

UNITED STATES SENATE  
Committee on Commerce, Science and Transportation  
Subcommittee on Science, Technology and Space

**Hearing on Fighting Bioterrorism:  
Using America's Scientists and Entrepreneurs to Find Solutions  
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Mr. Chairman, Distinguished Members of the Committee:

Thank you for inviting me to appear before you to discuss the ways that medical professionals and voluntary organizations in the private sector can contribute to the war against bioterrorism. My name is Richard Hatchett. I am an Emergency Room physician at Memorial Hospital in New York City and coordinated the efforts of medical volunteers at the Stuyvesant Triage Center in the days after the attacks on the World Trade Center. In 1997 I served as Clinical Coordinator of the Yale University Ebola Project in Makokou, Gabon and I recently coauthored a privately circulated white paper on smallpox with Professor Jacob T. Schwartz of New York University. Over the last four months, I have served as the coordinator of the Civilian Medical Reserve Working Group, a citizens' initiative advocating the creation of a Medical Reserve Corps to enhance the capacity of local communities to respond effectively to epidemics, acts of terrorism, and natural catastrophes. Last Wednesday, in an Executive Order, President Bush endorsed our effort by calling for the creation of a Medical Reserve Corps as one component of his USA Freedom Corps initiative.

I called the first meeting of what became the Civilian Medical Reserve Working Group within a couple of weeks of the attacks. The efforts of volunteers after the events of September 11 were characterized by intense camaraderie, and the dedication, endurance, and integrity of the volunteers was awe-inspiring. In terms of human capital, one could ask for nothing more: the doctors and nurses, medical students and residents who converged on Ground Zero were hard-working, intelligent, independent, and used to taking responsibility for their actions. Where their efforts were well coordinated they performed almost miraculously. The problem was that because the response was spontaneous, in most cases the efforts of the volunteers were *not* well coordinated.

From an operational point of view, the spontaneous flocking of medical volunteers to Ground Zero highlighted the problems associated with an uncoordinated response. Dr. Antonio Dajer, the Associate Medical Director of the Emergency Department at NYU Downtown Hospital, an

institution located four blocks from Ground Zero, has written eloquently of his frustration at finding “trauma triage areas” run by volunteers set up on the street within a few blocks of his fully equipped emergency room. The triage areas that were set up operated independently, outside the New York City Office of Emergency Management’s Incident Command Structure and with no overall system of coordination. The chains of command governing such sites were thus ambiguous or non-existent. Several operated in areas that had not been cleared by structural engineers. The lack of coordination also meant that there was no functional system of communication or supply, even for the “approved” triage facility at Stuyvesant High School, and no way to assure continuity of staffing. The credentials of volunteers could not be verified, and security was compromised by the continual flow of self-declared “volunteers” across the established police perimeter. Finally, hospitals throughout the city reported significant concerns that their own staffing would be compromised because their employees were “helping out” at Ground Zero.

It was to explore ways to address these problems while harnessing the extraordinary talents of civilian medical professionals that we convened what became the Civilian Medical Reserve Working Group. As mentioned above, we gathered for the first time before the end of September – which is to say, before anthrax was distributed through the United States Mail. We had considered abstractly whether an organization such as we envisioned might prove useful in the event of biological or chemical attack; the anthrax episodes convinced us that it would. One of my colleagues, Eric David, participated as a volunteer in the distribution of antibiotics at the Morgan postal facility and witnessed firsthand the difficulty of educating and dispensing antibiotics to large numbers of anxious employees of varying educational backgrounds and degrees of sophistication. Ed Carubis of the New York City Department of Health notes that the evaluation of a single case of anthrax at Manhattan Eye, Ear, and Throat Hospital required setting up 12 registration stations to process worried patients and employees (personal communication). In more widespread outbreaks, the need to ramp up and create field stations for epidemiologic interviews, sample collection, and distribution of antibiotics or vaccines would rapidly overwhelm even the most robust Departments of Health.

