and latency of health outcomes and the possibility of short or long term health impacts
- access to appropriate health services for those affected by or exposed to the incident, including specific vulnerable groups
- improved understanding of the epidemiology of the incident and the resultant health outcomes (leading to improved health interventions in the future)

The health effects of flooding, in particular long-term health effects such as mental health impact, are poorly understood and enumerated. There are clearly defined vulnerable groups to flooding (such as the elderly, mentally ill, and those on low-incomes), who need to be identified and provided with appropriate assistance during a flood.[1] Understanding the epidemiology of a flood-affected population has been shown to assist targeting of healthcare[21] and will also improve future prevention strategies.

The decision to establish a register, however, should be based on a careful consideration of local circumstances, the feasibility and potential usefulness of a health register in light of the flood's circumstances and existing response activities by a core group of scientific experts and professionals who have particular experience in dealing with floods and major incidents.

Registers require significant time, funds, staff and resources, and to be successful must be established rapidly, so it is essential that pre-agreement and support for their implementation is granted prior to planning for a register. It is strongly recommended that all national authorities and services with an interest in flood emergency response are consulted during the preparation of the health register protocol. This could include health authorities, government, emergency services, environmental agencies and utility companies. As large flooding events are rare, plans could be established at a national level to be disseminated locally when required.

2. Epidemiological strategy and implementation protocol

This epidemiological strategy and implementation protocol is based on Public Health England's (PHE) *Major Incident Health Register Implementation Plan*. PHE's *Major Incident Health Register Implementation Plan* was developed in 2012 to provide a protocol to systematically collate data in the immediate aftermath of a major incident. Multiple agencies and experts were involved in its development. The methodology used to develop the protocol can be found in the paper by Close et al.[5]

As a result, this protocol for the PHASE (Public Health Adaptation Strategies to Extreme weather events) project has been written mainly from a UK perspective. Similar systems and protocols for establishing health registers in the aftermath of a major incident exist in the US[25] and the Netherlands (Center for Health Impact Assessment of Disasters).[26] The processes for setting up and implementing a health register will depend on country-specific circumstances and pre-existing arrangements for the emergency response.

Three phases can be recognised for the epidemiological work required after a decision to establish a register has been taken:

- Phase 1: Recruitment to a health register
- Phase 2: Early studies to better establish exposure and health effects
- Phase 3: Later studies to establish longer term health effects and outcomes

2.1 Establishing a health register

2.1.1 Membership and meetings of the health register implementation group

Following the decision to set up a health register, a health register implementation group should be established. The group could consist of:

- chair
- medical director
- local government representative
- senior epidemiologist
- flooding or disaster public health specialist
- local public health specialists
- health emergency planner
- communications manager
- administrative support

Membership of the implementation group may change during the course of the register, for example psychological services, chemical or infectious disease specialists, or the voluntary sector may be co-opted at later meetings. Regular liaison with multi-agency partners involved in the response on scene is required to ensure the smooth running of the register; this could be the role of the health emergency planner and communications manager.

The frequency of meetings should be determined at the first meeting. It is likely that they will need to be more frequent in the early stages of the response. Full use could be made of teleconferencing facilities to ensure speed of response.

2.1.2 Objectives of the health register implementation group

The aim of the health register implementation group is to set clear criteria for information collection, storage and use. Clear goals are imperative to ensure that the appropriate data are collected to generate useful information for public health action and intelligence. The implementation group will lead on the following tasks:

- Define the nature, scale and extent of the hazard
- Identify the ‘population affected’
- Recruit the ‘population affected’. Gather information on exposure and outcomes in the immediate aftermath of the incident (Minimum Data Set)
- Consider how the information should be used, including:
- offering appropriate advice on relevant interventions
- facilitating access to appropriate services
- Consider what further follow up and epidemiological studies might be done and what the implications are for the methodological approaches and data to be collected

2.1.3 Operations of the implementation group

National public health organisations will need to identify staff who would be utilised in the event of a health register being established.

In addition to the experts listed in section 2.1.1, data collection staff are required to collect the minimum data set on people affected by or exposed to the incident. It is suggested that those with public health or epidemiological training should be used, for example, trainees on the European Centre for Disease Prevention and Control (ECDC) European Programme for Intervention Epidemiology Training programme (EPIET) or national field epidemiology training programmes. These staff would need to be deployed rapidly once the decision to establish a register has been made.

It is likely to be impractical to have a cadre of data collection staff permanently trained for the rare occasions when a health register will need to be established. However, staff likely to be involved could be briefed in advance and be familiar with the processes and location of the minimum data set (see section 2.2.4), as well as what would be expected in the event that the register was activated. It is also proposed that, following the decision to establish the health register, the (identified) data collection staff should be provided with more detailed training and standard operating procedures so that they fully understand their responsibilities.

