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Chief Epidemiologist for Iceland

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DIRECTORATE OF HEALTH
CHIEF EPIDEMIOLOGIST
FOR ICELAND

Austurströnd 5
170 Seltjarnarnes
Tel: +354 510 1900
Fax: +354 510 1920

E-mail: mottaka@landlaeknir.is
Website: www.landlaeknir.is

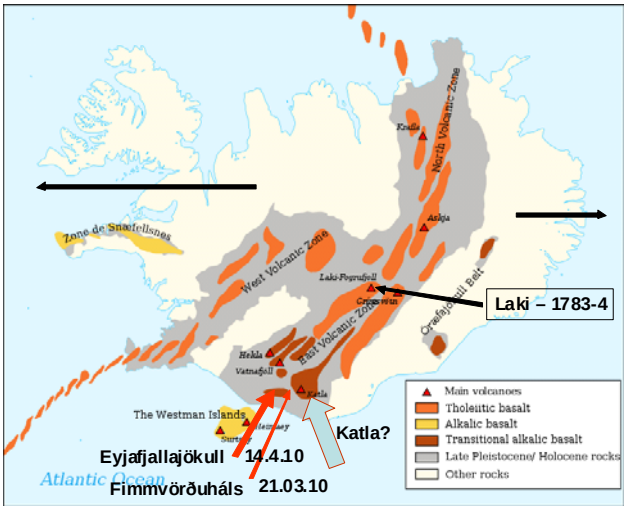
VOLCANIC ERUPTION IN EYJAFJALLAJÖKULL AND ITS EFFECT ON HEALTH

Iceland is an active volcanic area. Since the first settlement in Iceland more than 1100 years ago, volcanoes have been erupting every few years. Most of them have not caused human casualties. However, the catastrophic volcanic eruption in Laki in 1783–4 caused famine and a large number of deaths among humans and animals in Iceland. There is evidence that this volcanic eruption had a serious impact on health in Europe as well as globally.

On 21 March 2010, a volcanic eruption started in Fimmvörðuháls, an area located between the glaciers Eyjafjallajökull and Mýrdalsjökull. This eruption ended 13 April 2010. It produced mainly lava but not ash in any significant amount, while the lava flow was a great tourist attraction. This eruption did not cause any damage. The Civil Protection in Iceland had been activated according to rescue plans mainly because of a possible eruption in the infamous volcano Katla in Mýrdalsjökull.

On 14 April, a new volcanic eruption, linked to the previous one, started in Eyjafjallajökull. The eruption occurred beneath a glacier, producing ash in great quantities. This ash has caused harm to farming and disruption of daily life for more than 800 people in the vicinity of the volcano. Also, the ash spreading in high altitudes had serious consequences for international air traffic and therefore also disrupted travelling for millions of people in Europe and globally.

The ash and toxic gases from the volcano may have serious effects on health. Consequently, this event is within the scope of the Act on Health Security and Communicable Disease Prevention, No. 19/1997. The Chief Epidemiologist is the National Focal Point for the WHO and has to report on any health effects due to the volcanic eruption that may be of international concern. This event was reported accordingly to the WHO and also to the Early Warning and Response System and the European Centre for Disease Prevention (ECDC). Both these organisations have been helpful in providing expertise and guidelines for the public.



The figure shows active volcanic areas in Iceland. The arrows to the right and left show the drift of the continental plates of Europe and America.

Chemical composition of the ash

Samples of the ash taken on 15 April 2010 were investigated by the Environmental Agency, the Institute of Earth Sciences of the University of Iceland and the Icelandic Radiation Safety Authority. Investigation of the particle size of the ash showed that 25% of its weight was composed of particles less than 10 microns. The chemical composi-

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It is important to investigate any possible long-term effects on health since knowledge of those effects is insufficient.

tion of dry ash contained fluoride of 25 mg/kg. The main chemical in the ash was silicone dioxide (SiO2), 58% of the weight.

The investigation of the ash was repeated 19 April 2010. The fluoride content had increased to 850 mg/kg compared to the previous measure. The reason is that the ash did not penetrate steam clouds which clean the ash of fluoride as was the case in the beginning. The chemical composition was unchanged but the proportion of small particles in the ash had decreased. No increased radiation was detected in the ash.

Investigation of air quality

The Environmental Agency measures air pollution in areas affected and elsewhere and publishes the results.

Risk assessment – human health

A medical investigation was made of 12 inhabitants from the area most heavily affected by the volcano ash. Almost all of them suffered from mild symptoms of the eyes, nose and pharynx. Two of them, with known asthma, had respiratory wheezing, possibly due to insufficient medication. One elderly man had mild dyspnoea. Further medical investigation showed that this was a condition he probably had before the eruption due to an underlying disease. Goggles intended to protect the eyes seemed to collect a lot of ash, blurring visibility and therefore it was difficult to use them for any length of time. The respiratory masks tended to become wet and collect a lot of ash so they needed to be replaced frequently.

