

Preface

"Terror and Medicine" was an offspring of worldwide requests for broader information on the topic originally published in *IMAJ (The Israel Medical Association Journal)* in July 2002 and in light of the extensive experience accumulated in Israel in confronting the ogre of terrorism. Recent events throughout the world, including in the United States, Britain, Australia, Kenya, Bali in Indonesia and the Middle East, have focused on the unscrupulous threat of terror.

Hence, the publishers approached us to compile a book involving the most outstanding Israeli specialists in the field of biological, chemical and radiological warfare. Our mission, an ethical and moral obligation of the medical community, was to enlighten individuals and institutions on the basis of our Israeli experience in medically preparing for and handling the aftermath of terror.

The book aims to provide useful guidance, pragmatic knowledge and practical experience not to be found in a textbook to date. We hope that this book will serve as a guide to others in the present reality of terror, and it is with our most heartfelt wish that the need for combating terror will some day transpire to be merely theoretical.

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Introduction

Diabolical, Haunting Terror – Here and Now

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On 11 September 2001 the world changed irrevocably. The unfathomable reality of a ruthless and inhuman annihilation of the lives of young and old, close and afar, at any moment in time has strewn havoc on the very fiber of society and public health – regional, national and global. The terrorism of today wields conventional and non-conventional weapons of mass destruction – biologic, chemical and nuclear – that damage the body, the mind and the soul.

We must prepare for the offensive with knowledge and technology to confront this modern monster. Knowledge of the enemy, his tools, and our own fears are essentially combined with technological innovations to enable the medical community to activate preventive and protective measures (such as vaccination), alerts, and preparedness including extensive training for medical staff, diagnosis, treatment, containment and surveillance. Appropriate funding, research and development are crucial to ensure flexible and versatile responses to the expected unimaginable.

Information and communications are integral elements of deployment. Since September 11 the U.S. Centers for Disease Control and Prevention (CDC) issued revised directives and updates via telebriefings, *Morbidity and Mortality Weekly Report* publications, and broadcasts for both the medical community (physicians, laboratories) and the general public. Leading medical journals provide important medical updates, such as articles in the *Journal of the American Medical Association*, including consensus statements on anthrax and biologic warfare, articles in the *New England Journal of Medicine* on smallpox, bioterrorism and public health issues, and a special issue devoted to terrorism in the *British Medical Journal*.

Funds have been appropriated around the world in preparedness for terrorist casualties. In the USA, the Department of Health and Human Services made US\$ 140 million in emergency funds available to healthcare organizations that suffered losses as a result of the September 11 attacks. In May 2002, the Department of Health and Human Services announced 12 grants worth \$10.5 million to fund research and training to address health concerns in the wake of the events of September 11. A total of \$6 million has been allocated for education and training efforts, and \$4.5 million assigned to support research organizations' efforts to conduct exposure assessment, epidemiology, and community outreach in lower Manhattan. The House and Senate of the U.S. passed the Public Health Security and Bioterrorism Preparedness and Response Act (H.R. 3448). The bioterrorism bill includes billions allocated to:

- Upgrade the CDC's laboratories and equipment
- Develop a national database to track biologic agents and toxins
- Build medicine and vaccine stockpiles
- Provide state and local grants to improve the public health system's ability to respond to an attack.

In January 2003, the biodefense program in the United States was implemented and the vaccination of first responders began in the controversial atmosphere of the public debate in favor and opposing the smallpox vaccination. President Bush's decision reinforced the need for alertness throughout the world.

The satanic forces of terrorism have necessitated the diversion of enormous resources. Instead of investing in the promotion of health, the eradication of disease and the utilization of sophisticated medical technology for the benefit of people throughout the world, we are forced to dedicate billions in monetary terms as well as untold human efforts to counteract the plots of terror. The medical community of the world has a major role to play in the primary prevention of terror, destroying its roots throughout the world and minimizing the damages. Israel, regrettably, is not unfamiliar with terrorism. We have sadly learned from the experience gained from decades of terror attacks against civilians, the chemical threat of the 1991 Gulf War, and the recent wave of suicide bombers. Our resilience and survival depend on cooperative global resources – financial, intellectual, and spiritual.