While causing only 23 infections and 5 deaths, the anthrax attacks did in fact place a severe strain on the American government and public health system. Activities of all branches of the federal government were disrupted, approximately 300 postal and other facilities were tested for the presence of anthrax spores, and approximately 32,000 persons initiated antimicrobial prophylaxis following potential exposure to *B. anthracis* at workplaces in Florida, New Jersey, New York, and Washington, D.C. The November 9 *Morbidity and Mortality Weekly Report* reported that “For the week of October 21-27, Colorado, Connecticut, Louisiana, Maryland, Montana, North Dakota, Tennessee, Wisconsin, and Wyoming reported 2,817 bioterrorism-related calls (mean per state: 313; range: 23-800) and approximately 25 investigations of bioterrorism threats in each state. From eight to 30 full-time personnel are engaged in these responses in each state. . . . For the same period, public health laboratories in 46 states participating in the Laboratory Response Network reported receiving approximately 7,500 specimens and isolates for *B. anthracis* testing.” The obvious lesson is that even limited

attacks can cause major disruption.

Biological weapons are agents of terror. In this regard, they succeed so well precisely because they are so insidious. They exert a profound multiplier effect, creating a vast number of “worried well” patients, many of whom will crowd medical facilities seeking treatment or reassurance. Because infections with anthrax share many clinical features with those of influenza, and the threat of anthrax emerged just as the flu season was getting under way, this effect was exacerbated, so that many patients who ordinarily would have been diagnosed with flu or an unspecified viral syndrome received Cipro or other antibiotics “just in case.”

The anthrax episodes precipitated a public health crisis; what they did not do was precipitate a crisis in the nation’s hospitals. With a different mechanism of distribution and larger quantities of spores, the situation could have been quite different. The release of a few grams of highly refined spores in a crowded stadium or into a subway station at rush hour could conceivably produce hundreds or thousands of victims, many of whom would be critically ill, within a few days. These victims would present to local emergency rooms and be admitted to local hospitals; and it might be days before anthrax was identified as the causative agent.<sup>1</sup> Very large cities, such as New York, might be able to handle the surge of patients; smaller cities would surely be swamped.

For a variety of reasons, it is difficult to estimate the true capacity of hospital systems. For one reason, the systems are seldom if ever tested. September 11 might be regarded as a full test of the New York City hospital system, which contains more than 100 hospitals. Most hospitals within the city cleared their emergency rooms, created extra emergency room capacity by adding beds, electively discharged or transferred patients to more distant facilities, and cancelled elective operative procedures. Because of the violence of the collapses, however, most people who survived and were injured qualified as “walking wounded” and did not require admission. The emergency departments of the four hospitals closest to the World Trade Center and another hospital serving as a burn referral center reported treating 1103 survivors in the first 48 hours after the attack, but of this number only 181 (16%) required admission (data from *Morbidity and Mortality Weekly Report*, January 11, 2002). NYU Downtown Hospital treated in excess of 400 patients between 9 a.m. and 1 p.m. and cleared its emergency room by early afternoon (Antonio Dajer, personal communication). No formal assessment of the actual admitting capacity of New York City hospitals on September 11 has been performed, but based on information collected by the Greater New York Hospital Association from a number of hospitals it is possible to extrapolate that the system possibly could have absorbed about 3000 patients. How many critically injured patients requiring mechanical ventilation the system could have absorbed is unknown. By comparison, in testimony before the U.S. Senate Government Affairs Subcommittee on International Security, Proliferation and Federal Services on July 23 of last year, Dr. Tara O’Toole reported that the state of Maryland, home to more

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<sup>1</sup> Although this seems unlikely, given the currently heightened awareness among physicians about the disease and its manifestations.

than 60 hospitals and two academic medical centers, would be unable to handle an emergency that produced 100 patients needing ventilators.

The United States health care system is fiercely competitive and notoriously inelastic. Hospitals are under tremendous financial pressure, with thin and falling margins forcing many to decommission beds and switch to “just-in-time” models of staffing and supply. An aging population and reduced lengths of stay mean that the beds that are available are filled by older and sicker patients, who require comparatively more attention. My hospital, for example, has reduced its bedspace by approximately 20% over the last few years and reconfigured several of the floors thus emptied. This means that only a portion of the decommissioned beds can be brought back into service in any reasonable time frame. A slight surge in hospital admissions two weeks ago left 17 sick cancer patients requiring admission sleeping in the Urgent Care Center, which itself contains only 12 beds, overnight. It took until about 3 p.m. the following day for beds to be found for all of these patients. One can imagine, then, the crises that would develop should a real and sustained surge in patients occur.

