Catastrophe Medicine

Anticipated Threats on the Territory of Poland

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Summary:

The development of accident and emergency medicine is accompanied by the development of identifying and monitoring the ever growing number of threats, both human-dependent and natural, which are indentified more and more effectively. The "Atom Club" is growing, China has joined the "Star Wars" arms race, and stemming the increase of ecological and biological threats is producing diminishing returns. The authors reviewed the most important threats, focusing on the least known – those from the outer space – and also on attempts made to defend ourselves from them, like the "Don Quixote" programme. Another focal point is the effect of an electromagnetic impulse covering vast areas if a nuclear weapon is detonated in the ionosphere, a fact which has been kept secret so far. The most spectacular disasters of the last decades are discussed: earthquakes, tsunami waves, hurricanes and floods. The most powerful toxic substances, their labelling, classification and properties are also detailed. Other issues in the article include: radioactive contamination, INES scale (nuclear reactors' accidents), construction and transport disasters which, as the authors point out, occur mainly due to wrong decisions, irresponsibility and lack of imagination.

Key words: accident and emergency medicine, forces of nature (elements), terrorism, toxicology.

1. New threats

The development in accident and emergency medicine is accompanied by the development in identifying and monitoring the ever growing array of threats. A new threat can occur almost unnoticed by the public opinion. On 11 January 2007, for instance, China has successfully shot down its own satellite using an anti-ballistic missile launched from the ground. Hence, China has joined the "Stars Wars" club.

A hackers' attack on the Estonian government's computer systems in May this year, has made the public aware that a science-fiction scenario about cyber-terrorists and cyber-spies has started becoming a reality. The websites of the Ministry of Foreign Affairs and the Ministry of Justice, and many others, were completely blocked.

All forms of web reconnaissance, espionage or sabotage have been experienced by government agencies responsible for the safety of the web in the USA, Japan, Taiwan, the UK and France. New means of terrorist attacks have been noticed, i.e. dioxins and polonium. The threat of new genetically modified biological agents being created and then used by all

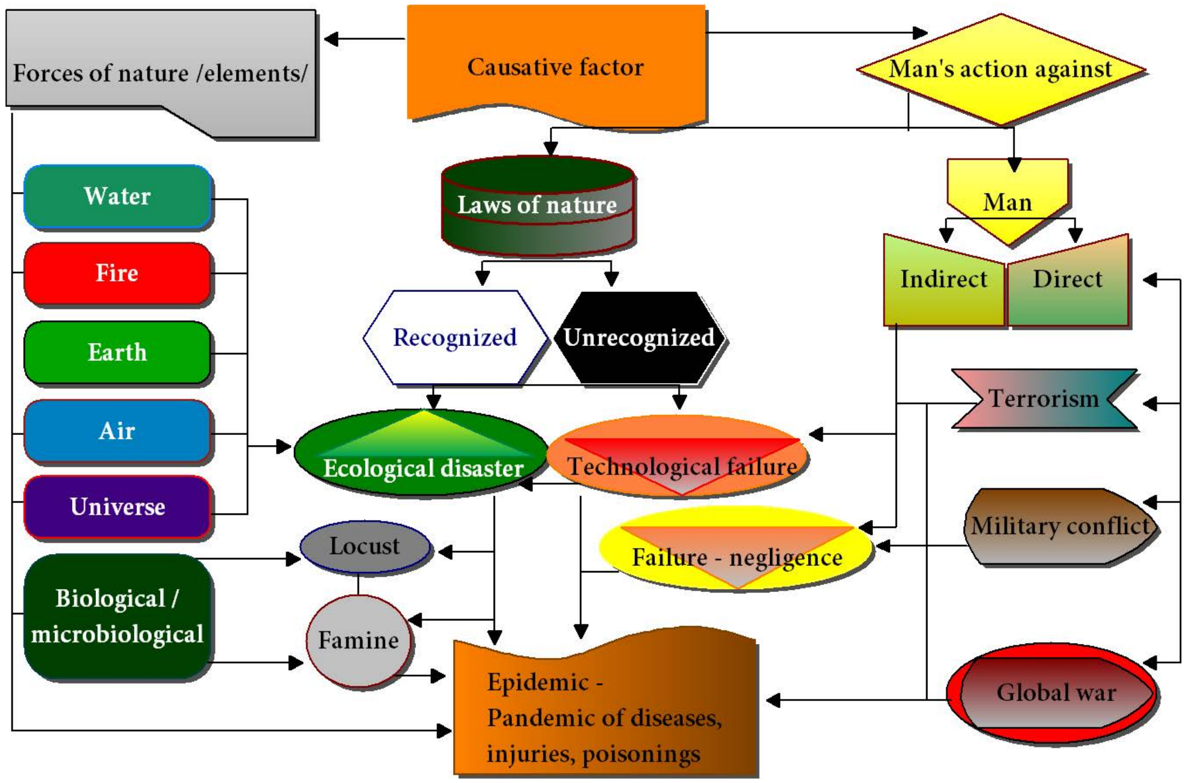

Figure 1: Classification of disasters.

sorts of madmen (like the Aum Shinrikyo cult, also "Supreme Truth") is still growing.

