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SHARP

Strengthened International HeAlth
Regulations & Preparedness in the EU

Lessons learnt from the review of health threats of three different origins: biological, chemical and environmental.

Carmen Varela Martínez

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Contents

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I. Executive Summary

This review was elaborated under the Joint Action — SHARP JA "Strengthened International HeAlth Regulations and Preparedness in the EU". This JA will strengthen implementation of Decision 1082/2013/EU, supporting the EU level preparedness and responses to health threats and the implementation of the International Health Regulations (2005). Through the JA, the member and partner states and the Unions common ability to prevent, detect and respond to biological outbreaks, chemical contamination and environmental and unknown threats to human health will be strengthened.

Specifically the Work Package of this JA related to this review (WP 6) will support in the development of an integrated multisectoral preparedness and response plan in which Member States can incorporate into their national Preparedness and Response plans.

Three different public health events affecting EU Member States were selected through literature search in webpages of International Organizations like the European Centre for Disease Prevention and Control (ECDC) and the World Health Organization (WHO) and searching in PubMed and on Internet. These events were selected on the basis that they were public health threats affecting EU countries. The selection of the events were focus on more recent events involving more than one country and due to different hazards, but due to availability of the information the selected events were from 2010, 2011 and 2014 and in one of the events only one country was affected. These events had different origins: a biological threat, a chemical threat and an environmental threat.

Information publicly available from official and non-official sources from these events was reviewed in order to identify the main stakeholders involved, factors that contributed to the success or failure of the implemented actions and allow extracting some lessons learnt. Moreover, the information regarding the biological threat collected for this document was review by the partner of SHARP JA from Germany that was involved in the management of this event in Germany. Similarly the partner from Hungary together with Hungarian authorities reviewed the information from the chemical threat and used as reference the Parliament's committee report that is available in Hungarian language: https://www.parlament.hu/irom39/04795/04795.pdf.

Elements of this review will serve for the preparation of all hazards e-learning and tabletop protocols and for the selection of best practices.

In order to analyse the management of the events, including the multisectoral collaboration, we gave a brief description of the main stakeholders involved, according to the available information. Factors that could help to the success or fail of the management of the events were also extracted from the available information.

Core Public Health capacities according to the International Health Regulations (2005) were covered while reviewing the selected health threats (legislation, policy and financing,

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coordination/national focal points communications, surveillance, response, preparedness, risk communication, human resources and laboratory core capacities). The Decision 1082/2013/EU on serious cross-border threats to health was also taken into account for the reviewing.

Main lessons learnt from the review were:

1. The use of existing structures for international collaboration and communication is crucial. Examples of such structures are the Early Warning and Response System, the Rapid Alert System for Food and Feed, EpiPulse (former EPIS), International Health Regulations, INFOSAN, the EU Civil Protection Mechanism, etc.
2. Multisectoral coordination with all the stakeholders is key and competences and responsibilities of all of them should be clear.
3. Countries are becoming increasingly aware of the need to cooperate and share best practices for a better preparedness and response.
4. Capacities to perform risk assessment should be strengthened.
5. Capacities, both of trained personnel and equipment, should be maintained and reinforced. Training is key and simulation exercises to test the plans are crucial. Volunteers, charities and non governmental organizations play a role in preparedness and response but should not be a substitute.
6. Preparedness and response plans should be available and incorporated at all levels. It is necessary to have action plans with detailed instructions and procedures. Plans for emergencies should take into account the health sector; they should also include mental health and psychosocial aspects. Gender mainstreaming should be incorporated in the preparedness and response against public health threats. To assure a high vaccination coverage is key for preparedness.
7. Decisions should be taken based on the precautionary principle and scientific evidence as far as it is available.
8. Surveillance should be strengthened and enhanced both on specific risks and overall systems for identifying unexpected risks. Recording, collection and access to data should be optimized in order to have information on a timely manner and to have all involved institutions working with the same information. Harmonization of procedures for detection and characterization of different threats in humans, food and the environment should be strengthened.

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II. Biological event: *Escherichia coli* O104:H4 outbreak in Germany (2011)

a. Background

Shiga toxin producing *Escherichia coli* (STEC/VTEC) infections can go from mild intestinal symptoms to severe kidney disease. Haemolytic Uremic Syndrome (HUS) can appear in a small percentage of people infected with STEC, mainly in young children. It is a potentially life-threatening condition characterized by acute kidney failure, haemolytic anaemia and thrombocytopenia. STEC is transmitted to humans primarily through consumption of contaminated foods, it can be transmitted also by contact with animals or person to person transmission. The proportion of STEC non-O157 serogroups has been increasing over the years as more laboratories are testing for other serogroups. A high proportion of HUS cases due to non-O157 serogroups points to an emerging risk of severe infections.

The *Escherichia coli* O104:H4 outbreak that occurred in Germany in 2011 was one of the largest outbreak due to STEC reported in history worldwide. The outbreak started at the beginning of May 2011 and reached its peak on 22 May 2011. On July 26, 2011 Germany declared the outbreak officially closed. Cases were detected in 13 other European countries. Most of the cases had a history of travel to northern Germany. A total of 3842 cases (including 55 deaths) were reported, 855 of which (22%) involved the haemolytic–uremic syndrome.

This STEC outbreak was unusual in its magnitude, gender (women more affected), age distribution (majority of cases involved adults), STEC strain implicated and clinical picture of cases (high incidence of neurological symptoms). The outbreak strain possessed an unusual combination of virulence factors of STEC and enteroaggregative *E. coli*, stx2+ and resistance to 3rd-generation cephalosporines due to Extended Spectrum Beta Lactamases (ESBL). The serotype of outbreak strain STEC O104:H4 was very rare and only few human cases had been reported before.

First analytical studies indicated an elevated risk of infection for persons eating raw tomatoes, fresh cucumber and leafy salad, they were the likely vehicles of infection. Hence the Robert Koch Institute (RKI) and the Federal Institute for Risk assessment (BfR) made a recommendation to the public to avoid the consumption of these vegetables. Samples of fresh cucumbers taken in Hamburg tested positive for STEC, which were later confirmed to be of a different serotype than the strain causing the outbreak.

Further epidemiological investigations and traceability results showed an association of germinated seeds with the outbreak. On Friday 10th of June 2011, the three federal institutes (RKI, BfR and the Federal Office of Consumer Protection and Food Safety) published a joint statement with the recommendation to abstain from eating sprouts. At the same time, the recommendation not to eat cucumbers, tomatoes and lettuce was lifted. Hundreds of samples were taken from the suspect farm, including germinated and

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ungerminated seeds, water, and environmental samples, without the pathogen STEC O104: H4 being found in any of them.

On 24 June, France reported an outbreak of 11 cases of bloody diarrhoea, including 9 HUS cases. There was microbiological evidence that the strains from both outbreaks (Germany and France) were indistinguishable. The European Food Safety Authority (EFSA) technical report concluded that a specific lot of fenugreek seeds imported from Egypt could be the most likely common link but that it could not be excluded that other lots could be implicated and EFSA advised that consumers should not grow sprouts for their own consumption and should not eat sprouts or sprouted seeds, unless these products were cooked thoroughly. The European Commission took the decision to withdraw certain types of seeds imported from Egypt from the market and temporarily ban the import of these products.

