Lessons to be Learned from the 2002 Floods in Dresden, Germany

D. Meusel · W. Kirch

When I was asked to deliver a speech at the Meeting on Extreme Weather Events and Public Health Responses here in Bratislava, I felt particularly grateful to present you the lessons we learned from the events that the 2002 flood brought to Dresden and its neighbouring areas.

Firstly, let me begin by summarizing the main chronological events that we experienced in the Dresden region in the summer of 2002. Afterwards, I would like to draw your attention to public health actions that had to be solved immediately in the course of these events. Finally, I would like to present you with some arguments and perceptions on how these public health actions appear from the perspective 2 years afterwards.

Chronological events

As most of you know and many of you even experienced, July 2002 started with unusually intense rain and violent thunderstorms, causing high waters and floods in many parts of Europe. In the second week of August, the catastrophic dimensions of those forceful weather events had firstly become evident in Lower and Upper Austria, in Slovakia, in the Czech Republic as well as Bavaria. Cyclone Ilse, which later became recognized as a meteorologically perfect cyclone with plenty of warm humidity in its lower spheres and a cold higher sphere, arrived in the mountains surrounding Dresden on the 10th of August 2002. More than 100 litres per square metre rain at night causing small mountain rivers to collapse and water reservoirs to be overfilled. The weather station of Zinnwald, 50 km south of Dresden, registered a 24 hour measure of 312 mm rain between the 12th and 13th of August, being the highest 24 hour measure in Germany since weather had been recorded on a regular basis. This amount of rain falling within 24 hours equalled a third of the yearly average and experts believe that such a quantity is the physically possible maximum amount of rain for the region.

These huge amounts of water caused destruction all the way between the mountain villages at the summit of the Erzgebirge (Ore Mountain) to the cities located in the valley of the River Elbe. The usually small River Müglitz caused many villages to be isolated for hours and to be destroyed to an extend far beyond imagination.

One example showed a family sitting on a remaining house wall in the village of Weesenstein, after the River Müglitz had destroyed the rest of the household within minutes. Furthermore, you can see the family having rescued themselves on top of the wall. In this hopeless situation, they even had to hold out for several hours because rescue helicopters were in operation in the nearby Dresden.

On the morning of 13th August, Dresden was surprised by the severe flood wave on the River Weißeritz that abandoned its century old river bed and took its way directly through the historical parts of central Dresden.

Fig. 1

Dresden's central train station flooded by the River Weißeritz (Source: Sächsische Zeitung 2002)

Figure 1 shows the River Weißeritz taking its way through the central train station, causing most of Dresden's infrastructure to collapse that morning. In the nearby city of Meißen, which is well-known for its porcelain and wine, the small River Triebisch destroyed huge parts of the town. Especially small businesses lost their stores and facilities. Within hours, many of them faced an uncertain future of their enterprises or even immediate ruin. Even more devastatingly, the River Mulde destroyed most parts of the city Grimma, 80 km west of Dresden, while running through the main road of the town. *Figure 2* shows the city of Grimma.

Many more examples could be mentioned here to illustrate the detrimental effects of this first flood wave throughout Saxony. Small rivers grew to raging torrents, leaving behind devastated cities and villages [1, 2].

All the masses of water that had flown down valleys in Bohemia and Saxony in the preceding two days, summoned up in the River Elbe the next days. Following the 15th of August, a second, more silent but nevertheless detrimental, flood wave passed through the cities of Prague, Pirna, Dresden and Meißen and affected all the regions located at the River Elbe in the following weeks.

On the 17th of August, Dresden's water level indicators at the River Elbe showed 9.40 metres as the highest level ever registered. Normal water levels in Dresden circulate around the 2 metre mark and, ironically, reached in the following summer of 2003 their lowest level ever at 0.80 metres. This corresponds to a difference of 8.60 metres or 1175 % taking the minimum as baseline!

Complete streches of farm land on the banks of the River Elbe between the cities of Dresden and Meißen were flooded. An observer from air would have seen sloped trees standing in the water that marked the normal course of the river. Complete regions were converged to a temporary seaside.