2. Electromagnetic Impulse (EMI)

An electromagnetic impulse being a result of a thermonuclear explosion in the upper parts of ionosphere can damage the power, telephone and Internet, transistors and microprocessors – all the modern civilization – on an area covering millions of square kilometres.

In July 1962, 400 km above a lonely island of Johnston on the Pacific Ocean, 1300 km from the Hawaiian Archipelago, an American nuclear head exploded with the power of 1.4 megatons of TNT. As a result of the explosion, the Compton effect occurred generating an electromagnetic impulse, which spread as far as 1500 nautical miles. The power grid shut down on the whole Hawaiian Archipelago; in Honolulu, automatic sprinklers turned on, soaking the textile storehouses. The cause was immediately classified as secret information. In the American movie "The Day After" – after a nuclear war – there was a scene with a motorcycle (of the main character) whose engine suddenly stopped, and long lines of other vehicles on the highway, brought to a standstill. It was not explained that it was all the effect of the EMI which preceded the attack of Soviet ballistic missiles. After neutralizing the anti-ballistic systems, the rockets could reach their targets undisturbed. The authors did not take into consideration the fact that anti-ballistic Command Centres can be made immune to EMI, though it is extremely expensive because, for example, it requires installing optical fibres immunized by a stream of fast electrons from a nuclear accelerator.

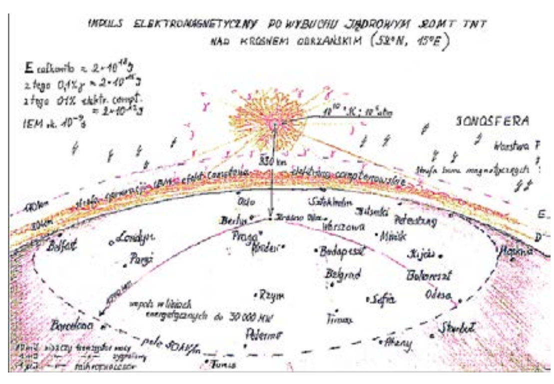

Figure 2: The range of an electromagnetic impulse after a nuclear explosion.

In case of a nuclear explosion equal to 20 megatons of TNT in the centre of Europe, for instance 350 km above Krosno Odrzańskie city (52 N, 15 E), the electronic systems and devices (e.g.

watches) and the power grid would be damaged from Belfast (54 N, 6 W) to Odessa (46 N, 31 E) and from Barcelona (41 N, 2 E) to St. Petersburg (60 N, 30E). Of course, all the supply chains and the healthcare system on this area would become completely disorganized.

3. Earth's Defence – threats from the outer space

Between 16 and 22 July 1994, the Hubble telescope orbiting the Earth and radio telescopes and telescopes on the ground were pointed at Jupiter, to which the Shoemaker-Levy 9 comet was heading. The comet was detected the previous year (cat. No. 1993 e) after it fell apart to 23 pieces, having diameters ranging from 1 to 3 km. The first piece, marked with letter A, having a diameter of 1 km, gave out the amount of energy equal to 225 000 tons of TNT on impact with the planet and the ball of fire reached the height of 1000 km above the planet's surface. The biggest piece – G – 3 km in diameter, caused an explosion equal to detonating 6 million one-megaton bombs, which is 6 000 times more than the combined power of the nuclear arsenal on Earth.

If our planet was at risk of a similar event, the astronomers penetrating the solar system would find out about it only about 10 months before the happening. It would be too late for defence – bearing in mind present technological capabilities.

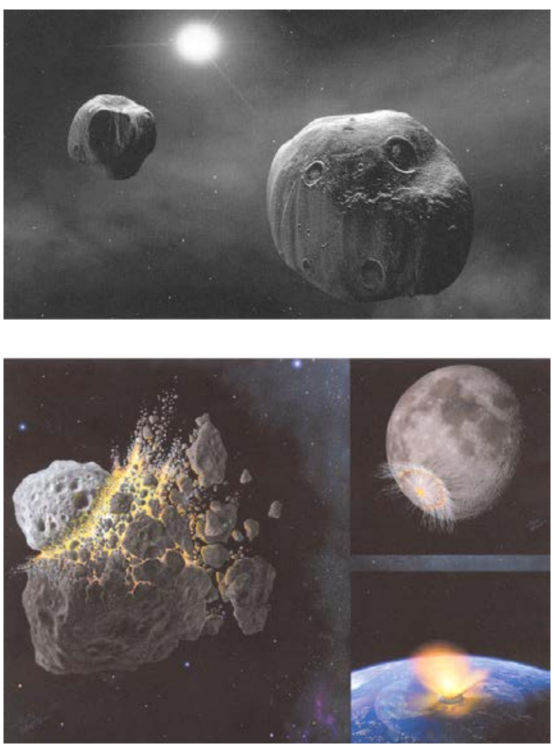

Figure 3: A catastrophic collision of asteroids.
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A super-accurate rocket loaded with hundreds of megatons of TNT would reach the orbit of Mars at best. Even if it did break the comet apart, its fragments could still hit Earth. The further the distance, the less energy is required to change the trajectory and various scenarios of effective actions are possible.