Once the infection vehicle (sprouts) was identified and its distribution was stopped at the beginning of June, there were no further clusters associated with the consumption of this food item. In the late stages of the outbreak, cases of secondary transmission by infected persons via close contact within households occurred, as well as distinct localized outbreaks that could be attributed to secondary contamination of food products by employees in the food industry or due to contaminated seeds remaining in circulation. Asymptomatic carriers were also detected. Moreover, a few laboratory infections were recorded. Single nosocomial infections occurred in hospitals (coloscopy). Therefore, raised awareness of the risk of infection was also emphasized in public announcements during the months after the official end of the outbreak.
Eculizumab, an antibody that targets a protein involved in regulating the human immune system, and immunoadsorption were successfully used to treat HUS cases.

b. Actors involved

- In Germany, three stakeholders collaborated at the federal level in the investigation and management of the outbreak:
    - The Robert Koch Institute (RKI). It is Germany's public health institute, responsible for epidemiological studies; moreover the National Reference Laboratory for Salmonella and other enteric bacteria performed the characterization of the E. coli strain.
    - The Federal Institute for Risk Assessment (BfR) responsible for the food-related risk and food sampling.
    - The Federal Office of Consumer Protection and Food Safety (BVL) responsible for the trace back studies in the food chain.

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- Federal Ministry of Food, Agriculture, Consumer Protection and Regional Development (BMELV). If a crisis is beyond the concerned federal state, the BMELV provides status reports, recommendations for Risk Management options and takes responsibility for Risk Communication.
- The Federal Centre for Health Education (Bundeszentrale für gesundheitliche Aufklärung, BZgA), has provided outbreak-related health advice to the public.
- Food safety and public health authorities performed extensive investigations at the German federal states level.
- The German Task Force EHEC (Enterohaemorrhagic Escherichia coli) was established by the BMELV. Members of the Task Force EHEC were experts from the Federal States in Germany, from the BVL, the BfR, the RKI and the EFSA. The Task Force EHEC was hosted in the crisis centre at the BVL.
- EU Reference Laboratory on E. coli.
- European Centre for Disease Prevention and Control (ECDC). It is an EU agency aimed at strengthening Europe's defences against infectious diseases.
- The European Commission (EC) activated all existing networks created to manage this kind of incidents the moment the outbreak was confirmed.
- The WHO and the International Food Safety Authority Network (INFOSAN) closely worked with national and international health authorities. WHO's role was to ensure that countries reported cases that might be linked to this outbreak, to keep up to date on developments and recommendations that might affect other countries and to be aware of any implications for food products that were being traded internationally.
- A task force was set up by the EFSA to provide immediate scientific assistance in hazard monitoring and risk assessment. It consisted of experts from the European Commission, relevant European Union member states, the ECDC, the World Health Organization (WHO), the Food and Agriculture Organization (FAO) of the United Nations, and EFSA staff members.

c. Success factors

In Germany, STEC and HUS have been statutorily notifiable since 2001 according to the Protection against Infection Act. When a need for enhanced surveillance was identified on 23 May 2011, the surveillance system was rapidly adapted to the specific outbreak situation. Physicians, laboratories, local and state health authorities supported the acceleration and extension of the system extraordinarily well. The following amendments for surveillance were implemented:

- Accelerating the epidemiological data flow to the national level.
- Implementing a syndromic surveillance system for bloody diarrhoea in emergency departments, as a proxy for potentially new STEC cases.

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- Assessing the capacities for HUS-treatment in Germany. From 30 May onwards, the German Society for Nephrology collected data on the HUS treatment capacities in Germany and reported these regularly via e mail to the RKI. During the outbreak period, 79 hospitals, located in 15 of the 16 federal states, provided almost daily information: all but two confirmed having sufficient capacities for treating HUS patients. Monitoring capacity for treating HUS patients in German hospitals allowed to evaluate whether or not international help would be needed.
- Initiating active laboratory surveillance. A rapid diagnosis with differentiation with respect to the outbreak strain was implemented. This served as an important tool for monitoring any potential reoccurrence of the outbreak.

The RKI informed the medical experts and the public health service in a very timely fashion. During the outbreak, at least daily updates were distributed by e-mail and publically on the website.
There was close cooperation of health authorities and food safety authorities and a rapid exchange of information in the analysis of outbreak clusters.

Raised awareness of the risk of infection was emphasized in public announcements. The web page of RKI was extensively visited (4 to 6 million page uses per month). Since 24 May the BZgA provided outbreak related public health advice to the public.
The fact that the BfR, RKI, and the BVL published shared press releases is an example of good communication between risk assessment (BfR) and risk management (BVL), and shows that management options were agreed upon. At federal level, risk assessors and risk managers put forward the same message to the public. Risk Assessment provided sound and scientifically based assessments with a clear indication of the current uncertainties. Risk Management, on the other hand took actions to protect the consumers as fast and as effective as possible with a clear focus on the precautionary principle. The complex risk analysis structure in Germany had provided advantages. The interactions between different levels and authorities challenged the decisions being made constantly and required fast corrections. This iterative approach made the whole process more efficient.

The EC used the Early Warning and Response System (EWRS) and the Rapid Alert System for Food and Feed (RASFF) to manage this kind of incidents the moment the outbreak was confirmed. On 22 May 2011 Germany posted a message through the EWRS reporting a significant increase in the number of patients with HUS and bloody diarrhoea caused by STEC. On 24 May, Germany reported to RASFF, the investigation on cucumbers from Spain and the Netherlands. On 25 May, Germany launched an urgent inquiry through the EPIS platform (Epidemic Intelligence Information System from the ECDC, now named Epipulse) with the preliminary information on the strain. In addition, following the outbreak in France, the EC asked EFSA to support the Member States and coordinate activities to investigate the source of the outbreaks in France and Germany in order to allow risk managers to take the necessary and appropriate risk mitigating

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measures towards prevention of further outbreaks. For this purpose, EFSA set up a task force.

ECDC supported the diagnostic capacity by providing the national reference laboratories the opportunity to order antiserum for the detection of O104 *E. Coli* serotype. On 30 May a rapid diagnostic test was available. A specific PCR for differentiation of the outbreak clone from other STEC was available.

Moreover, on 24 May 2011 Germany notified to WHO the event as a potential public health emergency of international concern within the framework of the International Health Regulations (IHR). WHO shared information on this outbreak with its Member States through the IHR closed web site and the INFOSAN.

The RKI sent updates on the situation to EWRS, the EPIS and the WHO on a daily basis. Daily meetings of these networks allowed for the rapid exchange of all new data between the Member States and different agencies, thus laying the ground for immediate action based on the latest information.

Regarding the clinical management of the cases, logistical problems were overcome by increased activities: no extra personnel were provided although the number of patients increased by 300% for HUS alone. Routine care for children with kidney disease was continued.

On May 26, in the middle of the outbreak, a letter in the New England Journal of Medicine appeared reporting the benefits of using eculizumab in HUS, especially for patients with neurological complications that were resistant to plasma exchange. During the following days and weeks, eculizumab became available and was used in many adult patients with STEC-HUS but also in individual children.

d. Fail factors

There were reporting delays. Transferring information on a case from the local through the federal state to the national health authority during the outbreak took from a few days up to 8 days. Most of the HUS cases in the early phase of the outbreak were notified later than the 24 hours mandated by law.

While the confirmation methods of O157 STEC infection were well established, this was not the case for infections caused by STEC non-O157 serotypes. Therefore, underreporting of non-O157 STEC infections was very likely. Because of the rare serotype involved, commercial laboratory assays specific for *E. coli* O104:H4 were not available. Using the resistance phenotype to identify *E. coli* associated with the outbreak could had been a problem as plasmids can be lost, in this outbreak the STEC from a secondary case was not antimicrobial resistant.

Single nosocomial infections occurred in hospitals (coloscopy) and few recorded laboratory acquired infections were reported.

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Difficulties of detecting STEC in seeds and sprouts thereof with the applied sampling plans and analytical methods when the contamination is low and unevenly distributed have been observed in previous outbreaks. Bacteria on or in seeds may undergo stress induced by very low water activity and therefore exhibit low culturability (i.e. viable but non-culturable (VBNC) state).