2.1.4 Conclusion and stand down

The implementation group should endeavour to ensure that the health register is as complete as possible and is likely to continue to meet for a number of months whilst the register is being populated and refined. They will work with partner organisations in the statutory and voluntary sector to achieve this for the purpose of meeting the aims of the register.

The implementation group will cease its activities once it feels that it has achieved its aims and with the agreement of the group/senior officer to which it is accountable. The group may handover to a team of epidemiologists who will continue to use the register for long-term studies.

2.2 Phase 1: recruitment to a health register

There may already be a large humanitarian response to the flood underway according to existing national disaster response plans, including identifying and providing emergency care and advice to victims at the scene and in evacuation shelters. Telephone helplines and victim support centres may be in place. The implementation group will need to liaise with frontline responders to gather context and understand existing local activities in order for the register to complement and, if necessary, supplement, these existing systems, both in the emergency phase and the recovery phase.

2.2.1 Nature, scale and extent of the flood

There should be an investigation into the nature of the flood itself, including any environmental assessment that may be necessary. This might include biological, radiological and/or chemical sampling and/or testing, for sewage, industrial or commercial leakages. Meteorological data

should also be recorded, for example temperature, as summer flooding may lead to different health outcomes than winter flooding.

As detailed as possible information should be gathered from local flood teams on all flooded buildings (not just residential), roads, agricultural and public recreational areas, including floodwater depth and speed of inundation if known. Where relevant, data should also be gathered from utility companies regarding loss of services. These data could be mapped using a geographical information system.

Information on flood warnings provided to the community, flood alert subscription rates (where available), and previous floods in the area may also be important for interpreting the preparedness and resilience of the population affected.

This thorough environmental exposure analysis should feed into the risk assessment and guide any epidemiological studies and analyses. A team of experts should be selected and convened to consider this.

2.2.2 Identifying the 'population affected'

The 'population affected' can be defined as the population of potentially exposed individuals, or population at risk and will vary depending on specific flood circumstances, for example populations not directly affected by floodwater may be indirectly affected by loss of power supply. Obtaining information about the nature and extent of the flood in space and time from responding agencies will direct initial identification of the population affected, with detailed individual exposure information being gathered at a later stage of the health register. It should be remembered that floods and their consequences are dynamic and the situation should be regularly re-assessed.

The definition of the population affected should explicitly include those individuals who are at risk of developing psychological (rather than just physical) consequences from the flood. Table 1 provides examples of a variety of hazards and the related population affected that would consequently need to be recruited onto a health register.

A definition of flood-affected properties should be agreed in advance and explained on the questionnaire to ensure consistency (eg floodwater touching any part of property (including outside space), or floodwater ingress into the property itself).

2.2.3 Recruiting the 'population affected'

The single biggest challenge following an incident is to identify the affected individuals and then to recruit them onto the health register. Individuals in the population affected will fall into one of three categories outlined in Table 1. Table 1 also describes potential methods for recruitment for these groups. Table 2 describes additional possible recruitment strategies for those who present to healthcare providers in more detail.

Recruitment during Phase 1 should involve completing a minimum data set on each person (see Section 3.1), and can be as simple as taking down individuals' names and contact details, flood exposure information and obtaining their consent to contact them in the future to obtain further information. The more complete the register the more reliable and meaningful any data

collected from recruited individuals are. Recruitment should happen as soon as possible after an incident so that the best estimation of exposure can be determined and appropriate interventions can be offered to those who need them.

The individuals most difficult to identify are those not directly affected by the flood. This may include individuals who suffer the psychological or economical, rather than physical, effects of an exposure. To minimise selection and enrolment bias and to get a true picture of the health impact, recruitment of these individuals is equally important.

Particular attention should be given to identifying and recruiting vulnerable groups, as they may be more at risk of health impact and require more public health support.

Initial recruitment methods by the data collection staff may include (see Tables 1 and 2 for more detailed information):

- collation of affected individual's basic details from existing data sources, such as emergency response records, local authority records, hospital records
- recruitment of individuals affected in person, such as in hospitals, family doctor practices, evacuation centres, support and information centres. Consideration should be given to whether data collection staff need to be on scene to collect data from the individuals or whether minimum data set questionnaires could be provided for other professionals to administer
- using dedicated helplines set up to provide flooding advice or existing telephone services such as national health helplines or poisons information services. Minimum data set questionnaires could be provided for call centre staff to complete
- writing to all those in the affected area and asking them to self-register. Consider whether this needs to be provided in more than one language
- direct media campaigns using social, local or national media to encourage individuals to self-register, and web based and recruitment options should be explored with the communications manager

As before, consideration should be given to existing arrangements for flood response and the implementation group should ensure that they understand and can establish the register alongside these. See Box 1 for existing approaches used to identify flood victims in England.