Only in the previous century over one hundred non-periodic comets were discovered; comets which are unpredictable, with a parabolic or close to parabolic orbit, such as Shoemaker-Levy 9 and because of unknown reasons they enter the solar system or leave the Oort cloud located about one light year from the Sun. As a result of numerous collisions, planetoids (there are hundreds of them on the outskirts of the solar system) are knocked out of the Kuiper belt and start their long journey changing their trajectories many times, eventually hitting the Sun after 10 to 100 million years.

More than 400 000 asteroids (planetoids) are on the orbits between Mars and Jupiter. The orbits of some of them intersect with the Earth's orbit, e.g. Apollo, Icarus, Hermes with diameters between 0.5 and 1.5 km and the biggest – Eros – with a diameter of 22 km. Fortunately, they do not pose a threat to Earth in the upcoming centuries. The cataloguing of these objects, calculating orbits and the probability of threats have been carried out for more than a dozen years. The first stage finished in 2008 by cataloguing 90% of objects with a diameter equal to or higher than 1 km. The second stage will take another 20 years and will result in cataloguing 90% of objects with a diameter of more than 140 m. The European Space Agency is preparing the "Don Quixote" mission, which is aimed at changing the trajectory of a 500-metre planetoid by hitting it with the Hidalgo space probe travelling at the speed of 10 km/s. A probe named "Sancho" will serve as an observer.

It is assumed that a 20-metre-diameter asteroid was the cause of an explosion in 1908, which took place on an altitude of about 4500 m above the taiga in the region of Podkamiennaja Tunguska river and knocked down trees on an area of 3000 m2. The power of the explosion was estimated to be equal to 1 500 nuclear bombs of the same type as the one dropped on Hiroshima. Four hours later, St. Petersburg would have been in the same place on the trajectory. Today 5 million people inhabit that region.

Only 29% of our planet's surface are lands, of which 4% is uninhabited; on the remainder surface, the population density is over 3 people/km2. Most of the unwanted guests from outer space hit the oceans and uninhabited areas. Every day about 100 tons of interplanetary matter falls on Earth – dust and small particles – most of which is unnoticed by us.

We can notice with peaceful serenity that during this lecture we have come closer to the Magellanic Clouds by approximately 150 000 km and that in a few million years there will be a collision of that galaxy with our galaxy, and that this sky and Earth will most likely cease to exist.

4. Forces of Nature on Earth

When we return to Earth, we can conclude that forces of nature are difficult to harness and often unpredictable. By causing threat suddenly, they leave us little time for an effective preventive action or rescue efforts. Let us take Tsunami for example. On Sunday morning 26 December 2004 it turned an idyllic holiday on paradise islands into hell. It was the last day of life for 140 thousand people.

4.1. Tsunami

Tsunami is a name devised by the Japanese to describe an enormous wave on the Pacific Ocean – a result of underground earthquakes and volcano eruptions. Tsunami can also be caused by an underwater nuclear explosion or an impact of an asteroid on the ocean. That kind of wave is fairly short on an open ocean (1-2 m) but its width is a few to ten or so kilometres and it spreads with the speed of a jet plane; when approaching the land, it grows in inverse proportion to the depth of the water, reaching a height of a few dozen metres and, before it hits the land with the speed of a speeding car, it causes a sudden ebb. The Thai fishermen knew that the amount of water that ebbed was going to come back, so they ran uphill to a temple. No one died on their small island on the second day of Christmas 2004. On the neighbouring islands and on the coast of Indonesia, the angel of death had a busy day. The death toll reached 80 thousand people of many nationalities.

The earthquake under the ocean, 38 km from the island of Sumatra had the power of 9 degrees and was the fourth since 1990. The Tsunami wave travelled the whole Indian Ocean with the speed of 800 km/h, reaching the African coast in 7 hours.

4.2. Earthquakes and volcano eruptions

Earthquakes occur mainly in areas where the fric-

Figure 4: Tsunami in Asia – 1994.

tions between tectonic plates are the strongest. Nearby Sumatra there is the Burma plate; southern Europe and Caucasus are within the range of a less active Eurasian plate and the Pacific Ocean is in the range of the Pacific Ring of Fire – the most active seismic zone. It is a belt extending along the coasts of both south and north America, New Zeeland, Micronesia, Indonesia, Japan and the Kuril islands.

In upcoming years the volcanologists predict an increase in the activity of Vesuvius and Etna. In the past two thousand years the Vesuvius has killed over ten thousand people. Currently the danger zone is inhabited by 600 000 people – many of whom might not manage to escape in time, or may hesitate if an evacuation is ordered.

The most powerful earthquakes since the beginning of the 20th century were in Chile – 9.5o in 1960; Alaska – 9.3o in 1964 and in 1957 – 9.1o; Russia in 1952 – 9.0°, also in Sumatra in 2004 – 9.0o. In terms of the number of casualties, the biggest three were in China: in 1920 – 200 000 killed (8.6o), in 1927 – 200 000 (7.9o) and in 1976 a record number of 255 000 casualties (7.5o). The one on Sumatra totalled 140 000, similarly as in Japan in 1923 (7.9°).