In a first case-control study, the consumption of sprouts was mentioned only by 25% of cases, so consumption of sprouts was not tested analytically. Sprouts may have been the ingredient that consumers recalled least in a mixed salad.
The consumption of fresh sprouted seeds however, is based on the understanding that they are sold as ready to eat. For fresh produce this assumes and relies on a production process which prevents contamination and ability to detect contamination when it occurs. These conditions have proven not to have been met in this outbreak.

Although hygienic measures were satisfactory and local food-safety authorities had inspected the company routinely under the same conditions as a food-processing company, it became apparent that European legislation had important deficits regarding Shiga-toxin–producing *E. coli*.

The way in which information about the outbreak and the identification of the pathogen was conveyed to the public was debated. Contradictory messages from different authorities had played a role in confusing the public and jeopardizing their confidence in efforts to contain and trace the outbreak.

Initial evidence of the 2011 outbreak pointed to a broader range of vegetables posing an elevated risk of acquiring disease; the public was advised for avoiding the consumption of vegetables: particularly cucumbers, tomatoes and lettuce. Certain regional announcements were not backed by sound scientific evidence or risk assessment. On 26 May, the Hamburg Institute for Hygiene and Environment informed about isolation of STEC from two samples of cucumbers originating from Spain that eventually were confirmed to be a different serotype than the outbreak strain. Economic losses were registered in Spain, but also affected other countries, including Belgium, Bulgaria, France, Portugal, Switzerland, The Netherlands and Germany. The EU approved more than 200 million Euros in emergency aid for European vegetable farmers affected by the crisis, a sum estimated to be a mere fraction of actual losses. The separation of risk assessment and risk management in Germany and the shared responsibilities between federal and local authorities led sometimes to seemingly premature risk management and risk communication. The main disadvantage of the complex administrative structure was though that the regional authorities tended to take actions, even when the assessment of the situation was not completely clear.

The number of plasma exchanges increased dramatically and resulted in considerable logistical problems (supply of staff, machines, fresh frozen plasma). Consequently, many adult patients had to be referred to other centres, and in Hamburg included many private dialysis practices that were recruited to dialyze and to treat patients with plasmaphereses.

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Peritoneal dialysis was performed in most children who required dialysis, however, extracorporeal modalities were used in 40%, sometimes for logistical reasons, for example, a lack of Tenckhoff catheters on a weekend.

At the beginning of the outbreak, an ad hoc committee of the German Society of Nephrology recommended treating all HUS patients with renal or neurological and haematological symptoms with plasmaphereses. The rationale behind this recommendation seems to be limited, as cell-bound Shiga toxin may not be effectively eliminated from the circulation by plasmaphereses. Accordingly, the German Society of Nephrology extended the recommendation to include treatment of all patients who exhibited no short-term improvement after beginning plasmaphereses with eculizumab. There was not time for a rigorous controlled clinical trial; instead, guidelines for compassionate use of eculizumab were written up when, just days into the outbreak, The New England Journal of Medicine published a study of three children who rapidly recovered from STEC the previous year, after treatment with the antibody.

A variety of patients have been treated with different antibiotic regimens despite reports that antibiotics might worsen the course. At the beginning, only eculizumab-treated patients received antibiotics to prevent meningococcal infections, as well as patients with necrotizing enteritis or concomitant systemic bacterial infection. However, on the basis of the specific potency of STEC O104:H4, some centres liberalized the antibiotic treatment option to eliminate the causative agent earlier. Despite this rather favourable outcome, this outbreak was characterized by the uncertainty of specific therapeutic options.

e. Lessons learnt

Although STEC is under surveillance at EU level, the EU zoonoses report shows that there are still three countries (Belgium, France and Luxembourg) where notification of STEC is based on a voluntary system; moreover, in Italy, STEC surveillance is sentinel and primarily based on the HUS cases reported through the national registry of HUS. The surveillance systems for STEC infections cover the whole population in all EU MS except for three MS (France, Italy and Spain). Therefore, surveillance of STEC, according to EU case definition from 2018, should be improved.

The surveillance system in Germany was enhanced for shortening the reporting delay. Timeliness of surveillance systems should be evaluated to successfully apply detection algorithms that would indicate potential multicounty or multistate outbreaks. Generic nationwide or worldwide protocols for outbreaks of STEC should be available. Harmonization of procedures for detection and characterization of STEC in humans and food should be strengthened. According to a questionnaire on diagnostic and characterization of STEC in human, sent in 2019 by EFSA, to the national reference laboratories (NRL) in the EU/EEA countries:

- Less than half of the MS had a national guidance for the detection of STEC in human samples and there was no harmonised approach in the methods used to detect STEC in human samples.

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- All NRL had capacity for virulence gene profiling of STEC isolates, including stx subtyping.
- Whole Genome Sequencing (WGS) was routinely used in most of the NRLs together with other methods.
- The criteria used when deciding if a patient should be tested for STEC infection varies between the different MS.
- More than half of the MS had implemented a national sampling strategy for routine STEC testing in food, feed or animal samples, mainly concerning meat, milk and sprouts.

Commission Regulation (EU) 2073/2005 on microbiological criteria, that was in place during the 2011 outbreak was amended with Commission Regulation (EU) No 209/2013, to consider six STEC serogroups that are recognised as causing most cases of HUS: O157, O26, O111, O103, O145 and O104, nevertheless STEC O157 is more readily detected than non-O157 STEC.

Further diagnostic methods would need to be developed and the molecular typing ones would need to be integrated into routine surveillance. The faster and the more accurately the source could be narrowed down, the more precise the advice for consumers could be and the more targeted the action to remove the contaminated food. Moreover, it would be useful to develop more general methods which can detect also unexpected pathogens and to be able to transfer them to a more specific, more targeted, method when it is needed. The detection of STEC carriers involved in food handling would be very important since there was evidence of asymptomatic carriers of STEC. Monitoring and/or the exclusion of carriers of STEC related to food handling should be considered as a control option.
As secondary clusters of cases from person-to-person exposure might occur, personal hygiene messages could be reinforced. The explicit advice to consistently observe personal hygiene and food hygiene measures is generally essential in a household, but particularly in the presence of STEC-infected persons or persons with diarrhoea. Although international guidelines generally recommend otherwise, what happened in this outbreak suggests that food items or ingredients that are deemed to be hard to remember, as the sprouts, should be included in analytical studies, even if such items are mentioned by less than 50% of those surveyed.

Using the experience of the back tracing of sprout seeds in Europe, appropriate tools for the generic methodology of trace back should be developed and validated at the EU level. Recommendations regarding sprout use and consumption were strengthened or adjusted as a consequence of this outbreak. EFSA and ECDC strongly recommended advising consumers not to grow sprouted seed for their own consumption and not to eat sprouted seeds unless they have been cooked thoroughly. Special attention should be paid to the potential contamination from seeds as it is known that *E. coli* can survive on dried seeds for longer periods of time, potentially for years and bacteria on or in seeds may undergo stress and therefore exhibit low culturability.

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Countries are becoming increasingly aware of the need to cooperate and share best practices to ensure food safety globally, taking into account the rapid globalization of the food trade and travelling have increased the risk of international incidents involving contaminated food.

Handling an effective and reliable flow of information between health professionals, scientists, media, politicians and finally the public is certainly a complex and delicate issue. Transparent, clear, and accurate risk communication is critical during effective outbreak responses. Reliable and responsible communication channels involving all stakeholders are also essential to deal with any outbreak.

