After an Attack:
Preparing Citizens for Bioterrorism

By Richard J. Danzig, Rachel Kleinfeld, and Philipp C. Bleek

Center for a
New American
Security

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"Citizen preparedness is a key variable in our response to a catastrophic bioterrorism attack, but while the United States has made substantial investments in professional preparation, only rhetorical attention has been paid to preparing the broader public."
—Richard J. Danzig

EXECUTIVE SUMMARY

Responses to a catastrophic bioterror attack are likely to greatly amplify or substantially mitigate the attack's consequences. No less significant, if our post-attack responses fail, we are likely to encourage future attacks by demonstrating their efficacy in spreading terror.

Citizen preparedness is a key variable in our response, but while the United States has made substantial investments in professional preparation, only rhetorical attention has been paid to preparing the broader public. Using aerosol anthrax and smallpox attacks as primary examples, this paper demonstrates that our present preparations are likely to fail when measured against the six most fundamental citizen expectations. It advocates five research and development investments that would enhance citizen preparation.

The Likely Failure to Meet the Most Fundamental Citizen Expectations

We anticipate that if a substantial aerosol anthrax or smallpox attack were to occur in an American city, most members of the public would reasonably expect six fundamental kinds of support from the government. However, at present we believe local, state, and federal officials would fail to provide this support. Phrased as expectations from individual citizens, the requested support and likely responses would be:

1. **Instruct and equip me to protect myself as much as possible immediately and in the event of future attacks.** Advice about modes of protection (the value of masks, modes of decontamination, means of infection control, etc.) is for the most part designed for professionals in hospitals rather than laypeople in everyday environments. It is remarkably rudimentary, without a sound scientific basis, and without consensus. After a bioterrorist attack, citizens would receive little or no advice, and the advice they receive will likely be conflicting, often incorrect, and would probably amplify their anger at the government's failure to prepare.

2. **Tell me whether I and/or those I love have been infected by this attack.** Our health care system cannot diagnose smallpox early enough for the most efficacious treatment and our anthrax diagnostic capabilities would be overwhelmed in the wake of a catastrophic attack. Jurisdictions across the United States lack a mechanism for informing individuals about the whereabouts and status of their loved ones in the aftermath of an attack, as made clear by the confusion in the initial 24 to 48 hours after the September 11, 2001 collapse of the World Trade Center and experience after Hurricane Katrina in 2005.

3. **If I cannot be reasonably assured that I was not infected, operate a system that will fairly, safely, and expeditiously provide me and others at risk with whatever drugs or vaccines will protect us.** Policymakers have taken significant steps to accumulate supplies of some critical drugs and vaccines. But present distribution mechanisms are not likely to be fast, fair, or credibly safe. They are especially vulnerable to further terrorist attack and inadequately prepared to cope with likely transportation, staffing, and psychological obstacles.

4. **Provide health care to those who require it.** Emergency room and hospital bed capacities plan to "surge" to approximately 20 percent beyond capacity. We estimate that the requirement will be on the order of 1,000 percent of present capacity. Beyond this number, estimates of the number of "worried well"—those who mistakenly fear they have been infected—are both huge and hugely variable. Little effective attention has been given as to how to minimize that number and cope with the triage problems it presents.

5. **Prevent more attacks of this kind so that I can be assured the worst is over.** A bioterrorist who can attack once will likely have the ability to reload and attack again and again. The United States has improved forensic capabilities that will facilitate long-term criminal investigation, but has not developed quick reaction and interdiction tools to prevent follow-on attacks. The inability to prevent follow-on attacks will have even more debilitating effects on capabilities, confidence, and morale than the initial attack.

6. **Speedily establish conditions and provide information that will permit me and my family to safely return to ordinary daily activities.** While resuming normal activities soon after bioterror attacks risks illness, delays in resumption entail great costs. The United States has dramatically underinvested in decontamination research and development, lacks standards and a strategy for mass decontamination, and capabilities are so rudimentary that the best analysis of the subject concludes that after an aerosol anthrax attack on Manhattan, effective decontamination would take decades or even centuries.

Recommendations for Research and Development

A program of technological and social science research, development, and testing is required to meet citizen needs, empower laypeople to care for themselves and their loved ones, and adjust their expectations. We suggest allocating three percent of the current Department of Homeland Security research and development budget of $1.2 billion, i.e. $36 million, for initial development of a program based on our recommendations. We would spend this money on five priorities:

1. **Research, development, and testing to develop and evaluate different methods of self-protection and self-decontamination by laypeople.** To the extent warranted, this program would result in more specific and well-grounded messages of advice to be distributed in advance and most especially to be immediately disseminated after

authorities become aware of an attack. It may also lead to stockpiling, distribution, surge-production capabilities, and building code innovations.

2. **An aggressive program to develop advice and support systems that would facilitate home care and protection of home caregivers from infection in the event of broad-scale aerosol biological attack.** Because we anticipate that the demand for hospital care will greatly outstrip its supply, home care will play a vital role. Moreover, home care can be effective, particularly since for many of those exposed to biological agents the care required will be palliative. Home care can be enormously enhanced if systems are developed in advance to provide caregivers with information that allows them to minimize risks of transmission of infectious agents and maximize quality of care.

3. **Determine ways to supply individuals with the medical goods and basic supplies of daily life that they will need for self-care at home, or for ongoing sequestration in the case of a contagious disease.** Neither price nor a first come, first served system will be an appropriate rationing mechanism. The vulnerability, logistical difficulties, and psychological resistance to central distribution points suggest that alternate mechanisms are required, including outreach systems that support people in their homes and efforts to flood the system so that supplies can be obtained in multiple ways from multiple places.

4. **Create means for rapid diagnosis outside of hospitals to reduce demands from the worried well and enable hospitals to focus on treatment.** Effective diagnosis outside the hospital setting is enormously difficult, but also enormously important to targeting treatment for those who require it, reducing the burden of the "worried well" on hospitals, and improving the psychological wellbeing of the population after an attack.

5. **Supplement traditional "hub-and-spoke" communication from centralized government with complementary social network systems.** The research program suggested here will be of practical use only if its findings can be credibly disseminated to the public at a time of great stress. Traditional hub-and-spoke communication from government authorities to citizens has a vital role to play, but sole reliance on it ignores the deeply ingrained human tendency to double-check information with trusted members of social networks. Social and peer-to-peer networks and trusted points of contact can complement existing information distribution capabilities. For example, peer-to-peer users could identify in advance those authorized to receive notice in the event of an injury, illness, or emergency. Experience of past catastrophes suggests that local and personal contacts can dramatically reinforce or undermine centralized government communication.

"The 2006 National Strategy for Combating Terrorism highlights the need to develop a 'Culture of Preparedness,' but to date there have been virtually no steps toward the creation of such a culture."
—Richard J. Danzig

INTRODUCTION

The *National Strategy for Combating Terrorism,* announced in September 2006, highlights the need to develop a "Culture of Preparedness" as a bulwark against "future catastrophes" in the United States.[1] The "creation of a Culture of Preparedness will be among our most profound and enduring transformations in the broader effort to protect and defend the Homeland." Central to this, the document asserts, is the development of "citizen and community preparedness."[2]

Despite strong language and emphatic capitalization, the *National Strategy,* like U.S. policy more generally, substitutes promulgation for program. There have been virtually no steps toward the creation of such a culture, no such steps are described in the "national strategy," and the paucity of concrete ideas about how to do so is highlighted by the fact that the exhortation is the very last sentence in the document.

At present, "citizen and community preparedness"[3] is, in the main, a tail pinned on the end of more traditional security programs invested in the pursuit of terrorists, border controls, infrastructure protection, consequence management, and other items described at length in the *National Strategy.* Our investments in public preparation are marginal and consist principally of some web sites,[4] handouts at fairs and public gatherings,[5] a smattering of media education,[6] reflection on how to prepare official messages,[7] occasional support of local efforts to revise building codes and appoint emergency coordinators,[8] and rail and subway advertisements imploring people that if they "see something" they should "say something." The most direct federal program targeted at educating members of the public for their own self-protection, Citizen Corps, began with significant funding, only to have its budget halved in

the following years.[9] Underlying this failure are three harsh realities: as a government and more broadly as a country, we do not appreciate how public preparation could contribute to combating terrorism; we do not recognize how institutional, political and psychological impediments inhibit this preparation; and we do not have substantial concepts of what to do even if we wanted to and could do it.

We aim in this essay to show why preparation of the public is critical, why this has been neglected, and how a federal research and development program could create a foundation for a program that would make public preparation real and valuable. To make our observations and recommendations concrete, we focus on the particularly demanding problems the public will confront in the immediate aftermath of a biological attack.[10] Biological attacks will be especially demanding and potentially unnerving for laypeople because unlike traditional terror the weapon is invisible, attacks do not resolve in an instant, and most deaths and injuries do not occur immediately.[11] Bioterrorism can also involve repeated attacks and unfamiliar and unnerving threats. We address the most challenging cases[12] by assuming an urban dissemination of an aerosol composed of pathogens that cause anthrax (a disease that is not contagious)[13] or smallpox (a contagious disease).[14]

An aerosol distribution of a kilogram of anthrax could be expected to infect about 100,000 individuals, even assuming that the anthrax released was less pure than that used in the 2001 letters sent to the U.S. Senate Hart Building, and taking into account particle clumping, wind variation, and physical and atmospheric obstacles that would create uneven patterns of distribution.[15] For purposes of discussion, we conservatively assume a similar

number of infections from an aerosol smallpox attack, though this contagious pathogen is likely to infect far more individuals.[16]

In Part I of this essay we contrast the current, professionally based supply-side paradigm with the complementary approach of a layperson-centered model, and develop the case that public preparation has rich potential as a part of a national strategy to combat terrorism.[17] Empowering the public can reduce demand on government services. By providing laypeople with some ability to protect and care for themselves and their loved ones, it can make our society more resilient and resistant to terrorism.

Part II describes the six requirements that our government would have to address to meet the demands that the public is likely to have in the aftermath of a bioterror attack. We conclude that our current preparations fail to meet any of these needs. Indeed, we believe that the failure to meet layperson demands is likely to lead to the failure of bioterror preparations generally. Most disturbingly, we conclude that by failing to meet basic public needs, our current paradigm will weaken faith in our government and do so in the midst of a catastrophe in which solidarity is essential. This establishes additional, indeed transcendent reasons for attention to the general public's needs.

In Part III, we recommend a program of technological and social science research, development, and testing that would meet layperson needs, empower individuals to care for themselves and their loved ones, and prepare them for areas where they must lower expectations of the government and find ways to meet their needs themselves. We believe this work would enrich the agendas and rewards from a range of government and government-funded homeland security research

institutions.[18] This research would constitute a fraction of existing expenditures on homeland security research and development.[19] As a starting point, we suggest allocating three percent of the current annual Department of Homeland Security research and development budget of $1.2 billion, i.e. $36 million, for initial development of this program.[20]

In Part IV, we conclude by examining why a professional bias in our bioterrorism programs is understandable, though undesirable. We summarize our view that for a successful response to large scale bioterror attacks, professional perspectives need to be complemented with much more robust attention to layperson needs.

I. WHY DEFENDING AGAINST BIOTERRORISM DEPENDS ON LAYPEOPLE NO LESS THAN PROFESSIONALS

For most issues of personal safety, responsibility is implicitly shared between the public and the government. Individuals are expected to wear bicycle helmets, refrain from smoking in bed, cross at crosswalks, and take other everyday safety measures, while the government takes responsibility for enforcing traffic regulations, checking on building code violations, funding fire departments, and deploying police. Yet national security—protecting the country against enemies—is viewed both by our government and our public as almost exclusively government's responsibility. The public is implicitly regarded as a vulnerable, dependent population to be protected by the government; in this context, members of the public are not treated as co-equals in ensuring their own personal safety.[21]

These differences are reflected in the different response paradigms for handling the twin threats of pandemic influenza and bioterrorism. While pandemic influenza planning assumes the need for layperson education and action to contain the spread of disease and reduce risks and consequences,[22] present preparations for bioterrorism follow a professional paradigm with little consideration as to how laypeople could be involved in their own security.

In the present paradigm bioterrorism planners at the federal, state, and local levels tend to assume that:

• Rapid awareness of an attack will be achieved by either environmental sensors[23] or health surveillance systems.[24] These systems will create an alarm that will trigger federal-state coordination through an "Emergency Management Assistance Compact."[25]

• Political leaders and professionals, principally including public health officials and medical personnel, will inform the public about what is occurring, and will direct them to appropriate professional resources.

• The public health sector (assisted, if deemed necessary, by first responders such as emergency medical personnel, firemen, policemen, and the National Guard) will create Points of Distribution (PODs) at which they will distribute drugs or vaccines that will counter the pathogen that has been employed.[26]

• Hospitals will treat those who are not protected by drugs and vaccines. Insofar as hospital capacities are overwhelmed, alternate care sites, including private sector facilities such as hotels and college dormitories, will be used to inspect and treat casualties.[27] As required, medical personnel from other areas will supplement local resources.[28]

• Hospitals and alternative sites will have to cope with perhaps ten times the number of those who are actually infected because the "worried well"—those who fear they have been infected but have not been will demand treatment.[29] These worried well will burden the medical system.

Most experts would describe these challenges as Herculean but nonetheless predictable in the wake of a mass aerosol attack. If the United States could meet these challenges, most policy experts believe we would be reasonably well prepared. As a result, we now invest approximately $5 billion per year in these efforts, devoting the bulk of our funding and planning resources to alarm systems, first responder capabilities, drug development, creation of stockpiles and distribution systems, amplification of surge capacity in hospitals, and (to a

limited extent) the preparation and communication of messages from authorities to residents in affected areas so as to calm them and reduce the number of worried well.[30]

This response paradigm considers only what professionals must do to care for the public after a bioterror attack. Professionals will discover an attack, then group, route, and organize laypeople into the appropriate categories for response. Professionals will treat individuals as needed, based on professionally determined triage. Professionals will provide accurate and timely information to the public.

The predominant planning paradigm therefore considers layperson response as one of a number of post-attack problems, not as a resource.[31] Laypeople are seen, at best, as subjects for control, at worst, obstacles that reduce survival rates and impede recovery operations through ill-informed or self-interested behavior.[32] Many professionals fear "scaring" laypeople by sharing the burden of safety.[33] It is common for professionals in many arenas, from flight attendants to event managers, to treat those under their care as impediments to the seamless implementation of standard operating procedures. If people would do what they were told, go where they were sent, and follow directions, the jobs of professionals would be far easier. In current bioterror response plans, it often seems as though the actions and concerns of laypeople are akin to the pathogens that have been released: they are problems to be controlled.

None of these premises are squarely wrong and none of these priorities are irrational. But taken together they yield a program that will fail in the face of catastrophic attack. Our current bioterror strategy is analogous to training firefighters in new techniques, increasing our supply of volunteer

firemen, and purchasing improved equipment for firehouses, while neglecting to preposition fire extinguishers, run fire drills to teach evacuation plans, or instruct people to evacuate by stairs rather than elevators. It addresses only half of the problem—and in doing so, creates a much more difficult task for professionals.

To correct the failures of the professional paradigm, those engaged on this issue must not only ask what professionals and bureaucracies need to better prepare for a catastrophic bioterror attack but also what the public will experience and expect after an attack. What can laypeople do to protect themselves, their loved ones, and their communities, reduce their own casualties, and otherwise meet their own expectations? What does the government need to do to empower laypeople, to help them take care of themselves and reduce the demands on and expectations of government? Adopting this perspective makes laypeople potential assets as well as potential problems.

Four compelling reasons support this approach. First, the skills of citizens will be demanded because professionals will not be sufficiently numerous to cope with mass aerosol biological attacks on their own. As illustrated below, America's best-laid plans for building surge capacity in hospitals and related facilities still leave our emergency health systems well behind the likely demand.[34] While enhancing the supply of professional capability is essential, it is also difficult, expensive, slow, and yields only marginal gains.[35] Complementing a professional, supply-enhancement strategy with an equally robust demand-reduction strategy is likely to yield greater protection at less cost.

Second, even if policymakers do not plan for layperson care, it will occur. Laypeople are often the

first to respond to an emergency.[36] Friends, family, and co-workers are the most likely to be nearby when a person exhibits symptoms associated with a bioterror-related illness, and laypeople will generally play the key role in deciding when and how to seek medical attention, where to go, and how to support treatment. The most reasonable planning premise is that in the wake of a mass attack, ordinary men and women will provide health care (or advice on seeking health care) to loved ones, particularly in the short term.[37] If movement is restricted because of contamination (a probability in the wake of an anthrax attack) or contagion (a certainty in the wake of a smallpox attack), lay capabilities are even more likely to be the only resource immediately present in circumstances of need. The United States can either plan for the eventuality of layperson-supplied health care or fail to prepare and have it occur anyway without assistance or planning.

Third, even if professionals were able to meet America's post-attack healthcare needs, laypeople would be essential in other ways. Unless and until the military is mobilized and deployed,[38] it is ordinary individuals, not "first responders," health care professionals, or microbiologists who will need to provide the power, food, water, sanitation, burial, transport, mass communications, and other supplies and services that will sustain our society in the face of bioterrorist attacks. These ordinary people will be de facto "first suppliers," and must understand the needs and threats that they face, be reasonably capable of caring for themselves and their families, and be well informed about how they should do their jobs without unduly endangering themselves.

