Can Science and Technology Help to Counter Terrorism?

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Many papers at http://www.fas.org/RLG

Some examples of basic research needs:

- **Information technology**
  - **Security, priority, data mining**
- **Action of bacteria and viruses**
- **New understanding of social dynamics and personal motivation**

Far-reaching benefits for both the public and for business, but dual-benefit activities are difficult to design and fund

Problems of misuse of *this* S&T, manipulation, use by terrorists and by states in warfare

- **But how else preserve free and democratic societies in the face of the evolving threats of personal empowerment and terrorist use of technology?**

How motivate counterterrorism work?

- **Not like the engineering challenges of cost, time, limited space, gravity, wind, and functionality.**

- **Rather an attempt to counter human efforts by reducing vulnerability to terrorism and losses if terrorism should occur.**

  - **Eliminate the possibility of damage from blast? Shift of threat to incendiary or biological or chemical attack, or to a building not yet protected.**
  - **Must counter threats that may not be evident or even imminent; they may be the next resort of terrorists.**

Society must routinely harness S&T, manage, provide incentives to individuals and to organizations to prevent damage from terrorists and to provide mechanisms to inhibit their activities.

Many will work effectively to counter terrorism, even if result is only ameliorating rather than eliminating damage.

Major damage from terrorism can result from the analog of "immune response" of society to terrorist acts. More damage than terrorist attacks themselves. Must minimize the inhibition of freedom and commerce to permit the evolution of democracy and enhancement of well being.

Terrorism disruptive of entire societies:

- **Familiar "mall" bomber with a vest, sac, or briefcase of high explosives**
- **CW terrorism**
- **Disruption of unique bridges or other urban choke points**
- **Nuclear explosion**
- **Multiple seeding of contagious disease such as smallpox.**

Learn from experience, even with the loss of dozens or even hundreds of people to a single suicide bomber.

- **Reduce numbers willing to do this by a careful look at the behavior of one's society and government, and what the government says and how it is perceived.**
- **U.S. society remarkably free for an individual to cause damage or death, with the number of such activities held down by the promise of detection, prosecution, and punishment.**
  - **Normal criminal justice system little help against the individual suicide bomber**
  - **Significant utility against the structure that organizes suicide bombers.**

- **Strictly protective measures: Explosive-detection systems sniffers) at mall entrances;**
- **Discreet detection of explosives or explosive-carrying devices.**
- **Rapid detection systems for detecting hundreds or thousands of kg of explosives in a vehicle.**
- **Roadblocks or barriers to prevent high-speed access of vehicles carrying large amounts of explosive**
- **Suicide bombers may choose the lesser goal of blowing up the guard if they are frustrated in their approach to the more lucrative target.**

- **In order to limit the self destructive response to the threat or practice of a modest amount of mall bombing, it is essential for leaders and citizenry to put this threat in context. U.S. deaths from all causes in year 2001 were 2,400,000. Of these, heart disease: 700,000; cancer: 553,800; stroke: 164,000; accidents: 102,000 (motor vehicles: 42,000); influenza: 36,000.**

- **Perspective can avoid societal disruption impairing civil liberties and commerce alike.**

***Radiological dispersal devices* (RDD): "dirty bombs" , might not be explosives but aerosols with radioactive materials[1].**

Post-event

- **Identify radioactive material**
- **Characterize threat in terms of duration of exposure. If cobalt-60, with a half-life of five years, even though many exposed for five years would be at risk from cancer, controlled evacuation within days or weeks could limit the hazard by a factor 50.**

[1] **http://www.fas.org/ssp/docs/030602-kellytestimony.htm**

Need risk-based standards for decontamination.

Consistent with the regulatory approach to environmental hazards such as arsenic in drinking water, for which the regulated limit in the United States is now 50 parts per billion: lifetime cancer risk ~ 1.7%. The new limit of 10 ppb to be reached by 2006: lifetime cancer risk ~0.3%. To my mind, this is unacceptably high, but there is also a requirement that consumers be notified of the arsenic level in their municipal drinking supply, so that they can take individual measures if they so wish.