Contradictory messages from different authorities had played a role in confusing the public and jeopardizing their confidence in efforts to contain and trace the outbreak. This outbreak required a special communication strategy with a strong focus on precautionary measures and a clear communication of uncertainties. Subsequently, EFSA re-invested in its Communication Expert Network (CEN) of Member State communicators and developed Crisis Communications Guidelines in 2016. Dealing with uncertainty is a critical component in this framework. EFSA's approach to uncertainty communication supports this framework by providing standardised numerical and verbal formats for expressing uncertainties. The real challenge was the communication of these precautionary measures with adequate stringency and to convey the message of a high uncertainty at the same time. Consumers were advised to refrain from eating raw tomatoes, cucumbers and lettuce even though these commodities were not identified as the source of the STEC contamination. The precautionary principle was applied to protect consumers.

More evidence would be needed on virulence and fitness factors of STEC, and on the mechanisms of their interaction with the host cells and their targets. The protective host mechanisms including immune response and the role of commensal microbiota could be investigated.

New therapeutic strategies to effectively remove Shiga toxin from the gastrointestinal tract once STEC has been diagnosed should be developed. Regarding the antimicrobial therapy, a major objective would be to determine the effect of antimicrobials on *stx*-phage induction, and the role of antimicrobial therapy in shortening bacterial shedding should be determined. The administration of certain probiotics to humans or reservoir animals may reduce colonization and carriage of STEC, which will prevent and/or reduce the risk of infection and transmission of the pathogenic bacteria. Moreover, use of direct-fed microbiota was found to reduce shedding of E. coli O157:H7 in cattle. Despite the observed beneficial effects in animals, it is very difficult to extrapolate the data to humans. Furthermore, it remains unclear how and when the probiotic should be administered.

This outbreak shows how epidemiological evidence can guide food investigations, and that this must be accompanied by rapid traceability studies to identify the source. It also

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highlights the need to have action plans available in each EU/EEA country so that this highly virulent pathogen can be rapidly identified in laboratories.

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III. A chemical incident, due to red sludge release after the failure of a containment dam, from an aluminium factory. Hungary October 2010

a. Background

On 4th October 2010 the rupture of the wall of a dam containing red sludge, from an aluminium factory in Hungary, caused the contamination of the Torna Creek and its valley with the estimated amount of 1 million m^3 of alkaline red sludge. The red sludge is the residuum of aluminium production; it contains sodium hydroxide which is a caustic base.

The accident caused 10 deaths, 286 injured people (of which 121 required treatment in hospital) and major environmental and economic damages. Approximately 4,000 workers and volunteers employed in rescue and rehabilitation operations were also injured. There were over 300 houses in three villages damaged by the red sludge, and a thousand hectares of soil contaminated. Several rivers (Torna creek (the most heavily damaged), Marcal and Rába) were contaminated causing severe environmental damage. There was a risk of further spread of the spill to the river Danube, which fortunately did not result in environmental damage of the transboundary regions.

The speed and the amount of the flood waves pouring out of the reservoir was the cause of the casualties and traumatic injuries and the physical damages of the houses, roads and the railways. The high pH level of the red sludge resulted in chemical burning injuries and chemical damages on property. Besides high alkalinity, certain heavy metals may had mildly contaminate soil, groundwater and water.

b. Actors involved

Rescue and disaster management

- The Government. The Hungarian Government carried out the activities with the joint actions from the Ministry of Interior, the National Directorate General for Disaster Management and the Ministry of Rural Development. A Governmental Coordination Committee, chaired by the Minister of Interior was set up.

  The Government declared the state of emergency (defining a range of organizational, financial and communication tasks related to damage control) in the three affected counties and activated the EU Civil Protection Mechanism for urgent international assistance, through the European Union Monitoring and Information Centre.
  The government took control of the aluminium company and set up a specific website, in order to provide the Hungarian and international media with reliable information related to the ‘red sludge’ disaster.
- Rescue management teams:
  - National Directorate General for Disaster Management managed the rescue operations: firefighters of 10 neighbouring Fire Departments were involved.
  - Army: soldiers were directed to the area to support rescue operations.
  - Hungarian National Ambulance Service.

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- Healthcare Leading Point was set up with continuous medical on-call service.

- Health Operators:
  - National Public Health and Medical Officer Service (ÁNTSZ), had an institutional role in supporting the assessment of potential risks to health related to these events. The ÁNTSZ and the Army assessed radiological threats. Both laboratories concluded that there was no hazardous radiation exposure in the area. The ÁNTSZ coordinated follow-up examinations of lung-functions and heavy metal exposure from human samples.
  - Health providers/hospitals: Hospitals of Ajka, Veszprém and Győr (major neighbouring cities).
  - Public health and occupational health professionals.
  - Mental hygiene experts.
  - Pulmonology Institute of Veszprém County: provided local support with screening centre and anti-inflammation treatment.
  - National Institute of Oncology: did a 3-year human genetics study (follow-up study).
  - Occupational healthcare launched at Devecser from 14 October.
  - Continuous moving healthcare service at Devecser (3 ambulance units) and Kolontár (2 ambulance units).
  - Reopening of the closed medical room at Kolontár.

- Scientific task force/scientific institutes:
  - The Governmental Coordination Committee requested to set up an ad-hoc task force. It was led by the director of the Material and Environmental Chemistry Institute at the Chemical Research Centre of the Hungarian Academy of Sciences. It comprised nine members, including biologists and ecologists. The task force was set out to map the impact of the release and provide the government with advice on how to limit the harm.
  - University of Veszprém (University of Chemistry).
  - Geological Institute of Hungary.

  Apart from scientific advice the Hungarian Academy of Sciences, the Geological Institute of Hungary and an independent laboratory (the Balint Analitika) did the samples analysis. They took samples on behalf of the Central Directorate for Water and the Environment.

- Authorities:
  - The environmental authorities ordered the suspension of alumina production; they monitored and measured the pollution (environmental exposure by dust and heavy metals), carrying out a comprehensive environmental audit, clean-up work and waste management fine.
  - Regional offices of the Central Agricultural Office declared a ban on fishing and hunting. Sales and use of contaminated fodder and food was prohibited through an official intervention by the Chief Veterinary Officer, working together with the

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Veszprém County Defence Commission. It also involved public workers and municipal forces in the works in the municipalities.
    - The Central Trans-Danubian Environmental. Nature Protection and Water Management Inspectorate.
- Danube Protection Convention. Hungary informed the Danube basin countries through that convention. The Danube River Protection Convention forms the overall legal instrument for co-operation on transboundary water management in the Danube River Basin. The Convention was signed in 1994 and came into force in 1998.
- Water suppliers. By 2010, there were more than 400 WSS (Water Supply and Sanitation) independent operators in Hungary.
- Other: charity organizations (e.g. Red Cross Hungary), international rescue support, aerial mapping investigation of the contaminated area, local population, local councils, civil defence organisations, the fire department, environmental protection activists and hydrological experts.

Rescue and disaster management

- Committee of the Hungarian Parliament, the National Investigation Office, the police and the Parliamentary Commissioner of Future Generations subjected the accident to an investigation. The Committee was set up ad hoc on 12 October 2010 by the Hungarian Parliament.
- MAL Co.Ltd. The Hungarian aluminium industry was previously owned by the state. In 1995 the privatization of this industry started. In1996-1997 MAL acquire the Aluminium plant in Ajka, involved in this event. The responsibility of the management and various operators/employees of the company was examined in court procedures (criminal and civil liability were both investigated).
- The Central Trans-Danubian Environmental, Nature Protection and Water Management Inspectorate. It had endorsed the classification of the deposited material as non-hazardous waste.
- District Mining Inspectorate. It was the competent institution for the licensing of mining waste deposits.
- Governmental Screening Center at Devecser. From 14 December 2010 for occupational healthcare service with 2700 patients screened until June 2011.

c. Success factors

Actions were aligned to the various phases of the catastrophe:

- Rescue and minimization/elimination of further damage was the first and most important.
- Assessment of short and long term risks of health and environmental damage.
- Decontamination, reparation and relocation.
- Investigating and assessing responsibilities, drawing consequences.

