

Review of Different Aspects of Bioterrorism for a comprehensive medical informatics-telemedicine system

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Introduction

This paper presents an abridged version of a status report being prepared by the author in order to be submitted to the key academic institutions and hospitals in the state of Pennsylvania, spearheaded by University of Pennsylvania, for creating the blueprints of a project proposal to the newly established Department of Homeland Security in the United States. The project would simulate different sorts of bioterrorist attacks in the Greater Pennsylvania area and would entail the study of different aspects of usage of medical informatics and telemedicine including emergency data delivery systems, electronic communications between the healthcare practitioners in a critical situation, psychocognitive aspects of bioterrorism and of telemedicine, vaccine information systems integrated with drug databases, population health technology and public health law related aspects, role of clinical genomics and bioinformatics etc. The author has been involved in the review of more than three thousand articles and abstracts, multiple newspaper articles and two hundred websites which directly or indirectly deal with bioterrorism. Due to a lack of space, some of most recent and important articles are mentioned here, with a brief mention of certain key aspects which should form the core of a comprehensive medical informatics-telemedicine system for the management of bioterrorism.

Reviews Regarding the Status and Roles of Healthcare Providers

(Pavlin et al 2003) have noted that a system designed to rapidly identify an infectious disease outbreak or bioterrorism attack and provide important demographic and geographic information is lacking in most health departments across USA. (Kahn 2003)'s report point out that physicians now lead fewer than one-fourth of local health departments. When appointed leaders are not physicians, leadership falls on elected officials or non-medical administrators who become managers of outbreaks.

In Israel, more than 60% of patients who were questioned about their preferred sources of care and information in case of a bioterrorist attack involving anthrax, chose their family doctor or the health authorities instead of the hospital emergency department. Most of the physicians (89%) felt it was their responsibility to treat anthrax-infected patients and that they should therefore be supplied with appropriate guidelines (Kahan *et al* 2003).

Review of the Vaccine program and the Possible Agents

National Pharmaceutical Stockpile Program (NPS) under the management of the Centers for Disease Control and Prevention (CDC) and the Department of Health and Human Services was transformed into Strategic National Stockpile (SNS) Program under the new Department of Homeland Security (Esbitt 2003). The purpose of the SNS Program is to maintain a stockpile of pharmaceutical agents, vaccines, medical supplies, and equipment to augment state and local resources during a large-scale disaster or bioterrorism event. Upon request, the SNS Program will deliver materials anywhere in the United States within 12 or fewer hours.

(Duncan 2003) has reported that new information about smallpox vaccine is included in 2003 American pediatric vaccine recommendations because of increased concerns about the use of smallpox as a bioterrorism agent. Besides anthrax and smallpox, there are many other potential agents which can be used to cause a bioterrorist attack. (Azad & Radulovic 2003) reviewed the rickettsial attributes that make them potential bioterrorism agents, as well as issues related to signs

that would alert the responsible authorities, and the preventive measures that could reduce impact of these agents. Plague, an infection caused by *Yersinia pestis*, is a major agent that might be used as a biological weapon (Bossi & Bricaire 2003). A growing list of other agents which can be used for a bioterrorist attack can be accessed from the CDC's website <http://www.cdc.gov>.

Psychosocial Aspects Related to Bioterrorism

Winning the war against terrorism means acknowledging and responding to the psychological dynamics inherent in this form of warfare, as well as the military and law enforcement aspects of the war. Consistent with Caplan's notions of preventive psychiatry, the fight against terrorism must occur on three levels: (1) prevention of the terrorist attacks themselves, (2) mitigating the adverse psychological impact of the persistent threats of terrorist acts, as well as the terrorist attacks when they do occur, and (3) psychological treatment of the lingering adverse effects of threatened or actualized terrorist attacks (Everly GS Jr 2003). (Eyesenbach 2003) has pointed out some of the technologies brought forward during the SARS epidemic may have been primarily motivated by marketing efforts, or were more directed towards reassuring people that "something is being done," ie, fighting an "epidemic of fear." To understand "fear epidemiology" is important because early warning systems monitoring data from a large number of people may not be able to discriminate between a biological epidemic and an epidemic of fear.

Population Health Technology

(Eyesenbach 2003) has noted that SARS (severe acute respiratory syndrome) outbreak provided an opportunity to study the use and impact of public health informatics and population health technology to detect and fight a global epidemic. Population health technology is the umbrella term for technology applications that have a population focus and the potential to improve public health. This includes the Internet, but also other technologies such as wireless devices, mobile phones, smart appliances, or smart homes. In the context of an outbreak or bioterrorism attack, such technologies may help to gather intelligence and detect diseases early, and communicate and exchange information electronically worldwide.

Public Health Law

(Reynolds 2003) surveyed current issues in public health law, highlighting these reforms and the potential for public health legislation to deal with bioterrorism. While recognising the anxieties bioterrorism brings, public health responses must be grounded in a coherent philosophy of risk management. Its administrators must also be aware that large-scale threats to public health are not unprecedented and that past experience can provide an important guide for future strategies.

Role of Clinical Genomics and Bioinformatics

Recent events make it imperative that full genome sequencing be accomplished as soon as possible for pathogens that could be used as weapons of mass destruction or disruption (Slezak *et al* 2003). The team at the Lawrence Livermore National Lab (LLNL) developed reliable and validated assays for a number of the most likely bioterrorist agents as a part of Chem-Bio Non-Proliferation (CBNP) programme of the US Department of Energy (DOE), which began a large-scale effort of pathogen detection in early 2000 as a preparation for the 2002 Winter Olympic Games in Salt Lake City, Utah. Different algorithms are being used for aligning the incomplete fragments of genes which are present within the possible agents.

Recommendations for a medical informatics-telemedicine system

Certain key recommendations which can be derived from the above review are:

1. The clinical workflow must not neglect the roles of different healthcare delivery teams which exist at the primary care levels. Interpersonal communication within the healthcare teams should be adapted to the primary, secondary and tertiary care levels.

2. Different vaccination and agent detection programs should be fully linked with the clinical workflow and to the drug delivery and drug information databases.
3. Psychosocial aspects of bioterrorism should be modelled as a part of the telemedical systems. The psychosocial aspects of telemedicine and usage of digital telecommunication tools themselves should be considered within this model.
4. Population health technology should be an interdisciplinary collaborative approach between different institutions, both clinical and otherwise.
5. Risk management should be rightfully addressed both within legal and medical informatics system.
6. Clinical genomics and bioinformatics tools should be fully integrated with the clinical databases and risk management systems.

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