Terror and Medicine – The Challenge

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Key words: *bioterrorism, chemical warfare, civil defense, crisis intervention, anthrax, radiation*

On the 11th of September 2001 the world changed [1]. After this horrific mass casualty terror attack on the United States, any and all forms of assault seem possible.

Until recently, the use of chemical and biological warfare by countries, including nations ruled by dictators and totalitarians, was prohibited [2]. The threat, however, prevails. The latest events of terrorism in the USA have taught us that chemical and biological warfare, as well as radiation weapons, could be used quite easily by fanatic and ruthless terrorist groups. Malicious anthrax attacks already occurred in Florida and New York. Although the world's interest is targeted toward anthrax, one should also suspect and be alert to other non-conventional threats.

The use of anthrax as a biological weapon was demonstrated in April 1979 in the aftermath of an accident in the Soviet Institute of Microbiology and Virology in Sverdlovsk, which resulted in the release of 1–2 kg of anthrax spores. Within 10 days of exposure, residents living downwind from the military facility developed high fever and severe dyspnea. Animals within a radius of 50 kilometers died. Thirteen years later the Soviet authorities admitted that the accident had occurred and reported 77 cases of anthrax, of which 66 were fatal [3].

In March 1994, members of the Aum Shinrikyo cult in Japan released the nerve gas sarin in a crowded Tokyo subway system, resulting in 5510 casualties. Twenty-five percent of these casualties required hospitalization, while 195 of the medical and rescue teams were affected by secondary contamination. The death toll was 12 [4,5]. It is estimated that the sarin in this terror attack was diluted.

Epidemiology of terror

Today, the medical community faces a new era in medicine that should be an integral part of common medical practice. This community should therefore be alert to diseases caused by chemical and biological warfare and exposure to radiation.

While the doctrine of management of conventional mass casualties is well known, clinicians and health service providers should be aware of the occurrence of incidents – ranging in dimensions from sporadic cases to mass casualties – of chemical, biological and radiation warfare. Clinicians and healthcare providers should recognize the harm caused by the variety of non-conventional weapons as a potential epidemiology, and the relevant authorities should prepare for the prevention and early detection of the effects of the terrorist attacks [6]. This “epidemiology” includes the etiology, onset, appearance, signs and symptomatology, detection and identification of the agent and the ailment, treatment, and lasting effects of the attack. Therefore, continuous and ongoing national morbidity surveillance should be conducted. The medical community can envisage new but realistic threat scenarios, and forecast different epidemiologic perspectives associated with mass destruction weapons (MDW). The various methods of implementation of these MDW can lead to injuries in individuals or in masses.

A mass casualty event can be described as an incident in which there is a temporary imbalance between the sudden and urgent demand for large-scale resources at a specific location, and the availability of such resources. The resulting medical disaster can be an event of such widespread extent that available local, regional and sometimes even national resources are overwhelmed [7]. Primary injuries from MDW can be related to mechanical forces, thermal energy, and chemical, radiation or biological agents. Regardless of the primary etiology, the acute event, especially if not well managed, may be followed by a final common pathway of ongoing ill effects such as acute and post-traumatic stress disorders that can escalate to manifold dimensions, such as epidemics and disruption of the intricate structure of society [8–11]. As in other fields of medicine, the best methods of managing disasters involve the implementation of four major appropriate preventive measures. These include [12]:

- **Primary prevention**, which attempts to avoid the actual casualty event and makes the appropriate preparations
- **Secondary prevention**, which is projected at containment of the event, managing through early detection, isolation and defensive measures, and incorporating prophylactic measures to decrease the damage once the offensive incident has occurred
- **Tertiary prevention**, which involves appropriate extrication, evacuation, decontamination, and the provision of high standard medical care
- **Quaternary prevention**, which includes the debriefing process and reconstruction of the social components that had been damaged to varying extents.

Non-conventional warfare – unique epidemiology and medical management

The decisive factor in the outcome and management of the event is not just the management of the single patient, but the overall preparedness for the hazard and the consequences of the event.