The dynamics of an attack with a contagious agent such as plague or smallpox would be quite different from even large-scale attacks with noncontagious agents such as anthrax or botulinum toxin. The effect of such an attack would not be an outbreak, as with the latter agents, but an epidemic. And epidemics, once they pass a certain critical threshold, are difficult to control, contain, or predict. The scope of the epidemic might accelerate for weeks and not peak for several months. Depending on the agent used, patients might require respiratory isolation and need to be admitted to specially vented rooms, which (it goes almost without saying) are in extremely short supply. Depending on the size of the epidemic, and to some extent on the virulence of the causative organism, it might be necessary to convert schools, gymnasiums, hotels, or armories into auxiliary facilities or quarantine stations. It might even be necessary, as was the case during the Spanish Influenza epidemic in the fall and winter of 1918, to switch over to a system of home care.

And the issue of bedspace may, in fact, pale beside the issue of staffing. Tara O’Toole has argued that “The big problem is not beds as everyone seems to suppose – it is staff. And there is no way to fix that in the short term.” Staffing shortfalls may be exacerbated by the fear and flight of persons inadequately trained in the management of infectious diseases and other illnesses related to biological or chemical terrorism. Such staffing shortages would undoubtedly be particularly acute in the event of an outbreak sufficiently large to require the opening of auxiliary facilities or switching to a system of home care.

This was the complex bundle of problems we set out to address. The model we have evolved for a Civilian Medical Reserve incorporates the Medical Reserve Corps as an essential element but also relies on the dedicated work of AmeriCorps and other volunteers. It requires the creation of a medical registry, the purpose of which is to enumerate and incorporate in community-wide planning what we have called “hidden” human and institutional assets. It also requires tight integration and coordination of the Medical Reserve Corps into local emergency

response planning and anticipates the development of certain information technology assets and capabilities. In the sections that follow I will attempt to lay out a blueprint of what we believe an adequately structured and sufficiently funded Civilian Medical Reserve can accomplish.

## **The Role of the Medical Reserve Corps<sup>2</sup>**

The Medical Reserve Corps will consist of physicians, nurses, and supporting personnel who coordinate and work with the other elements of the Metropolitan Medical Response System. The Medical Reserve Corps will be led by doctors, nurses, and other medical professionals who receive special training in disaster medical response, the theory and practice of triage, biocontainment, and other relevant disciplines. As part of our proposed Civilian Medical Reserve, they would be assisted by a substantial group of civilian volunteers drawn from outside the medical profession and trained within the Medical Reserve itself. Local units of the Medical Reserve Corps will be pre-equipped and coordinated with existing municipal disaster plans, so that in the event of a major structural disaster they can be activated and establish field triage sites within three to six hours. They will also provide back-up in the event of major public health crises (particularly bioterrorist attacks) placing unusual demands on the medical system and be trained to detect and manage the agents of concern in such situations (e.g. anthrax, smallpox, plague, tularemia, viral hemorrhagic fevers, etc.).<sup>3</sup> They will augment the efforts of public health authorities in administering vaccines and performing epidemiologic investigative work during outbreak situations or bioterrorism events, and they can assist with non-emergent, large-scale community medical projects during “peacetime”.

Designing the Medical Reserve Corps so that it remains flexible and adaptable is essential. The Medical Reserve Corps must be capable of responding to both mass casualty incidents and evolving crises. With mass casualty incidents, local coordination is crucial. Studies of mortality patterns in earthquakes consistently demonstrate that response time is pivotal, that 25 to 50 percent of those who are injured and die slowly could have been saved if first aid had been rendered immediately, and that the greatest demand for patient care occurs during the first 24 to 48 hours after the disaster. Thus, the most critical needs of an affected population *must* be met by local providers. So must the needs of a community grappling with a severe epidemic or the consequences of a bioterrorist attack. We believe the development of locally coordinated and potentially mobile medical reserve units can play a role in enhancing the State’s preparedness to deal with such situations.