Multisectoral coordination is a key success factor for public health events:

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- A Governmental Coordination Committee and a scientific task force were established ad hoc and involved different agencies and disciplines.
- Regarding the emergency response, the Kolontar report (elaborated by the cooperation of the European Green Party, environmental organizations, non-governmental organizations and expert groups) mentioned an unprecedented high level coordination among the Police, the Army, the National Emergency Response Directorate and the National Ambulance Service.
- According to the WHO report there was an example of good communication and rapid response between the Water Company and the authorities in order to minimize the consequences in the water related needs since the main services lines were damaged.
- The animal side was taken into account, the collection and disposal of animal carcasses was done and it was recommended to take measures to protect animals from disease, and, furthermore, to prevent the production of food.
- The acceptation of donations was centralized.

Communication and local support:

- Rescue operator, health professional and representatives of authorities ensured continuous information to public on site: community forum was organized for every evening.
- Various health providers ensured local support: mental hygiene, screening, occupational health.
- Information in various Hungarian public media and news sites was ensured
- Special website was set up by the authorities to inform public and interested parties.

International communication and collaboration:

- Following this unprecedented accident the authorities responded with the expected rapidity and decisiveness managing, contamination of the river Danube was successfully averted. Hungarian authorities made efforts to prevent further spread of the spill to the river Danube, which could have led to trans-boundary environmental damage. Before the accident there was already a structure in place for the Danube basin countries (Danube Protection Convention) that allows the quick communication to closer countries.
- Hungary triggered the EU Civil Protection Mechanism and received a European team of experts charged with drawing up recommendations, for instance on how to work out optimal solutions for eliminating and mitigating damages.

Recommendations and requirements for Personal Protection Equipment were established. Based on the test results the authorities communicated that wearing FFP2D dust masks was deemed secure and generally recommended. Dust concentration in the air only exceeded the limit values in the disaster impacted area (in proximity of the dam break). In this area, wearing a dust mask was made compulsory for participants in the rescue operations. On the day following the accident, the Disaster Management drew up strict regulations for the protection of the health of all those, who take part within the endangered area in the rescue and cleaning operation of the grounds and the properties.

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They shall wear Wellington boots, closed clothing, acid and alkali-proof protective gloves and safety goggles in case of the risk of spillage.

The authorities were not only concerned with attending to the physical damage but also provided mental health care. Psychological effects were recognized among the affected population. Stress, anxiety, sense of loss and posttraumatic stress disorders were reported by some community members, particularly those who were evacuated, and suffered personal and family injuries, loss and damage to housing and property. A specialized crisis intervention team (with among others Charity organizations, e.g. the Maltese Charity Service) was available on site to provide psychological assistance. The Comprehensive Mental Health Action Plan 2013-2030, from WHO, was the first plan to include an indicator on preparedness for providing mental health and psychosocial support during emergencies.

Non-governmental organizations played a role in responding to the emergency. Community engagement in the preparedness and response against a public health emergency is an added value for the management of the event.
Lessons learnt during the management of the event were used to improve preparedness against similar future events:

- Immediate actions were taken (also in other countries) to re-examine and strictly control similar dams and industrial sites.
- As the result of the incident investigation, amendments were accepted to the current laws and decrees. The legal situation became clear. Moreover this incident has exerted a strong influence on the development of 153 European environmental laws. The Directive 2006/21/EC was meant to prevent accidents resulting directly from the prospecting, extraction, treatment, storage, recovery and disposal of mining waste and to limit their harmful effects on the environment and human health. However, after the adoption of the proposal and this event in 2010, two loopholes were identified: the distinction between hazardous and non-hazardous waste and the legal situation of abandoned sites and reservoirs. Commission Decision 2014/955/EU indicates explicitly that red mud should be classified as hazardous waste in the absence of proof to the contrary.
- The company had to shift to the use of a safer technology (the dry technology) in order to receive the new permit for further five years. This means that the red sludge is less liquid and less alkali, therefore the chance of a similar accident has significantly decreased (however exposure to dusts needs to be monitored).

d. Fail factors

Clear competences on licensing and monitoring were lacking. The licence prescribed MAL further reporting, revision, operational, managerial obligations from the monitoring wells to sound protection, data that is also the responsibility of the authority to inspect, however the District Mining Inspectorate was not involved in the licensing. The environmental protection inspectorate did not have the competence of performing structural engineering examinations and it was not obvious which authority would have the duty to examine the technical status of similar dams, even weeks after the dam

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rupturing. Following the disaster, a court ruling was required to clarify which authority should have granted a permit for the dam building at the reservoir and carried out static stability inspection of the built structure.

There were deficiencies in monitoring. None of the authorities substantially considered the risk of a dam break. There was previous evidence that the dam had deteriorated, however the environmental authorities referred that their obligations do not extend to the supervision of the structure of the ground or the stability of the dams. Monitoring could have drawn attention to the danger of a potential rupture in the structure, thus creating an opportunity for prevention. No use was made of the satellite imagery in the structural engineering inspection of the dam, even though they were continuously available. Directive 2008/98/EC, which imposes an obligation of regular monitoring on the operator, to be carried out at least annually with regard to both the condition of the built structure and of the waste, was not fully implemented. The obligations of environmental protection for the Aluminium plant were not properly regulated within the contract and there were also gaps in monitoring implementation. Moreover, the authorities allowed on more than one occasion for the owner to postpone meeting these obligations. The environmental authorities have also endorsed the unsubstantiated disaster management plan handed in by MAL Co. Ltd; that it was designed for a much smaller scale of accident.

At the time of the accident the aluminium factory still used a so-called wet technology, which was outdated and resulted in having in the reservoir the red sludge with a considerable amount of alkaline water. The District Mining Inspectorate did not demand the use of the best available technology. In an international context, the trend, at that time, was shifting away from wet disposal technologies towards dry disposal, which poses less risk. On the other hand, the dry technology about to be introduced in Ajka, at the time of the accident, a technology which involves blending in power plant gypsum, had not yet been implemented at an industrial level anywhere.

The regulation in the European Union regarding the red sludge was not exactly clear, there was a possible choice between hazardous and non-hazardous waste. The Commission considered that this waste should had been classified as hazardous given the highly corrosive properties of the waste. According to the Hungarian proposition for the amendment of the relevant EU law, if the red sludge is not the result of the dry technology, but the residuum of the wet method, then it should had been labelled as hazardous waste. However, the classification of the waste is not only a compulsory requirement at a given static moment, i.e. at the time of licensing, but it is an act to be repeated periodically, since the waste disposed and its properties change depending on its chemical constituents and the method of treatment. Based on the documentation sent in by MAL Co. Ltd., the Central Transdanubian Environmental, Nature Protection and Water Management Inspectorate accepted the reclassification of the waste, this way the red mud of MAL Co. Ltd. became non-hazardous waste, thus significantly relaxing requirements on disposal and subsequent monitoring. Instead of a risk-based, rather a European Waste Catalogue code based approach was practiced without detailed

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assessment of the risks posed by the waste and by the individual chemical substances contained in it.

The environmental protection authority did not have sufficient capacity (human and material resources) for the inspection activity. The inspection services were especially hit by the austerity measures of previous years. While desktop investigations are standard procedure, on-site inspections are more resource demanding. The unclear division of powers, the lack of regulatory precision and the enforcement procedures had a clear effect on the licensing and monitoring competences. The administration could have taken a more relevant part in the process of assessing risks and potential damage. The reclassification of the red mud also happened based on documentation submitted by the Company.