Box 1: Methods used to identify flood-affected individuals in England, as part of existing emergency response plans

- Local authorities have a statutory duty to investigate flooding events, and so usually make an attempt to capture information on the properties that have been flooded. Although this varies by the authority involved, this information is often gathered via door knocking to ensure residents are safe/well and information has been passed to them by emergency responders and the Environment Agency. The local authority runs evacuation rest centres, where individual's details are collated. The local authority is responsible for recovery and therefore will often arrange follow up visits and write letters.
- Environment Agency (EA) has a responsibility for flood prevention, advice and response. This agency will usually map the flood-affected properties and provide support to those people, alongside the local authority. The EA can provide geographical floodwater maps for informing areas of exposure.
- Local resilience forums have post-disaster recovery plans (see East Sussex LRF Recovery Plan[27] for an example), which outline tasks for health, welfare and housing subgroups. These include hazard assessment, coordination of health monitoring, victim support groups, helplines and identification of damaged residential properties, as well as plans for identifying vulnerable people during major emergencies.
- In England, ethical approval should not be required for the initial collection of individual's data due to its use as part of the public health response to the flood. Personal data collected by organisations such as the local authority and Environment Agency can be disclosed to Public Health England (PHE) staff without prior consent under several exceptions and special rules within the Data Protection Act. PHE would make every reasonable effort to contact the individual concerned and obtain their consent.

Table 1: Groups of population affected and suggested methods of recruitment

Population group	Evidence for inclusion (Quotes from The Pitt Review[4] into UK's 2007 floods)	Possible methods of recruitment
Group A: All those resident within the flooded area, including those within an area defined by environmental contamination or other monitoring (eg pollution of water), or all those within an area defined by absence of electricity supply, drinking water supply etc	Even those whose homes or premises were not directly flooded were still affected by the flood, for example from damage and disruption to community facilities. The loss of a water treatment works left 350,000 people without mains water supply for up to 17 days. An electricity substation was shut down leaving 42,000 people without power for up to 24 hours.	• Local authority registers of population affected, including those in centres set up to provide shelter and care for those displaced by the flood. • Electoral roll for the area and community affected; if only recruiting specifically flood-affected properties, the geographical extent of the flood could be used to identify specific addresses. • Individuals who seek medical care at primary or secondary facilities, or from national health helplines, are likely to be the worst affected proportion of the population exposed and represent the 'tip of the iceberg' of all those exposed. Possible routes of recruitment for this group are further detailed in Table 2. • Utility company data (or governmental department data) on the area with supply loss. • Modelling from environmental sampling. • Resident lists of care homes. • Self-registration through web portal or forms at advice centres.
Group B: People and organisations involved in the local economy and infrastructure, such as residents, schools, workers.	Anecdotal evidence showed difficulties trying to keep working in flood-affected areas, for example from additional duties and increased sickness absence. Health impact among children included causes such as the use of temporary facilities, extended travel times to school and the need to re-do destroyed school work.	• Local authority registers of population affected, including those in centres set up to provide shelter and care for those displaced by the flood. • Work and occupational health departments records to identify employees. • School registers. • Self-registration through web portal or forms at advice centres.
Group C: Emergency services, other first responders, medical staff and investigators involved in the response to the incident or others providing assistance at the site of the incident. Consider also those involved in clean-up and staff of voluntary organisations.	Organisations responsible for response and recovery reported increased levels of stress amongst staff, including local authorities, the emergency services and the voluntary sector, who worked tirelessly to provide a wide range of humanitarian assistance to people made temporarily homeless by the events. In the recovery phase, builders were concerned about whether renovating damp properties posed health risks.	• Emergency responders will mostly be members of the fire, police and ambulance services. However, a large number of other organisations may have also deployed staff in response to an incident, including local authorities, utility companies, private industry, military, civil defence and voluntary organisations. Individuals from these groups can usually be traced from work records after an incident and recruitment could take place in collaboration with occupational health departments. • Self-registration through web portal or forms at advice centres.

Table 2: Possible methods of recruitment of members of the public who seek medical care