Reduce the threat from RDDs by stricter control and reporting of the millions of sources of intense radioactivity. Used for radiotherapy in hospitals, industrial radiography of heavy thick materials, sterilization of food, polymerization of plastics.

1. **Reduce opportunities for terrorists to obtain dangerous radioactive materials,**
2. **Install early warning systems to detect illicit movement of radioactive materials,**
3. **Minimize casualties and panic from any attack that does occur.**

At the other extreme of nuclear threats is the explosion of a nuclear weapon or improvised nuclear device in an urban environment or in a harbor. I estimate[2] hundreds of thousands of people would be killed by the explosion even of a one kiloton bomb (about 5% yield of the nuclear weapon that destroyed Nagasaki). For a ground-level explosion, far more people would be killed by exposure to the prompt radiation from the explosion and to the immediate fallout

[2] **"Nuclear and Biological Megaterrorism," Erice, Sicily, August 19-24, 2002. http://fas.org/rlg/020821-terrorism.htm**

of the debris from the explosion itself than was the case in Hiroshima and Nagasaki.

Protecting society against terrorist use of nuclear weapons lies in the better protection of nuclear weapons of those states possessing them.

- **Russia: >10,000 nuclear weapons, rather poor security created by economic problems.**
- **Pakistan: nuclear weapons at risk of diversion by sympathizers with extremist Islamic groups, by potential coup, by free-lance scientists**

Nuclear materials most commonly used for nuclear weapons: Pu-239 or U-235 (HEU)

- **HEU the greater problem**
  - **Less detectable than plutonium.**
  - **Easier to fabricate into a nuclear weapon**
  - **Improvised HEU weapon might have the full yield of the Hiroshima bomb-- 13¬kilotons.**
- **A general instrument against terrorism is intelligence. To this one needs to add the powerful tool of financial rewards for informants.**

***Human and agricultural health systems--bioterrorism*.**

- **E.g., foot and mouth disease, Salmonella, and smallpox.**
- **FMD, highly contagious disease of animals, affects pigs and cows, for example. Not apparently a threat to human health, but because it is so contagious, it is typically forbidden to import any animal product from an infected region into a country free of foot and mouth disease. This is a problem that cries out for improved vaccines, in order to**

prevent the spread of FMD in places in which it exists, and to protect animal populations in states free of FMD. Ironically, existing vaccine is not much used for protection because its use results in the animals developing antibodies that cannot be distinguished from FMD. It is in the interests of trading nations of the world to develop such effective protection. Could very well be done in India.

- **U.S. has been free of FMD. As with smallpox, the absence of even a single case should not convey a sense of security, but a profound**

sense of insecurity and instability against the introduction of the disease.

- **Salmonella a frequent cause of food poisoning in the United States and to a greater extent in other countries. A common bacterium causing primarily illness and occasionally death. The one recorded bioterrorist incident in the United States, other than the anthrax attacks of Fall 2001, was from a sect in Oregon that wished to reduce the number of people voting, in order to give their candidate a better chance at election. In this case, Salmonella was spread on food at a self-service salad bar. It could**

also be used to contaminate supermarket vegetable counters, and would surely sicken a large number of people.

- **Recent experience with anthrax has taught us much, despite familiarity over the centuries. Among our new-found knowledge is the effectiveness of antibiotic treatment after symptoms begin. Anthrax forms a hardy spore, survives in the environment for decades. When ingested in the lungs or GI-tract, some fraction enter the vegetative state, from which the bacteria can reproduce.**

- **Effective vaccine against several strains of anthrax, and effective antibiotic treatment.**
- **Recent knowledge of the disease implicates three protein products of the bacteria. Action of these toxins can be blocked by appropriate chemical counters. Would be another approach besides preventing the disease or preventing the multiplication of the bacteria, so that the disease itself would be less harmful to its host. Much more biomedical research along these lines is warranted, and because of the substantial competence and lower cost for**

such activities, India should be a prime location.

- **Despite the effectiveness of a few grams of anthrax in killing a number of people, through the inefficient means of dissemination from postal sorting machines, as well as from direct communication from envelopes containing the anthrax spores, anthrax is not highly communicable from one individual to another. In principle, therefore, improved hygiene can protect individuals from the primary source;**

not necessary to take strong measures to isolate people sick with anthrax.