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<sup>2</sup> In the sections that follow, “Medical Reserve Corps” refers specifically to the voluntary organization created within the USA Freedom Corps to recruit and train retired or otherwise inactive healthcare professionals as an emergency preparedness initiative. “Civilian Medical Reserve” refers to a larger initiative in which the Medical Reserve Corps would work in conjunction with AmeriCorps, Senior Corps, and Federal Work Study Program volunteers and be charged with a wide range of tasks relating to biopreparedness.

<sup>3</sup> Advance training and drilling considerably reduces the anxiety associated with caring for patients with frightening infectious agents, and specially trained teams could deploy to hospitals caring for patients with diseases such as Marburg or Ebola fevers.

In the immediate aftermath of a disaster, the responsibilities of reservists might include triaging patients, providing essential medical care, and preparing patients for evacuation to local hospitals. In the twenty-four to seventy-two hours after a disaster, their role will likely shift to providing frontline support to search-and-rescue workers. In evolving crises triggered by bioterrorist attacks or severe epidemics their role in supporting overtaxed medical systems would be equally important. The establishment of mutual aid arrangements with Reserves in nearby cities will create a mechanism whereby care can be expanded into auxiliary facilities or provided in patients' homes as the need arises.

Given recent events, we strongly believe that the general medical community will find the concept of the Medical Reserve Corps extremely attractive and that such an organization will have no difficulty attracting volunteers. The Medical Reserve Corps will provide for the special training and continuing education of its members and enable the State to identify and coordinate those physicians and other medical professionals with special experience and expertise. A properly trained and coordinated Medical Reserve Corps will be ready to meet the needs of our communities in acute crises and to provide the backbone of a sustained response in prolonged ones.

### **Identifying Hidden Assets**

One of the major activities of local units of the Civilian Medical Reserve will be the creation and maintenance of comprehensive medical registries in the communities they serve. These registries will include but not be limited to practicing professionals and existing institutions. Perhaps the best reason to create such a registry, in fact, is to identify "hidden" human and institutional assets. By enumerating these assets, the registry will permit emergency planners to put together a census of the "total available medical assets" within a given community. The ways in which such information can then be used to facilitate planning and enhance preparedness are discussed at greater length below.

The idea of accounting for hidden assets evolved from an event on September 11. Dr. Mark Robson, a breast oncologist at Memorial Hospital and a man who gives chemotherapy for a living, called me to see if he could assist in preparing the Urgent Care Center to receive patients. He explained that prior to joining the staff at Memorial he had served in the military and received training in triage and mass casualty response. Subsequently we realized that in any community there must be many physicians with special skills or relevant prior experience not reflected in their practice designations. Such experiences include but are not limited to military service, work in refugee camps or other austere environments, involvement with medical relief efforts in complex humanitarian emergencies, and prior employment in emergency rooms. This realization made us ponder other ways in which available but untapped medical expertise might be hidden or buried. Other hidden human assets we have identified include

- Retired medical professionals
- Persons with prior medical training and licensure who no longer practice (because they are administrators, entrepreneurs, scientists or consultants)
- Medical professionals who work outside of traditional hospital settings (in community health centers, visiting nurse practices, etc.)
- Medical and nursing students

Registration with the Civilian Medical Reserve will create a mechanism for calling such persons into the hospital system in the event of a severe crisis, and persons with special skills or prior experiences can be deployed where and as needed. We believe finding and registering such personnel represents a quick and exceedingly cheap way to enhance local response capacity.

As there are hidden human assets, so also are there hidden institutional assets. The first step would be to assess a community's existing resources in terms of beds, isolation facilities, and critical care capacity. The Reserve would then assess the extra capacity provided by community health centers, post-anesthesia care units (which can provide intensive care), decommissioned but restorable clinics and wards, and potential auxiliary facilities such as schools, gymnasiums, and armories. This information would be useful in elaborating community-wide plans, assessing gaps in current levels of preparedness, and identifying thresholds at which mutual aid arrangements would need to be activated, auxiliary facilities opened, home care provided, and responsibilities devolved (from physicians to nurses, medical students, etc.).