Finally, beyond these practical needs, there are compelling political and psychological reasons for adopting a layperson-centric perspective. Catastrophic attacks on America can have tactical ends — to kill or maim, to cripple our economy, to distract our military, to damage our image, to galvanize foreign constituencies — and strengthening lay response systems can help to counter these ambitions. But first and foremost, these attacks will pose a strategic political and psychological challenge. Terrorists seek to reduce confidence in government; their attacks sow fear to weaken public resolve. It is in the minds of our citizens that an attack's success of failure will be determined. As Danzig has previously written:

> A much quoted insight of Clausewitz is as applicable to terrorism as to conventional conflicts. "Psychological forces exert a decisive influence on the elements involved in war."[39] A catastrophic attack will be a psychological and a political intensifier: it will either increase our national unity and support of our government or, as terrorists intend, it will induce divisiveness, loss of confidence, and distraction.[40]

A public that is unprepared for attack, and that is unable to take positive actions that enable self-protection, is far more vulnerable psychologically as well as physically. If laypeople can be made aware of the threat, have the time to absorb and normalize the idea, and be provided with actions they can undertake to protect themselves, they will be far more resilient.[41] If, concomitantly, expectations about government care are lowered to realistic levels, the polity will be less beset with recriminations and broken confidences.

For us there is no more critical question about the response to bioterrorism than this: In the wake of these attacks, does our population unite, increase its confidence in and support for our government, retrieve its sense of security, and redouble its sense

of purpose,[42] or does our population divide, lose confidence, and become diverted by problems ensuing from attacks, thus diminishing our ability to pursue our previous political and military agenda?

The latter is not only bad in its own right; it will also encourage more attacks. Improvement in this political and psychological dimension is not, then, just a matter of consequence management. Our failures and achievements in addressing the concerns of our citizens and helping them to help themselves will go a long way to determining whether attacks will be defeated and therefore whether future attacks will be encouraged or deterred.[43]

As Friedrich Nietzsche said, "Forgetting our objectives is the most frequent stupidity in which we indulge ourselves."[44] Our objective in the face of a bioterror attack is not to increase surge capacity, improve sensor alerts, or make distribution systems more efficient—important as these tactics will be. Our larger aims are to minimize injury, death, and economic destruction. Beyond this, our greatest goal is to maximize societal resilience so that America will not be fundamentally destroyed or degraded by terror. A knowledgeable and empowered public, which is able to take responsibility for itself and to lower its expectations on the government to realistic levels, is imperative to achieving these goals. That requires implementing the kind of public preparedness and empowerment that the *National Strategy for Combating Terrorism* contents itself with only reciting. To instantiate this ideal, we begin by asking: What will the public expect and require as support in the wake of a major bioterrorist attack? Put another way, we take up the challenge that the United Kingdom Parliamentary

Report on Britain's July 2005 terror attacks identified as central:

> There is an overarching, fundamental lesson to be learnt….emergency plans should be re-cast from the point of view of people involved in a major or catastrophic incident, rather than focusing primarily on the point of view of each emergency service. A change of mindset is needed to bring about the necessary shift in focus, from incidents to individuals, and from processes to people.[45]

II. SIX REQUIREMENTS, SIX FAILURES

We anticipate six predictable and reasonable public expectations from our authorities following a major aerosol anthrax or smallpox attack:

1. Instruct and equip me to protect myself as much as possible, immediately and in the event of future attacks.

2. Tell me whether I and those I love have been or could be infected by this attack.

3. If I cannot reasonably be assured that my loved ones and I are not infected, provide us with whatever drugs or vaccines will protect us and do so quickly, fairly, and safely.

4. Provide health care for me or others who become ill as a result of attacks.[46]

5. Prevent more attacks of this kind.

6. Speedily establish conditions and provide information that will permit me and my family to return safely to ordinary daily activities.

Three things are noteworthy about this list. First, establishing a baseline for public expectations should be among the first steps in developing both a "Culture of Preparedness" and a strategy for consequence management after a bioterror attack. To our knowledge, however, this is the first time any such list has been compiled.[47]

True, each of these concepts is encompassed by Department of Homeland Security statements about the need to "prepare, prevent, protect, respond, restore, and mitigate"[48] and the military mantra of "sense, shape, shield, and sustain." But the abstraction of this vocabulary and scope of the task list that results obscures a practical sense of what is required, a sound grasp of priorities, and recognition that these are not merely technical requirements but rather critical variables in a struggle for the hearts and minds of our population. We hope others will adopt, or improve and adopt, our short list. If this leads to a consensus, we will have made progress towards establishing an agreed set of essential goals for public preparedness and consequence management programs.

Second, there is rich reward in harmonizing lay public and professional priorities. In our view, a present comparison of the two repeatedly reveals contrasts rather than similarities. While some citizen demands appear to be implied in analyses of professional requirements, in reality the professional paradigm focuses almost exclusively on what existing professional constituencies ordinarily supply—not on what will be demanded by the lay population. For example, the professional paradigm places great priority on trying to expand professional health care, but even in the face of an unbridgeable gap between supply and demand very little attention is given to non-professional care.[49] As discussed below, when professional and layperson plans and expectations are forced to the surface and laid alongside one another, a large and troubling disconnect becomes apparent. To improve America's resiliency, either professional priorities should expand or citizen expectations need to be lowered.

Finally, there is not just a failure of focus but also a likely failure of achievement. If a catastrophic bioterror attack occurred today, our governmental authorities would not be able to meet any of the public's key demands. Such a failure would have grave repercussions in both lives and livelihoods lost. Worst of all, it would undermine public solidarity and confidence in the government following a terrorist attack. America had a taste of

this in the wake of the 2005 Hurricane Katrina,[50] but a catastrophic terrorism incident would make the problems of Katrina seem miniscule.

A. The Failure to Meet the Public's Expectations

In this section, the paper considers each public need in greater depth. In Part III, we will offer a set of recommendations to begin meeting these unaddressed needs.

1. Instruct and equip me to protect myself as much as possible immediately and in the event of future attacks.

Upon hearing of a bioterror attack, individuals are likely to want immediate advice for reducing their chances of infection. They are likely to wonder, "Should I evacuate, or shelter in place? Should I wear a mask, breathe through my shirt, or otherwise protect my breathing?[51] Can I—and should I—pick my children up from school? Are there any steps I can take to protect or decontaminate my home and workplace?" In the event of multiple attacks, some might ask longer-term questions, such as, "Should I install a positive-pressure or filtration system in my office building, given that other cities have been hit by the release of anthrax?"

Providing reasonable, actionable answers to such questions is the first step toward reassuring and improving public confidence. Conversely, failing to accurately answer such basic questions will undermine public confidence, perhaps irretrievably. Preparing and achieving consensus about these answers in advance is a necessary first step towards establishing a "Culture of Preparedness."

The practical, political, and psychological needs of our public in the wake of a major bioterrorist attack cannot be achieved through empty reassurance that "the authorities are taking care of the problem." The cardinal lesson of risk communication is that public confidence and trust increase when the public is treated with honesty about what is known and unknown, and provided with information that individuals can act upon.[52] Laypeople will need accurate, useful information about what they can and should do, geared towards actions they can actually take—not general, abstract, or unrealistically optimal advice that cannot be carried out at home. A "public relations" approach of upbeat, empty reassurance is actually likely to cause greater suspicion, distrust, and rumor mongering.

The United States has not established research and development programs that would provide clarity as to the utility of masks[53] and filters or personal and home decontamination, and has not planned for surge production of these items or prophylactic medical treatments if policymakers conclude that they are useful. Nor has the United States developed consensus about how to react to risks once an attack has occurred. Broadly applicable public health advice and procedures for limiting contagion may be announced and implemented (avoid crowded places, close schools, etc.). But, as others have noted, policymakers are particularly confused about our policies and advice with respect to evacuation, quarantine, and control of movements into potentially contaminated areas.[54] Federal, state, local, and private advice is likely to be incomplete, inconsistent, and incoherent. The result is that expert judgments would be mobilized on the fly, messages are likely to be ad hoc, and disparate authorities would provide disparate advice.

Current grants to states and localities require public communication programs. These programs receive little guidance from the federal level on

publication and broadcast mechanisms or message substance.[55] While it makes some sense for localities to develop their own distribution mechanisms, the substance itself must be as consistent as possible across the nation. Discordant official messages will unnecessarily amplify confusion and reduce confidence.[56] Currently, however, there is no federal research program to create message substance that would meet the demands for information required by ordinary people. The lack of nationally approved substance for messages that could be adapted to respond to a range of potential scenarios practically ensures the profusion of "instant experts" and conflicting information.[57]

For this, and each of the other six requirements discussed here, means of public communication are essential. Yet along with our failure to develop the substance of our messages, we have also failed to establish a process for communicating information so that we can guide and reassure the public in a post-attack environment. The federal government will be a major source of advice, but the federal government is also widely distrusted.[58] It is also well established that people in stressful situations will consult many sources and seek to reconcile and harmonize advice they hear. Many will ignore federal inputs if they are inconsistent with comments from state, local and private officials, or from personally trusted individuals such as their doctors, their ministers, and their friends.[59]

Our current efforts to communicate with the public are based on a "public relations" model that uses the mass media and other mechanisms to send information from central authorities to the public. These efforts are primed for failure in the face of a distrustful public and the inevitable rumor and innuendo that surrounds catastrophe.

Simply redoubling these efforts to meet layperson demands for information is inadequate; what is required is research to develop answers people will want, and new ways of disseminating this information so that it will be both received and believed.

2. Tell me whether I and those I love were infected by this attack.

Our current medical system is remarkably ill-prepared to answer this basic question. Our doctors have no diagnostic techniques to reliably assess smallpox infection in the first days after exposure. Even later pre-symptomatic tests are uncertain and could not be applied on a mass scale. Our capabilities are only slightly better in the case of anthrax. Our medical system is well equipped to use x-rays and blood samples, along with clinicians' skills in observing symptoms, to identify individual cases of anthrax.[60] Hospitals in a major urban area could be expected to cope with demands for scores or even hundreds of such diagnoses. But they could not be expected to provide thousands, not to mention tens of thousands or hundreds of thousands, of timely diagnoses with current tests and technology, and certainly not prior to manifestation of symptoms, after which the disease becomes more difficult to treat.[61]

The Department of Homeland Security has developed a "BioWatch" system of sensors that would provide some limited information regarding geographies in which people are likely to have been infected; at least for people who happen to be in close proximity to a sensor that has captured a contaminated sample. The BioWatch system does not, however, provide substantial evidence about the size of the areas affected, or even the hour at which an event occurred.[62] Because the system provides little clarity about the scope and nature of an attack, it will not permit officials to credibly provide general

assurance as to who has not been infected. As a result, if BioWatch functions as advertised, it will merely sound an alarm. While an alarm system may be useful to professionals, to the layperson it will trigger a mass sense of exposure with no obvious route towards reassurance or succor. Put simply, the alarm is likely to be alarming.

Our failings are likely to be informational as well as diagnostic. "After the collapse of the World Trade Center, mass confusion existed about the location of victims and the status of missing persons. Particularly in the initial 24-48 hours, lower Manhattan hospitals were burdened by an overwhelming number of families trying to locate loved ones."[63] People across the country also overloaded phone lines in an effort to assure themselves that friends and family were okay.[64] E-mail trees and Internet sites blossomed to create ad-hoc lists of people who were safe.[65] Posters plastered the streets of New York searching for information about missing loved ones.

In the aftermath of a bioterror attack, the need for knowledge about potentially ill friends and family will be even vaster—and, in the case of contagious disease, this requirement will be ongoing. It will also be complicated by a potential patchwork of efforts at quarantine and isolation, as well as potentially quick or mass burials of the deceased prior to identification.[66] Israel has developed a centralized system that gathers information on any individual admitted to any hospital in a city, and enable worried callers to access this information.[67] American jurisdictions, however, have left problems of locating and identifying the whereabouts and health of loved ones to individuals to sort out for themselves.

As a result, in the chaotic conditions likely to affect medical facilities after a biological attack,

individuals are likely to feel frustrated and angry at their inability to gather "basic" information about whether someone has been admitted to a hospital. The flood of information demands is likely to divert vital communication and even health resources as it becomes a job for hospital staff to cope with information requests. Worried parents, friends, and relatives searching for word of loved ones can spread contagious disease, complicate decontamination, undermine confidence in government, and impede recovery.

3. If I cannot be reasonably assured that I was not infected, then operate a system that will fairly, safely, and quickly provide me and others at risk with whatever drugs or vaccines will protect us.

There is a natural tendency to focus on this problem as one of supply. Drugs and vaccines cannot be provided if there are no stockpiles of drugs and vaccines. Admirably, federal officials have stockpiled more than 300 million doses of smallpox vaccine, enough for every individual in the United States. Thus, theoretically, as soon as a case of smallpox was established, every American could be vaccinated even if early diagnosis of other likely cases were impossible.[68] The government has also built an inventory of anthrax antibiotics capable of treating some 40 million people for sixty days.[69]

The problem, however, is in distribution.[70] The logistics of establishing, staffing, supplying, and maintaining distribution sites are very challenging and may be unmanageable if transport, communication, and other systems are simultaneously severely stressed. For example, New York City's system, among the most developed and (because the city is so concentrated) feasible point of distribution systems, depends on manning 200 sites with some 40,000 workers, among

them Department of Motor Vehicles employees expected to report to administer vaccinations. Richard Falkenrath, formerly deputy director of the White House Homeland Security Council, has concluded that no American jurisdiction is presently in a position to distribute drugs within the recommended time.[71]

We agree, but would go further and argue that the problem is not simply one of execution, but of conception. We note three problems.

First, authorities naturally tend to extrapolate from their experience responding to natural disasters and overlook the fact that a malevolent enemy poses some different risks and requires different modes of thought. Unlike Mother Nature, those who engage in terror watch the reactions of their targets and plan counter-reactions. Point of distribution systems create vulnerable gathering points that are difficult to protect. We fear that if governmental authorities rely on centralized vaccination sites, terrorists are likely to see those as tempting targets for further attack, whether with bioterror or conventional means. A single attack on a single site—or even simply threats and hoaxes—is likely to scare both patients and caregivers away, rendering the entire system unworkable.

Even apart from what we regard as an unacceptable risk of attack, present point of distribution plans are flawed by slighting the fact that most individuals will be concerned not simply with receiving the requisite drugs within the recommended time, but with receiving them as soon as possible. Vaccination against smallpox is more effective the earlier it is received.[72] Similarly, the earlier a course of antibiotics is administered against anthrax, the more likely it is to be effective. When this is widely understood—and in the wake of an attack this information cannot be suppressed—it will create

large problems of public order and national unity as people strive not only to receive prophylaxis but to receive it ahead of others. Will the public accept distribution priorities[73] and line discipline? A rationed system would open opportunities for a "black market" in vaccines that could undermine mass immunization protection.

Apart from calling for security officers or National Guard troops to protect those administering vaccinations, public plans have not come to grips with this challenge. There is some evidence that the public will accept the need to vaccinate health workers first.[74] But the problems of inequity are likely to be exacerbated as a circle of public officials give priority to themselves, their staff, and possibly their families. These policies are logically defensible: their rationale is that protecting public officials first will enable them to protect others later.[75] But once the ring of "first protected" expands beyond health workers—Will it, for example, include security personnel? Other key workers? Their families?—we believe these policies are likely to be psychologically and politically divisive.[76] To keep terrorists from breaking down America's social fabric, a widely accepted sense of fairness in vaccine and palliative care distribution is essential. That requires an early and open public debate, far in advance of any bioterrorist attack.

Presently envisioned distribution systems will be exacerbated by a third difficulty. Apart from the risk of attack, many individuals are likely to fear that coming to central locations and standing in line for long periods to obtain vaccines or medications will increase their risk of infection.[77] According to a New York Academy of Medicine study, 64 percent of Americans would be moderately to extremely worried about contracting smallpox at a vaccination site, and 57 percent of

Americans would want additional information before following instructions to go to such a site.[78] Since smallpox symptoms are not immediately detectable, it will be impossible to reassure people that they are not increasing their risk of exposure.[79] Individuals are not likely to be contagious if they are not symptomatic, but symptoms may not be evident or truthfully reported. Medical distribution sites are also likely to be feared even in the case of non-contagious diseases such as anthrax, due to misinformation about how the disease is spread, or due to a plausible fear that the site itself was contaminated.

In sum, presently envisioned mass distribution systems are not likely to be fast, fair, or credibly safe. Instead, these systems may very well be perceived as unfair, unsafe, and inadequate. These problems cannot be circumvented by ignoring them. With more attention, effort, and skill some difficulties can be lessened,[80] but the envisioned system is likely to fail in the face of predictable conditions of great stress and anxiety. A better approach is required.

4. Provide health care to those who require it.

Present planning and investment for health care after a catastrophic biological attack is almost exclusively focused on hospitals. Plans and resources are devoted to expanding staff,[81] equipment, and bed capacity in America's 5,000 hospitals, improving mobility of resources between these hospitals so that unaffected jurisdictions can support affected areas, and establishing processes within these hospitals for security, triage, supply, and mass casualty treatment.

In the face of a catastrophic bioterrorist attack, we believe these systems will be overwhelmed and will fail to provide the health care needed.