In terms of material damage caused by an earth-

Figure 5: Kobe after an earthquake in 1995.
Source: http://bolgraph.com.pl/ftp/publikacje/3595.pdf.

quake the list is topped by the destruction of Kobe on 17 January 1995. One of the biggest container ports in the world stopped working, 100 thousand buildings turned into debris burying 6430 people and the damage was estimated at USD 100 billion. In a few years, the Japanese rebuilt the city and the port and the whole economy revitalized (GDP grew by 2%). Similarly, the Turkish economy revived quickly after the destruction of Izmit in 1999, where 15 000 people died and material damage reached USD 14 billion (4.7% of Turkish GDP).

In Poland, a few times in every century, very weak earthquakes can be felt, especially in the south. In a global village we live today, many of our globetrotting citizens have experienced the threat of earthquakes. Our rescue teams have also taken part in rescue efforts in distant countries around the world.

4.3. Hurricanes, Tornados, Typhoons

Hurricanes, tornados and typhoons have not attacked our country yet, unlike the densely populated tropical regions on the coasts of South Asia, the Caribbean or Florida. The climate changes observed in Europe and the increasing power and number of storms and local tornados can be intermittent weather anomalies, happening many times in the past, though not documented very well. Therefore, they cannot be compared with today's situation. All in all, we are not in danger of "huracinos" festivals, warning systems, shelters and mass evacuations, like those experienced every year in different parts on the coast of Florida or the Gulf of Mexico. Local tornados cannot be compared with American tornados, which leave vast areas of the southern states devastated, because it is a different scale. Similarly, one cannot compare the Polish Tatry mountains to Himalayas or a regular car to a sports car. European hurricanes knock down trees and tear the roofs off and have the speed of 80-120 km/h. Whereas the Caribbean hurricanes start at twice the speed. In terms of power, extensiveness and course of events the Caribbean hurricanes and Asian typhoons are very similar. They are accompanied by heavy rain, inundation and flooding of the lowlands located in the deltas of rivers and on the coasts.

4.4. Floods

Floods occur everywhere on our planet except for

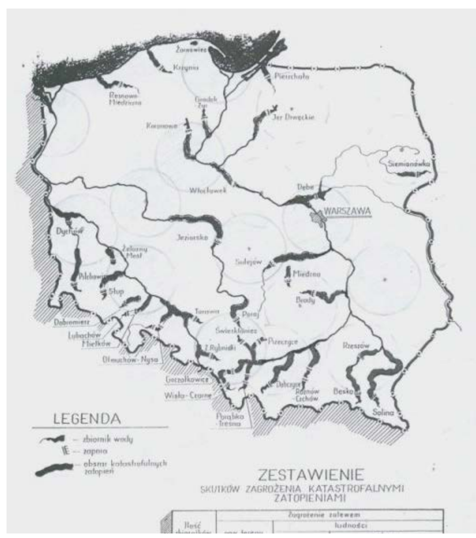


Figure 6: Threat of flood on the territory of Poland.

deserts and areas covered in ice. They are caused by forces of nature but their course and size can be a result of irresponsible human actions. The flood which took place in our country in 1997, had been long foreseen. The cause behind its dramatic results was human economic activity conducted for many years in the regions of the Lower Odra Valley without taking into account the extraordinary situation, i.e. a lot higher than the average risk of periodical flooding.

The upper water limit was set based on water level from the year 1901, the highest level recorded in the last 200 years. In 1997 the water level in the Upper Odra was exceeded by 2 metres. It was not taken into consideration that due to economic activity the natural floodplains, which in 1901 significantly lowered the level of the flood wave, had disappeared. The regulation of Odra had not been finished, the planned retention basins were never built. Whereas the floodplains, e.g. in Wrocław city, had already been urbanized.

Since 4 June 1997 it had been raining regularly in the south-west Poland. Daily precipitation was equal to the monthly average. On Sunday 6 July, a flood alert was issued in five voivodeships [administrative regions]. Behind the southern border, the Morawy region was severely affected by the flood. The next day, Opolskie and Katowickie voivodeships were in a state that could be described as a cataclysm. After a week, the flood covered 17 of 49 voivodeships according to the then administrative division. The whole of the Odra Valley and most of its upper tributaries were affected by the flood. The river basins of upper Wisła and Warta rivers were less affected. Even some small rivers in Mazowieckie voivodeship overflowed. Fifty people were killed and over 150 000 evacuated people had to stay away from their homes for 7 weeks. Material damage was estimated at over PLN 10 billion, 1350 locations were flooded, including 2 big cities and 180 villages. A total number of 130 bridges and 1300 km of roads were destroyed. The healthcare system of Wrocław city was paralyzed. Most of the hospitals located in the lower part of the city were flooded.

