DEFENCE S&T TECHNICAL BULLETIN

VOL. 11 NUM. 2 YEAR 2018 ISSN 1985-6571

CONTENTS

Ministry of Defence
Malaysia

SCIENCE & TECHNOLOGY RESEARCH INSTITUTE FOR DEFENCE (STRIDE)

FIRST RESPONDER CBRN - 9-LINER POCKET RESPONSE CARD

Patrick Wengler[1*], Orlando Cenciarelli[1, 2], Gian Marco Ludovici[1], Andrea Duggento[3], Maria Guerrisi[3,4], Andrea Malizia[1,3] & Pasquale Gaudio[1,2]

[1]International Master Courses in Protection against CBRNe Events, University of Rome Tor Vergata, Italy
[2]Department of Industrial Engineering, University of Rome Tor Vergata, Italy
[3]Department of Biomedicine and Prevention, University of Rome Tor Vergata, Italy
[4]Università Cattolica Nostra Signora del Buon Consiglio, Tirana, Albania

[*]Email: wengler_patrick@vo.lu

ABSTRACT

The nine lines or points related to Chemical, Biological, Radiological and Nuclear agents (CBRN) pocket response card represents a quick form that the operator can entirely fill with critical information of his investigation during the 5-10 first minutes after his arrival on the scene. The idea is, that, in a very short time, all the necessary information will be shared directly with other emergency services or emergency management services, so that everybody is aware of what they are dealing with, and what kind of equipment and personnel needs to be deployed or dispatched. This card is intended to implement a harmonized model of information flow between first responders, being able to act more quickly in prevention, first aid, and managing the incident at the scene, whether it is an act of terrorism, traffic accident or standard industrial incident. The card will be available for different emergency services, such as police, fire department, civil protection units and emergency first responders. This will help to integrate the different missions that every single emergency management system (EMS) unit has to cover.

Keywords: Chemical, Biological, Radiological and Nuclear (CBRN); Hazardous Material (HAZMAT); response card; first responder; emergency management system (EMS).

1. INTRODUCTION

Looking at the developing threats of Chemical, Biological, Radiological and Nuclear (CBRN) / Hazardous Material (HAZMAT) incidents (Interpol, 2017), it is important for first responders to have basic knowledge of CBRN / HAZMAT response and the related possible complications. Moreover, first responders should also have basic knowledge of decontamination and personal protective equipment (PPE). With adequate basic knowledge of CBRN / HAZMAT response, the adoption of the CBRN / HAZMAT 9-liner pocket response card and a minimal amount of training, first responders would be capable of communicating in a fast and easy way the required information for an appropriate action plan and the right dispatch of units during a CBRN / HAZMAT incident.

During an incident or attack occurring with CBRN agents, having the right information at an early stage is crucial (Garcia *et al*., 2011), since it involves the agent implicated in the event, and to determine if it is a terrorist attack or just an accident. At the same time, it will also specify which protective equipment needs to be worn for first responders rushing in. In this regard, to better analyze the difference between deliberate attack or accident in a CBRN incident, it is important to define what are CBRN threats (CEEP, 2017).

CBRN agents are weaponized or non-weaponized chemical, biological, radiological and nuclear agents that if used for terrorist purposes could cause extensive damage to both the population and

infrastructure. Weaponized materials can be used to create conventional weapons (e.g., bombs), improve and enhance existing explosives (e.g., mixtures of fuels and fertilizers), or advanced and enhanced conventional weapons (e.g., dirty bombs) (Cavallini *et al*., 2014). Generally, non-weaponized materials are classified as Dangerous Goods (DG) or HAZMAT, and can include contaminated food, livestock and crops (Pellegrino *et al*., 2012). An accidental CBRN incident may result from human error, tainted food products, technological failure or a natural disaster, and may include spills, leaks or airborne releases. These accidents are usually identified as DG (dangerous goods) or HAZMAT incidents (Pellegrino *et al*., 2012). Contrarily, intentional releases of hazardous materials are deliberate criminal acts, such as for example: purposeful dumping of chemicals or radioactive waste by industries to avoid regulatory requirements, or any kind of terrorist acts using CBRN agents (Santella & Steinberg, 2011). Despite the fact that the response to a CBRN incident whether intentional or accidental always remains the same, intentional CBRN incidents also imply special conditions related to territorial responsibility, public security and international relations (Coppola, 2006). Whether accidental or intentional, the impact of a CBRN event can be significant.