The short-term effects of ash fall are characterised by runny nose, sore throat and coughing. People with heart and lung diseases may have increased symptoms from their underlying diseases for days. The ash may cause symptoms in the eyes, e.g. a sensation of foreign particles in the eyes, soreness, itching, red eyes, discharge and scratches of the cornea. The ash is particularly dangerous if contact lenses are used. Also, the ash may cause skin symptoms such as irritation, soreness, redness and itching, especially if the ash is acid.

The long-term effects of newly fallen volcanic ash are not well known. Considering the small particles found in the ash that can reach all the way to the alveoli of the lungs it is considered very important to protect the respiratory system.

It is to be expected that ashen mist could be distributed widely over the country. The ashen mist could, in small quantities, reach the Reykjavik Capital Area where two thirds of the population of Iceland live. Ashen mist is a condition with reduced visibility and

A week after the eruption began the Chief Epidemiologist, in cooperation with three other institutions, published two pamphlets: "The Health Hazards of Volcanic Ash. A Guide for the Public" and "Guidelines on preparedness before, during and after an ash fall". They are adapted versions in Icelandic of pamphlets issued by the International Volcanic Health Hazard Network.

measurable air pollution without any visible ash fall. No specific measures are required under such conditions. It is predicted that the air pollution due to ash fall will be similar to that often caused by car traffic and that warnings from environmental officers will be given accordingly.

The gaseous components released in volcanic eruptions can pose a public health threat when in close proximity to the eruption and in high concentration at low ground level. Typically, these gases include sulphur dioxide (S02), hydrogen sulphide (H2S), and carbon monoxide (CO), among other gases. Hydrogen sulphide (H2S) and carbon monoxide can lead to suffocation. Other symptoms of poisonous gases can be obstructive breathing and general irritation in the respiratory airways, the eyes and the skin. It is considered unlikely that these gases will pose a threat to people in the volcanic area but nonetheless the Environmental Agency is monitoring the quality of the air.

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Volcanic ash and poisonous gases from the eruption can have serious effects on the health of humans. Photo by permission of *Morgunblaðið.*

An electronic system was put in place for monitoring symptoms of people affected by volcanic ash and other consequences of the eruption.

tween the Chief Epidemiologist and the Civil Protection Department of the Commissioner of Police was initiated. The same structure as applied during the influenza pandemic of cooperating with local epidemiologists and chiefs of police was activated. Protective masks and goggles purchased for the influenza epidemic were distributed to those in need of them.

Animal health and food production

The Icelandic Food and Veterinary Authority has assessed the health and welfare of animals in the areas affected by the ash fall. So far, it has been good but the increasing content of fluoride in the ash has been of concern and its long-term effect on animal health. Animals from the affected area sent for slaughter will be examined for any adverse effects. The production of milk is carefully monitored but it is deemed unlikely that this product is contaminated. A special task force under the Minister of Fisheries and Agriculture is preparing an evacuation plan for animals, if necessary, in cooperation with the Civil Protection Department of the Commissioner of Police. Also, the effect of the ash on grain production, grass, carrots, potatoes and other vegetables grown in the affected area will be investigated. Uptake of fluoride in these plants seems unlikely.

Response

When it became clear that the health consequence of the volcanic eruption in Eyjafjallajökull was within the scope of the Act on Health Security and Communicable Disease Prevention, and consequently the Chief Epidemiologist, it was decided to apply the methodology of the preparedness plan for pandemic influenza to managing the appropriate response. An electronic system for monitoring symptoms of affected people was put in place. A close cooperation be-

Recommendations to people in areas hit by volcanic ash fall:

- Use dust masks outdoors, preferably also protective clothing.
- If masks are not available, use a handkerchief or a piece of clothing that will filter out larger ash particles.
- Use of safety goggles is recommended.
- Children and adults with heart and respiratory diseases should stay indoors.
- Avoid the use of contact lenses.
- If ash gets in the eyes the eyes may be washed with clean water

Recommendations to people in areas where ashen mist is present:

When ashen mist is present and air pollution is detected people with underlying chronic heart and/or lung diseases are advised to stay inside but the use of masks is not advised. The air pollution due to the volcano is expected to be comparable to pollution often caused by car traffic in the Capital Area. People are encouraged to follow instructions given by health officials regarding air quality.

Research

It is necessary to investigate the health effect of ash from volcanoes on humans and animals. It is also important to investigate any possible long-term effects on health since the knowledge of those effects is insufficient.

Haraldur Briem