A bioterrorist event will challenge a system that by all accounts is already severely stressed.[82] Staff may be the most severe limitation,[83] but emergency room visits and bed availability provide the hard data that best conveys a sense of the magnitude of the mismatch.[84] While America's population grew by 13 percent between 1993 and 2003, cost-cutting eliminated 17 percent of our in-patient beds.[85] By 2001, more than 60 percent of hospitals claimed to be operating at or over capacity *under normal conditions.* A recent study of academic emergency departments reported that on one of every three days *all* the following conditions were present: there were no vacant emergency beds, ill patients were being kept in hallways, the waiting room was full, ambulances were diverted, doctors described themselves as rushed, *and* waiting time to be treated was over an hour.[86] Nor are these conditions particular to academic hospitals. In Los Angeles, county ambulances needed to divert patients to other hospitals 23 percent of the time due to overcrowded emergency rooms.[87] In other words, many hospitals lack the ability to care for patients that come to them on a normal day.[88]

To give these observations more meaning, consider the supply of beds and visits in the Washington, D.C. area. Though precise numbers are elusive, we concluded that there are approximately 9,000 operational hospital beds in the National Capital area and that area hospitals process approximately 3,250 emergency room visits a day.[89] It is reasonable to expect that in the event of a biological attack, these hospitals could send home patients who were not severely ill and postpone non-essential surgery. Present plans suggest that this could be expected to free on the order of 1,000 beds for bioterror victims.[90] Even if every available bed were free, there would be no possibility for that number to reach even 10,000

patients — one-tenth of the number presumed to be infected by a bioterrorist attack. If anthrax were suspected, emergency departments could likely test individuals at a faster rate than is achieved for regular patients, since documentation could be minimized and a blood test could be conducted far more quickly than setting broken arms or caring for gunshot wounds. Nevertheless, it strains credulity to imagine that more than a doubling or tripling would be possible, and we do not anticipate that the ongoing stream of other emergency needs would cease to exist in the chaotic post-attack conditions. Given that emergency departments are full or nearly full on normal days we anticipate that in Washington they might treat an extra five, six, or seven thousand cases, far short of the spike in demand that the simultaneous infection of 100,000 people would imply. [91]

Increments of aid from other jurisdictions could be expected if those places were not themselves subject to attack. But the increments anticipated, even if they arrive as expected and in a timely fashion, are on a much smaller scale than required. For example, in the face of intense demand after Hurricane Katrina, the federal government deployed ten 250-bed "transportable hospitals." [92] As another measure of potential, we note that Houston's peak processing of Katrina victims was some 2,000 patients per day. [93] No supply-side increases have ever been achieved, nor are they envisioned that would meet the 100,000-patient demand we anticipate over a two to four day period as a result of a catastrophic bioterrorist attack.

Moreover, after an aerosol attack, there would be no good way of immediately discerning who would be exposed to infection. Many have pointed out that hospitals will be besieged by "the worried well." The rule of thumb advanced by the

Department of Homeland Security is that the "worried well" can be expected to exceed those actually ill or injured by a factor of ten to one. [94] Even if the worried well were only one half as numerous as expected, in our hypothesized anthrax case there would be demands for diagnosis and/or treatment from more than 500,000 people over the course of the first two or so days after announcement of an attack.

In addition, many potentially ill individuals will worry about whether a health care facility has been contaminated by an aerosol anthrax attack. At the same time, the safety of any given place will be difficult to ascertain. Contagious diseases pose a more severe version of this problem. Hospitals are often perceived, sometimes quite correctly, as centers of contagion. Fears of contamination and contagion will make it more difficult to secure, maintain, and retain staff; [95] they will greatly increase human and physical resources required for processing and care of each patient; and they will increase the demand for self-care outside of the hospital.

We doubt that in the wake of a catastrophic bioterrorist attack, hospitals could achieve even the inadequate expansions their surge plans now anticipate. Planners must recognize that a substantial fraction of personnel assumed to be present on a full-time basis will not be available to hospitals as other facilities, other employers, personal, logistical, and family problems demand their attention. For example, many doctors practice at multiple facilities within a single region; each of those facilities expect them in an emergency. Security personnel are often also reserve officers and off-duty policemen. Nurses have family responsibilities and are frequently single parents. Transportation difficulties and fears of

contamination or contagion will impede moving from place to place and performing roles, especially multiple roles.

Some plans expect that surge capacity will be met via care provided by neighboring regions under mutual aid agreements or on an ad hoc emergency basis. But the movement of personnel from unaffected areas is not a panacea that will offset these difficulties. Bio-terror attacks would be very different from the precedents so often referred to for mobilization of resources from the surrounding areas. Hurricanes, earthquakes and floods, even if they encompass a broad area and have aftershocks and collateral consequences, are essentially localized, one-time events. When they are over, they are over. In contrast, bioterrorism attacks can be rather easily repeated. Because of this potential for bioterrorists to "reload" and attack again, bioterrorism must be planned for not as an incident, but as a part of a campaign. We think the risks (or worse, the experience) of multiple attacks in multiple jurisdictions would deter policymakers from shifting resources and would reduce the willingness of medical professionals to leave their families and their home institutions.[96]

Moreover, even if there were complete confidence that an attack was a one-time event, there is simply not enough "give" in the system to meet demands. America faces a nationwide shortage of healthcare, health professionals, and emergency department capacity. We doubt that the resources that regions could provide to areas attacked will be on the scale needed, particularly within the critical first forty-eight hours. Surge capacity is being constructed one room at a time and cannot be expected to meet the needs of 100,000 new patients descending upon a region at once.[97]

After a catastrophic biological attack we anticipate that fewer than one in ten of those who seek hospital treatment will receive it. Policymakers must not pretend that our "Bioterrorism Hospital Preparedness Program," whose annual grants are typically $5,000-$10,000 to each hospital[98]—less than the amount that would equip even one critical care room—will make an impact on a demand-supply mismatch of this proportion. Better answers are needed for those who seek medical help than "there is no room at the inn."

5. Prevent more attacks of this kind so that I can be assured the worst is over.

Unlike an explosive attack, a bioterror attack is likely to be silent and slow to unfold. An aerosol attack may be detected by analysis of BioWatch filter samples some hours after it has occurred or it may become evident over the course of days as symptoms manifest and individuals present to multiple hospitals with difficult to explain ailments. Because of these delays, an attacker, using conventional spray equipment as small as a backpack, is unlikely to be caught right away, if ever, and will be free to attack repeatedly. We note that the attacker who used anthrax in 2001, for example, remains at large, and that snipers who used rifles for repeat attacks in the Washington area attacked more than a dozen times before they were captured.

Terrorist groups that have developed biological weapons are not like a terrorist with a nuclear device. Bioterrorists are likely not to have acquired a single weapon, but a means of production. A terrorist who can produce and store a kilo of anthrax is likely to be able to produce and store many kilos. Such an attacker therefore acquires the capacity to, as Danzig has put it, "reload" and attack again. Repeated and unpredictable attacks will have effects on a population well beyond

those associated with a single attack. As Danzig has argued elsewhere, the need to prevent future attacks is perhaps the most important variable for maintaining public order and confidence.[99]

The problem of reload makes it particularly imperative to have tools for identifying the modus operandi of an attacker, tracking his activities as he attacks, and reacting as soon as an attack is initiated. It is striking, however, that while substantial effort has gone into improving the forensics of analyzing the strain of agents so that long-term criminal investigations can more probably identify the source of a pathogen and potentially attribute responsibility, virtually no national effort has gone into developing the tools for quick reaction and interdiction.

In our judgment, the result will be that our government will not display significant capability to prevent subsequent aerosol attacks after a first one, with devastating effects on our capabilities, confidence, and morale. If repeat attacks cannot be thwarted, they will undermine all our disease containment, decontamination, and restoration activities, and consequently lead to a dramatic loss of confidence in our government.

6. Speedily establish conditions and provide information that will permit me and my family to safely return to ordinary daily activities.

After a contagious disease has spread, when can ordinary life safely be allowed to resume? When can workers return to a contaminated building? If schools and workplaces have closed, public events have been cancelled, and transportation has been curtailed, when is it safe for these to reopen? In past epidemics, restarting normal life too soon led to resurgence in illness.[100] Yet each day that our economy and our polity are crippled is one further day of victory for terrorists.

Restoration activities and a return to normalcy are also paramount in the aftermath of a release of a non-contagious disease. It took two years to decontaminate the postal facilities contaminated by anthrax in the 2001 letter attacks. Current methods of decontamination could destroy sensitive equipment such as computers, or require extra time to remove and treat this equipment separately. And while our ability to decontaminate individual buildings has improved, almost no attention has been given to how to decontaminate wider areas of urban infrastructure, such as subway systems.[101] The chlorine dioxide methods used for small indoor areas are not applicable on a broader scale. The most careful and comprehensive published study of the problem calculated that if one kilo of anthrax were disseminated in Manhattan, clean-up using present methods would take 42 years; after correcting a calculation error the author subsequently revised that figure to 314 years.[102]

Not only are new technological initiatives to address these likely problems notably absent from terrorism planning, but basic consensus on the standards of acceptable decontamination is lacking.[103] Is some anthrax presence tolerable, as is the case at present in ranching communities? How much? Should standards differ for buildings or areas frequented by children, pets, the elderly, pregnant women, or immune-compromised individuals, and if so, how much? What exposures, over what period of time, are permitted or advised for members of these groups? How much time and money is justified for the extra few percentage points of safety? How many samples, and of what type, are required to assess the success of decontamination?

Answers to these questions are lacking. In fact, very few researchers are even asking them—and these are not supported by collaborative government efforts. Preparations are almost wholly focused on the event phase of an attack—not the aftermath. As a result, we will be making up answers on the fly in the midst of an emergency, when political and economic pressures will likely outweigh scientific fact in making these crucial determinations. Such political pressure can lead to poor risk communication—particularly because people tend to feel more confident in government reassurances regarding safety when government is *more* cautious than they themselves would be, while political and economic pressures tend to push in the opposite direction.[104] Because these questions require a great deal of research, it is very unlikely that accurate answers will be developed if research begins after an emergency.[105]

B. The Need to Change Our Approach

While policymakers readily acknowledge flaws and imperfections in the present system of sensors, messages, surge capacity, health care, and decontamination, most envision a better future. Detectors will proliferate as their costs decline; their speed and accuracy will improve; distribution systems will be better planned and become more rapid and robust; drugs and vaccines will improve; stockpiles will grow; hospital personnel will be better trained and equipped. In other words, practice will come closer to theory.

The problem is that the theory, even if fulfilled in practice, will not address principal public concerns. Even with maximum improvement over the next five to ten years, present programs will leave us unable to meet any of the six basic expectations the public is likely to have after a bioterrorism attack. Professionally-focused initiatives are helpful—and in some cases, essential—but they can never be enough. An equal focus on layperson concerns that can reduce demand is needed in research and technology development to complement the systems now being developed.

III. RECOMMENDATIONS FOR A LAYPERSON-FOCUSED RESEARCH AND DEVELOPMENT AGENDA

A robust research program is badly needed to address the systemic failings we have identified, and enable the public to prepare for and live through a bioterrorism scenario. Without a well-designed, well-thought out research program we anticipate that the advice provided by government will be like that associated with the duct tape recommendations issued before the invasion of Iraq in 2003: impractical, incorrect, and incredible.[106] It is disingenuous and dangerous to preach that a "Culture of Preparedness" will be "among our most profound and enduring transformations in the broader effort to protect and defend the Homeland" and then to fail to invest in research on layperson preparedness for bioterrorism.[107]

It may be that limited citizen interest in advice and protective activity in advance of an attack will limit how much pre-event preparedness can be achieved. Nonetheless, we should establish recommendations and infrastructure now that will permit layperson self-help after an attack, when anxiety about future attacks is likely to induce a hunger for information.[108]

The federal government must take the lead. States and cities cannot be expected to undertake the broad research, development, and testing we think is necessary. Nor can localities achieve the consistency and coordination that is imperative for engaging and protecting our public in the face of biological attacks. Inconsistencies in advice and protection will increase confusion, anger, conflict, and flight from jurisdiction to jurisdiction, particularly if attacks occur in multiple places. Though states and localities have critical roles, only the federal government has the ability to

prepare adequately for these contingencies. And in the event of a major attack, the federal government inevitably will assume the central role in coping with the situation.[109]

The federal research agenda should be directed toward five goals:

1. Establishing consensus advice about measures the general public should and should not take in the wake of an aerosol biological attack, and preparations they should undertake beforehand.

2. Developing means for rapid diagnosis of illness outside of hospitals, to provide reassurance, reduce hospital demand, and identify those who require treatment as quickly as possible.

3. Promulgating methods for self-care and family care in the home, to reduce demands on the health care system and reduce the spread of contagious disease.

4. Devising methods for providing both medical and everyday necessities to individuals in a timely, fair, and understandable manner that will sustain care at home while reducing movement and therefore contagion.

5. Improving mechanisms for message dissemination, with the aim of flooding multiple channels of information dispersal, including peer-to-peer networks and personal networks of trusted individuals.

These five items would guide a research agenda geared toward meeting layperson requirements. We note, however, that they do not address the critical issue of ensuring that attackers are caught so that future attacks are stopped. On that issue, Danzig has suggested elsewhere an approach that might meet the imperatives of mapping the

geographies of aerosol attack, capturing attackers (thereby preventing reload), and achieving mass area decontamination and restoration.[110] Here we turn to programs more directly related to strengthening layperson capabilities.

RECOMMENDATION ONE: **Fund research, development, and testing directed toward developing and assessing different methods of self-protection and self-decontamination by laypeople in the event of a broad-scale aerosol biological attack.**

The post-attack need for advice about self-protection will be enormous. The ridicule that followed advice to insulate rooms with duct tape and plastic sheeting in the lead-up to the Iraq War showed not that such advice was fruitless, but that the general public reacts intensely and negatively when they are misled by poor recommendations. While the experience demonstrated that bad advice is damaging and pre-attack advice difficult, it also demonstrated that advice was desired and would be followed by many. What was the butt of late night comedy would be the stuff of tragedy if no better counsel is developed.

It will be impossible to achieve complete civilian protection. Even in the military context, protection requires warning that an attack is about to occur or at least is occurring; it requires sophisticated, cumbersome and costly filtering and protective equipment; and, notwithstanding all these steps, it is unlikely to be fully effective. But this is not synonymous with saying that no protection is achievable. Citizens will accept help that falls far short of the ideal when the ideal is not realistically achievable. What they will not accept is a failure to accurately and comprehensively inform them about steps they could take, however small, to better protect themselves.[111]

Research, development, and testing programs completed in advance of a bioterror attack should yield a much clearer understanding of the benefits (and methods for enhancing the benefits) of potential lay activities such as the use of mass-produced and improvised masks,[112] hand-washing,[113] filtration systems,[114] cleaning systems, "home infection control," [115] avoidance of crowds and other "social distancing" mechanisms, movement restrictions,[116] and evacuation procedures.

Some research and assessment of these methods of protection is being catalyzed by present concerns about the risk of a worldwide influenza pandemic.[117] However, even for influenza, the World Health Organization concludes, "the knowledge base for use in developing guidance for non-pharmaceutical interventions…is limited and consists primarily of historical and contemporary observations, supplemented by mathematical models, rather than controlled studies evaluating interventions."[118] The bottom line from a recent European Centre for Disease Prevention and Control evaluation has been well summarized: "There is surprisingly little evidence and almost no experimental studies to show whether personal protective measures work. Indeed, the ECDC's strongest recommendation is that this topic should receive urgent research attention."[119]

The research agenda we recommend should fund controlled studies with the pathogens and circumstances simulated in contexts encompassing bioterrorism and influenza scenarios of principal concern.[120] It should devote high priority to the following sets of questions:[121]

• *Masks:* Are there circumstances in which masks would contribute to the protection of ordinary people living or working in areas subject to recent anthrax aerosol attack? Are masks relevant

to protection against contagious epidemics, as a result of mask wearing by those who are ill, by those who are healthy, or both? Are there sub-populations (caregivers, children, those recently symptomatic) for whom masks are particularly likely to be helpful or unhelpful?[122] Clinical tests, now entirely lacking, would be illuminating.[123] Can present limitations on mask effectiveness (principally relating to difficulties of achieving a close fit, problems of cleaning and reuse,[124] and shortages of supply and surge production) be overcome through development and production improvements? Are concerns about liability an important impediment to manufacture and if so can they be relieved by legislation? Are there any improvised mask devices — such as shirts, hand-kerchiefs, silk scarves and ties, etc — that could provide some protection from an attack?[125] It may be objected that these methods are of little use if there is no warning of an attack and that present alert systems do not generate this warning. This response does not, however, take account of the likely demand for this information. After an attack, masks will be alleged to be helpful to cope with contamination and/or contagion; some people will be inclined to wear masks as protec-tion against an anticipated further attack; others will want standby protective capabilities in the event terrorists choose to announce an attack through the media or other means. The govern-ment cannot responsibly ignore the information demands that will accompany these desires, yet currently lacks the research on which such infor-mation would need to be based.

• **Hand-Washing:** In what circumstance is hand-washing an effective protection?[126] To what extent can this effectiveness be enhanced by special soaps, alcohol-based products, biocides, and other materials that could be made readily available? How can adherence to effective hand-washing regimens be encouraged?

• **Building Filtration and Protection:** To what extent can economical, practical filtration methods in commercial buildings and homes reduce exposure?[127] Can protective coatings and architectures diminish or eliminate the residual effects of bioterror attacks?[128] Can private sector investments in protection be made more attrac-tive through research and development grants, regulatory requirements, or price or tax subsi-dies? Answers to these questions are valuable not only for their possible practical consequences, but also because they place some responsibility for self-protection on individuals and enter-prises (who will tolerate their own failures to act) as well as on the government (which will be regarded as culpable for having failed to develop the requisite information).