The necessary information gathered during CBRN / HAZMAT events may come from various sources, such as intelligence services or any other civilian emergency response unit (Jalalzai, 2016). Most of the time, the first person on the scene (referred to as the first responder) has no special equipment or training to deal with a CBRN / HAZMAT incident (HENDON, 2017). While arriving on scene, the first responder receives a basic set of information from the dispatcher. Frequently, arriving on the scene, the first responder realizes that the information received is not complete and important parts are missing. This usually happens because the citizen who called in was in shock or in fear, and missed out on communicating important information. The CBRN / HAZMAT 9-liner pocket response card will contribute to overcome these problems and it will help the first responders to gather all necessary information and be able to:

i) Protect himself correctly;
ii) Communicate important information;
iii) Create, adapt security perimeter;
iv) If possible, and necessary, evacuate and rescue citizens.

This paper will discuss on the items in the response card and their importance, as well as the training and knowledge required by first responders to fill up the card.

2. CBRN RISKS

2.1 Chemical

A chemical is considered hazardous if it has high levels of toxicity, flammability, and reactivity, causing potential damage to organs and tissues. Exposure to these substances can occur via inhalation, skin contact, ingestion or injection. Hazardous chemicals (e.g., toxic industrial chemicals - TICs) that may be dispersed in environment accidentally include petroleum substances (e.g., gasoline, liquid, natural and gases) and those used at industrial level (e.g., pesticides and chlorine) (Michałowicz & Duda, 2007). Chemical weapons released deliberately are often classified according to their effect on organisms. Nerve gases (e.g., SARIN, VX, and VR) enter the body through skin contact or inhalation, attacking the nervous system (Ganesan *et al*., 2010). Lung irritants (e.g., chlorine and phosgene) are inhaled and cause serious damage to the respiratory system. Vesicants (e.g., mustard gas) damage the skin, and if they are absorbed can also affect other areas of the body. Depending on the severity and duration of exposure, the effects may include temporary illness or injury, permanent complications or death (Ganesan *et al*., 2010).

2.2 Biological

Biological warfare agents (BWA) achieve their intended effects due to the dispersion in the environment of microorganisms (e.g., viruses and bacteria) or toxins, and the consequent possibility to cause a communicable disease in affected people (except for toxins, which are not infectious) (Cenciarelli *et al*., 2013). These events include natural spread of an infectious disease (e.g., influenza and SARS epidemics, or Ebola virus disease outbreak in West Africa in 2014) (Cenciarelli *et al.*, 2015), accidental dispersion of an agent (e.g., an accident in a laboratory where normally an agent is used), or intentional release as a terrorist act (e.g., letters containing anthrax spores, USA 2001) (Ludovici *et al*., 2015). The main characteristic of the biological agents is their capacity to multiply in a host over time. The disease that ensues is the result of interaction between the biological agent, host (including the immune status of the host) and the environment (e.g., sanitation and population density) (Eisenberg *et al*., 2007). Intentional release of aggressive biological agents aims to strike a large number of people, causing serious illnesses and spreading infections (Ludovici *et al*., 2015).

2.3 Radiological

Radiological risks occur due to exposure to excessive doses of harmful radiation (open sources). External radiation occurs when the radioactive material, in liquid or powder form, enters into contact with the skin or the clothes of the individual, while the internal contamination occurs with the ingestion / inhalation of radioactive substances (Rojavin *et al*., 2011). Accidental radioactive sources include natural underground reserves (e.g., uranium or radon gas) or leakage from facilities storing radioactive waste (e.g., spent fuel from nuclear power plants) (Barnett *et al*., 2006). In contrast, intentional releases may result from the radiological dispersal devices (RDDs), (e.g., dirty bombs), which trigger explosions that disperse radioactive material in the environment; or radiological exposure devices (REDs), which do not cause explosions but are hidden sources of radioactivity designed to unknowingly expose people to radiation (Barnett *et al*., 2006). The effects of radiation on health depend on many factors, including the source, amount of emitted radiation and exposure duration. Significant exposure concentrated in a short time can cause acute radiation illness and even death. Instead, low long-term exposures (e.g., during working life) increases the likelihood of developing chronic diseases, including various forms of cancer (Scott, 2004).

2.4 Nuclear

Nuclear accidents are those that directly result from the detonation of a nuclear device or from accidents that may occur in a nuclear power plant (e.g., Chernobyl and Fukushima), and the related release of large amounts of energy, resulting in the dispersion of a large amount of radiation, pressure, and heat (Bushberg *et al*., 2007). Nuclear accidents have the potential to cause catastrophic loss of lives and destruction of infrastructure (Will, 2011). Fortunately, nuclear weapons that various terrorist groups could obtain are relatively small, because of the great difficulties in obtaining a substantial quantity of radioactive material (Ferguson, 2005).