Many aspects of the event management are similar for all types of MDW, while some depend on the type of MDW used. Protocols should be prepared on two levels – organizational and clinical. The organizational protocol should be mainly logistic and administrative, placing emphasis on the activities of medical facilities and other rescue teams. The organizational protocol should focus on communication, coordination and cooperation among the different organizations managing the disaster scene and its periphery. This national/regional administrative protocol should also include a medical appendix containing data on medical institution capabilities and critical medical supplies, such as antidotes, antibiotics, blood components, ventilators, dedicated decontamination facilities, etc.

The clinical protocols should instruct the medical staff on the subjects of offending agents and radiation and the consequences of their intentional use. Emphasis should be placed on diagnosis and early awareness of the triage criteria, which differ from those valid in cases of small-scale events [13]. In MDW attacks the most severely injured patients will often not be treated at an early phase due to the overwhelming demand on resources. This is accentuated in chemical and biological warfare and radiation exposure, since thousands of people await treatment simultaneously. The principal triage in Israel for a chemical MDW attack is conducted between walking and non-walking patients. Emphasis is placed on saving the lives of patients with milder injuries. Critically ill patients are to be provided with comfort measures (pain relief and sedation). Futile resuscitation efforts should be avoided in order not to utilize essential equipment and personnel [14].

Other important general issues to be considered include the protection of medical personnel, which should be tailored to the specific MDW. Safety measures comprise universal precaution devices, protective garments, air-filtered devices, chemical prophylaxis, vaccines and antibiotics.

Decontamination facilities should preferably be separated from the main hospital complex. If located outside these facilities they should be situated downwind from the main hospital complex. Drainage of water and detergents should also be separated [15]. In view of the fact that diagnostic and treatment protocols for chemical, biological and radiation MDW are elementary, they can be distributed to the medical staff via personal pocket checklists, or presented as posters at relevant sites. Two types of drills should be implemented: a) management drills focusing primarily on communication system and decision algorithms, and b) full-scale drills in which simulated casualties arrive at the emergency facility; for example, in a chemical drill, staff in the contaminated area (hot zone) use the physical protective devices, so that all stages of decontamination, treatment, and patient flow can be examined [16].

Biological MDW management

It is believed that a number of totalitarian countries possess biological MDW. Thus, fanatic terrorist groups could obtain such pernicious weapons, which have a stronger lethal affect per weight than do chemical agents. Although inhalation is the main introductory route of biological weapons for particles measuring 1–5 μ , there are other ports of entry, including oral access or possible absorption through skin wounds and mucous membranes.

The biological MDW (BMDW) attack will often proceed unnoticed. Since symptoms and signs could initially resemble flu-like syndromes, detection will usually take a few days after the occult attack [17]. The occurrence of more than one casualty may arise long after the casualties have dispersed. Therefore, recognition of symptoms and signs and a high index of suspicion are of utmost importance and should be incorporated in early clinical and laboratory diagnosis and infection surveillance for effective treatment and disease containment [18,19]. We recommend using a central laboratory, which has obvious advantages, but the hazard of sample transportation requires attention. BMDW comprise either microorganisms or toxins.

In the literature there are a few organisms that are candidates for biological MDW, such as anthrax, which may function favorably as a BMDW because it is easily spread as a powder and is very resistant to drying, heat, and many disinfectants [20,21]. Other agents with the capacity of being BMDW are plague [22], botulinum toxin [23], tularemia [24], Ebola [25,26], and smallpox [27]. Treatment and management are dependent on a number of parameters: the susceptibility of the offending agent, the availability of a vaccine or antitoxin, contagiousness, and the level of isolation required.

Chemical MDW management

Organophosphates and mustard are the major chemical warfare agents besides cyanide and phosgene. Organophosphates, which are nerve agents, can be divided into two categories: volatile (tabun, soman and sarin) and persistent (VX). They produce their toxicity through irreversibly inactivating acetylcholinesterase at synapses. Presenting signs and symptoms are of immediate onset. Prophylaxis is available with pyridostigmine and treatment consists of atropine, oximes and anticonvulsants [28]. Mustard exerts noxious effects through nucleophilic attacks on the nitrogen and sulfhydryl moieties of nucleic acids. The appearance of cellular and tissue damage may take hours. Treatment is mainly symptomatic [29].