The historical city centre of Dresden was totally flooded for several days. *Figure 3* shows the baroque Dresden Zwinger (centre of picture), the world famous opera house Semperoper, in which the composer Richard Wagner conducted the Dresden Orchestra between 1842 and 1848, as well as the Dresden castle.

Fig. 2

The city of Grimma after having been flooded (Source: Sächsische Zeitung 2002)

Fig. 3

The flooded historical part of Dresden (Source: Deutscher Depechendienst (ddp) 2002)

Many art galleries that are located in these buildings had to evacuate most of their collections in the course of the flood. The opera house was not able to perform for many months, because costumes and scenery were damaged by the water.

Even the excavation site in front of the Frauenkirche, the well-known church that was destroyed in the bombardment night of February 1945 and is now being reconstructed, was filled by the river. Only 5 months after the flooding, the neighbouring Hilton Hotel Congress Centre hosted the 10th Annual Meeting of the European Association of Public Health, whose organization by that time seemed to be seriously jeopardized by the flood.

Not only parts of the historical Dresden were affected by the flood, but also complete residential districts. As *Figure 4* illustrates, the Laubegast district in the eastern reaches of Dresden had to be evacuated completely. In most of the cases, evacuations were initiated by the residents themselves and had to be forced in exceptional cases only. About 43 school houses with a total of 7,400 beds served as a temporary home for rescue teams as well as evacuated residents. At the River Elbe about 40,000 people had to be evacuated, almost 33,000 of them in Saxony alone.

Fig. 4

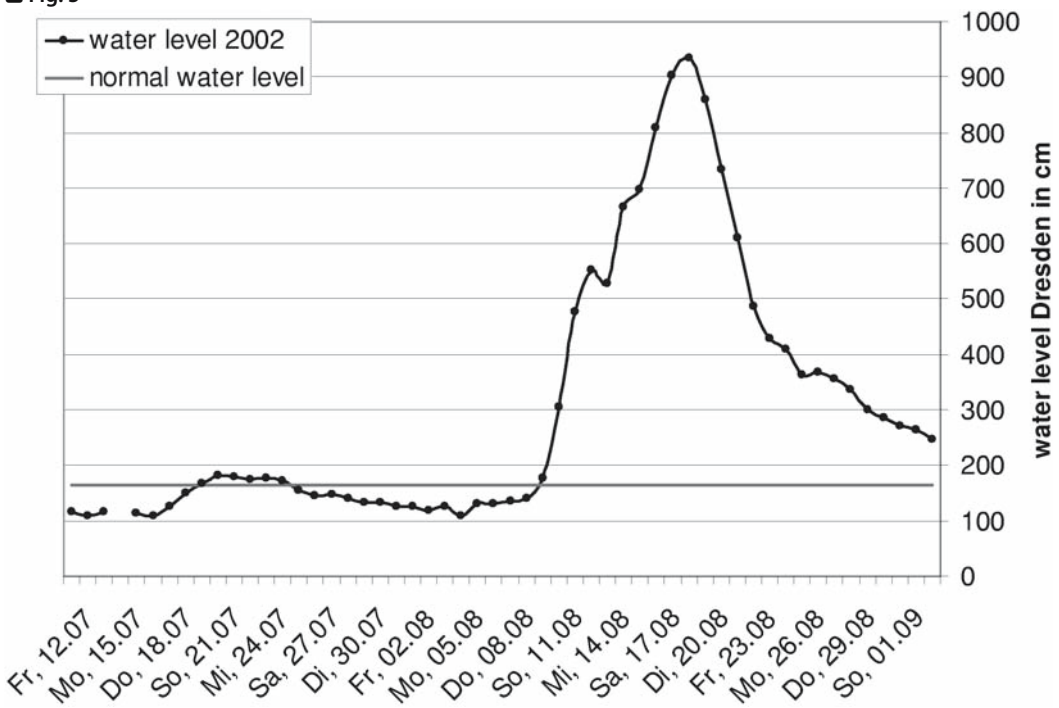
Flooded residential district Dresden-Laubegast (Source: Deutsche Presseagentur (dpa) 2002)

Public Health activities

Let me now draw your attention on public health actions that had to be solved immediately in the course of these events. In the case of Dresden, these can be divided into two parts: (1) issues of public hygiene; and (2) problems involved in evacuating complete hospitals.