The heavy metal content measurements were done by different institutions: the Hungarian Academy of Sciences, the Geological Institute of Hungary and independent laboratories. The results of their heavy metal content measurements were varied, some of them were found below the permitted limits and others were up to twice the limit. Contamination by arsenic and other metals have been reported in the media; however, at the time of the on-site visit the WHO team could not examine any conclusive evidence.

e. Lessons learnt

It is essential to have an intersectoral and multidisciplinary approach in preparedness and response against an emergency. Coordination with all the stakeholders is key and competences and responsibilities of all of them should be clear. In addition the use of existing structures for international collaboration and communication, like the Danube River Protection Convention that allowed the quick communication to closer countries and the EU Civil Protection Mechanism is crucial. Concomitantly, multiagency training should be considered to be undertaken, including the development of scenarios and exercises.

The results highlight the importance of monitoring and adherence to relevant legislation. This accident would not have happened in this form and with such a severe impact, had the company and all the authorities involved adhered to existing regulations and carried out the tasks derived from the latter in the course of operation, authorising and monitoring the reservoir. Full implementation, proper application and enforcement of all relevant EU legislation and all relevant international conventions is key.

Community engagement through awareness raising is recommended to be a component to ensure that the public is engaged and understand the risks. Non-governmental organizations may play an important role in such an event; they should not replace competent authorities but to be engaged with them. Community needed to be kept informed about available options for the safe return home and the help measures. In the same way, they received information about drying up operations at home and the proper counselling. Mental health and psychosocial support should be considered in preparedness and response against emergencies.

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Personal Protective Equipment should be available for those exposed, and they should be trained in its use.

Risk assessments should be done. In this event a detailed assessment of the risks posed by the waste and by the individual chemical substances contained in it was not done, therefore it was not classified as a hazardous substance. Unlike the previous IHR, the scope in IHR 2005 was not limited to any specific disease but there was a decision instrument for the assessment of events that may constitute a public health emergency of international concern.
The stakeholders should maintain and strengthen their capacities. Austerity measures should not hamper public health activities.

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IV. Environmental event: floods in Bosnia and Herzegovina, Croatia and Serbia (2014)

a. Background

Floods are the most common natural disasters. During the 20th Century, floods killed at least 8 million people. Between 2000 and 2009, floods accounted for 39% of all natural disasters, 6% of deaths and 43% of the population affected by natural hazards in the world. The immediate health impacts of floods include drowning, injuries, hypothermia, animal bites, population evacuation, shortage of health workers and essential drugs, and damage of health infrastructure.

Besides direct health effects, there are numerous indirect public health effects during flooding in terms of disrupted water and food supply, increased risk of water-borne and food-borne epidemics, alternative forms of collective accommodation with crowding and risk of respiratory and vector-borne epidemics. Moreover, other public health effects are biological and chemical contamination due to devastation of residential and public building, increased probability of vector-borne diseases, and a threat from anthrax due to disrupted waste disposal and inadequate treatment of animal carcasses.

Since 13 May 2014, communities in Bosnia and Herzegovina, Croatia and Serbia were severely affected by floods triggered by cyclone Tamara and the associated heavy rainfall, hitting large areas in all three countries. The floods were the worst in this area since the beginning of record keeping. The 200 mm rainfall in May 2014 in Serbia was about equivalent to the average rainfall in a period of 3 months in this region. Previously, this region was also experienced extreme rainfall events.

The heavy rainfall and rising water levels had three distinctly different effects in different areas: flash floods; rising water levels resulted in widespread flooding; and the increased flow of underground water resulted in widespread landslides leading to the destruction of houses, roads, and agricultural land. Many health facilities were destroyed. Large-scale cleaning, disinfection, fumigation and pest control were urgently required. Efforts were highly focused on the prevention and control of communicable diseases. In particular water-borne (mainly diseases caused by Leptospira, hepatitis A virus, *Cryptosporidium* spp., *Giardia* spp., *Shigella* spp., *E. coli*, norovirus, rotavirus, *Campylobacter* spp. and *Salmonella* spp.) and vector-borne diseases (favorable conditions for mosquitoes such as *Culex* spp. and *Aedes albopictus* and the risk of West Nile fever and arboviruses infections), as well as on psychosocial support.

On May 15th, the government of the Republic of Serbia declared the state of emergency brought about by a natural disaster (pursuant the Law on Emergency Situations), across the country, which was in force until May 23rd. According to official data provided by the Sector for Emergency Management, services responding to the emergency carried out emergency evacuation and rescue of 31 879 people from the affected areas.

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On 25 May, the World Health Organization's Regional Office for Europe (WHO Europe) reported two million people affected by the flooding, more than 60.000 displaced and 60 deaths in the three countries. In the affected areas, 61 health facilities were damaged.

b. Actors involved

Local, regional and national committees or institutions

- Ministry of Interior Sector for Emergency Situations (MoIES) from Serbia was a key stakeholder in the disaster management and immediate response, coordinating with the State and Municipal Crisis Management Teams (CMT). The CMT coordinated the calls for the urgent assistance and it was responding to the immediate life threatening situations.
- In Serbia: fire and rescue squads, police, Gendarmerie, Special Anti-terrorist Unit (SAJ), Counter-Terrorist Unit (PTJ), Helicopter Unit, the Army, the Red Cross, Mountain Rescue Service and other protection and rescue forces carried out emergency evacuation, rescue and distribution of humanitarian aid to the affected population. Divers played an important role in rescuing and first-response activities.
- Other Serbian Ministries and institutions: Ministry of Construction, Transport and Infrastructure (MoCTI); Ministry of Energy, Development and Environmental Protection (MOEDEP); Ministry of Defense, Ministry of Health, the Inspectorate from the control and supervision sector of the Ministry of Agriculture and Environmental Protection (MOAEP); the National Emergency Management Headquarters (NEMH) and the National Hydrometeorological Centre (RMHSS).
- The Croatian Government declared a disaster. State bodies and agencies such as the National Protection and Rescue Directorate, Ministry of internal affairs, Croatian Mountain Rescue Service, Croatian Red Cross, and other rescue services and organizations (firefighters, civil defence, and state administrative agencies) as well as the Croatian Armed Forces took part in salvaging the area, evacuating the residents of the flooded villages and distribute humanitarian aid to the affected population. The duties and activities of the abovementioned agencies were governed by national legislation and were aimed at alleviating the risk of epidemics/outbreaks. By introducing measures through the mobilisation of health workers and others involved in rescue operations, requisition of equipment, drugs and medical products, transport equipment, and temporary use of office spaces for providing health care, the Crisis Headquarters of the Croatian Ministry of Health coordinated the activities of all of the involved health services.

International committees or institutions

- United Nations Disaster Assessment and Coordination Team (UNDAC). The UNDAC Team based its assessments on a combination of information obtained from

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reports from the Serbian authorities, the Red Cross, the European Union (EU) Civil Protection Team, satellite imagery, and own observations during aerial surveys by helicopter and site visits by vehicle.