2.5 Psychological Warfare Related to a Terror Attack

A terrorist attack can be defined as any kind of incident that aims to terrorize and spread fear into the population. The intentional use of CBRN materials may create great panic and fear and the population may become violent while trying to survive. Such scenarios imply massive casualties to civilian life and property (Crenshaw, 2011; Kiras, 2014).

3. CBRN / HAZMAT 9-LINER POCKET RESPONSE CARD

The CBRN / HAZMAT 9-liner pocket response card is firstly directed to law enforcement officers, who have no specialized training on CBRN / HAZMAT. Since it is crucial to receive all the needed information as fast as possible during a CBRN / HAZMAT event, this paper includes a description of the card that could be used to help gather all essential information to evaluate the situation. Thanks to this simple card, the emergency response dispatcher will be able to delegate the right and necessary units to the incident / attack. The response card (Figure 1) may be used for various emergency management system (EMS) services. The distinction can be made upon the color on the upper part of the chart (Table 1).

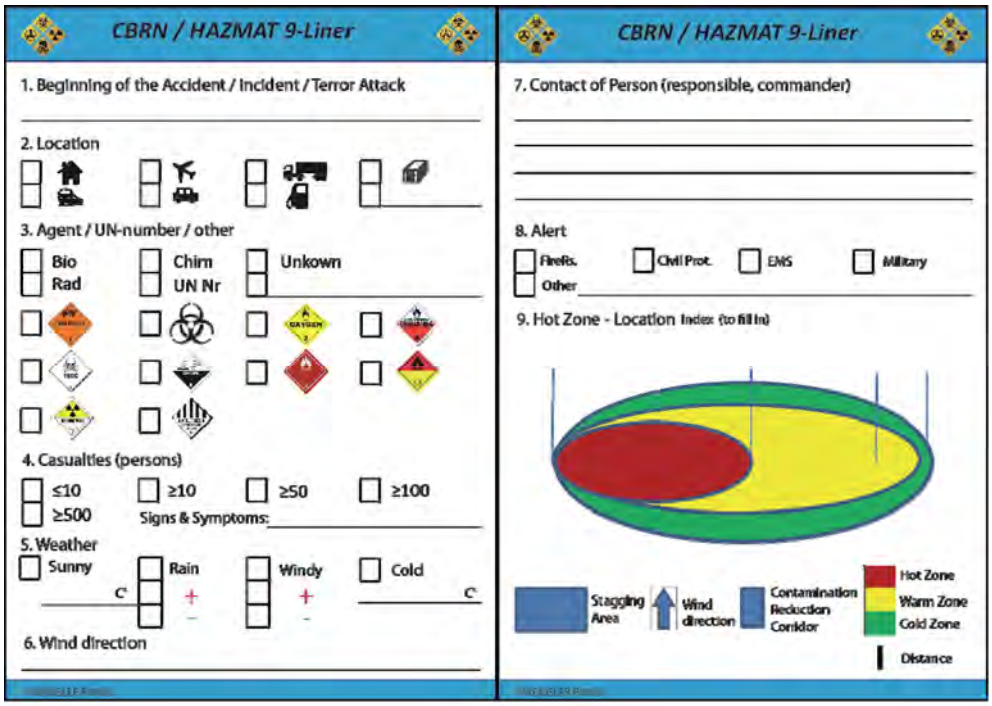

Figure 1: The 9-liner response card.

Table 1: Color of the card and emergency services related.

Color	Service
Dark Blue	Police
Red	Firefighters
Orange	Civil Protection
Clear Blue	Health Emergency Services
Green	Military

The first line in the card is important to know the exact time when the incident happened. This could be very useful to perform calculations on spreading or mutation of the agent over time, or the level of intoxication that could be present. At the same time, this information may be used later on for police investigations and report writing. The second line indicates where the agent was found or released. This would help to know how to control the contaminated area or the eventual need for packing

equipment. This information will also be used to make the necessary calculations on what the dispersion zones could be, facilitating the elaboration of an evacuation plan.

The third line is devoted to the agent that has been used if the conducted investigation was a success. This will help in using the adequate PPE and the right medical response. If the agent is unknown because there are no labels present giving some indications, the box unknown on the chart may be ticked. However, the chart also offers the possibility to insert the signs and symptoms observed, in case some characteristic of the agent's effect could help to define the agent implicated. This information is important so that the right decontamination product can be chosen and applied. The fourth line indicates the number of casualties. This will help to dispatch enough ambulances, and also give the hospitals enough time to prepare for large amounts of patients. If the first responder is unable to investigate the agent that was used while observing and writing down observed symptoms, the medical personnel has time to advise and prepare accordingly to the agent involved with antidotes or medical counter measures. Not only will this information help medical personnel to be prepared from a logistical point of view, it also gives the required information for choosing the right level of PPE for the response.

