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Key aspects of a Flemish system to safeguard public health interests in case of chemical release incidents

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HIGHLIGHTS

- A decision support system was developed to aid Flemish public health officials in identifying actions in case of incidents.
- Different instruments including (but not limited to) human biomonitoring are integrated in one holistic approach.
- The DSS is a flexible and structured decision tree, yet also values expert opinion to account for uncertainties.

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ABSTRACT

Although well-established protocols are available for emergency services and first-responders in case of chemical release incidents, a well-developed system to monitor and safeguard public health was, until recently, lacking in Flanders. We therefore developed a decision support system (DSS) to aid public health officials in identifying the appropriate actions in case of incidents.

Although the DSS includes human biomonitoring as one of its key instruments, it also goes well beyond this instrument alone. Also other, complementary, approaches that focus more on effect assessment using in vitro toxicity testing, indirect exposures through the food chain, and parallel means of data collection (e.g. through ecosurveillance or public consultation), are integrated in the Flemish approach.

Even though the DSS is set up to provide a flexible and structured decision tree, the value of expert opinion is deemed essential to account for the many uncertainties associated with the early phases of technological incidents. When the DSS and the associated instruments will be fully operational, it will provide a valuable addition to the already available protocols, and will specifically safeguard public health interests.

1. Introduction

Flanders, the Northern part of Belgium, is sometimes referred to as ‘the crossroads of Europe’ by virtue of one of the most extensive highway networks in the world, a high-density rail system, and four major sea ports. With the harbour of Antwerp, it also hosts the second largest cluster for chemicals and plastics production in the world, and is one of the key innovation areas in Europe and the world. At the same time however, Flanders is densely populated, with an average population of 468 inhabitants per km^2 or more than four times the European average (Eurostat, 2012). This region also serves as a transit region between several large industrial areas, including the harbours of Zeebrugge and Antwerp, the Dutch Rijnmond area, the German Ruhr and Rhine areas, and Northern and Eastern France.

The high population density, combined with an important industrial activity and an extensive transportation network along which many potentially hazardous substances are distributed across Europe, causes the general public in Flanders to be at relatively high risk of encountering exposure to chemical release incidents compared to other regions in Europe. A large fraction of the population lives within close vicinity of highways or railways, and residential areas often border areas with high industrial activity. Hence, in case of the occurrence of a chemical release incident, the risks of exposure and/or potential adverse health effects in the general public are real.

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As is the case in many countries throughout the world, Flanders and Belgium have developed detailed and comprehensive procedures to allow for a rapid and coordinated acute response to chemical release incident, in which the tasks and contributions of different first responders are described in detail. Nonetheless, the Flemish Government, through the Department of Environment and Health and the Flemish Agency for Care and Health initiated the development of a decision support system (DSS) to indicate which potential actions and instruments in the area of environmental and public health protection could be relevant to assist in particularly the long-term, chronic follow-up of chemical release incidents, safeguarding the general public's health. Specifically, the DSS was aimed at identifying relevant instruments and measures which were directly relevant for the exposure and health risks for the general public, rather than the already widely available previously mentioned contingency plans for first responders (e.g. fire fighters, medical personnel) or occupational exposures that are available at various administrative and political levels in Flanders and Belgium.

