Introduction to CBRN Protection

In this chapter we familiarize the reader with the general concepts that are most important to CBRN protection and personal protective equipment, acting as an introduction to later chapters, where we deal with these topics in more depth.

1.1 WHAT IS CBRN PPE AND WHY IS IT USED?

Personal protective equipment (PPE) is equipment worn to protect the wearer from some external hazard: in this case, chemical, biological, radiological, or nuclear hazards, all of which can be considered to be toxic. The term CBRN, an acronym for "chemical, biological, radiological, and nuclear," is used here to describe the particular combination of the hazard environment and the intent of use. The book is focused primarily on protection against deliberate use of CBRN agents in a terrorism or combat environment. The same PPE may be useful in a workplace setting in which CBRN agents are handled; however, as we discuss later, this results in some potentially important distinctions in the concept of use of the equipment.

CBRN PPE almost always has protective or operational requirements in addition to its CBRN protective functions. In most cases, however, the CBRN protection is deemed a primary requirement, with the other requirements superimposed once CBRN protection is provided. CBRN protective equipment may be designed to be worn by:

- Those responding to the use of CBRN agents (e.g., first or later responders)
- Those who are expected to perform their normal functions despite the fact that CBRN agents have been used (e.g., the military)
- Those who are being provided with emergency protection for escape purposes (e.g., civilians located in the vicinity)

In addition, CBRN protective equipment may be worn by those who are performing activities such as remediation, demilitarization, or laboratory investigation, where the environment is more controlled but the possibility of exposure to CBRN agents still exists. Protection against toxic materials has often been treated, conceptually, as an "all or nothing" idea—a person is either protected totally or is not protected at all.
As we shall see, this approach is both overly simplistic and counterproductive. The degree of protection required is dependent on many factors, and protection need not be "total" to be effective; however, the protection requirements and expected performance must be well understood, and limitations and use of the equipment must be well defined.

A number of issues need to be considered to understand protection requirements. The first is the nature of the hazard for which protection must be provided.

1.2 WHAT ARE CBRN AGENTS?

CBRN agents consist of any chemical, biological, or radiological/nuclear substance that can be deliberately employed to cause harm to unprotected persons [1,2]. Chemicals may cause damage as a result of specific chemical reactions that happen when the body is exposed to them, disrupting bodily functions. Biological agents are living microorganisms that cause disease. Radiological agents (which may either result from a nuclear explosion or themselves be used) will damage living systems as a result of high-energy radiation interactions. CBRN agents may range from military agents, which have been designed or chosen to be particularly effective when used in a deliberate attack, to toxic industrial chemicals, which may be available more readily or in larger quantity.

There are a number of additional distinctions between C, B, and R/N agents: in terms of how they act on the body, their relative toxicity (Figure 1-1), and how they may be delivered, which is discussed in Chapter 2; nevertheless, it is apparent that they can all be described in general terms as materials that may be hazardous when the body is exposed to them, and there are a number of generic ways in which these hazards can be described, regardless of the class of agent. The most important aspect of these materials in the context of CBRN protection is the idea of deliberate use. Deliberate use implies the features outlined in Table 1-1 compared with those of an accidental release.

<table>
<thead>
<tr>
<th>Location and severity of event</th>
<th>Intention</th>
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<tbody>
<tr>
<td>Not targeted, large releases</td>
<td>Unintentional</td>
</tr>
<tr>
<td>Hazmat events</td>
<td>Criminal event</td>
</tr>
</tbody>
</table>

More toxic  Less toxic
Sulfur mustard  Sarin  Soman  Hydrogen cyanide  VX  Botulinum toxin  B. anthracis (anthrax)  Variola virus (smallpox)

FIGURE 1-1 Approximate relative toxicity (related to mass of agent required to cause effect) of a variety of agents by various routes of entry.