• **Movement Controls:** Isolation and movement controls were apparently useful in controlling SARS in Hong Kong.[129] A catastrophic bioterror attack in America would pose different issues in a different cultural context. What might evacuation procedures, quarantines,[130] isola-tion and movement controls contribute in the two scenarios of central concern to us? To what extent are school closings, mass transit closings, public event cessation, and other crowd control mechanisms likely to be useful?[131] How would closings, crowd controls, and movement controls be implemented[132] and their second order effects, including effects on police efforts to control terror risks, be addressed?

• **Home Decontamination:** In the wake of a wide area attack relying solely on professional decon-tamination is neither realistic nor even desirable. Individuals will want to know how they can

decontaminate themselves, their clothing, cars, and homes. Expert recommendations on the uses of soap and water, bleach and other biocides, vacuums, and ventilation can and should be compiled now while experimentation and reflection are possible rather than hastily after an incident.

For each aspect of this research agenda, some will argue that recommendations cannot be refined or assured until the particulars of a weaponized pathogen are well known. But while perfection cannot be obtained in advance, five realities suggest that the research process should be well underway before an attack:

- Debates about recommendations now will catalyze experiments and tests that will lead to sounder advice. There will be less time for these experiments in the wake of an emergency.

- Advance planning about advice can lead to pre-positioning and planning for surge production and distribution of required supplies.

- Recommendations will need to be conveyed to the public in the early stages of an emergency without the benefit of detailed information about pathogens used in attacks.

- A template developed in advance under conditions that permit reflection will facilitate a message that can be adjusted in an emergency.

- Experts will be in short supply after a biological attack. We should make investments now that save their time later.

Some may object that efforts at self-protection with, for example, masks that have not been fitted, or decontamination with household supplies, will necessarily be of limited value and cannot provide

assurance of effectiveness. But this is to overlook the realities of public demand and government responsibility. With present resources and tech-nologies, governmental authorities are unable to give every individual in the United States a supply of appropriately fitted N-95 masks, keep all indi-viduals in buildings resistant to infectious agent penetration, or decontaminate each home to EPA standards. Most individuals will not demand per-fection, but they will demand information about what they can do to make their homes and work places safer. Whatever our failings to allocate funds and develop technologies to prepare for govern-ment clean-up after catastrophic bioterrorism, the most inexcusable and confidence-draining failure will be if policymakers have not even considered the problem in advance and are not prepared to provide sound advice to the general public.

Beyond this, as emphasized throughout this essay, the power of the public's need for answers and for a personal protection plan after a terrorist attack cannot be ignored.[133] Even if there were no practi-cal value from any of these efforts, the media will demand information and many in the public will press these questions. In the absence of authorita-tive answers,[134] counter-productive answers will be provided and many individuals will adopt mea-sures and demand supplies according to their own intuitions. For example, more than three-quar-ters of the population of Hong Kong wore masks after the 2003 outbreak of SARS.[135] The United States does not have enough masks to supply any large proportion of our population.[136] What will our government's position be on this in the wake of a smallpox or anthrax attack? That masks are irrelevant? Helpful in some contexts? Generally desirable, but not necessary? It is important that policymakers have answers to these questions, and a reasoned position developed to help people even in cases where such help might be meager.

Finally, it is useful to engage the scientific community in answering these layperson questions. Science, by its nature, demands answers that strive towards certainty and perfection. The "80 percent solutions" acceptable to most laypeople, or even 10 percent gains that are not solutions, are uncomfortable propositions to many scientists. This perceptual difference could be disastrous during a bioterror catastrophe. If laypeople hear scientists appearing to refute advice on personal protection that the government is providing, it will undermine that advice and undermine trust in the government. Bringing scientists into a research agenda focused on what is achievable by laypeople will help counteract the tendency among experts in the scientific community to discount solutions that are not perfect, but are the best most people can achieve.

Problems of self-protection are complex. However, when confronting complex problems in areas of professional priority (for example, in the BioWatch detection systems or in the development of protective clothing for first responders) governments invest in research and development designed to improve our capabilities. It is a *sine qua non* of warfare that decision makers do what they can to harden installations and protect soldiers. It should be a *sine qua non* of countering terrorism that the United States does what it can to harden and protect civilians. Starting from a low base, policymakers are likely to obtain higher reward from a greater allocation of energies to the protection of laypeople than from additional allocations to research areas of traditional concern.

RECOMMENDATION TWO: Fund an aggressive program to develop advice and support systems that would facilitate home care and protection of home caregivers from infection in the event of broad-scale aerosol biological attack.

A recent Harvard School of Public Health Survey reported that 85 percent of a representative sample of Americans responded "yes" when asked, "If public health officials said you should be prepared to take care of members of your household at home for 7 to 10 days if they become sick, would you be able to do that, or not?"[137] The *National Strategy for Pandemic Influenza Implementation Plan* presumes that most care will be home-based.[138] Given the limited supply of hospital surge capacity described in Part II, we believe that the same situation will apply in the wake of a major aerosol biological attack. If this is right, governmental authorities have a critical responsibility to help individuals and families with that task.

This proposition is so at variance with our professional norms that it may sound radical, but it is supported by both history and analysis. An Israeli expert has observed:

"…disasters of today were simply natural phenomena of yesterday. Fires, floods, volcanic eruptions, earthquakes, and droughts were all part of everyday life and followed the natural course of nature; they were not considered disasters. Social groups developed ways to deal with them…Disaster behavior was simply another form of normal social group behavior found in communities."[139]

Against this backdrop he argues that "the key to successful preparation for disasters is primarily in the hands of mothers" and that "[t]he family unit should be looked at as the 'first line of

defense' against disasters — as the core organizational form…"[140] So it was in past American pandemics. When hospitals were crowded beyond capacity, most of the ill population was treated at home.[141] Given the imbalance between supply and demand that this paper anticipates, home care will predominate in the event of a catastrophic bioterrorism attack.

Moreover, we dispute that professional care is necessarily preferable to home care. Treatment for victims of most biological attacks will not involve surgery or blood transfusion, as would be the case after an explosive attack. Once clinically manifested and therefore beyond the range of prophylactic treatment, the medical needs for most of those affected will be palliative — as is the case with influenza. Some contagious patients may be helped by invasive procedures or intensive hospital care with high quality nurses. Confinement to Airborne Infection Isolation Rooms can be useful. But these facilities will be relevant to, and available for,[142] only a small fraction of patients. Planning for alternate care sites is underway[143] in recognition that hospitals will be overwhelmed. Yet for most bioterror victims, when the very limited ability of hospitals to provide intensive care is exhausted, home care in separate rooms with some rudimentary ventilation precautions and, optimally, contact with only a single caregiver is likely to be the best recourse for contagion control.

Moreover, homes have important psychological benefits that any mass-care site will lack. If supported by good supplies and advice, non-professionals can deliver better care than professionals in an overtaxed health system. In such situations, the psychological and emotional advantages of being cared for by a loved one are substantial.[144] Beyond this, since we give priority to maintaining

the bonds of community, we embrace solutions that strengthen rather than diminish those bonds. Allowing people to take charge of their personal and family care may diminish the psychological stress — and thus the overall effects of terrorism — on the caregivers themselves.

What guidelines can government offer to improve home treatment? Supply and support services are critical, but a focused program of research can yield insight that would greatly aid our population if translated into readily understandable advice.[145] For instance, it would be worth investigating the substantial, and growing, home health care industry, particularly visiting nurse programs that could be built upon and integrated into planning efforts. At a minimum, care-giving strategies that minimize risk to lay care-givers should be identified.

Encouraged by our approach, Stanford University Professor Larry Wein, for example, has developed protocols for influenza home care treatment that he concludes will substantially reduce the risk of contagion. His study assesses the relative value of different prophylactic measures (masks, humidifiers, hand-washing, ventilation, etc.) and offers specific recommendations on high value initiatives. Wein concludes that a 20 percent reduction in the re-infection rate can be achieved if there is 70 percent compliance with his recommended home protection recommendations and a 40 percent reduction can be achieved if the same compliance is extended to the workplace as well as home.[146] Similar strategies are needed for smallpox.

The path toward improved home care is difficult[147] and all steps will be intensely debated. We are not arguing that specific steps are immediately ready for endorsement. Rather, the reverse: there is a need and an opportunity for substantial research and debate. These are long-lead time items. It is

much better to initiate them before, rather than during, a crisis. Our present basic research programs, heavily oriented towards improvements in equipment and drug development, slight these non-pharmaceutical issues.

RECOMMENDATION THREE: Determine ways to supply individuals with the medical goods, and basic supplies of daily life, that they will need for self-care at home, or for ongoing sequestration in the case of a contagious disease.

Most goods and services in America are rationed by price or by establishing waiting times. Neither of these mechanisms is likely to be acceptable for essential medical supplies or for whatever decontamination or protective equipment may be deemed helpful after a major biological attack.[148] Delay would be dangerous and dispiriting. Economic distinctions would prove objectionable and divisive.[149] Moreover, in these emergency situations where by definition governmental authorities have failed to provide security, supply systems and hospital care systems should and will have to operate without reference to peoples' abilities to pay and without the burdens of normally elaborate insurance and payment mechanisms. Accordingly, different distribution mechanisms are needed.

There are four ways of dealing with this problem. First, ignore it and muddle through. Second, expect the population to come to central distribution points and provide goods there, presumably on a first come, first served basis. Third, establish outreach systems that support people in their homes. Fourth, flood the system so that supplies can be obtained in multiple ways from multiple places (as, for example, bread or milk can now be obtained at the drugstore or gas station as well as the supermarket). Our present programs and

plans predominantly pursue the first two alternatives. We recommend the latter two.[150]

Point distribution systems presuppose people's ability and willingness to move to central areas and to wait in long lines.[151] But, as discussed above, creating points at which people mass runs directly contrary to what should be a high priority for reducing the possibilities of infection, contagion, and re-attack by terrorists on a soft target. Furthermore, fears of lingering infectious agents, contagion from others, and repeat attacks will likely keep people away from long lines and central sites.[152] Even absent these considerations, movement to a central distribution point will be difficult for many individuals who have left the area, who are ill or infirm, or who are caregivers who cannot arrange substitutes to watch those under their care. For all these reasons, plans for layperson support should emphasize outreach and decentralization. A guiding principle should be, wherever possible, to minimize crowd congregation, not create it.

To their great credit, federal authorities have experimented with an outreach program for initial drug distribution in the wake of an anthrax attack. Tests in Washington D.C. and Washington State offered prophylaxis for postal workers and their families in return for their commitment to walk their normal routes distributing antibiotics in the event of a biological emergency. The principle here seems to be a correct one, but this approach is presently the exception rather than the rule.[153] Furthermore, the challenge is much greater than the Washington experiments considered. After a biological attack, the need will not simply be for a single round of antibiotic distribution, but for outreach systems that can provide follow-on medicines and food, diagnostic instruments, and support to those who are providing and receiving home care.

For us, the problem is too complex to see the path to a solution. But it is also too important to neglect, as is being done at present. In this light, we recommend that the Department of Homeland Security establish and chair two working groups to meet over the course of a year. The first should include representatives from the business package delivery industry, the transportation industry, just-in-time delivery systems, grocery home-delivery mechanisms, DHS, HHS, the Red Cross, the U.S. Postal Service, local police services, and other relevant participants. This group should develop plans for an overlapping network of delivery methods for moving critical supplies directly to homes over periods of weeks in the wake of a catastrophe. A layered network of methods, rather than a single protocol, is essential in case any one strategy is vitiated by circumstance or attack. A second effort should convene legal and financial experts to establish plans and legislation providing for federal assumption of post-attack costs directly resulting from a catastrophic bioterrorist attack.[154] If these groups are successful, DHS will need to test these plans after they have been developed. Since most of our major product supply lines are national or international and the financing and resources required to meet these demands exist only at the federal level, the federal government must lead on this issue.

RECOMMENDATION FOUR: Create means for rapid assessment of infection from likely bioterror weapons to reduce demands from the worried well and enable hospitals to focus on treatment.

One respect in which biological attacks will differ from terrorist attacks using traditional explosives, chemical, radiological, or nuclear weapons is that in bioterror attacks, those exposed to death and injury will not be readily identifiable. Time-tested triage systems like START ("Simple Triage and Rapid Treatment," assessing respiratory, neurological, and circulatory functions in the field) and SAVE ("Secondary Assessments of Victim Endpoints," based on survival assessment and treatment benefits in hospitals) "have limited application in bioevents in which point-of-contact decisions must be based instead on exposure or infectiousness."[155]

This situation must be addressed through development of triage protocols and strengthening emergency room capabilities,[156] with a special emphasis on improving diagnostic technologies. In the event of a catastrophic bioterrorist attack, we believe that hospitals will be overwhelmed, that no plausible amount of financial support and energy can bring them to an adequate capability for coping with demand, and that they will be able to perform their critical roles only if the pressure on them is relieved by developing systems that permit rapid assessment optimally outside of the hospital, and, to the extent possible, without extensive laboratory or specialist input.

Our interest in rapid assessment is tied to our views about that category of resource claimants often described as the "worried well."[157] The numbers of worried well are likely to be far greater than current government estimates, and may overwhelm hospitals even more than expected. Beyond this, we believe that the root of the worried well problem is misperceived: government should be encouraging the worried to seek diagnosis, rather than discouraging the potentially unwell from getting help.

Present "rules of thumb" for predicting the influx of worried well after an emergency do not withstand scrutiny. Policymakers have no sound basis for determining what the ratio of worried well

might be, particularly in the event of bioterrorist acts that unleash contagious disease.[158] The Department of Defense projects four worried well for every actual casualty based on a single case: after the 1995 Aum Shinrkyo sarin attacks on the Tokyo subway system some 5,500 patients were calculated to have arrived at medical facilities; of these, 1,046 were admitted with physical symptoms related to sarin. The Department of Homeland Security asserts that that the 9/11 World Trade Center attacks produced fifteen times as many hospital requests as actual victims. It averages this and the Aum Shinrkyo experience to project that the number seeking medical attention will be ten times those actually injured. Meanwhile, the National Academies report *Making the Nation Safer* claims that "experience suggests that for every legitimate patient presenting at the hospital, between 100 and 1,000 'worried well' will also arrive, looking for reassurance."[159]

These analyses obviously suffer from small sample size and the idiosyncrasies of particular cases. If the sarin attacks had been more potent, probably the proportion of the genuinely ill would have been higher. The World Trade Center attacks produced relatively few injuries compared with fatalities. Both occurred without warning, neither caused infections with extended incubation periods, and neither was a part of a prolonged campaign of repeated attacks.

American experience in the wake of the 2001 anthrax letters may be most indicative of actual worried well numbers, because it involves our own culture and a series of biological attacks, albeit small and relatively localized.[160] Twenty-two cases of cutaneous and inhalational anthrax were diagnosed in different locations along the East Coast, five individuals died, and seventeen others became ill. In New Jersey, where a postal facility was infected, fifteen nearby hospitals were found to have 508 cases of "worried well" visiting in the month after the media coverage of the anthrax attacks began. Since two postal workers in New Jersey contracted cutaneous anthrax, the ratio is 1:254, if using a geographic grouping of cases.[161] At Inova Fairfax hospital near Washington, where two cases of inhalation anthrax were successfully diagnosed, 1,127 patients with influenza like symptoms (unusual for that time of year) or fears of anthrax exposure presented themselves in the two week period following the Hart Office Building incident—leading to a ratio of infected patients to worried well of 1:500![162]

Not only do we think that worried well may be far in excess of current estimates, but we think such a situation, appropriately planned for and managed, is desirable. Given a large-scale attack whose contours cannot confidently be mapped or, worse still, a contagious attack or a series of attacks, those potentially affected are well advised to seek diagnosis and prophylaxis. In the contexts of concern to us, *the government will, and should be, in the forefront of creating this demand.* When 5,000 individuals went to hospitals in Tokyo after a subway attack employing a then-unidentified chemical, it was because most of them knew they were on the subway, that an attack had occurred, and that they might have been exposed. The Tokyo authorities directed these people to seek hospital help. Under present plans, our governmental authorities would do the same in the wake of a similar attack. In potentially affected areas, *the problem is not to reduce the "worried well," it is to assess them without burdening the regular health care system,* while maximizing our capability to offer treatment to those who require it.

To accomplish this, the United States needs an aggressive research program to develop simplified screening methods that could be used today inside hospitals and in the longer term could allow diagnosis outside hospitals, optimally by deploying diagnostic teams house to house. Ideally, these teams would be largely composed of lightly trained personnel, just as TB tests are now administered and read by school nurses. Ultimately, at an improved stage, lay-diagnosis would be enabled on a broad scale, as is now possible with home pregnancy tests.[163]

None of the recommendations offered here will be easy to implement, but the challenge of detecting infected though pre-symptomatic individuals is probably the most difficult item on our agenda. Our Star Trek fantasies ("Bones just waves a Tricorder over Kirk in the sick bay and has an instant diagnosis")[164] are a long way from realization. Symptoms often manifest differently in different individuals and detecting a disease in its early stages is an art as much as a science.

A "Zebra chip" that could distinguish the presence of diseases caused by biological agents ("zebras" among the usual "horses" that doctors see) was given the highest priority by a Defense Science Board report more than five years ago, yet despite subsequent work by the National Institutes of Health, the Air Force, and the Naval Research Laboratory,[165] the United States is still a fair distance from having such a tool even for use in hospital diagnosis. Existing tests have unacceptable expense, complexity, and false positive results. Moreover, they are envisioned only in hospital settings and are rarely being researched for lay use.