Recognizing and addressing exposure of the general public to the emissions from chemical release incidents has until now been grossly overlooked in emergency preparation. Already 10 years ago, a report from the World Health Organization (WHO) on "Environmental health in emergencies and disasters" highlighted that "*... public health plans to deal with chemical incidents are usually non-existent or poorly developed ...*" (WHO, 2002). More than five years later, very little progress had been achieved, as was voiced by the ISEA2007 panel following the characterization of emergency responses following the 9/11 disaster in the USA: "*... Without adequate application of exposure sciences across acute and chronic disaster timelines, the most effective strategies to collect the necessary information to guide risk characterization and management approaches simply cannot be effectively achieved ...*" (ISEA, 2007; Rodes et al., 2008). And more recently, the WHO again brought the need for adequate plans for public health management to the surface in its "Manual for the Public Health Management of Chemical Incidents" (WHO, 2009). This document again highlighted the need for a multidisciplinary, multisectoral and trans-boundary approach to the public health management of chemical release incidents. However, while the WHO document provides an overview of various available instruments for exposure, hazard, and risk assessment, including, e.g. biomarkers of exposure and effect, it fails to provide actual practical guidance on how to develop and implement these instruments in disaster planning (WHO, 2009). In a way, the current DSS aims at developing a roadmap similar to the WHO Human Health Risk Assessment Toolkit (WHO, 2010). In this latest manual, it is mentioned that the WHO Toolkit could aid in risk assessment of chemical incidents, yet the Toolkit does not in itself describe the practical implementation of such a roadmap for chemical incidents. While for example the application of human biomonitoring (HBM) in the context of a chemical incident can be very similar to other applications of HBM such as population surveillance, several differences in, e.g. selection and recruitment of participants, ethical constraints, finding laboratory capacity and identification of relevant biomarkers within a reasonable period of time limits the transferability of existing protocols to the unexpected and ill-defined nature of a chemical release incident (Scheepers et al., 2010).

There are several good reasons why paying attention to the exposure of the general population may be very relevant as well:

- The general public typically is unaware of the potential hazards associated to a chemical release incident as they do not immediately receive the most relevant information, or often are unable to fully grasp the potential adverse health effects (WHO, 2009; Svendsen et al., 2012). If not addressed properly, the insufficient management of uncertainty among first responders, the media, and the general public following an incident may evolve into a 'toxic fear' (Boin et al., 2001).
- Individuals living within the relevant radius around an incident area may be exposed to low levels of chemicals, for a long time. While emergency personnel generally worries about acute exposure levels, the general public may be chronically exposed, often through pathways that are very different from those during or immediately after the incident (Maslow et al., 2012; National Academy of Sciences, 2005). Chronic exposure may occur through indirect pathways, including for example the local food chain, which may necessitate a different exposure follow-up compared to acute exposure pathways (Lioy and Georgopoulos, 2006; WHO, 2009).
- First responders are generally well equipped and trained for their activities, thus limiting their personal exposure during interventions, contrary to the general public. Moreover, the general public also includes elderly, children, individuals with chronic diseases, etc. which may be susceptible to emissions from an incident at much lower levels than relevant for first responders (Aguilera et al., 2010; Weinhold, 2010).
- Finally, as a chemical release incident may expose large numbers of individuals, the potential adverse health effects of chronic exposure, in terms of for example disability-adjusted life years, may be much larger than through immediate acute exposure (Svendsen et al., 2012).

In this article, we provide an overview of the work done in Flanders to develop a decision support system (DSS) to aid public health and other regional and local officials in identifying the appropriate actions in case of chemical release incidents. Instruments include human biomonitoring, but also look at the option of performing health effect-oriented screening tests, ecosurveillance, and food surveillance as possible instruments. Because of the potentially sensitive nature of actions taken in case of chemical incidents, the detailed content of the DSS is only available for the competent authorities, not for the general public. Therefore, although a generic overview can be provided in this paper, it is not feasible to go into all the specific details of how the DSS is implemented in the field.

The DSS to a large extent takes into account the existing intervention strategies and plans from first responders and emergency services that are targeted at the acute phase of disaster management. For example, no specific chemical analyses for different environmental compartments (e.g. air or water) are included in the DSS, as these data are typically collected by first responders in the early phases of disaster actions. Again, the topic of the DSS typically is the identification of relevant actions that may be included in the aftermath of a chemical release incident with the purpose of protecting public health. In this perspective, the DSS is complementary to other available plans, and tries to avoid any overlap as this would only confuse communication and result in a diffusion of available resources and responsibilities.

2. Building blocks

By nature, technological and other types of incidents are unpredictable, and it would be very difficult to establish a set of routines to guide health officials through a predefined number of fixed steps without the options to include case-specific information. Hence, flexibility in approaches and instruments is essential. Which instrument may be useful to address a specific situation to a large extent depends on the type of chemical release incident (i.e. *what is the cause of the incident*), and the identification of the care target itself (i.e. *why is action and follow-up required*). Therefore, the decision