CHEMICAL RELEASES CAUSED BY NATURAL HAZARD EVENTS AND DISASTERS

INFORMATION FOR PUBLIC HEALTH AUTHORITIES

World Health Organization

CHEMICAL RELEASES CAUSED BY NATURAL HAZARD EVENTS AND DISASTERS

INFORMATION FOR PUBLIC HEALTH AUTHORITIES

World Health Organization

Chemical releases caused by natural hazard events and disasters – information for public health authorities

ISBN 978-92-4-151339-5

Suggested citation. Chemical releases caused by natural hazard events and disasters – information for public health authorities. Geneva: World Health Organization; 2018. Licence: CC BY-NC-SA 3.0 IGO.

Cataloguing-in-Publication (CIP) data. CIP data are available at http://apps.who.int/iris.

Sales, rights and licensing. To purchase WHO publications, see http://apps.who.int/bookorders. To submit requests for commercial use and queries on rights and licensing, see http://www.who.int/about/licensing.

Design and layout by Lushomo Communications Ltd.

Printed in Switzerland.

CONTENTS

ACKNOWLEDGEMENTS

The following people working as consultants contributed to the preparation of this document: Rebecca Cremades, Raoul Iraheta, Jessica Jarvis, Bernice Schaddelee-Scholten, Cindy Tsao and Saskia Wehrli. Overall supervision was provided by Joanna Tempowski of the Department of Public Health, Environmental and Social Determinants of Health at the World Health Organization (WHO), Geneva, Switzerland.

From WHO, comments on the draft document were provided by: Jonathan Abrahams, Department of Country Health Emergency Preparedness & IHR, Geneva, Switzerland; Magaran Bagayoko, Communicable Diseases Unit, WHO Regional Office for Africa, Brazzaville, Congo; Ana Boischio, WHO Regional Office for the Americas, Washington, United States of America; Mohamed Elmi, Eastern Mediterranean Regional Centre for Environmental Health Activities, Amman, Jordan; Oyuntogos Lkhasuren, WHO Country Office, Vientiane, Lao People's Democratic Republic; and Irina Zastenskaya, WHO European Centre for Environment and Health, Bonn, Germany.

We are very grateful for the detailed comments provided by the following external reviewers: Elisabeth Krausmann, European Commission Joint Research Centre, Ispra, Italy; Džejna Milaković-Ramadani, Ministry of Health and Social Welfare of the Republic of Srpska, Banja Luka, Bosnia and Herzegovina; Virginia Murray, Public Health England, London, United Kingdom of Great Britain and Northern Ireland; and Emilia Wahlstrom, Emergency Preparedness and Environment Section (joint UN Environment Programme/Office for the Coordination of Humanitarian Affairs), Geneva, Switzerland.

Cover photograph from Wenchuan earthquake in China courtesy of E Krausmann.

1. INTRODUCTION

Disasters resulting from natural hazards such as earthquakes, hurricanes, tsunamis and floods, are increasing in intensity, frequency and impact, in part due to climate change *(1, 2)*. They can cause severe environmental and infrastructural disruption and significant economic losses. Disasters can directly affect human health through injuries, death and disease outbreaks, and longer-term impacts may include noncommunicable diseases, psychiatric morbidity and disabilities. The capacity of the health sector to respond to these effects is frequently impaired by damage to health facilities and disruption to health services *(3)*.

A natural hazard can trigger a chemical release. When the release is the result of a technological accident it is called a 'Natech' (natural-hazard-triggered technological) event. Natech events can exacerbate the impact of a natural disaster on the environment and on human health because of the release of hazardous materials, fires and explosions *(4–6)*.

The causes and consequences of Natech events are relatively recent areas of study by risk managers. It has been observed that, while there may be prevention and preparedness measures and response and recovery plans to deal with the risks from either technological or natural hazards, these are rarely integrated *(4)*. Moreover, there is a lack of methods and tools for Natech risk analysis and mapping *(4)*. In areas prone to natural hazards it is, therefore, important to develop plans that incorporate the possibility of dealing with natural and secondary technological disasters at the same time.