Nonetheless, we think the effort warrants redoubled priority. Some early indicators (like elevated temperature in SARS patients) may be identifiable for pathogens likely to be used in bioterror.[166] False positive and false negative rates that would be unacceptable in normal situations may be tolerable in emergencies. Simplified large-scale hospital diagnosis of anthrax should be possible, for example, by blood agar plating and colony counting systems that are automated and very inexpensive.[167] In the near-term, methods of expanding plating capacity and reducing time to diagnosis (now approximately fifteen hours) would have high reward and are likely to make "bleed to read" our dominant first line anthrax diagnostic strategy. Faster, more broadly applicable and more sophisticated (but presently much more expensive) approaches would invest in probes that detect protein and gene signatures ("biomarkers") of likely bioterror pathogens. Embedded on a single silicon computer chip, these could be used with routine blood tests,[168] nasal swabs, or respiratory samples to determine the difference between someone suffering "flu-like symptoms" and a victim of bioterrorism.[169] A similar program is suggested in *The National Strategy for Pandemic Influenza Implementation Plan,* which sets a target for the creation of rapid diagnostic tests for influenza that would provide results within 30-60 minutes. At least ten such rapid seasonal influenza diagnostic tests have been approved by the U.S. Food and Drug Administration,[170] and promising systems warrant development.[171]

Finally, we underscore that the rewards from such systems ought not to be measured merely in terms of health treatment for the sick, but also in terms of relieving burdens on hospitals. Most significant, the existence of easily available, rapid assessment tests could play a pivotal role in improving the psychological wellbeing of our population

following an attack. To oversimplify: Doctors value diagnosis predominantly as a means of identifying appropriate treatment for the sick. It should be similarly valued as a means of reassuring the well.

RECOMMENDATION FIVE: Supplement traditional, centralized "hub-and-spoke" communication with complementary social networks.

The research program suggested here — particularly the first two recommendations — will only be of practical use if its findings can credibly be disseminated to the public at a time of great stress. As emphasized above, credible information dissemination, with a minimum of contradiction and a maximum of reinforcement, will also be psychologically crucial to a worried public. An act of terror aims to be divisive and disorienting. These effects will be amplified by inconsistent information and contradictory advice; they can be countered by harmonizing information and assurance.

Traditional government communication models — including current communication plans by the CDC, Department of Homeland Security, and federal, state, and local public health agencies, use hub-and-spoke systems to communicate centrally-approved information (created for example in "Joint Information Centers")[172] to a population that is presumed to be otherwise uninformed and unengaged. We think this approach is essential. It can be quite creative and effective,[173] and the failure to follow though on it was a major cause of problems in New Orleans in the wake of Hurricane Katrina.[174]

However, this system ignores the deeply ingrained human tendency to double check information with trusted members of social networks. To build a resilient population, our governmental authori-

ties must create means for people both to receive information from central sources *and* to receive and provide information through decentralized sources, including sources they already know and trust.[175] A comprehensive program of "citizen and community preparedness" should explore mechanisms to address this need.[176] Modern telecommunications, especially the Internet, cell-phones, GPS systems, and multi-channel satellite radios[177] offer huge opportunities in this regard. Many of these were nascent at the time of 9/11, more evident in Hurricane Katrina's aftermath, and will be more robust in the future.[178] Two examples follow of systems that could draw on these technologies, intertwine them with new modes of social organization, and complement hub-and-spoke approaches.

Social and Peer-to-Peer Networks. Some types of information generated in an emergency can be centrally created and are well conveyed from a single point of contact. For instance, we previously discussed the desire of friends and family to know the whereabouts of loved ones, and how this need can overwhelm crucial communication systems and medical systems. Israel has built a system in which each hospital or medical facility can input the names of admitted patients—allowing worried family members in the aftermath of a terrorist attack to check a single cyber-location or call a single number to determine the whereabouts of potentially injured loved ones, rather than having families frantically moving from one hospital to the next, clogging emergency zones and potentially, in the case of bioterror, spreading contagion.[179]

Systems of this kind can be enriched by peer-to-peer information. Privacy concerns will inhibit the amount of information that will be provided

to any caller through the hub-and-spoke system. Moreover, information input to such a system will be difficult if, during an extended catastrophe such as a contagious disease outbreak, many people are confined at home. An optimal system would allow both hospital and homebound individuals to tell family members, friends, or local authorities about their whereabouts, health status, needs for basic supplies, and medical needs.

The spread of peer-to-peer networks that operate on the Internet (such as MySpace, with 70-80 million members, Xanaga, with 10-40 million members, and Facebook)[180] opens opportunities for imaginative social planners to meet these needs. Both uses that emphasize individual privacy and those that are more public are plausible. The latter are exemplified by informal Internet-based bulletin boards that sprang up to share information about potential victims in the aftermath of the September 11, 2001 attacks and similar online bulletin boards through which information was shared following the April 16, 2007 shootings at Virginia Tech.[181] Participant behavior on these occasions suggests that privacy concerns, though certainly relevant, are a lesser priority in the aftermath of disaster or when individuals feel a sense of community with one another.

More sophisticated options could better shield privacy and be more authoritative than often rumor-filled online bulletin boards. For example, participants in existing social networks or specially constructed sites could identify those who were authorized to receive notice in the event of an injury, illness, or emergency, just as these sites currently allow different levels of disclosure to different friendship groups. Besides proactively providing for the transmission of that data, these sites could be reactive as well, permitting authorized users

to make inquiries as to the others' location and status. Cell phone-GPS based locator and notification systems, such as Buddy Beacon, Dodgeball, and Boost Loop (all of which notify friends of each other's locations)[182] offer even greater opportunities for abating anxiety in affected populations and reducing demands upon professionals who are now the sole sources of information.[183] Moreover, the history of Internet innovations suggests that once the system is established, programmers and users will devise additional applications.[184] For example, as the movement toward electronic medical transcripts gains force,[185] these transcripts can be linked to notification systems so that doctors, patients, and families, operating with the relevant privacy approvals, share information that is now excessively compartmentalized, scattered, and withheld.

All Hazards Points of Contact. Experts on communication have long recognized that assimilating information is not simply a cognitive process of hearing and remembering. Instead, analyses of catastrophes have repeatedly demonstrated that people in crisis look to their friends, families, co-workers, neighbors, and respected nongovernmental authorities such as ministers and doctors to corroborate information and advice they have received from "authoritative" government sources before they decide how to act.[186] These trusted individuals carry as much, or more, weight than official government instructions intended to guide and reassure.[187] As one might expect, there are differences between ethnicities, 188 classes, genders,[189] ages, and cultures, but there is a recurring distrust of government and a strong inclination to want confirmation of government messages from others who are trusted at the local and personal level.[190]

The desire for message confirmation occurs because even a well-honed message creates uncertainty and questions in the receiver's mind, particularly in an unprecedented emergency, leading the receiver to seek further feedback and information that will corroborate and therefore solidify the message.[191] Thus, for example, a study of over 400 employees from twelve firms who were in areas evacuated because of hurricanes found that while 55 percent of upper-level employees "eventually turned to some agency of local government" to confirm that they were supposed to evacuate and find out where they were supposed to go, 70 percent of line-level workers contacted relatives to ascertain this information. Nearly all employees (93 percent) from all levels discussed and argued with their co-workers over probable damages, information, and whether they should leave work. Two-thirds reported that they consulted at least four sources of information before making a decision—despite clear government instructions regarding what to do.[192]

This human desire for confirmation of new information from trusted individuals is intensified by Americans' strong distrust of government. For example, a New York Academy of Medicine survey of reactions to a hypothetical smallpox attack concluded:

> "35 percent of the American population say they would be extremely or very worried that government officials might tell them to do something that is not the best thing for them to do in the smallpox situation (65 percent of the population would be moderately to extremely worried about this)…People are concerned that government officials would knowingly: (1) conceal or withhold information from the public; (2) lie or provide false information to the public (e.g., about the safety of the vac-

cine); (3) experiment on people; or (4) look after their own interests—or the interests of wealthy Caucasian Americans—at the expense of others."[193]

In this light, the Academy study asked "what kind of decision-making support would be most helpful to the American public?" and offered as its first conclusion the observation that people want decision-making support, not simple facts, and therefore care almost as much about finding someone who has their interests at heart as someone who is knowledgeable. Thus, in establishing an information-hotline:

> "58 percent of the American people would find it extremely or very helpful if they could talk by telephone at no cost with someone they don't know, who works for their local government, and who has been specially trained by the health department to give people information and advice about what to do in this situation. However, considerably more people (84 percent of the population) say they would find it extremely or very helpful to talk with someone they know well, who they are sure wants what is best for them, and who has been specially trained in advance to give people information and advice about what to do in this situation. This finding suggests that government-run telephone networks need to be supplemented by a more community embedded telephone support capacity."[194]

The Academy study addresses only a hypothetical situation. Like all surveys the form of its questions affects its conclusions. Some of its judgments may be peculiar to the smallpox scenario tested, particularly because the smallpox vaccine is known to have substantial risks for a segment of the population. But the observations quoted

here are consistent with both the social science literature and the observations of those who were charged with communicating in emergencies.

Government efforts can strive to increase trust and diminish the need for confirmation through determined efforts to avoid conflict among government speakers, to provide only accurate information, and to attend with care to the manner and phrasing of information that is conveyed. But it would be blinkered to address these problems only by shaping government statements, and to ignore the repeated finding that people corroborate official information within their unofficial social networks before acting. An effective information program cannot be carried out by the mass media alone. If the government believes a piece of information is important enough to be conveyed to the public, this information should be reinforced by corroboration within informal trusted networks.[195] Current efforts to educate journalists,[196] public health officials, and other opinion leaders about bioterrorism should be supplemented with a broader voluntary effort more deeply embedded in the networks in which people live and work.

Organizations like workplaces,[197] churches, schools,[198] and volunteer groups can be encouraged to designate one of their employees or members (such as a PTA member who already communicates frequently with parents on issues of community interest) as an emergency point of contact (EPOC), and this individual can be provided special education in advance of an event.[199] While we do not think this education itself will be highly significant, the recognition of this individual and the practice of establishing a link with him or her (for example by satellite radio) will provide a reinforcing and reassuring reference point for group members in an emergency and a place to which government information can be sent to disseminate "virally" through the community. Practice working with these all hazards volunteers will enhance government understanding of the required support resources, methods, difficulties, and opportunities of communicating with laypeople about these difficult subjects.[200] Beyond this, true engagement of these individuals can help to unlock capabilities and innovative perspectives in our non-government workforce about how to handle emergencies. As the paper "Citizen Engagement in Health Emergency Planning" puts it:

> People outside the traditional establishment help raise the intelligence quotient of planning because their imaginations are not necessarily constrained by legalistic, bureaucratic, scientific, and other limited views of disaster and epidemic management. Public participation in emergency planning provides ready access to "citizens' wisdom"—lessons distilled from the life experiences of many and diverse people—on how best to tackle serious, unforeseen events.[201]

This paper does not propose attempting to compel the appointment of these all-hazard EPOCs.[202] Rather, we believe that if experiments with programs of this kind show value, organizations, churches, volunteer groups, and even families and self-organizing groups will seek to enroll members in them, just as individuals volunteer now for Red Cross training or Citizen Corps programs. Moreover, after a first attack we think it is evident that demand for participation will soar. It makes sense to have the structure and content of such a program on hand at that time, rather than to build it on the fly.

IV. CONCLUSION

There are substantial reasons why public perspectives are slighted in the development of federal programs to prepare for bioterrorism. Interaction with the general public is commonly seen as predominantly a city or perhaps a state responsibility, but not a federal one. Even if perceived as needed, federal efforts are seen as difficult when preparations, responsibilities, and opportunities for dealing with laypeople are fragmented across thousands of jurisdictions with culturally, psychologically, and physically diverse populations. Moreover, it is hard to capture the public's attention before a crisis, to communicate with them during a crisis, and to secure their trust and effective action in the face of fear, rumor, family fragmentation, and suffering from potential or actual injury. As one of us has written elsewhere:[203]

> "The neglect of laymen is understandable. We live in a society that idealizes and relies upon professional competence. We employ licenses (predicated on training), rewards (dollars and prestige), and punishments (e.g. by a ban on unauthorized practice of medicine) to reinforce the division of labor. By these means, also, we seek to assure consistency and quality in professional services. Conversely, we distrust laymen. Their ethics, skills, knowledge and judgment vary widely. One well-designed survey of laymen flatly concluded: 'The majority of respondents have a number of beliefs about smallpox and smallpox vaccination that are false.'[204] Deficiencies run deeper than this. In an urban area beset by biological crisis we can anticipate that a third of all citizens are likely to be depressed, alcoholic, addicted, paranoid, psychotic, incarcerated, elderly,[205] infirm, disabled,[206] infants and children,[207] immature adolescents,[208] or some combination of these.[209] Moreover, a quarter of the populations of New York or Los Angeles, for example, describe themselves as not speaking English 'very well.'"[210]
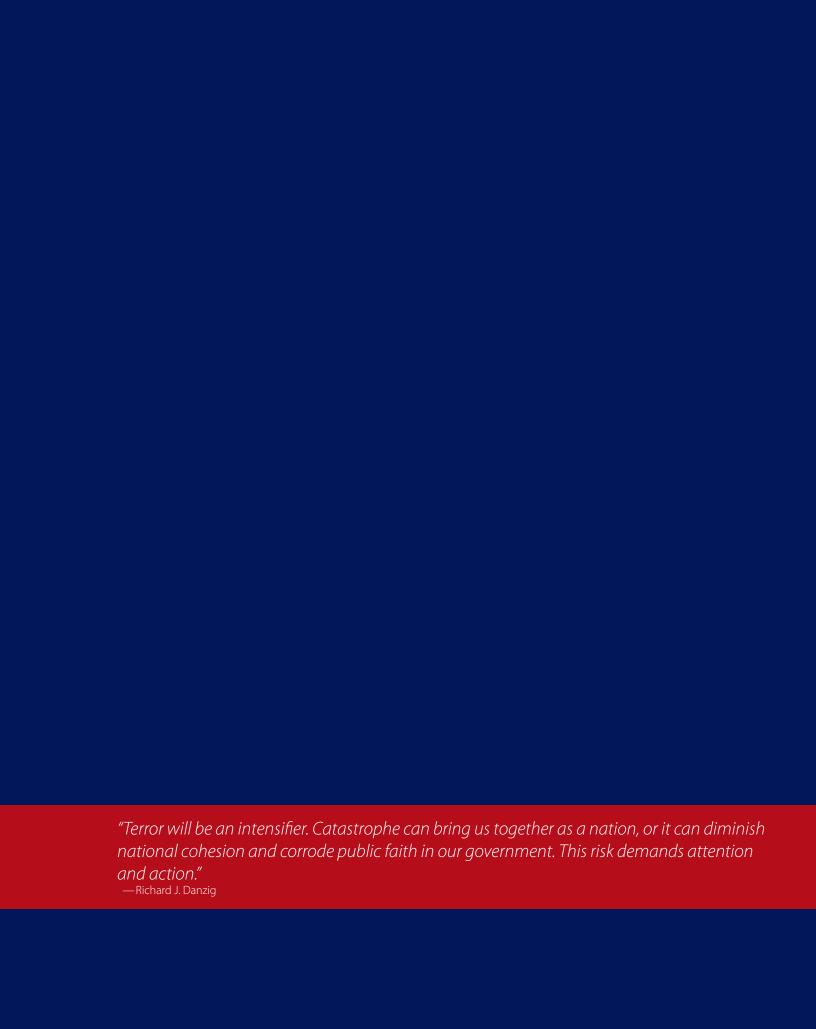
However discouraging this situation may be, readers should bear in mind that professional and bureaucratic perspectives have repeatedly demonstrated their own limitations. Bureaucracies and professional groups are notoriously fragmented as each looks at a problem parochially, asserts the privilege of its own procedures, employs its own vocabulary, and fights for its own status and resources. Professionals and bureaucrats are trained to focus on previously defined problems, follow routinized procedures, and meet consensus standards. It is therefore hardly surprising that they are institutionally conservative and tend to react to new problems with old procedures. They have strong predilections to divert energy and resources, even if intended for future contingencies, to meet pressing present-day priorities. They are self-referential, even self-reverential: The FBI tends to ask about a proposal, "Is it good for the FBI?" An Admiral demands, "Is it good for the Navy?" And a hospital administrator asks, "Is it good for my hospital?"[211]

At the same time, an empowered citizenry is more likely to be mentally, as well as practically, resilient during a crisis. Accounts from London during the Blitz and Israel under threat of Iraqi Scud missiles during the first Gulf War illuminate how a citizenry that has been prepared for worst-case scenarios can withstand attacks beyond expectation.[212] People can also learn to protect themselves physically. Returning to the fire analogy made earlier, deaths by fire have decreased steadily since 1974 when Congress mandated a range of fire safety measures, including educating citizens on how to protect

themselves, and fatalities are now less than a third of what they were prior to these measures.[213]

It is important to recognize that in an emergency like that which would be caused by a bioterror attack, the public is often going to be thrown upon its own resources. If this reality is ignored, we risk facing a Katrina-like disaster raised an order of magnitude by its malevolence, its immediacy, its potential for recurrence, and its scale. If, on the other hand, citizens are empowered, they will be able to take measures that will improve their protection, reduce demands on our health care system, and enable our country to return to normalcy more quickly.