5. 5. Industrial and Chemical Threats

5.1. Poisonings

In Polish epidemiology of chemical poisonings at the turn of the century, poisonings with medications comprise 80% of all hospital admissions, the remaining 20% include (respectively): poisonings with crop protection chemicals, toxic industrial fumes, other industrial and chemical poisons. Oral poisonings comprise about 80% of all cases, poisoning by inhalation about 15% (an increase from 5 to 15% in a quarter of a century), absorption through skin 4-8%.
In statistics of accidents and disasters involving Toxic Industrial Chemicals (TIC), the top place is taken by rail and road transport. The following places are taken by accidents and disasters in industrial plants – mainly fires and explosions.

5.2. Fires

It is important to remember that every fire causes a release of existing toxic chemicals and new ones, formed at high temperature – not only carbon monoxide. For instance:

- burning wool, cotton, silk and polyurethanes release **hydrogen cyanide**;
- burning polyurethanes cause the formation of isocyanides and **bicyclic organophosphates**;
- PVC, i.e. polyvinyl chloride – **phosgene** and **hydrogen chloride**;
- Teflon and other materials containing fluorine – **hydrogen fluoride**;
- polyamides, wool, silk, phenolic resin – **ammonia**;
- coal, mineral oils, sulphur compounds – **sulphur dioxide**;
- nitrocellulose, polyamides – **nitrogen oxides**.

These are in fact materials found in every household, and not only in the industry. Most of the toxic fumes released due to a fire form explosive mixtures when mixed with air and pose a major threat of explosion, thus stimulating the fire. The ashes are toxic as well. Many rescuers and volunteers who cleared the area after the 9/11 attack on the World Trade Centre towers found out about it themselves.

5.3. Toxic Industrial Chemicals (TIC)

Potentially the biggest threat to the industrialized countries is the storage and transport of toxic industrial chemicals, mainly intermediate substances for the production of various chemical products, which are stored and transported in large quantities, i.e. ammonia, chlorine and sulphuric acid.

Fortunately, there has not been any huge tragedy in Poland due to accidents of tank trucks carrying chemical substances so far, though a few such accidents happen every year. Here are a few examples from a long list of TIC accidents:

In 1968 near Jackowice nearby Łódź city, rail tanks containing chlorine derailed. Seven people died due to unawareness of threat, 15 were saved.

In 1985 four rail tanks with propane and butane gas derailed in the centre of Września town. Had they exploded, it would have been one of the most dangerous disasters of the 80s in Europe.

In 1989 in Białystok city, three Russian rail tanks carrying 150 tons of chlorine derailed. Death loomed over the city. No one died, though no safety regulations were followed during TIC transport.

Here are a few examples from a long list of chemical accidents in industrial plants:

On 26 June 1971, in Czechowice-Dziedzice town, in the local oil refinery, the biggest chemical disaster in Poland in the 20th century took place. As many as 37 people were killed, and over 100 suffered injuries, burns and poisonings. The reason was a lightning bolt which had struck the tank no. 1 and started a fire. Because the embankments were not fully sealed, the burning oil spread around the other tanks. Two other tanks burnt along with the pump room and a section producing engine oil. The fire was put out after 60 hours. People living nearby were evacuated.

July 1976, in Seveso, Italy, 20 km from Milan in MESA chemical plant: a sudden pressure surge opened up a safety valve in the reactor releasing 2 tons of hot chemical substances containing two kilograms of TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin), C12H4Cl4O2 – one of the most toxic substances with a lethal dose for a human being of 0.04 mg/kg of body weight. TCDD is a by-product during the production of a popular herbicide – 2,4,5-T (2,4,5-trichlorophenoxyacetic acid). TCDD causes overall emaciation and a possible death after two weeks. It is also embryotoxic, teratogenic and carcinogenic, it releases free radicals by inducing peroxidation of lipids. The mechanism of action is that TCDD binds to the cytosolic aryl hydrocarbon receptor forming a complex with it. This complex is absorbed by the cell nucleus, where it binds to the DNA. This substance contaminated 1500 ha of a densely populated area for many years ahead, excluding it from any economic activity.

Third December 1984, in Bhopal, India. At night, within one hour, 30 tons of methyl isocyanate (CH3-CNO) used for synthesis of pesticides, were released into the atmosphere from the Union-Carbide pesticide production plant. It is a very toxic liquid, creating an explosive mixture when mixed with air and causing carbamylation of proteins. It has a highly irritating effect on the respiratory system, it damages the walls of pulmonary alveoli resulting in pulmonary edema; it also damages the corneas causing refractive disorders, blepharitis (chronic eyelid inflammation) and cataract. Over 3000 people died, most of them surprised in their sleep by a sudden shortness of breath and pulmonary edema. As many as 100 000 people fell ill, 200 000 were evacuated.

During a disaster with TIC there is a risk of losing health or life as a result of ignorance of the nature of the threat and procedures in case of such an event or lack of efficient warning and information system. The ones living in the immediate vicinity of the industrial plants using TIC are not trained in rescue procedures in case of a disaster due to fear of panic and protests such a training might trigger. In case of a highly unfavourable coincidence during a major chemical disaster, there may be more than 100 000 casualties, e.g. the whole city of Włocławek after blowing up all the ammonia tanks when full.