- **Smallpox a different story. The world has been free of smallpox since the extraordinary effort made by the World Health Organization (WHO) to eradicate smallpox worldwide. Possible because smallpox has no animal hosts other than humans.**
- **In 1972 U.S. government terminated the U.S. vaccination program. Arguments in favor included the fact that several people per year**

died of side effects of the vaccine, and nobody died of smallpox. Therefore, why vaccinate?

- **Consider the example of the nuclear reactor with its control rods fully inserted, and no significant neutron population in the core. If one pulled out the control rods rapidly enough ("not needed because there are no neutrons"), a few stray neutrons would soon produce an enormous amount of heat and radioactivity, leading to melting of the reactor core and liberating much of the radioactive material accumulated in the core.**

Routine vaccination against smallpox is the analogue of permanently inserted control rods in a nuclear reactor.

- **Failing substantial vaccination, the country is at risk to the dissemination of virus at a busy airport, from which tens of thousands of people would unknowingly disperse all over the United States and the world, so that within two weeks, when the disease became apparent, they would have infected a good many others.**

- **Smallpox vaccination is effective during the first four days after exposure. Therefore it is**

possible in principle with an appropriate distribution of vaccine and a few-minute course in vaccination techniques, for a few thousand workers throughout the United States to create 10,000 in the first hour and many times that in the second hour, so that it should be possible to vaccinate all reachable individuals within a couple of days. But this takes a plan, stocking of the appropriate bifurcated needles for the vaccination process, vaccine, and people seeded throughout the country.

- **The United States has been largely unsuccessful with the Administration's initiative to vaccinate large numbers of first responders and health-care workers, and to make vaccination available to those who wished it. I believe this is a significant failure, and we do not yet have a plan to vaccinate hospital and emergency workers in a single day.**

Centuries-old measures can *eliminate* some epidemics by reducing transmission < 1.0

Assume that a primary smallpox case in the United States would infect three others. Then 1000 primary cases would grow in two weeks to 3000, two weeks more to 9000, and so on. If the transmission could be reduced by a factor four-- to an average of 0.75 secondary cases per primary case-- even if there were no other treatment, 1000 primary cases would result in a total of 4000 altogether :

$$(a + as + as^2 + as^3 + \ldots = a \times (1/(1-s)).$$

- **Society need not fragment itself or maintain quarantine or other barriers routinely, but**

they should be available in case of an outbreak of smallpox (or SARS), at the first sign of a significant number of cases. This would do nothing for the primary victims, but it would keep a tragedy from becoming a disaster. And limiting the infection by a factor $1/(1-s)$ would save every one of the tens of thousands or millions of victims of a fulminating epidemic.

- **In order to achieve this there must be analysis and planning. But *implementation* requires action by much of the society-- action messages via radio and particularly television. The**

internet is an excellent distribution medium in the United States because it provides data on demand; following an alert, anyone with internet access would be able to access and print the information relevant to their locality. In case of biological terrorism, a radiological dispersal incident, or the release of toxic material, the channels for distribution of warning and action information to the public are not inherently affected. But simultaneous attack on the internet and the power grid would amplify greatly the impact of BW, RDD or chemical attack.

- **Some S&T specific to countering terrorism: e.g., means for premature detonation or of inhibiting the triggering of explosives.**
- **Most S&T counter-terrorism tools are also highly useful for public health, law enforcement, or general intelligence purposes.**
- **Much S&T now useful for counter terrorism is embodied in systems in general use, such as the media of mass and selective communications.**
- **Science and technology cannot eliminate the problem of terrorism, but can help in reducing it.**

Four specific joint projects:

- **Plans and practice for nationwide just-in-time vaccination against smallpox or some future disease**
- **Expedient modular replacements for EHV transformers: small, cheap, inefficient replacements for costly, highly optimized, purpose-built and slow-to-build systems**
- **Development and production in India of modern vaccines for smallpox, foot and mouth disease.**
- **Indo-U.S. improved control of commercial radioactive materials and sources.**