Above and beyond these practical considerations stands an overriding psychological need. Terror will be an intensifier. It will make the United States stronger or it will make us weaker. The critical battle is in our citizens' minds. Catastrophe can bring us together as a nation, as occurred in the aftermath of 9/11. Or it can shatter our national myths and diminish national cohesion. Our greatest concern about a future terrorist attack, and a biological attack in particular, is that it may corrode public faith in our government, and thus in our democratic system itself. We think this risk demands attention and action.

"Terror will be an intensifier. Catastrophe can bring us together as a nation, or it can diminish national cohesion and corrode public faith in our government. This risk demands attention and action."
—Richard J. Danzig

After an Attack: *Preparing Citizens for Bioterrorism*

Methodology Used to Assess the Size and Capacity of the National Capital Region Health Care System

It is very difficult to calculate the surge capacity in the health care resources of any metropolitan region of the United States. Definitions vary, databases are inconsistent, and realities often differ from records.[214] In this appendix we recapitulate the information we obtained about the Washington D.C. ("National Capital") region and the basis for the conclusions we drew about it as a test case.

Bed Availability

"Licensed beds" are recorded for each section of each hospital. But for some purposes licensed beds will result in an overestimate of resources. Some licensed beds are un-staffed or lack adequate equipment—they are commonly described as "paper beds" of so little utility that they are commonly omitted from hospital calculations of "operational bed" or "bed capacity." On the other hand, sometimes physical and well-supported beds are present, but licensed beds are not. This permits some emergency surge capacity. A 2003 survey of Maryland showed 334 unlicensed acute care beds in the Southern Maryland and Montgomery Counties that could be considered part of the surge capacity of the National Capital Region.[215]

We calculated that in 2004 Northern Virginia held 3,062 operational beds and 3,264 licensed beds.[216] Average bed occupancy (operational beds divided by the average number of patients) was 69 percent—meaning that on average, 949 beds in Northern Virginia were open for emergencies. The District of Columbia had 3,619 operating acute care beds in the fourth quarter of 2004, and a 76 percent occupancy rate.[217] Thus, 869 beds may be free in the District on any given day. Maryland provided no operational bed statistics, but did list a total of 2,171 licensed acute care beds in the two National Capital Region Counties for that year.[218] Maryland provides no statistics on bed occupancy in these counties, but we applied the rule that the Maryland Health Care Commission uses that on average the operational bed occupancy rate will be 71.4 percent.

Taken together, this suggests that the National Capital Region has somewhere in the range of 9,000 operational beds, and a very approximate estimate is that around 2,500 beds would be unoccupied on any given day.[219]

Emergency Department Capacity

Available beds are relevant to capacities for caring for patients in hospitals. In some bioterror cases, such as anthrax inhalation, the most severely affected patients would need to stay in the hospital—but many would need to be processed *through* hospitals and health care facilities. Also, as we describe, the "worried well" will increase the demand for assessment without, presumably, increasing the requirement for hospital stays. This suggests that emergency department capacity is the more vital statistic. In the District of Colombia's eight public hospitals and four military hospitals, 397,000 emergency department visits were recorded for 2001, or approximately 1,087 per day.[220] That same year, the National Capital Region of Maryland saw 420,973 emergency room visits, or approximately 1,153 visits per day.[221] Given similar numbers of operational hospital beds in the District and Northern Virginia, we inferred that emergency room visits would be comparable between the two jurisdictions and therefore that Northern Virginia's present emergency room throughput was probably in the range of 1,000 per day.

From this, we estimated that the National Capital Region regularly sees around 3,250 patients per day in its emergency rooms. Processing patients for bioterror may be far more rapid, on a per patient basis, than processing the random patients of a typical emergency room day — unknown fevers and unspecified coughs, gunshot wounds, children with broken bones, alcoholics, heart attacks, and the like may take more time to assess, diagnose, and treat than hundreds of individuals presenting with similar symptoms wishing for a similar diagnostic test and/or a prescription or shot. (However, this may not be the case — diagnosis of unspecific symptoms such as fever and cough can take far longer than straightforward, known problems such as broken limbs, especially early on in a bioterror emergency before such symptoms have become regularized). Thus, it is reasonable to assume that emergency departments could process somewhat greater numbers of bioterror casualties and worried well then their average patient load. However, they will be processing these additional patients *atop* much of their normal load — not in a vacuum.[222] Given the orders of magnitude of expected casualties and worried well, vs. the average daily intake of the National Capital Region's emergency departments, treating more than a small fraction of potential casualties seems unlikely.

[1] The White House, *National Strategy for Combating Terrorism,* (September 2006). Accessed December 27, 2006 at <http://www.whitehouse.gov/nsc/nsct/2006/nsct2006.pdf>.

[2] Ibid., p. 21. The other components recited as important to creating this culture are securing recognition "of the certainty of future catastrophes," defining roles for all levels of government, and stressing initiative and accountability.

[3] In this paper, we use the terms "individuals," "laypeople," and "the public" interchange-ably. We avoid the words "resident" and "citizen" as the requirements for information, supplies, and other measures we describe apply equally to foreign residents, legal and illegal immigrants, businessmen, vacationers, and others. In Part IV we comment on the disparate character of the lay population.

[4] One of the most useful and imaginative of these has been developed by the Council for Excellence in Government. It presents ten questions that permit a site visitor to evaluate his or her "readiness quotient" and compare it with others in the same community and the nation. Answers that suggest un-preparedness (for example indicating that the respondent has not made family rendezvous plans or does not know where to access an emergency radio channel) are linked to information that can be used to correct these deficiencies. See "What's Your RQ?" accessed March 5, 2007 at <http://www. whatsyourrq.org/>. More broadly, <www.ready.gov> is the site to which all other government sites point on the issue of citizen preparedness. It is notable that even this Department of Homeland Security effort was largely privately financed (by the Alfred P. Sloan Foundation) and prepared with labor donated by the Advertising Council. In fact, the Alfred P. Sloan Foundation has been the main mover behind nearly all of the "government" efforts to educate citizens; see, for example, endnote 5 below. However, the efforts accomplished with this outlay of funds have been less than optimal. The inadequacies of the advice on the www.ready.gov site were highlighted in the summer of 2006, when the Federation of American Scientists built a parallel "ReallyReady" website offering more concrete suggestions with better organization — created by one 20-year-old intern in nine weeks. See the site at <http://www.fas.org/reallyready/> and for information, see Zachary A. Goldfarb, "Is DHS Site Really Ready? Science Intern Thinks Not," *The Washington Post,* August 10, 2006, p. A21. The contrast between the generality of advice on www.ready.gov, and the level of concrete, helpful advice offered at www.pandemicflu.gov, is striking — these issues are discussed in detail at: <http://fas.org/reallyready/analysis.html#generic>. The best present summary of advice for citizens in the wake of a bioterrorist attack is provided in Lynn Davis, et al., *Individual Preparedness and Response to Chemical, Radiological and Biological Terrorist Attacks* (2003), a RAND Corporation publication also funded by the Sloan Foundation. See especially p. 41 ff.

[5] In addition to its support for ready.gov, the Sloan Foundation provided a grant for pamphlets and handouts to be offered to passers-by at public gatherings, television commercials, and information disseminated via national media

[6] The Department of Health and Human Services has prepared a thorough media handbook—but it is of a length and level of generality that makes it unlikely to be of great help in enabling journalists to guide citizens during an emergency. See "Terrorism and Other Public Health Emergencies: A Reference Guide for the Media," Department of Health and Human Services (2006), accessed December 27, 2006 at <http://www.hhs. gov/emergency/mediaguide/field/>. See also Nancy Ethiel, ed., *Terrorism: Informing the Public* (McCormick Tribune Foundation, 2002).

[7] We do not deprecate the utility of this effort. An excellent guide to emergency risk communication has been prepared that incorporates the best social science research in the field — see "Crisis and Emergency Risk Communication: By Leaders, for Leaders,"

Centers for Disease Control and Prevention, (February 16, 2006), accessed December 27, 2006 at <http://www.cdc.gov/communication/emergency/leaders.pdf>. Other notable contributions include: Clete DiGiovanni, et al., "A Prospective Study of the Reactions of Residents of an American Community to a Bioterrorist Attack," Defense Threat Reduction Agency (2002), which presented Louisiana citizens with an extended video about a hypothetical intentional West Nile Disease outbreak and evaluated their reactions as reflected in questionnaires; Lynn Davis, et al., *Individual Preparedness and Response to Chemical, Radiological, Nuclear and Biological Terrorist Attacks* (RAND: 2003) accessed December 27, 2006 at <http://www.rand.org/pubs/monograph_ reports/2005/RAND_MR1731.1.pdf>; The Working Group on Governance Dilemmas in Bioterrorism Response, "Leading During Bioattacks and Epidemics with the Public's Trust and Help," *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 2.1 (2004): p. 25-40; Bradley Stein, et al., "Emotional and Behavioral Consequences of Bioterrorism: Planning a Public Health Response," *Milbank Quarterly* 2 (2004): 413; and Thomas Glass and Monica Schoch-Spana, "Bioterrorism and the People: How to Vaccinate a City Against Panic," *Communicable and Infectious Diseases* 217 (2002). See also a classic work by the National Research Council Committee on Risk Perception and Communication, "Improving Risk Communication" (1989).

Nonetheless, we agree with the observation of Monica Schoch-Spana that:

> "Public communications, 'risk communications,' and the like have unfortunately become code words with which to skirt the sociopolitical complexities associated with community responses to terrorist crises, especially those that involve bioweap-ons. When authorities say that they want better communication with the public, what they tend to mean is public "buy in," public compliance, and understand-ing — possibly even absolution — when tough choices arise for officials such as how to distribute scarce resources in an emergency. When members of the public indicate that they want better communication from officials, what they are asking for is inclusion, consideration, and mutual respect as "peer" decision-makers; expert guidance on which they can act; and proof that their needs have justly been considered by people in authority." "Public Archetypes in U.S. Counter-Bioterrorist Policy," p. 3 (Unpublished Paper for NATO Security Through Science Series, received December 2006).

[8] In 1997, FEMA launched "Project Impact," a multi-year effort to increase preparedness for natural disasters in more than fifty communities. Results from this effort are well described in reports and presentations available at "Project Impact," Disaster Research Center, accessed December 27, 2006 at <http://www.udel.edu/DRC/projectimpact. html>. Project Impact was eliminated in 2001.

[9] Citizen Corps had a budget of $40 million in 2004 supporting programs ranging from direct citizen training as part of its Citizen Emergency Response Teams to collecting lists of trained medical personnel through the Medical Reserve Corps. In 2005, its budget was cut to $15 million, and in 2006, it was allocated $20 million. Budget figures are drawn from the Appropriations for the Department of Homeland Security, state and local programs, FY 2004, FY 2005, and FY 2006. For more on the Citizen Corps program, see their website at <http://www.citizencorps.gov> (accessed May 3, 2007) and see Monica Schoch-Spana, et al., "Disease, Disaster, and Democracy: The Public's Stake in Health Emergency Planning," *Biosecurity & Bioterrorism* 4.3 (2006): p. 313-19. We address the Citizen Corps program in more detail later in endnotes 32 and 81.

[10] While this paper focuses on bioterrorism response, we believe that our points are relevant to catastrophic health events of all kinds and we subscribe, as does the *National Strategy,* to efforts to build an "all-hazards" approach. We believe that our recommendations are

particularly relevant to pandemic flu response, in which the palliative care that could be offered at home would be of even greater benefit to patients than that which could be offered after bioterror. However, we do not address pandemic flu and other hazards in this paper.

We note also that the program we propose is predominantly directed to strengthening layperson capabilities in the aftermath of an attack. We think this is presently the most rewarding area for government effort. If this program is adopted, however, it should lead to greater possibilities for education and preparation of our citizens *before* an attack. That effort will encounter special difficulties because there are many competing claims for citizen attention and the credibility and urgency of any proposed preparation is subject to doubt. We think it is most effective first to enhance our capabilities for strengthening post-attack preparations and then to use this as a base for pre-attack outreach to laypeople.

[11]More than half of deaths in past terrorist incidents have been found to occur within the first hour. A recent analysis of terrorist incidents over a three year period in Jerusalem found that more than four-fifths of deaths occurred at the scene and half of the balance occurred within four hours thereafter. S.C. Shapira, et al., "Mortality in Terrorist Attacks: A Unique Modal of Temporal Death Distribution," *World Journal of Surgery* 30.11 (2006): p. 2071.

[12]Though we are not discussing the two other types of bioterrorism targets identified in Richard Danzig, "Catastrophic Bioterrorism: What is to Be Done?" Government Printing Office (2003), as principal risks — food supply and agricultural attacks — we think that a similar analysis and set of recommendations would be applicable in these contexts. See for example, R. G. Breeze, "Technology, Public Policy and Control of Transboundary Livestock Diseases in Our Lifetimes," *Rev. Sci.Tech. Off.Int.Epiz.* 25.1 (2006): p. 275: "The prevailing wisdom is that it is the responsibility of government to keep transboundary livestock diseases out of our countries: when government fails . . . it is again the government's responsibility to control the ensuing disease outbreak . . . The general public is not involved except as the intended audience for displays of government competence . . ."

[13]Anthrax, the disease caused by the inhalation of the bacterium *Bacillus anthracis,* is a likely bioterror weapon. While it cannot be spread from person to person, it is infectious to those who breathe a significant dose, and if not treated, will cause death in 90 percent of those infected. Agents that are contagious pose additional problems for treating and containing bioterror because they can be spread from person to person after the initial release. Smallpox (caused by a virus) is the most often referred to of these agents. In this and subsequent references, we use the terms "anthrax" and "smallpox" in a lay sense to refer to both the pathogen and the disease, and we are focused exclusively on human effects. Tularemia and pneumonic plague are examples of other infectious but non-contagious and contagious (respectively) potential biological weapons. We regard these as lesser cases, similar to anthrax, but not so severe. We also believe that anthrax is the biological weapon most likely to be used for a mass attack. This point is discussed more extensively in Richard Danzig, "From MAD to SAD: An Axiom and Six Hypotheses About Instrumental Terrorist Non-Use and Use of Pathogens as Weapons of Mass Destruction," unpublished paper prepared for DARPA's Defense Science Office (2006).

[14]A number of other contagious bacteria and viruses have been enumerated as possible weapons. See for example, the list offered by the Centers for Disease Control and Prevention at "Emergency Preparedness and Response: Bioterrorism" accessed December 27, 2006 at <www.bt.cdc.gov/bioterrorism/>.

[15]For a detailed discussion of the spore count likely to be fatal to the average citizen and the infectious dose for anthrax inhalation, see D. R. Franz, et al., "Clinical Recognition and Management of Patients Exposed to Biological Warfare Agents," *Journal of the American Medical Association* 278 (1997): p. 399. For a recent discussion, see Dean Wilkening, "Sverdlovsk Revisited: Modeling Human Inhalation Anthrax," *Proceedings of the National Academy of Sciences* 103.20 (May 9, 2006): p. 7589, emphasizing the likelihood that lower doses account for a substantial number of victims in Sverdlovsk's accidental release of weapons grade anthrax.

[16]While smallpox is likely to decay in the atmosphere faster than anthrax, just one viron might be enough to infect an individual, after which the virus could pass from person to person.

[17]This paper focuses on federal programs. State and local efforts in this arena, though more broadly targeted, are substantial. Among recent efforts, see, for example: "2006-07, Governor's May Revision Highlights" California Department of Health Services (May 12, 2006), accessed December 27, 2006 at <http://www.dhs.ca.gov/admin/pdf/Final percent20Highlights percent20May percent20Revise percent2006-07.pdf> detailing planned expenditures of $400 million on "address[ing] gaps in California's capacity to provide healthcare services required during both moderate and catastrophic emergencies." We believe, however, that the observations we make here about federal programs will be equally applicable to state and local programs — and that the research and message creation functions require federal effort to provide adequate resources and essential message coordination.

[18]We believe that our recommendations could be a priority for the newly established office of the Assistant Secretary for Preparedness and Response within the Department of Health and Human Services (HHS), of the new "National Interagency Biodefense Campus," and the new Biomedical and Advanced Research and Development Authority (BARDA), all mandated in legislation passed by Congress and signed by the President at the end of 2006, and currently in the process of being established. See United States Congress, Senate, 109th Congress, 2nd Session. S. 3678, *A Bill to amend the Public Health Service Act,* accessed December 27, 2006 at <http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_bills&docid=f:s3678enr.txt.pdf>. For more information on the National Interagency Biodefense Campus, see endnote 109. We also think our recommendations are appropriate for the "Homeland Security Advanced Research Projects Agency" (HSARPA) within the Department of Homeland Security. Though this entity does not now substantially engage in the social science research relevant to some of our recommendations, we think it would be an improvement if it did so. We further note that the Science and Technology division of the Department of Homeland Security has recently established a "Human Factors" unit which could support some of the research we recommend.

The Department of Health and Human Services has announced a strategy for developing medical countermeasures to chemical, biological, nuclear, and radiological threats. The Department's statement admirably recognizes that non-medical countermeasures will be important to the success of the medical program. See "Draft HHS Public Health Emergency Medical Countermeasures Enterprise Strategy for Chemical, Biological, Radiological, and Nuclear Threats," Department of Health and Human Services, Office of Public Health Emergency Preparedness," *Federal Register* 71.174 (September 8, 2006): p. 53097, accessed December 27, 2006 at <http://www.hhs.gov/ophep/ophemc/drafthhs.html>. Four of our recommendations would form concrete agenda items for the non-medical portion of this draft HHS strategy. Our recommendation of investment in improved diagnostics is directly relevant to the main focus of the HHS program. See point 4, page 53099 for the non-medical countermeasures portion of this project.