The administrative work of establishing and maintaining the medical registries would be performed by AmeriCorps or Federal Work Study Program volunteers under the supervision of the Medical Reserve Corps' full-time medical staff.

### **The Role of Other USA Freedom Corps Programs and Volunteers**

The President, in his Call to Service, has recognized and called upon the industry, goodwill, and commitment of the American public in this time of national need. By creating the USA Freedom Corps Council and naming John Bridgeland to head the affiliated office within the White House, President Bush has signalled his faith in the capacity of normal citizens to contribute in areas related to national security and domestic defense and demonstrated his strong personal commitment to this endeavor. By calling for the expansion of AmeriCorps, Senior Corps, and Serve Study programs, he has dedicated his Administration to mobilizing a vast number of citizens in this effort. By establishing Citizen Corps and the Citizen Corps Councils, he has created a mechanism of coordinating these efforts in the interest of homeland security. And by asking Congress for more than \$500 million in Fiscal Year 2003 to support these initiatives, he has called for the funds needed to transform this vision into reality.

The Citizen Corps Councils have been tasked with developing community action plans that include assessments of infrastructure vulnerabilities and possible threats, available local

resources, and the best ways to organize and expand local efforts. These plans will coordinate the community-based prevention and preparedness efforts of the programs falling under the mantle of the Citizen Corps (Medical Reserve Corps, Volunteers in Police Service, Neighborhood Watch, Community Emergency Response Teams, etc.). FEMA will provide \$144 million in matching funds in Fiscal Year 2003 to help create and maintain the efforts of the Councils. I would urge the local Councils to allocate a portion of this funding to censusing available medical assets in the manner described above, and to make performing such censuses a very high priority. The resulting registries could then be maintained by Americorps or Federal Work Study Program volunteers working in conjunction with local emergency offices and Departments of Health and under the supervision of the Medical Reserve Corps' full-time medical staff.

Coordinating the response to and remediation of acts of bioterrorism poses considerable technical and logistical challenges. One of the biggest obstacles is that the groups whose activities must be coordinated (EMS and other first responder services, Departments of Health, hospitals) function autonomously in their day-to-day activities and historically have not forged strong links with each other. A Civilian Medical Reserve has the potential to become a nexus connecting these groups and promoting the formation of enduring institutional alliances. Municipalities implementing the Civilian Medical Reserve model would coordinate the Medical Reserve Corps and Community Emergency Response Teams with AmeriCorps, Senior Corps, and Serve Study volunteers engaged in public health and disaster preparedness and relief programs. Volunteers would interact on a regular basis, to foster team building and *esprit de corps*, and participate in drills and exercises together. These activities would lay the groundwork for a broad-based but coordinated civilian response in times of crisis.

President Bush and Senators McCain and Bayh have called for an expansion of the AmeriCorps National Civilian Community Corps program to support homeland security, public health, and disaster preparedness and relief activities. I would urge that some of these new recruits be specifically assigned to Civilian Medical Reserve units to provide administrative and other support to members of the full-time medical staff. A large fraction of the AmeriCorps volunteers thus assigned would, when not otherwise engaged, be detailed to local hospitals to help implement hospital preparedness plans and foster the development of interhospital communication and coordination.

A Civilian Medical Reserve unit would consist of a small full-time medical staff, the Medical Reserve Corps, and non-medical staff. The non-medical staff would engage in training and self-organization activities and have the following responsibilities when mobilized during disasters or other public health crises

- Providing general assistance to physicians and nurses
- Transporting patients and handling supplies
- Tracking patients and maintaining medical records
- Maintaining communication and supply networks

- Providing security
- Performing situational tasks appropriate to their level of training

Under normal circumstances, the non-medical staff would have the following functions

- Developing communication and database systems
- Developing and distributing training materials
- Contingency planning
- Nurturing alliances with private voluntary organizations
- Exchanging solutions with other Civilian Medical Reserve units
- Creating and maintaining the medical registry
- Assisting local authorities in their efforts to foster communication and coordination between hospitals and implement hospital preparedness plans

The problems of designing and implementing Civilian Medical Reserve structures will vary from community to community, depending on what human and institutional assets are available and how these are organized and configured. A solution that works in Boston may not be relevant in Buffalo and almost certainly will not be applicable to Binghamton. Creating a central clearinghouse to which local Citizen Corps Councils can refer for guidance and inspiration would permit communities the freedom to develop solutions appropriate to their needs and resources while allowing them to profit from each other's experience.