1. RECRUITMENT THROUGH AGENCIES PRESENT AT SITE OF INCIDENT:	
Ambulance Service	Some individuals will receive medical attention from paramedics at the scene of a flood but do not go to hospital – for example, vulnerable people who have had to be rescued and are then handed over to evacuation centres.
2. RECRUITMENT THROUGH PRIMARY CARE SERVICES:	
Family doctors / General practitioners	In the days following a flood, some affected people may seek medical attention from their family doctor who may be outside the disaster area. It may therefore be necessary to alert all medical facilities in the local area of the need to notify such individuals to the health register authorities. Protocols may be developed and implemented through syndromic and other family doctor surveillance systems that allow recognition of increased numbers of people presenting with specified symptoms (eg respiratory symptoms after exposure to damp, or gastrointestinal symptoms after exposure to contaminated floodwater).
Walk-in centres	Individuals with minor injuries may present at local walk-in centres. It may therefore be necessary to alert all medical facilities in the local area of the need to ask patients about flood exposure and notify such individuals to the health register authorities.
Health telephone helplines	Individuals with more minor health complaints may call national health helplines, if they are available. These health telephone lines should be alerted to ask callers about flood exposure and then collect relevant information for the minimum data set using agreed algorithms developed in response to the flood.
3. RECRUITMENT THROUGH SECONDARY CARE SERVICES:	
Minor injuries units	Individuals with minor injuries may present at minor injuries units. It may therefore be necessary to alert all medical facilities in the local area of the need to notify such individuals to the health register authorities.
Hospital accident and emergency departments	Individuals who receive hospital care may be identified through hospital computer systems, by reviewing medical case notes or by collecting patient details on arrival at the emergency department. For large floods, especially in urban areas, more than one hospital may be involved. In the days following a disaster, some affected people may seek medical attention from hospitals outside the disaster area. It may therefore be necessary to alert all medical facilities in the local area of the need to notify such individuals. Hospital registration systems usually contain most of the information required to complete the minimum data set.

2.2.4 Data sharing for recruitment

Numerous organisations and potential sources of data have been suggested in tables 1 and 2 for identifying the affected population and gathering details for the minimum data set. It should be clarified by each country whether personal (and sensitive) data collected by one organisation can be disclosed to another without prior consent, and what efforts should be made to contact the individual concerned to obtain their consent. In England, personal data collected by one organisation can be disclosed to another without prior consent under several exceptions and special rules within the Data Protection Act; data sharing between response organisations should not require ethical approval due to its use as part of the public health response to the incident. Section 2.6 discusses collection and use of personal identifiable data in the research phases following the emergency.

2.2.5 Data storage

A database for the minimum data set could be constructed in advance of a flood and be stored securely. This can then be activated in the event of a flood and populated by data entry staff once the collection process has been initiated. The cleaning, linking and de-duplication of records, as well as tracing individuals and verifying data, is an ongoing and resource-intensive task.

2.3 Phase 2: initial studies to better establish exposure and early effects

2.3.1 Potential public health actions

Individuals on the health register may be contacted and offered advice and/or referred on for relevant interventions if this is seen to be appropriate. This should be done in collaboration with the relevant stakeholders and service providers. Possible actions include providing information on sources of financial assistance, clean-up advice and support for recovery and return to normality. It is known that there is a long period of time between flooding and some mental health effects1, so a register can help to identify those people that may need help later.

2.4 Phase 3: follow up studies to establish longer term exposures, health effects and outcomes

Once Phase 1 and 2 are complete, the implementation group can use the information obtained to consider setting up epidemiological studies to explore the relationship between exposure and health outcomes in the population recruited to the health register, initiating Phase 3 of the protocol. These later, follow up studies can provide additional details of initial and ongoing exposure, plus more detailed information of health impact. As well as characterising the epidemiology of the flood, the information could be used to inform local authorities of ongoing exposures and stressors, directing longer-term public health and social interventions.

2.4.1 Potential study settings and study designs

The study setting will depend on the type of exposure and health outcomes of interest, and might be confined to a specific subgroup of the affected population, a workplace, a geographical area or might involve a number of different sites. The study design should also be tailored to the particular flood event and could involve repeating the initial cross sectional survey, undertaking further cross-sectional surveys, or performing cohort or case control studies.

2.4.2 Cohort study design

Cohort(s) can be defined as a set of individuals who have a common exposure in some way to a hazard – be that direct contact with floodwater, being flooded/evacuated, living in a flooded area, or other exposure. These individuals, already recruited on the health register, can be followed up over time to enable important questions relating to medium or longer term effects to be answered as well as to facilitate any interventions or sharing of relevant information with them. By registering all individuals initially and then selecting a subset for a cohort, removes any selection bias which might arise from only following up individuals who may subsequently present with health complaints to health care services. Self-selection might lead to an overestimation of the size of the heath effect as those recruited may be more likely to report adverse health outcomes. As the flood exposure has already occurred, a longitudinal study will inevitably have a retrospective component but could be supplemented with a prospective component when assessing long term health outcomes.

Although longitudinal cohort studies have many strengths, maintaining up-to-date records of individuals is costly. Alternative strategies such as follow up of a ‘sentinel’ sub-group such as those with the highest exposures (eg those living in flooded homes) might be considered. Although this might lead to an overestimate of the magnitude of any adverse heath outcome, it may provide an indication of potential problems among the total exposed population. This approach might be used for example to reduce costs. In some flood events, it may be more appropriate to follow up a random sample of affected individuals, for example a sample of the cohort, or alternately a cluster of households in a given geographical area.

2.4.3 Case control study design

This study design could be used to test hypotheses generated through literature review or through the early assessment of those recruited on the health register. Control selection strategies could be considered for the specific context and may be drawn from among the population at risk (the original cohort exposed) with cases defined as those with a recognisable adverse outcome.