Suggestions in this paper would also be appropriate for the newly founded academic "Centers of Excellence" supported by the Department of Homeland Security "National Consortium for the Study of Terrorism and Responses to Terrorism." See, for example, the website of the "National Consortium for the Study of Terrorism and Responses to Terrorism," at the University of Maryland, accessed March 5, 2007 at <http://www. start.umd.edu/about/>.

[19]It is difficult to calculate the precise level of bioterrorism related expenditures. An analysis of the bioterrorism budget can be found in Ari Schuler, "Billions for Biodefense: Federal Agency Biodefense Budgeting, FY2005-FY 2006," *Biosecurity and Bioterrorism* 3.1 (June 2005): p. 94-101. From FY 2001-FY 2004, the U.S. spent approximately $14.5 billion on civilian biodefense measures, with an additional $7.6 billion in the president's requested budget for 2005. Funding has flowed principally, but not exclusively, from the "Public Health Security and Bioterrorism Response Act of 2002." A Department of Health and Human Services press release reports that it disbursed $3.7 billion dollars for biodefense between 2002 and 2004. "Ready or Not? Protecting the Public's Health in the Age of Bioterrorism," *Biosecurity and Bioterrorism* 2.1 (January 2004): p. 47-50. "HHS Awards $498 Million to States to Improve Hospital's Response to Bioterror and Other Disasters," United States Department of Health and Human Services (December 2001). This report also notes (p. 4) "pre-9/11 funding for bioterrorism as $67 million in FY 2001."

[20]In the fiscal years between 2004 and 2007, the DHS R&D budget varied between $1 and $1.3 billion. Research into biological countermeasures formed the largest part of this budget, and ranged from $365 million in FY 2004, $407 million in FY 2005, $362 million in FY 2006, and $337 million in FY 2007. Other budgets could provide alternative baselines for assessing the investment we recommend. Basic medical research related to bioterrorism occurred predominantly outside this budget to some extent in the Department of Defense but most substantially at the National Institutes of Health, with priority setting and budget allocation derived from the Department of Homeland Security. The National Institute of Allergic and Infectious Diseases (NIAD), where the National Institutes of Health houses its biodefense R & D portfolio, received $1.9 billion specifically earmarked for biodefense in 2007, $1.7 billion in 2006, $1.8 billion in 2005, and $1.4 billion in 2004.

The Department of Defense also has a basic research portfolio through its Chemical and Biological Defense Program, allocated $94 million in FY 2006. In addition to these funding sources specific to bioterror, the DOD's Science and Technology budget funds some behavioral, cognitive, and social science that could be applied to the research needs we call for. Spending for this portfolio was $376.7 million in FY 2004. Heather Kelly, et al., "Behavioral and Social Science in the Administration's FY 2005 Budget," *AAAS Report XXIX: Research and Development FY 2005,* American Association for the Advancement of Science (2005): p. 228.

For greater detail on these budgetary assessments, see "AAAS Report XXIX: Research and Development FY 2005," accessed December 27, 2006 at <http://www.aaas. org/spp/rd/rd05main.htm>; "AAAS Report XXX: Research and Development FY 2006," accessed December 27, 2006 at <http://www.aaas.org/spp/rd/rd06main.htm>; and "AAAS Report XXXI: Research and Development FY 2007," accessed December 27, 2006 at <http://www.aaas.org/spp/rd/rd07main.htm>.

[21]A particularly problematic aspect of disempowering the public is that this disempowerment fuels unrealistic expectations about the government's ability to provide total security. Richard Falkenrath, "Homeland Security and Consequence Management," in Kurt M. Campbell, ed., *The Challenge of Proliferation: A Report of the Aspen Strategy Group Aspen Institute* (2005): p. 133, notes that "The first point to understand about incident management in post-9/11 America is that the public's expectations of the federal government are exceptionally, indeed unrealistically, high. In a domestic incident of national significance, the federal government is expected by many not only to make no errors, but to be virtually omniscient and omnipotent." Laypeople involved in the solution, however, are more likely to understand the difficulties of solving a problem, just as the difficulty of a "simple" home repair becomes more apparent when taken on oneself.

[22]Awareness of the need for layperson empowerment and self-protection is evident in pandemic flu preparedness activities. It is an integral part of the *National Strategy for Pandemic Influenza,* Homeland Security Council (November 2005), which states the need, for instance, to "Emphasize the roles and responsibilities of the individual in preventing the spread of an outbreak" (p. 8). The different paradigm is immediately apparent in the www.pandemicflu.gov website, which provides concrete, citizen-level advice for decreasing the chances of catching the flu and increasing the probability of successful treatment and recovery. The research agenda for a pandemic influenza epidemic includes computer modeling of how the virus spreads through regular interaction and thus what people can do to reduce their vulnerability, message development to communicate with citizens truthfully, and development of rapid diagnostics. See *HHS Pandemic Influenza Plan,* U.S. Department of Health and Human Services (November 2005), Appendix G accessed March 5, 2007 at <http://www.hhs. gov/pandemicflu/plan/pdf/HHSPandemicInfluenzaPlan.pdf>.

[23]Principally the federal "BioWatch" programs. See Dana A. Shea, et al., "The BioWatch Program: Detection of Bioterrorism," Congressional Research Service, *Report No. RL 32152* (November 19, 2003) accessed March 5, 2007 at <http://www.fas.org/sgp/ crs/terror/RL32152.html>.

[24]The American approach is characteristically professionally centered and technological. The National Disease Surveillance System and the National Environmental Public Health Tracking Network promote interoperable disease reporting among federal, state, and local public health officials, and cooperation between the EPA and CDC. In 2002, the Public Health Security and Bioterrorism Preparedness and Response Act required the federal government to strengthen surveillance. The present federal focus is on "BioSense," a syndromic surveillance system using data directly from hospitals and other health care systems in the United States. BioSense now tracks just 31 hospitals in 10 cities in "near" real time, but it is planned to expand this to 100 hospitals in 31 cities by the end of 2006. See Michael O. Leavitt, "Statement by Michael O. Leavitt, Secretary, U.S. Department of Health and Human Services on HHS Bioterrorism and Public Health Emergency Preparedness" U.S. Senate Committee on Health, Education, Labor, and Pensions," (March 16, 2006) accessed March 5, 2007 at <http://www.hhs.gov/asl/tes-tify/t060316.html>. The Department of Homeland Security is in the process of standing up a National Biosurveillance Integration System, currently operating as a pilot program on the basis of FY 2006 and FY 2007 Congressional appropriations, with a goal of deploying an initial operational capability of the full system in FY 2007. See Andrew J. Grotto and Jonathan B. Tucker, "Biosecurity: A Comprehensive Action Plan," Center for American Progress (June 2006): p. 23. See also Richard F. Besser, "Creating a Nation-wide Integrated Biosurveillance Network," Testimony Before the House Subcommittee on the Prevention of Nuclear and Biological Attack, (May 11, 2006) and Janeth Heinrich, "Gaps Remain in Surveillance Capabilities of State and Local Agencies," Testimony before the Subcommittee on Emergency Preparedness and Response, Select Committee on Homeland Security, GAO-03-1176T (2003).

There is also substantial local activity. For example, the New York City Department of Health (NYCDOH), a leader in this area, has monitored 911 ambulance calls in real-time since 1998, and also monitors emergency department visits at 33 hospitals. Conversation with NYCDOH Syndromic Surveillance team, further information from Farzad Mostashari PowerPoint presentation, "Syndromic Surveillance in New York City," New York City Department of Health, accessed March 5, 2007 at <www.syndromic.org/syndromicconference/2002/presentationpdf/farzad_mostashari.pdf >. Further information on local surveillance can be obtained in K.J. Henning, "Syndromic Surveillance Microbial Threats to Health: Emergence, Detection, and Response," National Academy Press (2003).

[25]The Emergency Management Assistance Compact is a federally authorized organization signed into law in 1996 that provides form and structure to interstate mutual aid. For more information, see <http://www.emacweb.org/> (accessed March 5, 2007). A National Emergency Response Plan, last updated on May 25, 2006, may be found at <http://www.dhs.gov/dhspublic/interapp/editorial/editorial_0566.xml> (accessed March 5, 2007).

[26]As described in Part III below, there has also been some experimentation, particularly in Washington, D.C., Boston, and Seattle with an alternative system of distribution of drugs by postal workers. The Centers for Disease Control "Cities Readiness Initiative" provides funding to 24 cities to help prepare them to "provide oral medications during an event to 100 percent of their affected populations." The general plan is to create a series of central points of distribution. However, CDC also states that "the grantee may elect to request staff and other resources from the federal Government to augment the POD network or to deploy elements of the United States Postal Service to complement the POD network with direct delivery of antibiotics to residences." See "Cities Readiness Initiative (CRI) Guidance," Appendix 3, Centers for Disease Control and Prevention (no date), accessed March 5, 2007 at <www.bt.cdc.gov/planning/guidance05/pdf/appendix3.pdf>. Results of the Seattle Postal Service test are summarized in Keith Ervin, "Seattle Antibiotics Test Goes Well" *Seattle Times,* November 12, 2006, accessed January 1, 2007 at <http://seattletimes.nwsource.com/html/localnews/2003406288_terrortest12m.html>. For reasons that we discuss below, we believe that the main points of distribution system are ill-advised and the alternative suggests a better approach.

[27]The AHRQ Bioterrorism Planning and Response Page describes alternate care sites and surge capacity, among other requirements; see <http://www.ahrq.gov/browse/bioterbr.htm> (accessed March 5, 2007). AHRQ's Emergency Preparedness Resource Inventory provides an Internet-based tool allowing local and state planners to find such alternative sites and surge resources; see <http://www.ahrq.gov/research/epri/> (accessed March 5, 2007). The Rocky Mountain Regional Care Model for Bioterrorist Events provides a software tool that allows users to rank alternative healthcare sites based on the availability of adequate ventilation, cooking facilities, plumbing, etc.; see <http://www.ahrq.gov/research/altsites.htm> (accessed March 5, 2007). Local planning for influenza has encouraged contingency planning that will be useful for bioterrorism. See, for example, Debra Berg, "Planning for Pandemic Influenza: Hospital Preparedness Issues," PowerPoint Presentation, Bioterrorism Hospital Planning Preparedness Program, New York City Department of Health and Mental Hygiene, (June 13, 2005).

[28]A Federal Interagency Committee on Emergency Medical Response facilitates Federal interagency communication on EMS issues; see <http://www.usfa.dhs.gov/subjects/ems/ficems.shtm> (access date unavailable; at time of publication, website not functional).

[29]As with other topics, planning for "worried well" in an influenza pandemic is somewhat more advanced than planning for this problem in the wake of bioterrorism. See "HHS Pandemic Influenza Plan Supplement 3" at <http://www.hhs.gov/pandemicflu/plan/pdf/S03.pdf> (accessed March 5, 2007) for the common wisdom on hospital surge capacity needs, alternative sites, and worried well care.

[30]It is difficult to be precise about programmatic spending because budget categories are aggregated by agencies and special interest line items obscure the particulars involved. See generally, Ari Schuler, op. cit. and the discussion in endnote 19, above. Among studies reviewing what is being done in the field of bioterror that point to the priorities we have described, see Lewis Rubinson, et al., "Augmentation of Hospital Critical Care Capacity after Bioterrorist Attacks or Epidemics: Recommendations of the Working Group on Emergency Mass Critical Care," *Critical Care Medicine* 33.10 (2005): p E1; Ali S. Khan, et al., "Biological and chemical terrorism: strategic plan for preparedness and response," Recommendations of the CDC Strategic Planning Workgroup, MMRW Recommendations and Reports 49, RR04 (April 21, 2000): p. 1; Michael J. Hopmeier and Gretchen Cullenberg, "Bio Research Programs," Unpublished manuscript, Unconventional Concepts, Inc., January 2005; Lawrence Wein, "Emergency Response to an Anthrax Attack," *Proceedings of the National Academy of Sciences* 100.7 (March 17, 2003): p. 4346.

[31]The most comprehensive chronicle and criticism of this phenomenon to date is from a foundation-sponsored "Working Group On 'Governance Dilemmas' in Bioterrorism Response." The thirty-member group (consisting of government officials, public health experts, journalists, and others) published its conclusions as an article, "Leading during Bioattacks and Epidemics with the Public's Trust and Help" *Biosecurity and Bioterrorism* 25 (2004). ("The Working Group was the culmination of a larger project focused on articulating best practices and principles for leaders when communicating with the public in the bioterrorist context. This statement reflects the experience, professional judgment and concensus recommendations of working group members . . ." Ibid., p. 25).

Writing in another context, the Chair of the Working Group has observed that scenarios and exercises typically reinforce the perception of citizens as problems, not assets:

"Playing one dimensional roles in bioterrorism scenarios, members of the public usually surface as mass casualties or hysteria driven mobs who self-evacuate affected areas or resort to violence to gain access to scarce, potentially life-saving antibiotics and vaccines. These images, around which official response systems are being built — the public as a problem to be managed during a crisis — preclude careful consideration of, and planning for, ways to solicit the cooperation of an affected population. The emphasis is on crowd control rather than enhancing the people's ability to cope with a public health emergency."

Monica Schoch-Spana, "Bioterrorism: U.S. Public Health and a Secular Apocalypse," *Anthropology Today* 20(5), (October 2004): p. 13.

For a passionate statement describing and decrying the exclusivity of the professional focus in the wake of 9/11 see David Brin, "The Other Culture War: Beleaguered Professionals versus Disempowered Citizens," Amazon Short Paper, (October 31, 2005), accessed March 5, 2007 (password protected) at <https://www.hlforum.com/briefs/hfxxix_dBrin-otherCultureWar.pdf>. Brin has written at greater length on this subject in *Transparent Society.*

A successor effort to the Working Group on Governance Dilemmas was convened late in 2006 as a "Working Group on Community Engagement in Health Emergency Planning." The group's full report is available at <http://www.upmc-biosecurity.

org/website/focus/community_engage/2007_working_group/full_report.html> (accessed May 3, 2007).

[32]There are a handful of programs under the Citizen Corps umbrella that counter this prevailing attitude and work to train laypeople for all hazards disaster response. These programs, particularly the Community Emergency Response Training and Medical Reserve Corps, are discussed at various points in this paper, and we encourage them. However, these programs, which were placed under the Citizen Corps umbrella and given additional focus following President Bush's 2002 State of the Union address, share just $20 million in their budget line item, and anecdotally, perceive themselves to be disparaged by much of the professional responder community.

[33]As Peter Sandman's research on the "fear of fear" has shown, professional concern over public "panic" is not well founded, but is nonetheless persistent. See Peter M. Sandman and Jody Lanard, "Fear of Fear: The Role of Fear in Preparedness . . . and Why It Terrifies Officials," (September 7, 2003) accessed March 5, 2007 at <http://www.psandman.com/col/fear.htm>.

[34]The Department of Health and Human Services has observed that "The aftermath of a major bioterrorist incident and its affects [sic] on the underpinnings of our society would be almost unbelievable. Designing a healthcare delivery system to care for thousands or even hundreds of thousands of patients or victims when the current healthcare system is overwhelmed poses an overwhelming task for any state, regional or city planner." As "a starting point" in developing response capabilities it has requested localities to "[e]stablish a system that allows the triage, treatment and initial stabilization of 500 adult and pediatric patients per 1,000,000 awardee jurisdiction (1:2000), above the current daily staffed bed capacity, with acute illnesses or trauma requiring hospitalization from a chemical, biological, radiological, nuclear or explosive (CBRN&E) incident." U.S. Department of Health and Human Services, Health Resources and Services Administration, Special Programs Bureau, "Fiscal Year 2004 Continuation Guidance National Bioterrorism Hospital Preparedness Program" *Catalog of Federal Domestic Assistance (CFDA)* No. 93.003, accessed March 5, 2007 at <http://www.hrsa.gov/bioterrorism/hrsa04biot.htm#beds>. Though the DHHS references capabilities for more limited attacks (for example, with botulinum), as we will show, this appropriate near-term goal is well short of the likely requirement in a major anthrax aerosol attack.

[35]Augmentation of this surge capacity will be slow, as it depends not only on the construction of space but on the training of people. Bottlenecks in that training process suggest that we are unlikely to be able to increase surge capacity quickly. For instance, in the midst of a nursing shortage, more than 147,000 potential nurses were turned away from U.S. nursing schools in 2005 alone because of diminished teaching capacity. See "Hospital-Based Emergency Care: At the Breaking Point," National Academies Press (June 14, 2006) accessed March 5, 2007 at <http://www.iom.edu/?id=35018>.

[36]Thomas Glass and Monica Schoch-Spana, "Bioterrorism and the People: How to Vaccinate A City Against Panic," *Clinical Infectious Diseases* 34 (2002): p. 217. We make the important point that laypeople are also often quite effective at delivering healthcare.

[37]Commenting on a draft of this paper, Peter Sandman observed that ordinary citizens who had been exposed to illness and recovered could be particularly valuable health care providers because they would have high levels of immunity to the pathogen of concern.

[38]There is better recognition and authorization now for active duty military to deploy in response to urban crises. See "Military Support for Stability, Security, Transition, and Reconstruction (SSTR) Operations" Department of Defense Directive 3000.05 (November 28, 2005) accessed March 5, 2007 at <http://www.dtic.mil/whs/

directives/corres/pdf/300005_112805/300005p.pdf>. Delays in triggering these authorities and logistical and lead-time difficulties will, however, predictably delay the arrival of troops where needed.