### **The Role of Other Voluntary Organizations**

Volunteers provided many critical services in the days after the attacks on the World Trade Center, from transporting workers and supplies from staging areas to Ground Zero to providing food and comfort to uniformed personnel and assisting in search and rescue efforts. Existing and spontaneously evolving voluntary organizations usefully channeled the outpouring of public support and provided their members with the ancillary but by no means negligible benefit of being able to do something. The emotional devastation of the attacks was compounded for many by the frustration of having no meaningful way to respond. The desire to respond and demonstrate solidarity with the survivors and rescue workers explains the long queues at blood donation centers across the country, the tremendous and immediate charitable giving, and the formation of numerous new voluntary organizations.

One of the most interesting phenomena of the last few months has been the persistence of these spontaneously evolved organizations. Such organizations have emerged to meet specific local needs, from the provision of clothes and supplies to construction workers to the "staffing" of cheering points along the West Side Highway and advocacy of victims' rights. Not surprisingly, many of these organizations are highly adapted to the functions that define their purpose. They were able to respond (and respond rapidly) to events because of their lack of rigid structure. Collectively, they demonstrate the ingenuity and initiative of affected populations and represent a

wonderful, bottom-up mechanism for addressing new and previously unrecognized societal needs.

Several of these new organizations address problems related to homeland security, and many of these are organized along disciplinary lines. Our Civilian Medical Reserve Working Group is but one of many examples. Andrew Rasiej, who has been involved with the effort to establish NET Guard, was instrumental in organizing Silicon Alley Cares, a consortium of about 1500 volunteers from New York City's information technology community. Sue Pinco, a social worker at Columbia, has put together a group called NYC-CAN that last week sponsored a weeklong "Training Institute for First Responders" with the goal of developing multidisciplinary crisis-response teams to address acute mental health care needs after future disasters. The needs that will arise after acts of bioterrorism will be complex and have consequences that extend beyond the domain of public health. Voluntary groups organized along disciplinary lines will give emergency management officials a way to mobilize otherwise widely distributed social assets.

Such initiatives, to be useful, however, must be coordinated and publicized. Ed Carubis, the Chief Information Officer of the New York City Department of Health, speaks of the acute need of his office for additional manpower during the anthrax crisis but was unaware that Silicon Alley Cares existed, and Silicon Alley Cares is not affiliated with the New York City chapter of VOAD (Voluntary Organizations Active in Disaster) or New York Cares, both of which coordinate requests for volunteers. Coordinating private philanthropic efforts related to homeland security and disaster mitigation is a function that the new Citizen Corps Councils may want to consider assuming.

### **Information Technology in Community-Wide Planning**

Finally, I would like to say a few words about the information technology needs that are likely to arise during severe epidemics or after acts of bioterrorism. This is a vast topic, obviously, so I will limit my remarks to how information technology can address certain logistical concerns. Our experience demonstrates that epidemics and acts of bioterrorism can profoundly stress local hospital and public health systems and that such events are dynamic processes. To respond to and mitigate the consequences of such events, then, we will need to capitalize on every asset at our disposal. And to do this, to allocate our resources effectively, what we will need first and foremost is reliable data. We must be able to detect unusual spikes in emergency room visits. Then, as the event unfolds, we will need to know where patients are presenting, which hospitals and emergency rooms are already overloaded, which hospitals need which supplies, and how to distribute supplies arriving from federal reserves such as the National Pharmaceutical Stockpile.