2.4.4 Measuring exposure and health outcomes

The implementation group will ensure the development of standardised tools such as questionnaires and their use in combination with physical examination and assessment of biomarkers, if appropriate, to assess exposure and health outcomes.

Suggested potential checklists of questions that seem likely to be relevant for inclusion in both initial screening and follow up questionnaires to assess the impact of flood exposures and associated health outcomes have been developed and included in section 3.3. These would

need to be adapted on advice from the implementation group for the specific flood circumstances when it arises.
Data collection could be done by one or several of the following methods:

- face to face or telephone interviews: performed by field epidemiologists, public health specialists, trained nurse practitioners or others
- self-completed questionnaires returned in the post or by email
- follow up could also be integrated into individuals' routine health assessments, such as when they visit their family doctor, or, for workers, as part of routine follow up by their occupational health department
- online completion of questionnaires eg on a dedicated web-portal.

Some European countries may be able to link individuals in the register with routine data such as mortality statistics, laboratory data, prescription data, hospital statistics or family doctor patient records.

Complete and accurate data are required to produce reliable information. It may be a challenge to achieve the high standards normally required in epidemiological research in the context of a rapid epidemiological response to a major flood. However, streamlined and pre-tested procedures and deployment of adequately trained staff should enable rapid data collection, its management and consequently the collation of high quality data.

2.4.5 Data analysis and interpretation

Data analysis should be carried out by epidemiologists and statisticians with support from experts in flooding or emergency response. Strands of analysis include:

- development of analytical models
- enhancement of health outcomes analysis through examination of median duration of exposure and other dose estimates
- risk ratios (RRs) for cohort studies and odds ratios (ORs) for case control studies
- adjustment for potential confounders and effect modifiers
- multivariable analysis, including, for example logistic regression analysis (Poisson and/or Cox regression for survival analysis and cancer analysis)

Consideration should also be given to analysing routine data within existing local or national surveillance systems, which could complement registry data.

A particular challenge for using post-disaster health registers for analytical epidemiology is that they are likely to be a biased sample of individuals. Those with the highest exposures and/or most significant health effects are more likely to be recorded because they were the easiest to identify. Typically this would include emergency responders, occupational groups, members of the public who sought medical attention or who registered their homes as being flooded. Recruiting via the media is likely to capture individuals who are concerned about their health or differ in other ways to individuals who do not self-report. This selection bias could lead to an overestimate of health effects, which is why initial data capture of those affected by the flood is particularly important, and stratification by exposure type may be necessary.

2.4.6 Write up of report and dissemination of findings

Results of any analysis should be communicated to appropriate audiences in various forms including a short anonymised summary report for those flood-affected communities and participants on the register.

Consideration should be given to evaluating the response arrangements to the flood including the emergency, public health, psychosocial and community support actions, and their impact on health outcomes. If different response arrangements have been put in place in different flooded areas, consideration should be given to assessing whether the health outcome is different between the different areas. These results could inform future response planning.

2.5 Communications plan

A review of previous health registers set up in the aftermath of incidents highlighted that the lack of communication between agencies and the public was one of the most common problem areas.[5] For this reason, PHE recommended that a communications manager should be part of the health register implementation group and a communications plan be established.

2.5.1 Objectives of the communications manager

To ensure that relevant emergency services and other responder staff have an awareness of the health register, including an understanding of the relevance of it, and how to access information about it.

To ensure that, following an incident, public health messages concerning the register are distributed as widely as possible to target audiences to encourage registration. If relevant, it should be made clear that members of the public indirectly affected by the flood, such as those with local economic ties to the area, should also register.

2.5.2 Tasks of the communications manager

The following communications tasks have been identified, much of which could be pre-prepared and adjusted and deployed in the event of the register being established:

- establish contact with communications counterparts in the other responding organisations
- develop public health messages to be issued in the days and weeks following a flood, drawing attention to the register, and to be disseminated by the press and broadcast media, government departments and voluntary organisations
- develop strategies to exploit social media tools. These encourage information exchange with and among the public rather than agencies seeing themselves as providers of information for example use of social media sites with links to the register site. Messages like: ‘Were you involved in the flood in x? Register here’.
- develop information for pertinent government and health websites that can be amended and posted as soon as possible after the incident and ensure that the

relevant information (including all the key documents) is available. This should include what happens if you are included on the register etc
- manage any press/media aspects of the implementation of the health register
- publication of articles describing the register in appropriate publications
- dissemination of results to members of the public and those on the register

2.6 Dara handling: ethics, data storage, legislation

The gathering of any person identifiable information and conducting research using those data must be done according to the law. It is recommended that plans should be made in advance of any major flooding to safeguard that all of the relevant legislation surrounding data protection, data sharing and data usage is fully understood in order to ensure the smooth implementation and delivery of a health register. National public health teams must ensure that throughout the process they comply with legal duties. This work will be country-specific and the following are examples of areas that may need to be considered.