Hygienic issues emerged in the course of the second flood wave. Whole parts of Dresden were cut off from all supplies. In practical terms this meant the breakdown of electric power, light and even news programs. Refrigerators did not work. Drinking water could not be boiled. Much more problematic was the breakdown of emergency phone numbers. Residents had to be urged to call in severe emergencies only. For nearly two weeks the tide of the River Elbe remained high. *Figure 5* illustrates the water level of the River Elbe in Dresden with a peak of 940 cm while the normal water level is about 165 cm.

Fig. 5



Water level of the River Elbe in the city of Dresden during July/August 2002 (Data source: [http://www.wetteronline.de/pegel/Elbe/Dresden.htm])

After the waters left, a new flood of problems emerged in making evident the real dimensions of the two flood waves. The waters left unhealthy, evil smelling and sometimes toxic layers of mud [3]. In particular, clearance worker had intense contact to polluted mud (*Fig. 6)* that endangered public hygiene by containing, among others, the coli bacillus. Furthermore, furniture damaged by the flood and other garbage piled up to huge dump heaps providing insects and rodents a welcomed home.

Since a flood of such severity presented a completely new situation for both residents and local authorities, information sheets and press releases were issued for the assurance of public hygiene and the protection against epidemic plagues.

The following recommendations were issued by the Ministry of Health and Social Affairs Saxony and Saxony-Anhalt [4]:

- For consumption purposes, only water from the central water supply should be used
- Prior to consumption water should be boiled, especially when preparing food for infants or babies
- Water from private wells should not be used at all
- Non-waterproof wrapped food should be regarded as contaminated
- Especially parents were advised to prohibit children from bathing or playing in flood waters for hygienic and injury reasons
- Direct contact with mud should be avoided by wearing gloves
- Contaminated areas in houses etc. should be cleaned carefully and disinfected; for that reason, chloride and aldehyde preparations were recommended to be obtained from pharmacies

Fig. 6

After the flood left a residential home (Source: Deutscher Depechendienst (ddp) 2002)

- Flooded basement rooms should be dried up on a longer time scale to prevent mould attacks
- Flooded gardens should be dug over to prevent reproduction of insects as well as unpleasant smell.

Fortunately, the broadcast news that a flooded chemical factory in Spolana (Czech Republic) contaminated the waters of the River Elbe with huge amounts of dioxin [5] could not be proved and the residents had been informed that they were facing no threat. Furthermore, it was recommended that persons encountering first symptoms of diarrhoea, vomiting or fever as well as persons having injuries from clearance work should contact their General Practitioner immediately. In contrast, additional vaccinations against hepatitis A and typhus had not been advised because of the good epidemiological situation in Germany. A post exposition prophylaxis against tetanus had been seen as sufficient in case of injuries resulting from clearance work. In summarizing the hygienic component, it can be stated that at all times public health issues could be handled and solved favourably.

A more severe problem was presented by the evacuation of Dresden's hospitals. Four out of six major hospitals in Dresden are located at the close reaches of the River Elbe and were affected by the flooding. On the morning of 13th, a complete electric power and communication failure cut off the hospital complex Dresden-Friedrichstadt from the city. Within a few hours, the evacuation of about 950 patients had to be organised without the help of computers and telephones despite the limited transportation capabilities. Nevertheless, because of its central location within Dresden's flooded areas and the probability of injuries amongst rescue workers, emergency medical treatment had to be maintained. After evacuation was completed on the afternoon of August 13, regular medical treatment was not possible until the 21st of August [6].

Temporary hospitals were set up to compensate for the limited ability of medical care by the major hospitals in Dresden. In particular, basic surgical and traumatologic treatment were carried out here. A nursing home for elderly people served as host for the temporary hospital. An empty complex of buildings was prepared with emergency ambulance, ultrasonic diagnosis and intensive-care units including artificial respiration. After 10 hours work, the first patients could be treated.