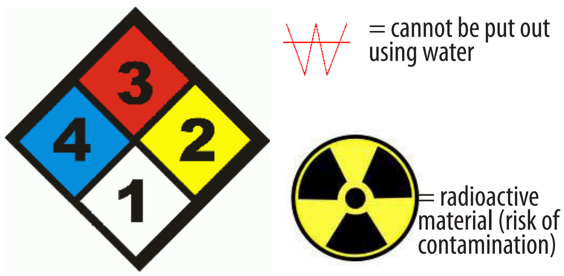
5.4. 5.4. Warning signs – levels of hazard

TIC transported by road and rail are significantly more likely to cause a disaster. Rescue teams can read warning signs in such cases – symbols understandable in every language, or digits from 0 to 4, representing the level of health hazard written inside the so called diamond [colloquial: fire diamond].
In terms of toxicity, there is a unified division into three classes of toxic substances in the whole European Union:

T+ *highly toxic substances*, for which lethal doses depending on the way of absorption are as follows:
- LD_{50}< 25 mg/kg of body weight – orally,
- LD_{50}< 50 mg/kg of body weight – through skin,
- LD50< 500 mg/m3/4 hours – inhalation.

T toxic substances:
- LD_{50}= 25-200 mg/kg of body weight – orally,
- LD_{50}= 50-400 mg/kg of body weight – through skin,
- LD_{50}= 500-2000 mg/m^3/4 hours – inhalation.

Xn harmful substances:
LD_{50}= 200-2000 mg/kg of body weight – orally,
LD_{50}= 400-2000 mg/kg of body weight – through skin,
LD_{50}= 2000-20000 mg/m3/4 hours – inhalation.
Xn and T labelling can be found on plant protection chemicals.



WHITE sector: blank field= can be put out using water

Figure 7: FIRE DIAMOND.
A system of immediate risk assessment in accidents with dangerous materials

SECTOR		YELLOW	RED	BLUE
RISK		Explosion	Flammability	Health
	0	None	None	None
	1	After heating	From a direct flame	Low ± filtering masks
	2	Strong chemical reactions – be cautious!	Ignites when heated	Hazardous to airways. Requires protection.
LEVEL	3	When shaken, hit or heated – explodes	Ignites in ambient temperature	Highly hazardous. Wear protective clothes.
	4	Highly explosive!	Ignites in every temperature	Very hazardous. Requires full isolation.

Among the most toxic substances, the top spot is taken by the aforementioned *TCDD – 2,3,7,8-tetrachlorodibenzo-p-dioxin*, with a lethal dose (LD) of 0.04 mg/kg of body weight. Slightly less toxic are natural venoms of tetraodontidae fish – tetrodotoxin and saxitoxin – and venoms of some Australian clams.

The following places are taken by *organophosphate chemical warfare agents* (CW) – acetylcholinesterase inhibitors, with the strongest one being *VX*, O-ethyl S-[2-(diisopropylamino)ethyl] methylphosphonothioate: $C_2H_5O(CH_3)$-P-(O)-S-$(CH_2)_2$-N-$(CH(CH_3)_2)_2$ – a volatile liquid, colourless and odourless, LD = 0.14 mg/kg of body weight or 50 mg/m3/min. It is a strong acetylcholinesterase inhibitor and contains choline residue. This similarity ensures quicker onset of action when compared to other organophosphate toxic agents. It is quickly absorbed through the skin (when in liquid form). Contaminates an area for a very long time.

Next on the list is SOMAN – code: GD; according to the American classification, all these compounds are marked with the letter "G" at the beginning. In Germany the organophosphate CW had also the cryptonym "Trilons". *GD: Phosphonofluoridic acid, methyl-, 1, 2, 2-trimethylpropyl ester;* $C_6H_{13}O$-$(CH_3)P(O)F$, very toxic and volatile, odourless and colourless liquid. It hydrolyses fairly quickly in alkaline environment and increased temperature, during which it releases hydrogen cyanide, similarly to other organophosphate chemical warfare agents. It was first synthesized in 1944 in the laboratory of IG Farben in Germany. It almost instantly forms a complex with acetylcholinesterase which cannot be reactivated and is resistant to detoxification. Anti-lethal factor, a measure of treatment effectiveness, never exceeded twice the LD_{50} dose, whereas for Sarin and VX, the LD_{50} dose was increased several or several dozen times. Lethal doses are LD_{50}= 1.2 mg/kg of body weight or 40mg/m^3/min.

Another one is *SARIN; GB (Trilon 46); methylphosphonofluoridic acid isopropyl esther*. It is a very toxic liquid, volatile and odourless. Synthesized also in IG Farben in Germany in 1938 as a chemical warfare agent. Easy synthesis made it useful for **terrorist attacks** – it was used in 1994 in Matsumoto and in 1995 in Tokyo subway. It is a lot more susceptible to detoxification than Soman – the complex with acetylcholinesterase is formed a lot slower; LD_{50}= 28 mg/kg of body weight through skin or 70 mg/m^3 through inhalation.

It should be noticed that LD doses are only theoretical – no one allows conducting lethal experiments on humans.

