

# Scenario-Oriented Assessment of Hazardous Biological Agents

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## Abstract

The aim of this study is to elaborate a system that will enable easy, yet sound, communication between persons of different background on the topic of dangers and risks associated with the liberation of potentially hazardous biological agents. This system could then be used to assist planning procedures involving people with different professional backgrounds, e.g. for identifying, discussing and assessing possible gaps in security concepts and associated research needs. As a first step the feasibility of such a system assisting biological hazard assessment is tested, including the analysis of possible limitations.

## 1 Introduction

The risk posed by potentially hazardous biological agents has been assessed in a number of different contexts, ranging from biological agents as possible weapons, as part of CBRNE related risks [1-5], to food chain security and/or food hygiene [6-8] and epidemic models (e.g. influenza), often in the context of standard, guidelines and legal issues [9-13].

Especially the nature of exposure (accidental or intentional liberation) influences the resulting pool of agents found to be most relevant. When regarding e.g. food, including the threat of deliberate release potentially changes the assumed amounts of the respective agent and widens and/or shifts the spectrum (that is otherwise mainly restricted to typical natural food-born biological agents).

Based on the experience of developing a concept of a “Weighted-Bit Assessment Table of Hazardous Chemicals” [14] - developed by Fraunhofer INT as part of a governmental expert group of the German Commission for Civil Protection (Ministry of Interior) and also aimed at enabling communication between people of different professional backgrounds - we explore the possibility to develop an adequate tool for biological hazard assessment.

## 2 Aim

The starting point of the research conducted in this project was to find out if and to what extent new insight on biological hazardous agents could be gained through a scenario-oriented assessment tool, supporting the improvement of civil protection and disaster management. The feasibility of the following methodological tools was to be assessed:

- A qualitative risk estimation approach to be used to facilitate communication between persons of different background (scientists, first responders, decision makers etc.) on the topic of dangers and risks associated with the liberation of potentially hazardous biological agents,
- A consistent description of influencing factors (a) allowing pattern recognition for biological agent attributes, parameters characterising the circumstances of its liberation, and combinations that are crucial for risk assessment, and (b) enabling a transparent comparison between results stemming from this model and other studies,
- A quantitative or semi-quantitative model for risk assessment/estimation, enabling both (a) a comparison of risks represented by different biological agents in different scenarios and (b) a comparison of these risks and other risks relevant for civil protection.

## 3 Methodology

### 3.1 Overall framework

The hazardous potential of a biological agent depends both on its agent-specific attributes and on parameters characterising the circumstances of its liberation. Therefore, we combine these two aspects and analyse them in the context of generic scenarios. This combined assessment is expected to have several advantages compared to conventional risk describing lists, as described in the previous section.

The level of detail of scenarios, however, has to be chosen and carefully adjusted: For practical reasons, complexity has to be limited; but care has to be taken that reducing the complexity does not lead to loss of crucial information: Agent characteristics are to be

categorised; other scenario determining factors are to be limited to the most crucial aspects. Based on this, sample agents and sample scenarios have to be chosen for analysing the feasibility of the envisaged method.

### 3.1.1 Choice of sample agents

Sample agents have been chosen to fulfil the following criteria:

- One toxin, one bacterium, one virus should be included,
- At least one agent should include human to human spreading,
- Data for the sample agents should be available,
- The agents should generally be considered to represent a hazard.

This led to the choice of three sample agents.

### 3.1.2 Choice of sample scenarios

Scenarios have been chosen to cover as many different extremes of the following aspects:

- Closed/open space
- Overall number of persons present
- Fluctuation of persons during short time periods
- Point in time
- Circumstances (private/business, everyday/special event; possible symbolic value, political denotation)
- Propagation pathway for the liberation of the biological agent

Based on these deliberations, three initial scenarios were chosen and refined into generic descriptions of three scenarios (large-scale catering establishment/canteen kitchen & propagation via food; metro station & airborne propagation, street festival & propagation via air and/or food). A scenario workshop focussed on the first two scenarios and expected differences of the third one was conducted.

## 3.2 Influence factors

The scenarios of this feasibility study are focussed on the intentional and unintentional liberation of the agent and its primary effect. For practical reasons, this deliberately excluded aspects of agent acquisition (in case of an intentional release) taking place prior to the release of an agent and also secondary effects including epidemiological and socio-economic aspects. Nevertheless, the tool developed allows the later inclusion of such factors.