The fifth and sixth lines include important information that need to be communicated. Depending on what area the incident happened, the weather may have greater implications on the incident. This will help, together with all the other accumulated information, to calculate the contaminated zone, evacuation zones and perimeter security that needs to be set in place; PPE that needs to be handed out; and what information should be given to the citizens to protect themselves. Knowing the three different states of agents (solid, liquid and gas), every product has its own boiling point (BP), where it may change its physical characteristics. Depending on the temperature present, and the known agent or product involved, the necessary actions can be taken to avoid the boiling being reached to prevent further damage, or health and safety issues for the surrounding areas.

The seventh line is a reminder to write down who was contacted and gave orders, so that later on when the report needs to be written, the correct person of contact (POC) is written down. This will help to make it easier for the follow-up. The eighth line gives an indication of which units were involved. This may help in administrating afterwards the right information, debriefing or request to the right unit. The ninth point is designed on the principle of the sandbox. The first responder can draw in all the related information, and make adequate changes as soon as they appear. In doing so, the first responder always has the information up to date, and is able to provide at any moment the right ones. This point is like a sandbox, where all the additional information is drawn on the 3-layer zone system, including wind direction, staging area, distance of the spill / contamination, decontamination line, emergency line and decontamination corridor.

4. TRAINING & KNOWLEDGE NEEDED FROM EMS OPERATORS TO FILL IN THE RESPONSE CARD

The training required for operators would be a very short and time-saving education, getting them all the basic knowledge they need, using the referenced material, such as the Emergency Response Guidebook (ERG) (Brown & Dunn, 2007), helping them to select the right PPE (personal protective equipment), since the safety of the operator on scene comes first (PAHMS, 2016). The selection of the right PPE can avoid contamination, and secure the health and safety of the operator.

Defining zones. Getting to know the 3-layer zone system, (N. J. S. P., 2016) and what would be set in place for contaminated casualties, the operator could not just only send in the correct information but also prepare the zone depending on weather conditions (Reason, 2016).

Predicting the weather in sight. The operator would receive basic knowledge on assessing the wind from the ground by having some very low-cost wind measurement tools. Basic knowledge on wind

strength measurements while observing its surroundings by using, for example, Swiss military weather kit (Gasic *et al*., 2009).

Hazardous material. The training and education needed for the operator are basic knowledge of the different dangerous goods regulations classes (DRG) (PAHMS, 2016) and their health and safety issues they can face in any kind of accident or incident. (N. J. S. P., 2016).

5. CONCLUSION

The 9-liner pocket response card presented in this work and the right training dedicated to it would be a very good basic knowledge for operators responding to any kind of CBRN / HAZMAT incident, by being able to do very a quick and correct scene assessment, and setting up the needed security and safety parameters. This card and its combined training would be a strong tool to helping to save and protect lives quicker and faster in cost effective manner.

REFERENCES

Barnett, D.J., Parker, C.L., Blodgett, D.W., Wierzba, R.K. & Links, J.M. (2006). Understanding radiologic and nuclear terrorism as public health threats: preparedness and response perspectives. *J. Nucl. Med.*, **47:** 1653-1661.

Brown, D.F. & Dunn, W.E. (2007). Application of a quantitative risk assessment method to emergency response planning. *Comput. Oper. Res.*, **34:** 1243-1265.

Bushberg, J.T., Kroger, L.A., Hartman, M.B., Leidholdt, E.M., Miller, K.L., Derlet, R. & Wraa, C. (2007). Nuclear/radiological terrorism: emergency department management of radiation casualties. *J. Emerg. Med.*, **32:** 71-85.

Cavallini, S., Bisogni, F. & Mastroianni, M. (2014). Economic impact profiling of CBRN events: focusing on biological incidents. *Arch. Immunol. Ther. Exp.,* **62:** 437-444.

CEEP (2017). *What is CBRN?* Centre for Excellence in Emergency Preparedness (CEEP), Ontorio.

Cenciarelli, O., Pietropaoli, S., Malizia, A., Carestia, M., D'Amico, F., Sassolini, A., Di Giovanni, D., Rea, S., Gabbarini, V., Tamburrini, A., Palombi, L., Bellecci, C. & Gaudio, P. (2015). Ebola virus disease 2013-2014 outbreak in West Africa: an analysis of the epidemic spread and response. *Int. J. Microbiol.*, **Vol. 2015:** 769121.