2. PURPOSE, SCOPE AND STRUCTURE OF THIS DOCUMENT

This document aims to provide brief information to planners in the health sector and to public health authorities who wish to learn more about chemical releases resulting from natural hazard events. While the main theme of the document is Natech events, information is also provided about other sources of chemical release subsequent to a natural hazard event. The particular challenges with Natech events are described. The document then gives an overview of the role and activities of the health sector at all stages of the risk-management cycle. Hazard-specific annexes (Annexes A–C) provide information on the mechanisms of chemical release resulting from earthquakes, floods and cyclones and the subsequent health impacts, as well as brief information on response activities. The annexes are intended to be standalone documents; hence there is some repetition of information. The two final annexes list other resources relevant to this topic and provide information on hazard pictograms.

A natural hazard can also cause the release of radioactive material, e.g. following damage to a nuclear power plant caused by an earthquake or flood. While these types of release are outside the scope of this document, similar principles of prevention, preparedness and response apply.

3. POLICY FRAMEWORK

In an effort to reduce the social, economic, environmental and health losses caused by disasters, governments adopted the *Hyogo framework for action 2005–2015 (7)*, which described the work that was required from different sectors and actors to reduce disaster losses. This was succeeded by the *Sendai framework for disaster risk reduction 2015–2030 (1)*, which has shifted the focus from managing disasters to managing risks. The Sendai framework has a wide scope, encompassing the risk of all types and scales of disaster, whether large or small, frequent or infrequent and natural or man-made. The framework specifically highlights the need for an integrated, all-hazard, multisectoral approach to disaster risk management and, in doing so, directly addresses the challenges presented by Natech events.

The Sendai framework has a strong focus on health; it emphasizes the need for resilient health systems and the integration of disaster risk management into health-care provision at all levels. This need is also reflected in a recent World Health Assembly Resolution, which urged Member States to strengthen all-hazards health emergency and disaster risk-management programmes and to integrate these into national or subnational health plans. Furthermore, Member States were urged

to facilitate access by relevant agencies to information on types and quantities of hazardous materials stored, used or transported, in order to support effective health emergency and disaster risk management *(8)*. The International Health Regulations (2005) provide further direction to countries on the need for capacities to detect, assess and respond to public health events caused by all types of hazard *(9)*.

4. WHAT IS A NATECH EVENT?

As mentioned above, a Natech event is a technological accident triggered by a natural hazard. These can include floods, earthquakes, lightning, cyclones and extreme temperatures *(10, 11)*. A technological accident can include damage to, and release of chemicals from, fixed chemical installations, oil and gas pipelines, storage sites, transportation links, waste sites and mines. **Table 1** provides some illustrative examples. The frequency of such events is not well known, but an analysis of a number of chemical accident databases found that 2–5% of incidents resulting in the release of hazardous substances were triggered by natural hazard events, and these figures were considered to be underestimates due to the underreporting of low-consequence accidents *(17, 18)*. It is likely that the risk and impact of Natech events is increasing, due to a combination of increasing industrialization and urbanization coupled with a predicted increase in hydro-meteorological hazards caused by climate change *(13, 18)*. A database listing Natech events can be found at http://enatech.jrc.ec.europa.eu/Home.

simultaneous damage or failure events and chemical releases; moreover, safety mechanisms intended to prevent a chemical release or mitigate its consequences may be damaged during the event *(4)*. Second, the ability of local authorities and services to respond to the chemical release will often be severely curtailed because of the other impacts of the natural event, e.g. blocked, damaged or flooded roads and overwhelming demand for rescue. The chemical release itself may prevent or hinder rescue operations because of the additional risks posed to emergency-response personnel.

The Kocaeli earthquake in Turkey (See **Annex A, Box A1**) illustrates the ways in which a natural hazard can cause a chemical release and how the Natech event can affect emergency response to the natural disaster. This earthquake triggered the release of highly toxic acrylonitrile, but also reduced response capacity by shutting down communication networks and causing roads to be inaccessible *(19, 20)*. The lessons learnt from this and other Natech events highlight the need to regulate and plan for such events in order to minimize the risk of chemical releases, and emphasize the importance of intersectoral coordination and good communication.

4.2 SOURCES OF CHEMICAL RELEASE

Chemical releases may be caused directly or indirectly by a natural hazard. These releases may be small, e.g. household chemicals washed out of their storage place into floodwaters, or large, e.g. thousands of litres of a toxic chemical spilling from a ruptured storage tank. Large-scale releases are particularly likely from