2.6.1 Ethical approval

An ethical oversight group comprised of individuals with expertise and responsibility for ensuring ethical aspects are properly managed could be established in advance or at the beginning of an incident. This task could otherwise be delegated to the implementation group if the expertise exists in that group. They should advise on the ethical management of a health register, such as obtaining consent and advising the public as to the purpose of the study. An individual should be made responsible for considering the validity of any research proposals. If a decision to move to Phase 2 or 3 is made, approval for the proposed epidemiological study should be sought from an ethics committee and relevant good practice guidance in relation to scientific research should be adhered to (eg ensuring consent etc)

The implementation group must also protect relevant stakeholders and the public against the misuse of health register data, such as access by insurance companies or special interest groups.

In England, ethical approval should not be required for the initial collection of data due to its use as part of the public health response to the incident. Further epidemiological surveys and longer-term storage of patient identifiable data may require ethical approval and consent from register members, so this should be considered by the implementation group, if appropriate.

2.6.2 Database storage

All personal data, including hard copies and electronic copies, should be stored securely. An individual should be made responsible for regulating access to the register by researchers and others in accordance with organisational and national guidelines.

Retention of records should comply with relevant policies and be kept under regular review, with records being deleted once no longer required for the purposes of future studies.

3. Questionnaires

3.1 Phase 1: minimum data set

This form should be completed for every individual identified and may be done from existing records or directly with or by those affected, depending on the method of recruitment. The questions and wording should be adapted according to the method used. This should be completed within the first few days of the flood.

Office use:
Unique reference number: _____ Date completed: _____
Name of data collector: _____
Job title of data collector: _____
Data source[1]: _____

Individual's personal details

Surname: _____ Forename: _____
Next of kin (name/contact details/relationship): _____

_____

Date of birth: ___/__/___ Male / Female
Country of birth/nationality: _____ Country of residence: _____
Permanent address: _____
If relevant, temporary address (eg if evacuated, displaced, in area on business/holiday)

_____
Telephone number: _____ Mobile number: _____
Email address: _____
National identity number (if applicable):_____
Family doctor name: _____
Family doctor practice address: _____
Hospital/other reference number (if relevant): _____

Emergency responder: Y/N If yes, specify role and agency: _____

Individual's exposure details (complete where known)

Location of flood (town/area): _____ Date of flood onset:___/___/___
Individual's connection to area (circle all that apply):
Resident Y/N Work Y/N School Y/N Other Y/N (specify): _____
Home flooded: Y/N Workplace flooded Y/N School flooded Y/N
Evacuated: Y/N
Direct skin contact with floodwater: Y/N

Individual's flood-associated health impact (complete where known)

Illness: Y/N Nature of illness _____
Injured: Y/N Nature of injury _____
Visited hospital emergency department: Y/N If yes, which one? _____
Visited other health-care facility: Y/N If yes, which one? _____

Consent to follow up

Was the individual present during completion of this form? Y/N

If yes, has individual given consent for contact details to be kept on a health register and for health professionals to contact them in future to provide advice in relation to the flood, and for health-related research purposes?[2] Y/N

[1]For example hospital records, local authority rest centre records, family doctor or health centre / helpline record (which may be completed with the patient present). If self-registration online, this will be pre-completed.
[2]Appropriate wording should also be provided here regarding confidentiality and data storage, according to law.

Phases 2 and 3: questions for initial and follow up studies

This section provides checklists of questions that could be used in either or both phases 2 (initial studies) and 3 (follow up studies) to identify exposures and health outcomes.

It is envisaged that initial studies will be conducted as soon as possible, within 24 hours to 2 weeks of the flood (ie during and just after the acute phase of the flood). The aims of an initial study are to understand the health needs of the population affected and provide appropriate public health action and advice, including preventing further exposure, identifying casualties and providing medical treatment. At this stage, exposures and stressors may include contact with articles contaminated by floodwater, evacuation, loss of homes or possessions; health effects may include poisoning, gastrointestinal disease, injury or mental health symptoms associated with the event.

The timing of the later studies will depend on the health outcomes or exposures of interest to the epidemiology group and what is known about on-going problems in the affected community. The recovery phase of a flood may take months or years, with different stressors throughout this period, such as mould growth, continued displacement and financial loss resulting in health effects such as respiratory symptoms, depression and stress.

3.2.1 Exposure questions checklist

A checklist of possible questions to ask regarding the individual's exposure is provided below. These are only suggestions for possible exposures to be investigated and the categories are not exhaustive. Those setting up the register should refer to the incident in question, the timing and the population groups affected and tailor the checklist accordingly, bearing in mind what will be feasible to collect in the circumstances.