Cenciarelli, O., Rea, S., Carestia, M., D'Amico, F., Malizia, A., Bellecci, C., Gaudio, P., Gucciardino, A. & Fiorito, R. (2013). Bioweapons and bioterrorism: a review of history and biological agents. *Defence S&T Tech. Bull.*, **6:** 111-129.

Coppola, D.P. (2006). *Introduction to International Disaster Management*. Elsevier, Amsterdam.

Crenshaw, M. (2011). *Explaining Terrorism*. Routledge, Abingdon Oxon, Oxfordshire

Eisenberg, J.N.S., Desai, M.A., Levy, K., Bates, S.J., Liang, S., Naumoff, K. & Scott, J.C. (2007). Environmental determinants of infectious disease: a framework for tracking causal links and guiding public health research. *Environ. Health Perspect.*, **115:** 1216-1223.

Ferguson, C.D., Potter, W.C. & Sands, A. (2005). *The Four Faces of Nuclear Terrorism*. Routledge, Abingdon, UK.

Ganesan, K., Raza, S.K. & Vijayaraghavan, R. (2010). Chemical warfare agents. *J. Pharm. Bioallied Sci.*, **2:** 166.

Garcia, A.F., Rand, D. & Rinard, J. (2011). *IHS Jane's CBRN Response Handbook*. IHS Global, Englewood, Colorado.

Gasic, B., Moeckel, C., MacLeod, M., Brunner, J., Scheringer, M., Jones, K.C. & Hungerbühler, K. (2009). Measuring and modelling short-term variability of PCBs in air and characterization of urban source strength in Zurich, Switzerland. *Environ. Sci. Technol.*, **43:** 769-776.

HENDON (2017). *Patrol Response to Hazardous Materials*. Available online at: http://www.hendonpub.com/resources/article_archive/results/details?id=1331 (Last access date: 8 February 2017).

Interpol (2017). *CBRNE*. Available online at: https://www.interpol.int/Crime-areas/CBRNE/CBRNE (Last access date: 8 February 2017).

Jalalzai, M.K. (2016). *Fixing the EU Intelligence Crisis: Intelligence Sharing, Law Enforcement and the Threat of Chemical, Biological and Nuclear Terrorism*. Algora Publishing, New York.

Kiras, J.D. (2014). *The Globalization of World Politics, 6th Ed.*, Oxford University Press, Oxford.

Ludovici, G.M., Gabbarini, V., Cenciarelli, O., Malizia, A., Tamburrini, A., Pietropaoli, S., Carestia, M., Gelfusa, M., Sassolini, A., Di Giovanni, D., Palombi, L., Bellecci, C. & Gaudio, P. (2015). A review of techniques for the detection of Biological Warfare Agents. *Defence S&T Tech. Bull.*, **8:** 17-26.

Michałowicz, J. & Duda, W. (2007). Phenols—sources and toxicity. *Pol. J. Environ. Stud.*, **16:** 347-362.

N. J. S. P. (2016). *Hazardous Material Technician*. New-Jersey: State Police Hazardous Material Response Unit (HMRU). Available online at: http://www.njsp.org/division/homeland-security/hazardous-materials-response.shtml (Last access date: 16 August 2016).

PAHMS. (2016). *Emergency Response Guidebook.* Department of Transportation, US

Pellegrino, F., Psinakis, T.J., Morrissey, R., D'italia, R., Vinciguerra, E.J., Tupper, K. J. & Bruzzi, M.C. (2012). *U.S. Patent, No. 8,154,399: Method of Operating a Networked CBRNE Detection System*. U.S. Patent and Trademark Office, Washington, DC.

Reason, J. (2016). *Managing the Risks of Organizational Accidents*. Routledge, Abingdon, UK.

Rojavin, Y., Seamon, M.J., Tripathi, R.S., Papadimos, T.J., Galwankar, S., Kman, N., Cipolla, J., Grossman, M.D., Marchigiani, R. & Stawicki, S.P. (2011). Civilian nuclear incidents: An overview of historical, medical, and scientific aspects. *J. Emerge. Trauma Shock*, **4:** 260-272.

Santella, N. & Steinberg, L.J. (2011). Accidental releases of hazardous materials and relevance to terrorist threats at industrial facilities. *Emergency*, **8:** 53.

Scott, B.R. (2004). Health risks from high-level radiation exposures from radiological weapons. *Radiat. Prot. Manage.*, **21:** 9-25.

Will, R.C. (2011). *Costs, Risks, and Myths of Nuclear Power: NGO World-wide Study on the Implications of the Catastrophe at the Fukushima Dai-ichi Nuclear Power Station*. Women's International League for Peace and Freedom, Geneva.