The characteristics of chemical warfare events are such that in a very short period many casualties are affected since the incident is abrupt and swift; furthermore the dynamic toxicity is often rapidly lethal. Therefore, antidote treatment should be accessible and must be initiated as soon as possible after exposure even before decontamination is completed. Due to the lasting effects of some of the agents, continuous monitoring is required, especially for those affected by organophosphates. Toxicity occurs mainly through inhalation and skin absorption [30]. Unlike war scenarios in which self-

protection – including masks, protective garments and early prophylaxis – is feasible, in the case of terror attacks with no prior alert the management should focus on early clinical and physical detection, if the latter is available, with rapid provision of antidotes. The medical staff should be physically protected.

Radiation MDW

Terror attacks using radiologic materials could be carried out by dispersal of radioactive material with or without the use of conventional explosive devices to enhance their spread. Radiation is classified into two subdivisions: electromagnetic (gamma and X-rays) and particulate (alpha, beta and neutrons). Alpha-ray tissue penetration is very low and can be blocked even by paper. Beta-radiation penetrates a few centimeters of tissue. Exposure to radiation from neutrons, gamma and X-rays transpires the body totally. Biological damage by radiation is measured by REM (radiation equivalent mean) units. Defensive factors are short exposure, physical devices, and remote distance [31].

Acute radiation sickness may appear minutes or even a number of days after exposure. The time of onset is dependent on the REM dose. Prodrome presents as gastrointestinal symptoms, erythema, high temperature, dizziness and headache. After a latent period ranging from a number of days to 3 weeks, bone marrow depression and damage to the gastrointestinal tract appear. REM of a magnitude greater than 600 is followed by severe central nervous system (CNS) signs and is usually lethal. Damage to the lungs, liver, thyroid and bone can occur from incorporation of radioactive material [32]. Monitoring devices for different types of radiation are readily available. Following decontamination, treatment is mainly symptomatic, observational and supportive. Treatment for selective patients may include bone marrow stimulants and bone marrow transplantation. There are agents to decorporate specific radioactive agents [33]. Patients presenting early signs of CNS involvement most probably suffered lethal radiation and should be provided with comfort measures only. It is important to note that there should be a follow-up of all survivors for long-term radiation effects.

Conclusion

The use of mass destruction weapons by terrorists is a realistic threat. Knowledge may decrease the degree of fear (terror) and MDW should be recognized by all members of the medical community – both clinicians and health managers – and by the public. Ongoing national and regional disease surveillance (including infectious diseases and unusual morbidity and mortality) is very important in peacetime as well as during war. This surveillance will enable health authorities and epidemiologists to obtain the earliest warning of suspicious case clusters and outbreaks, to detect an eruption of disease or toxicity, and to assess the necessity of special measures such as prevention, isolation, immunization and curative therapy, as well as providing relevant information to the public.

Early preparations are mandatory to increase the probability of survival of those injured and to decrease the potential devastating impact on society. It is of utmost importance to implement educational measures targeted at the medical and paramedical staff, such as the preparation of large quantities of simple checklists and algorithms to be rapidly dispatched to the medical teams. Medications, critical equipment and protection devices for the staff and the environment should be purchased, and potential suppliers should be designated. Dedicated decontamination facilities should be prepared. Periodic drills are essential to improve the teams' cognitive abilities, coordination and communication, and to decrease panic. Resources for psychological support for the casualties and the staff should be designated and trained. One of the most important aspects of the battle in this era of widespread information and communication is to prepare a task force to provide data and instructions to the public.

Adequate preparedness of the medical teams will decrease the chaos associated with a MDW attack, and increase patient survival and societal durability. The physician should be prepared to respond rapidly to any suspicion that his or her patient is possibly a victim of terror, since terror casualties can be managed medically.

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