Fig. 7

Evacuations of patients with severe diseases by aircraft (Source: Sächsische Zeitung 2002)

A logistic challenge was presented by the evacuation of the university hospital "Carl Gustav Carus" in the night of 14th to 15th August. Located directly at the river meadow lands, city officials decided to order an emergency evacuation. Facing the approaching second flood-wave hundreds of patients were transported to smaller, less endangered medical houses within Dresden. Seriously ill patients were flown out to the city hospitals of Leipzig and Berlin using military aircrafts (*Fig. 7*). At this point, a conflict between the hospital's management and the city's crisis management team was created by a lack of general emergency preparations. City officials handed over the medical responsibility for the evacuation of the remaining 180 seriously ill patients to a first-aid worker after the hospital's management had decided not to evacuate these patients. In the view of the medical professionals, the evacuation of these patients was expected to cause more harm than positive effects [7]. Some deaths are reported resulting from this overhasty evacuation. However, names were not published in order to protect the relatives of the patients.

Perspectives 2 years after

In summarizing these events two years afterwards, the most important and most general lesson we learnt from the 2002 flood in Dresden in terms of public health can be seen in the insight that severe floods can take place and that we have to be prepared for it. Reviewing the handling of public hygiene during the weeks of flood and tide, we can state, as I outlined earlier, that general preparations were satisfactory.

Regarding the contamination of farm land on the banks of the River Elbe, new scientific findings reveal only minor pollution with harmful chemicals 2 years after the flood [8]. During the flood, the breaking of about 150 dikes caused old industrial complexes, wastewater treatment plants, oil tanks as well as

former mining sites to be flooded and washed out. Initial water quality measurements showed elevated concentrations of heavy metals, arsenic, dioxins, pesticides and harmful organic substances in river waters as well as flooded farm lands. However, the enormous masses of water diluted polluting substances in such a way that environmental damage in relation to public health can be judged as limited. An extensive report on the pollution by various chemicals has been published elsewhere [9].

Nevertheless, the hospital evacuations should give reason to think over the general management of such a crisis. Here, I want to stress two central features: (1) the physical arrangement of hospital equipment; and (2) the preparation of crisis management.

To clarify the first: some severe problems resulting in the failure of the hospital's ability to keep up medical treatment during the flood were caused by the fact that the possibility of heavy floods had not been an issue of serious attention. Necessary technical equipment, such as electric power, telephone and computer network distribution devices, were installed mostly under earth basements because of space consideration. With the second flood wave, the rising groundwater-level caused all this technical equipment to malfunction or to break-down completely. Some believe that these factors contributed to the arising necessity of evacuating hospitals in the course of flood events in the first place. In fact, a hospital with autonomous power supplies does not need to be evacuated at all.

The second point needs as much attention as the first: Dresden officials were surprised by both flood waves in terms of organizing smooth cooperation of all parties involved. A crisis management team was set up sporadically by necessity. In particular, dispute over respective areas of authority revealed a lack of planning in advance that could have been easily accomplished. Therefore, prior to any possible crisis caused by extreme weather events we should be prepared to manage it in a coordinated and settled way. After all, threats to personal or public health is what we fear most of all when facing unforeseen situations.

According to the Dresden Flood Research Centre (2004), the following general Public Health recommendations for flood-risk reduction can be given:

1. Improving knowledge on flooding and damage processes in river and coastal zones
2. Further assessing the relationship between floods on the one hand and climate as well as social changes on the other
3. Providing flood warning systems together with improved weather forecasting
4. Availability of risk maps for endangered flood areas
5. Implementation of a multilevel flood disaster management plan coordinating the central and local decision making processes
6. Training of event handling with regard to flash flood risk
7. Political coordination of transboundary adjustments of flood mitigation between European countries
8. Prevention of new housing and potential toxic emissions in flood-prone areas.

Conclusion

Let me finally summarize the most important points from the Dresden flood: when severe floods occur, as in 2002, the following three points should be considered. Firstly, the public health community has to be prepared with regard to public hygiene. Secondly, important hospital equipment, such as electric power supply, has to be assembled in a "waterproof" environment. Finally, for general crisis management, the decision hierarchy between hospitals and administrative authorities should be set up prior to the crisis.

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