The weakest and oldest in this group is *TABUN – GA (Trilon 83): ethyl ester of dimethylphosphoroamidocyanidic acid, $(CH_3)2N(CH_3)P(O)CN$*. Very toxic colourless or brownish liquid, odourless or with a faintly almond odour. Synthesized in Germany in the beginning of the 1930s as an agent against the potato beetle. It proved a lot more harmful for mammals and was immediately classified as secret. LD_{100}= 7 mg/m^3, 150mg/m^3/min or through skin: LD_{50}= 23 mg/kg of body weight.

All the agents mentioned above belong to a class of highly toxic substances marked with the symbol **T+**. Tabun, Sarin and Soman are characterized by a short latency period, whereas in case of VX gases the period is significantly longer.
Multiple sub-toxic expositions can lead to a chronic poisoning with various atypical symptoms.

6. Radioactive contaminations

Between 1950 and 1963, due to over 300 experimental nuclear explosions in the northern hemisphere, a nuclear fallout consisting of medium- and long-lived radioactive isotopes contaminated air, water and soil in our country to a far greater extent than the Chernobyl disaster in 1986 (with the exception of iodine isotopes, whose concentration in the air in the first days after the Chernobyl disaster exceeded previous expositions by far).

Radioactive dust after a nuclear explosion in the atmosphere contaminates the immediate vicinity of the explosion and a strip of land depending on the direction of the wind in the lower parts of the atmosphere. Moreover, some of the isotopes travel long distances in the upper parts of the atmosphere and land in unpredictable places, contaminating different areas in a spot-like manner.

After the Chinese experiments, an ionized radioactive cloud passed our territory twice. It circled the Earth twice and during its presence an increase of heart attacks by a few percent was noticed.

After the Chernobyl disaster, no statistically significant negative health consequences related to thyroid, cancer or any other, were noticed. Research on the Japanese population, which survived the explosion of the atom bomb in Hiroshima, indicated that increased mortality between 1950 and 1982 applied only to those who had been no further than 2 km from the centre of the explosion and absorbed a dose not smaller than 0.5 Gy (0.5J/kg). After the Chernobyl disaster, no one in Poland was exposed to even a tenth of that dose.

It is worth mentioning that there have been more accidents in the nuclear energy industry.

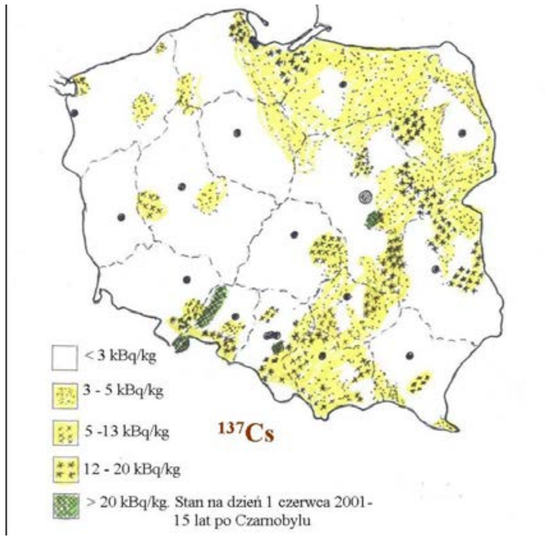


Figure 8: Radiological map of Poland - 2001 r.

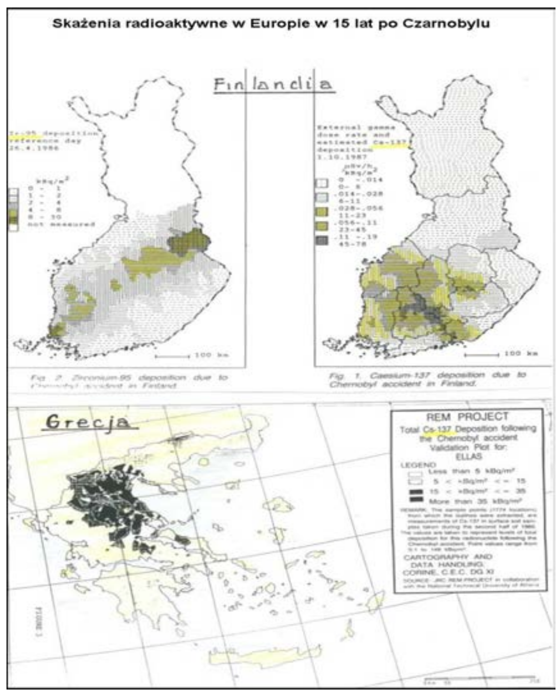


Figure 9: Finland and Greece –15 years after the Chernobyl disaster.

According to INES (International Nuclear Event Scale) Chernobyl had level 7 – the most dangerous level of threat. Level 6 was given to a serious accident in 1957 in a nuclear fuel processing plant in Kyshtym, the then Soviet Union, which lead to contamination of a vast area and the need to evacuate the local population. In the same year, an accident in a nuclear reactor in Windscale (now Sellafield, Cumbria) in UK resulted in contamination of fields in part of the county. Though the contamination was rather not serious, the isotopes concentrated in the milk of cows, so the local dairies had to dispose of the milk. The accident was classified as level 5. The same level was associated with the nuclear plant accident in Three Mile Island in the USA in 1979 where there was only a minor contamination outside the premises of the plant. The list of minor accidents and incidents without any contamination outside the premises is substantially longer and it gets longer almost every year.