- World Health Organization (WHO). An Emergency Support Team was established at the WHO Regional Office for Europe's Emergency Operations Centre to support all three countries through the WHO country offices. It assessed the health situation. WHO is supporting the MoH in an assessment of the health system from the aspect of communicable diseases and working on strengthening diseases surveillance and supporting early warning and response systems. It coordinated a comprehensive Public Health Needs Assessment and supported the MoH in the development of an emergency health strategy. WHO provided medical supplies, expert medical assistance and public health advice for the entire response.
- Council of Europe Development Bank-CEB, European Bank for Reconstruction and Development-EBRD and European Investment Bank-EIB were involved in loans and project activities for transport and road reconstruction projects, support to small and medium enterprises, agriculture and energy sectors.
- The World Bank Group approved loans for the Floods Emergency Recovery for the energy and agriculture sectors as well as repairing damaged flood control infrastructure.
- United Nations Development Programme (UNDP) and the UN Office for the Coordination of Humanitarian Affairs (OCHA) were involved in the access to safe water and clean sewage systems.
- United Nations Office for Project Services (UNOPS) and International Organization for Migration (IOM) were involved in the houses repairs. UNOPS and UNDP were involved in the complete reconstruction of houses and schools.
- United Nations Children's Fund (UNICEF), WHO and United Nations Populations Fund (UNFPA) for the assistance packages, health and hygiene kits for most vulnerable families. UNICEF was involved in the daily psychological support of parents and children and for school materials.
- Food and Agriculture Organization of the United Nations (FAO) was involved in restarting agricultural activities.
- The United Nations Central Emergency Response Fund (CERF) accepted WHO's proposal for a project to provide life-saving health interventions, access to essential health services and emergency public health action for flood affected communities in Serbia.
- The United Nations High Commissioner for Refugees (UNHCR) provided immediate support through cash grants of the most vulnerable families.
- Other UN agencies involved: World Food Programme (WFP), International Labour Organization (ILO), United Nations Department of Safety and Security (UNDSS),

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United Nations Environment Programme (UNEP), United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Human Settlements Programme (UN-HABITAT), United Nations Industrial Development Organization (UNIDO), Office of the United Nations High Commissioner for Human Rights (OHCHR), United Nations Entity for Gender Equality and the Empowerment of Women (UN Women).

- The Joint UNEP/OCHA Environment Unit prepared the Hazard Identification Tool (HIT) for the identification of potential hazards from damaged industrial facilities in the flood-affected area. The Flash Environmental Assessment Tool (FEAT) was used to identify and prioritise potential acute risks and to identify medium to long term environmental issues.
- International Commission for the Protection of the Danube River and the International Sava River Basin Commission (ICPDR and ISRBC).
- EU Civil Protection Team and the Union Civil Protection Mechanism (UCPM) were involved in the disaster management.
- The European Regional Development Fund and Cohesion Fund; the EU Solidarity Fund.
- The European Environment Agency collected information on fatalities and economic losses from disasters caused by natural hazards.
- The Commission's Disaster Risk Management Knowledge Centre (DRMKC).
- Joint Research Centre-European Commission, Directorate for Space, Security and Migration was involved in rapid flood risk assessment.
- EU- Copernicus Emergency Management Rapid Mapping Service: The service was fully operational since 2012 and is available to hydro-meteorological services with responsibility for flood warning, EU civil protection, and their networks. The European Flood Awareness System (EFAS) and the Global Flood Awareness System (GloFAS).
- The Swiss Humanitarian Aid. It collaborate with UNDAC to take samples (soil and water samples).

c. Success factors

There were national and international alert systems in place that issued warnings before the flooding. On 12 May 2014, the national hydrometeorological centre in Serbia, issued a warning regarding a forecasted precipitation for 14 May reaching emergency levels. The warning was repeated on 13 May. Heavy continuous rain started on 14 May throughout Serbia. The Copernicus European Flood Awareness System (EFAS) issued a series of warnings in the Balkan region. Thanks to EFAS, Copernicus satellites were programmed early to capture imagery of the area, even before the Copernicus Emergency

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Management Rapid Mapping Service was activated, thus enabling even faster production of the maps. Warning and evacuation constitutes one of the four pillars of the community emergency response during floods, together with emergency assessment, expedient flood mitigation and flood management.

The Protocol on Water and Health to the 1992 UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes was in place at the time of the event. It was adopted in 1999 and entered into force in 2005. The Protocol is the first legally binding agreement to ensure safe drinking water and prevention, control and reduction of water-related diseases in the WHO European Region. The goal of the Protocol is to protect human health and well-being through improved water resources management and by prevention, control and reduction of water-related diseases as well as detection, contingency planning and response to outbreaks. It was signed by 36 countries and ratified, acceded, accepted or approved by 27 Parties, in 2021.

The European Commission's Flood Directive adopted in 2007 aims at reducing the risks and adverse consequences of floods. It was implemented in the Member States in three stages, starting with a preliminary flood risk assessment (2011), followed by the development of flood hazard and risk maps for flood prone zones (2013) and flood risk management plans (2015). Moreover, the Commission intended to reinforce the links with existing early warning systems, such as the Joint Research Centre's European Flood Alert System or the Early Warning and Response System mentioned in the Decision No 1082/2013/EU on serious cross border health.

WHO Europe declared the early response phase focusing on enhanced epidemiological surveillance, strengthening early warning systems for communicable diseases and prevention of water and vector-borne infections as accomplished.

The Parliament of the Republic of Serbia introduced a national strategy of protection and rescue in emergencies in 2011. According to Serbian law on emergencies, each hospital was obliged to develop plans for protection and rescue in emergencies.

In Serbia, municipal crisis management teams (CMT), Ministry of Interior – Sector for Emergency Management (MoIES) and Red Cross responded to the disaster very well, through its professional personnel and majority of volunteers. Close cooperation was established between those Serbian authorities and international authorities (the EU Civil Protection Team, the UNDAC and other UN Agencies). Interagency Emergency health kits (IEHKs) with medicines and supplies, water purification equipment and water tanks have been shipped from the United Nations (UN) humanitarian response depots, with the financial support of Italy, Norway and the Russian Federation. There were also donations from Canadian Red Cross. Moreover, IEHKs were also delivered to Bosnia and Croatia. Thanks to the existence of the 2008 EU, UN and World Bank Joint Declaration to respond to crisis and assessment requests from Governments, requested expertise was immediately deployed to Serbia and financing required for conducting a post-disaster recovery needs assessment was assigned. The Recovery Needs Assessment included

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collection of quantitative baseline information, training of team on methodology for assessment, field visits to affected areas, estimation of damages and losses, of disaster impact and of recovery and reconstruction needs.

Clean water and electricity were restored in the affected areas. Therefore, there was only a limited risk of waterborne infections and zoonosis outbreaks in the coming weeks in connection with the floods. Vector control measures were also taken in the three countries (aerial spraying of some flood-affected municipalities). No outbreaks of communicable disease were reported in the affected areas. Taking into account the high vaccine coverage in Bosnia and Herzegovina, Croatia and Serbia, post-flood vaccination activities were not required.

Public health advice was provided to the affected communities through the distribution of leaflets developed jointly by the ministries of health of the three affected countries and WHO. The leaflets were available in local languages and provided information to the public on the health effects of the floods and appropriate preventive measures.

The gender mainstreaming was discussed. The Council for Gender Equality Government of the Republic of Serbia in an extraordinary meeting concluded that developing more gender-sensitive statistics, indicators of vulnerability, reconstruction, and recovery was a necessary initial step. The underline differences in risk perception, preparedness, and response behaviours of both women and men in the wake of flood events in Serbia were studied and analysed to foster increasingly targeted solutions for disaster planning and management.

d. Fail factors

Emergency plans for protection and rescue in municipalities were not developed. Communities were unprepared, uninformed and untrained on how to act during the state of emergency and evacuation. The health sector lacked an integrated plan for crisis management. Not all the emergency plans included health. Mental health was neglected in emergency plans. The recovery process and its impact on health was not properly recognized in emergency plans. The health services for patients with chronic diseases and special needs, like pregnant women, infants, under 5 years old and disabled were partly or completely interrupted in affected areas. Access to health care remained disrupted in some areas with health facilities damaged or destroyed, as well as the loss of stocks, equipment, medications and vaccines. According to Serbian law on emergencies, each hospital is obliged to develop plans for protection and rescue in emergencies. However, these plans did not contain detailed instructions and procedures for hospital evacuation in disasters, and the training of the staff for evacuation was not performed regularly.
Few monitoring and surveillance systems were in place. Even though the hydrometeorological centre issued a warning, the alert system was silent and the information about how to act during the imminent flood was not broadcasted on the local radio or television. Information that reached only a limited number of endangered citizens was disseminated in informal ways. There was little consensus while establishing trigger

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points, alerts and definitions to activate an emergency plan. The governmental executives did not have the proper tools to objectively assess the need for general evacuation. The lack of communication with neighbouring countries was a concern and was an important finding for the international coordination of disaster preparedness and response activities and in general for emergency planning in the WHO European Region. Scarce and fragmented data on exposure and disaster loss was one of the biggest obstacles to framing risk informed policies at national and international levels.