Addresses can be cross-checked by public health staff with what is known about exposure variables such as flooded or contaminated areas.

LOCATION DURING THE INITIAL FLOODING

☐ At home (give address)
☐ At work (give address)
☐ At school (give address)
☐ At other place / in transit (give address)

CONNECTION TO THE FLOODED AREA

☐ Resident (give address)
☐ Workplace (give address)
☐ Attend local school (give address)
☐ Friends / relatives live there (give address)

FLOODED PROPERTY

☐ Home flooded (give approx depth floodwater and details)
☐ Workplace flooded (give approx depth floodwater and details)
☐ School flooded
☐ Community flooded
☐ Friends' / relatives' homes flooded
☐ Vehicle flooded

LOSS OF UTILITIES

☐ Loss of power at home (provide dates)
☐ Alternative heating and cooking appliances used (provide details such as type of appliance, whether used indoors or outdoors, whether ventilated when in use) [NB to establish carbon monoxide exposure potential]
☐ Loss of water supply at home (provide dates)
☐ Loss of telecommunications (phone, internet) (provide dates)
☐ Loss of food supply (eg stored food contaminated / refrigerated items loss, unable to access shops) (provide details)

WARNING AND EVACUATION
☐ Received flood warning (provide details)
☐ Received evacuation notice
☐ Evacuated (provide dates and place evacuated to)
☐ If have pets, evacuated with pets
☐ Temporary accommodation (provide dates and place, such as hotel, caravan, relatives')
☐ If have pets, accommodated with pets
☐ Sheltered friends / family who were evacuated (provide dates)
☐ Rescued by emergency services (provide details)
CONTACT WITH CONTAMINATION
☐ Contact with floodwater
☐ Contact with sewage-contaminated floodwater
☐ Contact with chemically-contaminated floodwater
☐ Exposure to smoke from fires during flood
☐ Damp in building associated with flood (give details such as room(s) affected, dates resolved)
☐ Mould in building associated with flood (give details such as room(s) affected, dates resolved)
LOSS
☐ Bereavement
☐ Loss / destruction of property (provide details such as type of property, approximate costs)
☐ Loss / destruction of possessions (provide details such as type of possessions, approximate costs)
☐ Loss of livelihood (provide details such as approximate financial costs)
☐ Loss of social / community support networks (provide details)
RESTORATION
☐ Building works required (date completed, note any problems)
☐ Insurance company payment (date completed, note any problems)
FLOOD PREPAREDNESS
☐ Previous experience of being flooded (provide details)
☐ Flood and evacuation response pack pre-prepared
☐ Actions taken to protect home

Other questions to consider may include specific questions for relatives/friends of those in the affected area and questions for the emergency responders.

3.2.2 Health questions checklist

As with the exposure questions checklist, these are only suggestions for possible health effects to be investigated and the categories are not exhaustive and the questions should be chosen with both the study and current flood circumstances in mind.

Countries may have pre-existing, validated questionnaires to assess health impact, which may be used. For example, the Patient Health Questionnaire[28] is widely used to diagnose anxiety, depression, self-harm and somatic symptoms.

3.2.2.1 Health seeking behaviour

These questions will need to be carefully worded in order to assess whether health appointments were due directly or indirectly to the flood; this may be more difficult in later studies when the association may be less clear, in particular to members of the public.

VISITS TO HEALTH PROFESSIONALS
☐ Visited hospital (date(s), location(s))
☐ Visited family doctor (date(s), location(s))
☐ Visited walk-in clinic (date(s), location(s))
☐ Telephone national health helpline (date(s), location(s))
☐ Looked up health advice online (date(s), location(s))
☐ Received health advice directly in relation to the flood (eg from local governmental agency, local public health organisation, such as leaflet, public meeting etc) (give details)
TREATMENT
☐ Prescribed medication for flood-associated health impact

☐ Self-medicated for flood-associated health impact
☐ Accessed support networks in response to flood (such as charities, local support groups)

MISSED MEDICAL APPOINTMENTS

☐ Missed medication or treatment due to flood (eg due to evacuation)
☐ Missed health appointments due to flood (eg due to difficult access to health centre)

3.2.2.2 Checklist of possible signs and symptoms

Include for each health outcome the date that symptoms began and symptoms ended.