### 3.2.1 Description of agent properties

Parallel to and accompanying this scenario-oriented approach, a detailed list of agent properties was derived and harmonised with RKI/IBBS (Robert Koch Institut/Informationsstelle des Bundes für Biologische Sicherheit).. Data for the sample agents chosen was provided by RKI. The complete list comprises more than hundred aspects describing agent properties.

### 3.2.2 Description of scenario framework

The results of the scenario-generation process are three scenarios with different, but overlapping influence factors. The factors have been clustered:

- Overall framework parameters
  - Point in time (time of day, day of the week, season, ...)
  - Climatic conditions (air temperature, humidity, rain, pressure (gradients), UV light, dust...)
  - Volume/Dimension of the involved location/adjacent location
- Present and involved humans and animals (number, density, special aspects)
- Inventory
  - Mobile
  - Immobile

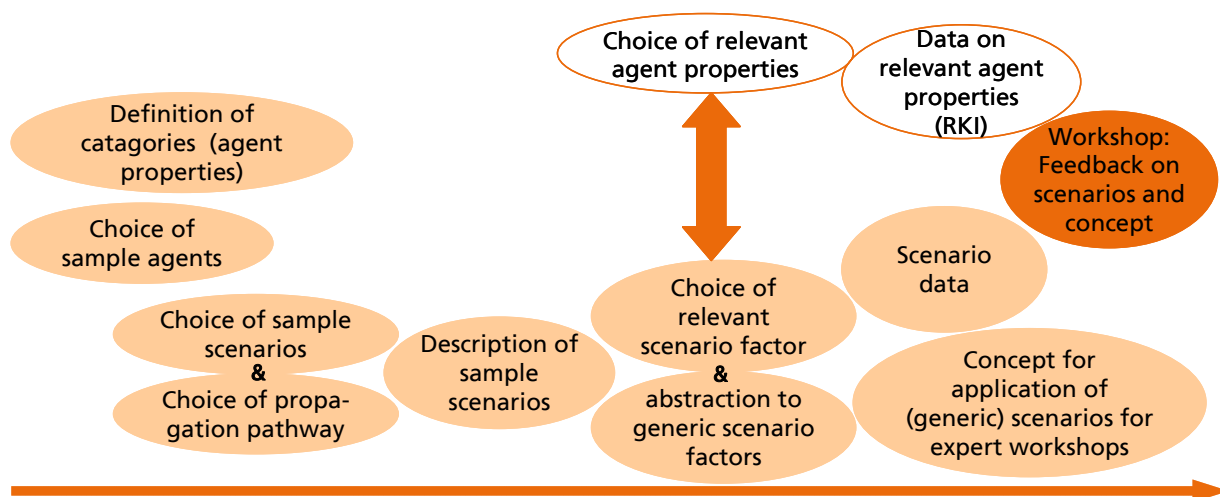


Figure 2: Project work packages

Any process or step in the scenario can be described by a combination of the above factors plus information of changes and their chronological sequence.

### 3.3 Scenario workshop

During the above mentioned scenario workshop, the scenario-relevant agent-specific attributes of sample agents were presented and scenarios were played through. The following questions were asked while going through the scenarios:

- Will the liberation of the biological agent under the prevailing circumstances result in at least one infected or intoxicated person?
- How can the liberation of the biological agent affect a major group of persons (50-200) within the scenarios?
- What are the vulnerabilities within the scenarios?
- Which random or intentional deviations affect the vulnerability?
- Which agent-specific attributes are the most important?
- Are there preventive measures/counteractive measures?
- How many infected or intoxicated persons are conceivable or what is the potential scale of the damage?

## 4 Results

We are currently evaluating the results obtained in respect to the following aspects:

- Data availability
- Range of scenarios (choice and detail level)
- Complementing factors
- Complementing methods

Next steps will include first conclusions on the feasibility of a quantitative or qualitative risk assessment: The description of necessary steps to incorporate the complementing factors (both on agent acquisition and on epidemiology/socio-economics) to assess the probability and impact, respectively. In addition, possible means for validation of the results shall be considered.

## 5 Conclusions

The feasibility of this method to provide an added value compared to other methodologies of assessing the risk of different biological agents and to incorporate it into planning processes involving people of different professional backgrounds still needs to be assessed.

The following applications are under examination:

- Risk identification: If a pattern can be concluded for relevant (i) agent-specific properties, (ii) sce-

nario-specific factor, (iii) combinations of both, these insights can be used for re-assessing hazardous agents and vulnerabilities.

- Risk characterisation: If a scenario-specific pattern for agent properties can be derived, this will add to risk characterisation.
- Risk communication: The identified clusters of scenarios can be used as a communication base for different stakeholders dealing with biological risks.

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