Genetic experiments on drosophila flies proved that increasing the background radiation eight-fold during a lifespan of one population can cause lethal consequences in 15 to 18 ascending generations. In the light of the above, the question whether humanity will live to see the year 2600 without resorting to genetic control over natural selection remains open.

7. Construction and Transport Disasters

Fortunately, major building disasters such as the fire in Gdansk shipyard during a concert in 1995 or the collapse of a vast roof (100x150 metres) on the premises of International Katowice Fair Ltd. on a chilly night on 28 January 2006 during International Fair of Pigeons, do not happen too often.

Figure 10: Fire in Gdansk shipyard – 1995.

Those guilty of negligence are always found and it is always a group of people responsible for a string of negligence. Irresponsibility, lack of imagination, incompetence and wrong organization from top to bottom led to a tragedy both in Gdansk shipyard and in Katowice. The only difference is details. The shipyard event produced an "epidemic" of burns and showed that the local healthcare system was not prepared for dealing with multiple similar injuries (202 people burned) efficiently.

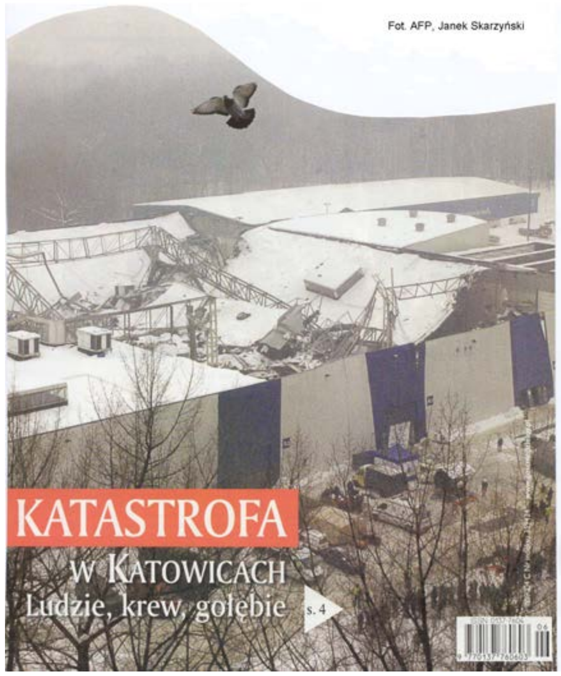


Figure 11: Disaster in Katowice - 2006.

Similarly, transport disasters and accidents usually have many causes which entwine just before the collision. Such cases are well documented, especially in documents regarding major plane crashes, disasters at sea, rail and coach accidents, e.g. Polish coach which crashed near Grenoble in France.

Number of people killed in Poland each year in ordinary everyday and holiday road accidents is far greater than the number of people killed in many spectacular disasters. Every year, 6 to 9 thousand people are killed on roads and 60 to 70 thousand are injured. The number of accidents remains fairly steady at 50-60 thousand a year. As much as 80% of road accidents are due to the driver's fault, such as speeding (20-25%), failure to yield right-of-way to other cars (20-24%), failure to yield right-of-way to the pedestrian (18-20%), illegal turning, overtaking, cutting in and even red-light running (5%). Pedestrians cause less and less accidents – a decline from 27% to 17% within 8 years. Lack of roadworthiness comprises only a small fraction of all the causes of road accidents and bad conditions of the roads affect the decisions of frustrated drivers only indirectly.

It is worth noting that impatience of young drivers and their excessive trust in their reflex cause them to participate in accidents a lot more often than drivers in their thirties and forties, not to mention drivers in their fifties (young drivers cause twice as many accidents as them, regardless of gender).

8. Conclusions

The review of natural threats indicates that only few of them can be prevented and this requires enormous effort of many people, e.g. the "Don Quixote" mission of the European Space Agency to change the trajectory of an asteroid [2002AT4 or 1989ML]. We can harness the element of water running in river banks and stop it from overflowing each year. Tsunami on the other hand leaves us with no other choice but to flee, provided the warning system should not fail. The areas where earthquakes occur can be utilized with the use of costly technology resistant to weak and moderate quakes. The example of Kobe shows that even the Japanese are not always successful in such efforts.

Most disasters Poland is struck by are caused by lack of imagination and irresponsibility – usually of many people at a time. We can prevent this mechanism by implementing new procedures but it increases bureaucracy and allows evading responsibility in cases previously not experienced, hence without proper procedures. The existence of laws which for many years have been evaded with impunity due to financial reasons or simply because it has been easier, will eventually lead to a disaster like the fire in Gdansk shipyard or the collapse of the roof during Katowice International Fair.

Accident and emergency medicine is not at risk of stagnation and there is no risk of unemployment among paramedics. Neither there is among ER staff in hospitals, air ambulance staff, nor those writing the law codes. Scientific, technical and organizational development implemented in many rescue specialties will result in a decrease in casualties, suffering and material damage. Unfortunately, at the same time we detect and monitor more and more threats that we were unaware of or new threats which emerged along with development.

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