TYPE OF INJURY

☐ Abrasion, laceration, cut
☐ Avulsion, amputation
☐ Concussion, head injury
☐ Fracture
☐ Sprain/strain

MECHANISM OF INJURY

☐ Burn, *specify*:
  ☐ Chemical
  ☐ Radiation
  ☐ Fire, hot object or substance
  ☐ Sun exposure
☐ Cold/heat exposure, *specify*:
  ☐ Cold (eg, hypothermia)
  ☐ Heat (eg, stress, hyperthermia)
☐ Electric shock
☐ Fall, slip, trip, *specify*:
  ☐ From height
  ☐ Same level
☐ Hit by or against an object (eg collapsed / damaged building)
☐ Motor vehicle crash in floodwater
☐ Non-fatal drowning, submersion
☐ Poisoning, *specify:*
  ☐ Carbon monoxide exposure
  ☐ Smoke inhalation
  ☐ Inhalation of fumes, dust, other gas
  ☐ Dermal
  ☐ Ingestion *specify* _____
☐ Use of machinery, tools, or equipment

INFECTION OF INJURY

☐ Skin infection
☐ Cellulitis

ACUTE ILLNESS/SYMPTOMS

☐ Conjunctivitis/eye irritation
☐ Dehydration
☐ Dermatologic/skin *specify:*
  ☐ Rash
  ☐ Infection
  ☐ Infestation (eg lice, scabies)
☐ Fever (≥100°F or 37.8°C)
☐ Gastrointestinal, *specify:*
  ☐ Diarrhoea
    ☐ Bloody
    ☐ Watery
  ☐ Nausea or vomiting
☐ Jaundice
☐ Meningitis/encephalitis
☐ Neurological (eg, altered mental status, confused/disoriented, syncope)
☐ Obstetrics/Gynaecology, *specify*:
  ☐ GYN condition not associated with pregnancy or post-partum
  ☐ In labour

- ☐ Pregnancy complication (eg, bleeding, fluid leakage)
- ☐ Routine pregnancy check-up

☐ Pain, *specify:*
- ☐ Abdominal pain or stomach ache
- ☐ Chest pain, angina, cardiac arrest
- ☐ Ear pain or earache
- ☐ Headache or migraine
- ☐ Muscle or joint pain (eg, back, hip)
- ☐ Oral/dental pain

☐ Respiratory, *specify:*
- ☐ Congestion, runny nose, sinusitis
- ☐ Cough, *specify:*
  - ☐ Dry
  - ☐ Productive
  - ☐ With blood
- ☐ Pneumonia, suspected
- ☐ Shortness of breath/difficulty breathing
- ☐ Wheezing in chest

☐ Sore throat

☐ Other, *specify:*
- ☐ Mosquito bites
- ☐ Wasp stings

EXACERBATION OF CHRONIC DISEASE

☐ Cardiovascular, *specify*:
- ☐ Hypertension

☐ Congestive heart failure
  - ☐ Ischaemic heart disease

☐ Diabetes

☐ Immunocompromised (eg, HIV, lupus)

☐ Neurological, *specify*:
- ☐ Seizure
- ☐ Stroke

☐ Respiratory, *specify*:
- ☐ Asthma
- ☐ COPD

3.2.2.3 Mental health questions

These should be carefully chosen with a clear perspective of the motives behind the questioning, and sensitivity to those being questioned. Also consider psychosomatic symptoms in those persons affected. Include for each the date symptoms began and date symptoms ended. The checklist has been developed after Brewin et al.[14]

MENTAL HEALTH

- ☐ Agitated behaviour (ie violent behaviour/threatening violence)
- ☐ Anxiety or stress
- ☐ Depressed mood
- ☐ Drug/alcohol intoxication or withdrawal
- ☐ Previous mental health diagnosis (ie PTSD)
- ☐ Psychotic symptoms (ie paranoia)
- ☐ Suicidal thoughts or ideation
- ☐ Sleeplessness

Posttraumatic stress

The occurrence of the following at least twice in the previous week:

- ☐ Upsetting thoughts about the incident
- ☐ Upsetting dreams about the incident
- ☐ Acting or feeling as if it (the incident) were happening again
- ☐ Feeling upset by reminders of it
- ☐ Bodily reactions (fast heartbeat, stomach churning, sweatiness, dizziness) when reminded of it

☐ Difficulty following or staying asleep
☐ Irritability or outburst of anger
☐ Difficulty concentrating
☐ Heightened awareness of potential dangers to yourself and others
☐ Being jumpy or being startled at something unexpected

Depression
☐ Being more bothered than usual by feeling down, depressed or hopeless
☐ Being more bothered than usual by feeling little interest or pleasure in doing things

Other psychological reactions [xii]
☐ Smoking more than usual
☐ Drinking more alcohol than usual
☐ Other reactions that concern you (if so please explain further)

3.2.3 Confounders and vulnerabilities

Questions on confounders, effect modifiers and vulnerability can also be included in follow up studies.

Vulnerable groups identified in systematic literature reviews[1] include: children, pregnant women, elderly people, people with physical impairments, people with sensory impairments, people with cognitive impairment, people with chronic illnesses and / or reliance on medication, homeless people, people with cultural and language vulnerability, people with poor resources or economically deprived.

Occupation information can be used to inform socio-economic status, but study design should also consider that some occupational groups may be more exposed, such as those involved in clean-up (contact with contamination) or those providing support to flooded communities (work-related stress).

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