The Serbian Sector for Emergency Management indicated not to have sufficient equipment and technical means to respond fully to its tasks. The teams swiftly organized refresher training and deployed significant numbers of volunteers that visibly resulted in the lack of the basic equipment for the search and rescue operations (lack of uniforms, life vests, basic telecommunication equipment etc). Serbian Red Cross was not equipped to smoothly supply the humanitarian aids to the municipalities. Red Cross relied on borrowed forklifts and warehouses for storage of the humanitarian aid, being only a short term solution. The large amount of charities received although a sign of vast solidarity of national and international community bares a risk to account for all the aid delivered. In addition to the lack of resources, the evacuation procedures were difficult to manage due to biological differences (sex and age), and levels of skills. This lead to failure of people to move away from hazard areas. Many people refused to evacuate, and one of the main reasons were their concerns about personal properties and about the pets and domestic animals that could not be evacuated simultaneously. General mistrust of individuals in government's actions, including evacuations, coupled with low levels of awareness and preparedness.

Many workers and individuals were conducting clean-up of debris without protective clothing, such as hard-soled boots and gloves. Clean-up operations by the private sector had insufficient capacity to meet demands and little regulatory control that may lead to shortcutting standards. Bosnia had no facilities to safely dispose of diseased animal carcasses; therefore it asked neighbouring Croatia for help in dealing with dead livestock. During the flood event, women were found (face-to-face interviews, administered to 2500 participants) to be particularly affected as they were weakly represented in the flood planning response and overall decision-making processes Women argued that information did not reach them adequately, thus exposing gaps in risk communication. Gender differences were found in a large sample in Serbia regarding a range of flood preparedness indicators. Men who served the army had advantage over women, because of their basic knowledge of how to respond during emergencies, rescue and evacuation. Large collective centres could be a security threat for women, especially those situated in isolated areas without proper lighting and continuous presence of organized support services, because of risk of human trafficking, sexual assaults and harassment. Crowded conditions were observed in shelters. Affected populations were exposed to the adversities and stress of the situation and were suffering from the adverse conditions in collective accommodation centres, including lack of privacy. An assessment by International Organization for Migration indicated that family separation played a

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substantial role in determining the negative feelings of people, irrespective of their gender.

Concerns over the lack of follow-up and referral care and living conditions in resettlement areas Roma families were moved to after the initial collective shelters. There was also no apparent support to host families of the displaced. In the affected areas, there was limited ability or adherence to boiling or treating drinking water, clear water for washing and hygiene supplies. Potable water delivery by public and private sources had little direct public health oversight for safety and quality. A limited number of short term epidemiological studies were undertaken to assess the health impacts of flooding, but there was a deficiency in studies of long term health and economic impacts. Population resilience is likely to vary widely depending upon the economic and organizational resources available.

e. Lessons learnt

Plans of flood health action, such as emergency plans and health prevention plans should ensure water quality, sanitation, hygiene, food safety, health precautions and protective measures, cross sectoral work (including infrastructure in health, transport, communication; engineering solutions, chemical sites, water facilities, military, sewage systems…) and effective communication. The national plan would require local level components for the implementation. It should contain detailed instructions and procedures.

It is necessary to continue to support the delivery of essential health services. Health facilities need to remain adequately and appropriately stocked and equipped to deliver essential services. Mental health and psychosocial support services need to be provided to people affected by the disaster based on coordinated and common approaches. Mechanisms should be in place to identify people in acute distress and those with pre-existing mental disorders through psychological first-aid outreach, community outreach and primary health care. Vaccination levels should be maintained to standard routine levels Develop a plan for the restoration of health system to pre-flood levels with attention to disaster risk reduction and support the government in implementation.
As the health sector lacks an integrated plan for crisis management, the development of a multidisciplinary risk management and crisis response plan for health would be a timely and useful endeavour to correspond with recovery efforts.

The effectiveness of any plan depends on the ability of policy-makers and those responsible for implementation to deliver useful, timely, accessible, consistent and trustworthy information to their target audience, and especially to high-risk populations. Then, adoption, government approval and integration into existing plans are crucial steps. Emergencies plans should include activities related to disseminating information and community education on how to act during emergencies. Activities of the civil protection units should also incorporate outreach activities into their work. Develop tailored outreach campaigns focusing on disseminating information or develop brochures adapted to the needs of the illiterate. In cooperation with municipal representatives, organize

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public campaigns aimed at raising awareness of the community on how the emergency warning system works and ensure the participation of women. In cooperation with local radio stations, launch radio shows, broadcasted periodically, that would focus on activities during the state of emergency and ways of informing the public, particularly targeting vulnerable population.

Health sector coordination facilitated with the MoH and partners through joint assessment, strategic planning and monitoring. Strengthen cooperation between agencies, effective command and decision-making. Reinforcement of the mulitsectoral approach in terms of preventive measures to minimize the health impacts. Effective implementation of focal points in all countries would facilitate communication of health issues nationally and internationally.

Increase sensitivity of the early warning systems to be able to provide alerts that trigger investigation, preventive and response measures. Timely decision-making regarding evacuation is crucial in a rapid flood for making the decision of general evacuation. If the decision is right, it saves human and animal lives; however, if it is wrong, it poses major economic loss and public dissatisfaction. Tools should be developed to objectively assess the need for general evacuation. Evacuation routes, including alternative routes, should be planned and practiced in advance. Training of the staff for evacuation should be performed regularly. A mechanism needs to be established to record and compile information on numbers of evacuees throughout the country. The evacuees should be provided with professional medical and psychological assistance.
Moreover, diseases surveillance and early warning systems for communicable diseases in the affected areas need to be strengthened and enhanced. Recording, collection and access to data should therefore be improved.

Evaluation of the flood risk in the area to reduce the flood vulnerability. These measures should go beyond dike improvements, but can include changes in land use, increasing storage capacity upstream, widening flood plains downstream etc. Apart from structural and/or spatial measures, also non-structural measures (early warning, evacuation, etc.) have to be considered as part of the overall mix to reduce flood risk. Since floods could be cross border health events, further cooperation between the various countries was strongly encouraged. A careful look is needed on potential climate change effects but also human induced effects on the flood probability and consequences.

Investment in human capacity for the effective implementation of the emergency response system, public health system and health care system. They should be adequately trained and equipped. Training should include regular simulation exercises. Participation of women in trainings should be assured. Community engagement should be reinforced, with promotion of individual and household preparedness.

Gender mainstreaming should be taken into account for preparedness and response. Planners might consider how gender differences may affect the way authorities can reach those people with hazard information and emergency warnings. Conduct a gender-

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sensitive assessment of the economic impact of floods and define indicators to monitor risks for women and men.
Smaller reception centres were more suitable for preventing and treating infectious diseases that frequently occur in large evacuation centres following emergencies.

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