We are making progress on the detection front. In part as a result of the West Nile Virus outbreak a few years ago, the New York City Department of Health has implemented a much

lauded “syndromic surveillance” system. This system, which depends on cluster analysis and cluster modeling, produces spatial representations down to the census tract and ZIP code level of where events are happening. The data fed into the system has so far been based on EMS coding, with certain types of call (e.g., respiratory distress) being specially flagged. This system may soon expand to the hospitals, though. Thirty hospitals now participate in emergency room surveillance, submitting patients’ chief complaints to the Department of Health within twelve hours of the patients’ arrival (and often prior to their discharge). An additional benefit of this program is that it has opened up contact between the Department of Health and emergency rooms and hospitals and enhanced the information stream flowing between them. Syndromic surveillance has predicted the onset of the flu season well in advance of other techniques each of the last three years. In hospitals that depend on just-in-time staffing and supply, this kind of advance notice allows for smoother ramping up of resources.

There are also promising developments on the response and mitigation front. Dr. Eliot Lazar and colleagues working in the New York Presbyterian Hospital system (which contains about 30 hospitals), in conjunction with the New York State Department of Health, have tested a data acquisition system that allows for essentially real-time collection of information about the availability of hospital beds and inventory throughout the system. This system creates a common platform that theoretically could be used in all hospitals and that could interface with the vendor-managed inventory system employed by the National Pharmaceutical Stockpile. Such a system will greatly enhance the efficiency with which supplies collected at central staging points are distributed, and in an epidemic situation it could be used to route patients away from overtaxed facilities.

Geographic Information Systems (GIS), which encode data spatially and generate updatable maps, show great promise as a tool for responding to and mitigating bioterrorism attacks. GIS has often been employed in epidemiologic investigations and thus used represents a technological enhancement of traditional medical detective work. Because GIS has fast response capabilities and permits fast access to integrated layers of information, the potential uses of GIS in bioterrorism events are numerous. The great strength of GIS is that it has strong analytic capabilities and permits the powerful visualization of spatial data. For example, by geocoding environmental samples (e.g., powders suspected of containing anthrax) and looking at the pattern of positives, GIS may permit the development of more rational prophylaxis and remediation strategies. Geocoding patients as they arrive at points of distribution (POD) of antibiotics and vaccinations will allow for more reliable and efficient follow-up (patients living next door to each other but presenting to different PODs will appear next to each other on a computerized map and can be visited by a single public health worker). GIS can also be used to develop emergency response plans by identifying the location of schools, medical centers, staging areas, and evacuations routes. Just before September 11, New York City’s Office of Emergency Management implemented an Emergency Management Online Locator System (EMOLS), a Web-based application that allows New York City residents to enter an address

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<sup>4</sup> Currently this application is dedicated to helping residents determine whether locations of interest fall

and see the location of the nearest emergency shelter.<sup>4</sup> This application could theoretically be linked with the New York Presbyterian Hospital data acquisition system described above and allow EMS units (or even patients themselves) to avoid overcrowded hospitals and determine alternative routing. ESRI, the GIS industry leader, has developed wireless technology that allows uploading and downloading of data in the field and has great potential to enhance all of these capacities.

Such technologies must continue to be developed and tested. Once implemented, they must be widely distributed and tightly integrated with existing emergency management operations. In terms of bioterrorism preparedness, this is one of the main challenges that we as a nation will face in the coming decade.

### **Conclusion**

We can anticipate that if a significant bioterrorist attack occurs on United States soil, it will cause massive disruption and panic and that it will severely affect the operational tempo of government. Given budgetary constraints it is highly unlikely that hospitals will build in new reserve capacity, that public health departments will massively expand their laboratories and personnel rosters, and that vaccines to the agents of concern will be developed any time in the near future. To meet the threat of bioterrorism, we will have to maximally leverage existing resources, identify untapped assets, and rely on the goodwill, industry, and intelligence of civilian volunteers. We have a unique opportunity to do so, and the USA Freedom Corps demonstrates great promise. Let us capitalize on both.

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within one of the city's Pedestrian and Vehicular Traffic Restriction Sectors. The EMOLS webpage is located at [http://www.nyc.gov/html/oem/html/emols/emols\\_wtc.html](http://www.nyc.gov/html/oem/html/emols/emols_wtc.html).