[39]Karl Von Clausewitz, *On The Theory of War,* Princeton University Press, translation (1984), p. 127. The excerpt was quoted at greater length in Danzig's "Catastrophic Bioterrorism" paper, op. cit.

[40]Richard Danzig, "Towards a Long-Term Strategy for Coping with the Risk of Bioterrorism," paper submitted to the Defense Advanced Research Projects Agency (December 2005). Danzig has also written:

"It is the public response, more than any other, that determines the success or failure of an attack . . . An uncertain public — and even more so a panicked public — amplifies the physical damage from an attack. Confusion, congestion, and distraction — not to mention flight — may impose more damage to the economy than the attack itself."

Richard Danzig, "The Dark Side of the Moon: Neglected Issues in Countering Bioterrorism," paper submitted to the Defense Advanced Research Projects Agency (January 2005). These papers stimulated the present essay and we are grateful to the Defense Advanced Projects Research Agency, Defense Science Office, for its support of those efforts.

[41]After studying recovery from 1997 floods in Grand Forks, North Dakota and East Grand Forks, Minnesota, Kweit and Kweit concluded that the latter was much more successful because it engaged citizens in two-way communication and choice about activities. "[T]he symbolic value of participation may be more important than its instrumental value." M.G. Kweit and R.W. Kweit, "Citizen Participation and Citizen Evaluation in Disaster Recovery," American Review of Public Administration 34.4 (2004), as quoted in Carol Amaratunga and Tracey O'Sullivan, "In the Path of Disasters: Psychosocial Issues for Preparedness and Recovery," Prehospital and Disaster Medicine 21.3 (May-June 2006): p. 152. Amaratunga and O'Sullivan, focusing primarily on disasters abroad, endorse the "need to involve aid beneficiaries as active partners in relief strategies" as one of their four "main themes" in disaster recovery. Findings on this point in domestic as well as foreign contexts are broadly documented in Peter Sandman's public com-munications research. See <http://www.psandman.com>, particularly Peter M. Sandman and Jody Lanard, "Crisis Communication: Encouraging and Active Rather Than Passive Public" (2004), accessed March 6, 2007 at <http://www.psandman.com/handouts/AIHA/page34.pdf>.

[42]It is evident that disasters can catalyze improvements in the social and political circumstances of affected societies. For example, after a tornado in Ohio most citizens found that they could handle crises effectively and felt that they were better off for having met the challenge. E.L. Quarantelli, "An Assessment of Conflicting Views on Mental Health: The Consequences of Traumatic Events," in C.R. Figley, ed., *Trauma and its Wake,* Routledge (1985). See also Christopher G. Davis and Jolene M. McKearney, "How Do People Grow from their Experience with Trauma or Loss?" *Journal of Social and Clinical Psychology* 22, 5 (November 2003), and Calhoun, L.G. and Tedeschi, R. G. "Posttraumatic Growth: Future Directions," in Tedeschi, R. G., et al., *Posttraumatic Growth: Positive Changes in the Aftermath of Crisis,* Lawrence Erlbaum Associates (1998): p. 215.

[43]The mental challenge of terrorism is substantial for all forms of attack, but the challenge from bioterrorism is particularly great because it is very unfamiliar; it involves elemental fears of disease and infection; it is invisible; it lingers; and, as we will explain, it readily lends itself to repetition ("campaign terrorism"). On the other

side of the coin, the unfamiliarity of bioterrorism means that potential users may be discouraged if they see that we are prepared and early uses have positive effects on our national unity and confidence in our government. For more on the particularly difficult mental challenge of bioterror, see H.C. Holloway, et al., "The Threat of Biological Weapons. Prophylaxis and Mitigation of Psychological and Social Consequences," *Journal of the American Medical Association* 278 (1997): p. 425-427.

[44]Friedrich Nietzsche, *The Wanderer and His Shadow,* (1879), R.J. Hollingdale, trans., (Cambridge University Press, 1996). The full thought is worth quoting, "Along the journey we commonly forget its goal. Almost every vocation is chosen and entered upon as a means to a purpose but is ultimately continued as a final purpose in itself. Forgetting our objectives is the most frequent stupidity in which we indulge ourselves."

[45]London Assembly "Report of the 7 July Review Committee," Greater London Authority (June 2006): p. 124, accessed March 6, 2007 at <http://www.london.gov.uk/assembly/reports/7july/report.pdf>.

[46]Both physical and psychological health care concerns will endure long after an attack. Some of these will be from enduring contamination or late manifesting consequences of exposure around the time of the attack, some of them arise from psychiatric trauma resulting from the attack. In regard to the latter, see for example, A. Baum, et al., "Emotional, Behavioral and Physiological Effects of Chronic Stress at Three Mile Island," *Journal of Consulting and Clinical Psychology* 565 (1983): p. 51. Here we are concerned simply with the more immediate demand for physical care.

[47]In 2003, the Centers for Disease Control conducted over fifty focus groups in which representative citizens groups were asked to identify their concerns in response to a variety of terrorist scenarios. The resulting summaries include citizen concerns about all the issues identified here, but they are mingled with other, lower priority concerns and were used only as inputs for considering future messages, not for developing strategies for consequence management. See generally, Steven Becker, "Emergency Communication and Information Issues in Terrorist Events Involving Radioactive Materials," *Biosecurity and Terrorism* 2.3 (2004).

[48]See, for example, this rhetoric in "Press Conference by Under Secretary George Foresman and Assistant Secretary Tracy Henke on the FY 06 Homeland Security Grant Program," Office of the Press Secretary, The White House, (May 31 2006) accessed March 6, 2007 at <http://www.dhs.gov/xnews/releases/press_release_0922.shtm> explaining their criteria for the release of $1.6 billion in 2006 Homeland Security grants. Many of these terms reflect the more overarching framework in Homeland Security Presidential Directive 10, "Biodefense for the 21st Century," The White House, (April 28, 2004) accessed March 6, 2007 at <http://www.fas.org/irp/offdocs/nspd/hspd-10.html>. This document, the most complete articulation of our biodefense strategy, proposes organizing around "four pillars": "Threat Awareness" (by developing intelligence and undertaking assessments, including efforts to anticipate future threats), "Prevent and Protect" (through diplomacy, interdiction and critical infrastructure protection), "Surveillance and Detection" (through attack warning and attribution) and "Respond and Recover" (through response planning, risk communication, medical counter-measures, mass casualty care and decontamination).

[49]The previously mentioned Citizen Emergency Response Teams (CERT) are the exception to this general tendency.

[50]See generally, Douglas Brinkley, *The Great Deluge: Hurricane Katrina, New Orleans, and the Mississippi Gulf Coast,* (William Morrow, 2006) and Christopher Cooper and Robert Block, *Disaster: Hurricane Katrina and the Failure of Homeland Security,* (Times Books: 2006).

[51]A mask could afford protection so long as anthrax particles were aerosolized or likely to be re-aerosolized. In cases of contagious illness (such as smallpox), masks may protect against people infecting one another.

[52]Peter M. Sandman, "Anthrax, Bioterrorism, and Risk Communication: Guidelines for Action," (December 29, 2001) accessed March 6, 2007 at <http://www.psandman.com/col/part1.htm≥. See also Richard G. Peters, Vincent T. Covello, and David B. McCallum, "The Determinants of Trust and Credibility in Environmental Risk Communication: An Empirical Study," *Risk Analysis* 17.1 (1997): p. 43 and "Communicating in a Crisis: Risk Communication Guidelines for Public Officials" Substance Abuse and Mental Health Services Administration, U.S. Department of Health and Human Services (2002), accessed March 6, 2007 at <http://www.riskcommunication.samhsa.gov/index.htm>.

[53]As this paper was being prepared for publication, the CDC issued "Interim Guidance for the Use of Facemasks and Respirators in Public Settings during an Influenza Pandemic." The guidance is billed as a "best estimate" pending the results of "studies. . .underway. . .to learn more about whether masks and respirators can provide protection from influenza and how people would use such devices." We view this as a step forward, but as discussed below (see endnote 112), we believe that the science base for this advice should be strengthened and it should be adapted to bioterrorism scenarios of concern.

[54]Falkenrath observes: "the U.S. government is more likely to be an observer than a manager of these rapid, large-scale changes in transportation patterns. . .the government will frankly have no idea of what to recommend to millions of different actors who will or could take to the roads, rails, waterways or skies." Op. cit. p. 137. Our conversations with members of different agencies within the same jurisdictions suggest that even they have different recommendations and expectations about these policies.

[55]After the anthrax attacks of 2001, Congress appropriated funds to assist states and localities in preparing for bioterror. These funds were distributed through two programs run through HHS CDC and HSRA components. CDC's Public Health Preparedness and Response for Bioterrorism Program established a set of critical capacities that states must meet to gain funding. Critical capacity #15 requires states that request CDC funding "to provide needed health/risk information to the public and key partners during a terrorism event by establishing critical baseline information about the current communication needs and barriers within individual communities, and identifying effective channels of communication for reaching the general public and special populations during public health threats and emergencies." However, these programs are left to states to plan and execute, with no federal guidance or evaluation measures. See U.S. General Accounting Office, "HHS Bioterrorism Preparedness Programs: States Reported Progress but Fell Short of Program Goals for 2002," GAO-04-360R, (February 10, 2004).

[56]"Federal, state, and local officials gave contradictory messages to the public, creating confusion and feeding the perception that government sources lacked credibility." The White House, "The Federal Response to Hurricane Katrina: Lessons Learned" (February 2006): p. 60, accessed March 6, 2007 at <http://www.whitehouse.gov/reports/katrina-lessons-learned.pdf >.

The confusion caused by differing action messages following an emergency is well documented. Dennis S. Mileti and John H. Sorensen, "Communication of Emergency Public Warnings: A Social Science Perspective and State-of-the-Art Assessment," Prepared for the Federal Emergency Management Agency, Oak Ridge National Laboratory (1990), reviews 200 empirical studies.

The Department of Homeland Security's ready.gov site is the primary citizen-communication program for bioterrorism. It has general information regarding preparing for emergencies, but reliable, useful messages backed by evidence on the specific questions individuals would ask following a bioterror attack have not been developed, because the basic research (on the efficacy of masks, filters, personal and home decontamination, etc.) does not yet exist. HHS and DHS have developed multiple, very well-crafted crisis communication tools — but all focus on the process, not the substance, of these communications.

The National Incident Management System created by Homeland Security Presidential Directive 5, also calls for the creation of a process for communicating with the public — but does not address the research needed to develop the substance of those communications. CDC calls for communication programs for all states and localities receiving its bioterrorism funding (see Budget Attachment F, Critical Capacity #15 in the 2005 CDC Budget). Yet these, like those of HHS and DHS, are mandates that call for state-based communications development — they do not fund the research needed to develop the substance of these messages; many states expect that substance to emanate from the federal level. (For example, see Colorado's pandemic influenza plan, which expects the substance of its communications programs to be supplied by the CDC).

A study across twelve nationally representative metropolitan communities found that smaller counties did not have the funds to hire an information officer to even disseminate information, and that they relied on the state and the CDC to educate the public on issues such as anthrax. See Megan McHugh, et al., "How Prepared are Americans for Public Health Emergencies: Twelve Communities Weigh In," *Health Affairs* 23.3 (2004): p. 205.

[57] The federal government's role in developing and testing messages, and providing the basic research for message content, has been recognized in pandemic flu preparedness. A comprehensive account of how the federal government should prepare communications materials for pandemic flu is available in Supplement 10 of the "HHS Pandemic Influenza Plan," (November 2005) accessed March 6, 2007 at <http://www.hhs.gov/pandemicflu/plan/pdf/HHSPandemicInfluenzaPlan.pdf>.

[58] Polling data shows that those who say they have "not much to none at all" trust in the federal government have hovered around 40-50 percent for the past forty years, although state and local government retains greater citizen trust. In meeting the citizen desire for response, we must be cognizant of this basic credibility gap. See "How Americans View Government: Deconstructing Distrust," Pew Research Center for People and the Press, 10 March 1998, <http://people-press.org/reports/display.php3?ReportID=95>. See also, "The ANES Guide to Public Opinion and Electoral Behavior" The American National Election Studies, Center for Political Studies, University of Michigan (no date), accessed March 6, 2007 at <http://www.electionstudies.org/nesguide/nesguide.htm>.

Clearly Katrina exacerbated this distrust. "Katrina did more than devastate New Orleans and the Gulf Coast; it deepened pre-existing divides between American institutions, government and the media, and, to varying degrees, between those institutions and citizens." May, op. cit. p. 20.

[59] This tendency of individuals to double-check information received from authorities with their own social networks is discussed in detail in part III. For studies of this effect, see D. Mileti and C. Fitzpatrick, *The Great Earthquake Experiment: Risk Communication and Public Action,* (Westview Press, 1993) and L. Christenson and C. Ruch, "The Effect of Social Influence on Response to Hurricane Warnings," *Disasters* 4 (1980): p. 205.

[60] E.M. Begier, et al., "Connecticut Bioterrorism Field Epidemiology Response Team, "Gram-positive rod surveillance for early anthrax detection," *Emerg. Infect. Dis.* 11 (2005): p.1483.

[61] Misdiagnosis may also be a problem, at least in the period before there is widespread awareness of an attack. A recent study from Johns Hopkins University of 601 residents and 30 attending physicians in over 16 states found that they would likely misdiagnose anthrax, botulism, plague, and smallpox an average of 47 percent of the time and they made incorrect management decisions regarding diseases diagnosed three-quarters of the time. The average diagnostic score rose above 79 percent after taking a web-based training course. Sara E. Cosgrove, et al, "Ability of Physicians to Diagnose and Manage Illness Due to Category A Bioterrorism," *Archives of Internal Medicine* 165.17 (September 26, 2005): p. 2002. In another case, authors sent a mock pulmonary anthrax patient to 23 emergency departments in Israel, planting X-rays and lab results consistent with anthrax. While 91 percent of the institutions admitted the patient, only 61 percent of emergency physicians entertained the diagnosis of anthrax, and only 43 percent of hospitals made appropriate warning notification to Israeli authorities. See: Leiba A. Goldberg, et al., "Lessons Learned from Clinical Anthrax Drills: Evaluation of Knowledge and Preparedness for a Bioterrorist Threat in Israeli Emergency Departments," *Annals of Emergency Medicine* 48.2 (August 2006): p. 194-199.

[62] These sensors also cannot detect whether an attack was from a moving or fixed source or whether multiple attacks occurred simultaneously in disparate places (an Al-Qaeda trademark, as for example when both the World Trade Center and the Pentagon were attacked and a third target was intended for the fourth airplane). These failings make BioWatch only marginally helpful in capturing the perpetrator of an attack, a point discussed in greater depth later.

[63] Joseph Barbera and A.G. Macintyre, "Medical Health and Management (MaHIM) System," Final Report, George Washington University (December 2002): p. 2. The urge for families to stay together during emergencies has been documented in multiple studies of evacuation behavior: E. Quarantelli, "Evacuation Behavior and Problems: Findings and Implications from the Research Literature," Disaster Research Center (1980); R. Perry, "Evacuation Decision-Making in Natural Disasters," *Mass Emergencies* 4 (March 1979): p. 25.

[64] See the "September 11, 2001, Documentary Project," Library of Congress, which contains oral histories, photographs, and other memorabilia, including accounts of missing person posters that clustered in multiple parts of Manhattan following September 11. "September 11, 2001, Documentary Project" Library of Congress, accessed March 6, 2007 at <http://memory.loc.gov/ammem/collections/911_archive/>.

[65] See "The Internet Under Crisis Conditions: Learning from September 11," The National Academies (2003): p. 44, 47, accessed March 6, 2007 at <http://www.nap.edu/catalog.php?record_id=10569#toc>. Immediately after 9/11, Prodigy Communications created an "I'm ok" online message center to help people locate loved ones, a frequent activity among others who spontaneously organized. See also, "Internet Proves Vital Communication Tool," CNN.com, (September 12, 2001), accessed March 6, 2007 at <http://archives.cnn.com/2001/TECH/internet/09/12/attacks.internet/index.html>.

[66] See generally, Kathleen Swendiman and Jennifer Elsea, "Federal and State Quarantine and Isolation Authority," Congressional Research Service Report RL 33201 (2006); and John Blum, "Too Strange to be Fiction: Legal Lessons from a Bioterrorist Simulation: The Case of TOPOFF 2," *Louisiana Law Review* 54 (2004): p. 905. Overly quick burials of the deceased prior to identification took place after the 2003 tsunami, and might occur if casualties mount quickly enough, as they did after the 1918 influenza.

[67]For more information on Israel's centralized medical facility admittance notification system, see endnote 179.

[68]A vaccinate-without-diagnosis strategy must grapple with the significant problem of vaccine complications and people who will balk at receiving the vaccine because of legitimate fears of complications. Individuals at high risk for developing complications from the smallpox vaccine include infants under 1 year of age, pregnant women, people currently undergoing chemotherapy, people with compromised immune systems from diseases such as HIV, lupus, organ transplant, or other causes, people taking steroids, those allergic to certain antibiotics, and those with a number of skin conditions from impetigo to burns. Roz Lasker, "Redefining Readiness: Terrorism Planning Through the Eyes of the Public," New York Academy of Medicine (2004): p. 13. According to the two major studies on adverse reactions conducted, both from 1968, serious complications from the smallpox vaccine may be as high as 935 per million, with life-threatening adverse reactions as high as 52 per million, and a death rate of 1.5 per million. A comparison of two study techniques viewed these as the higher, but more accurate, numbers for complications; see J.M. Lane, et al., "Complications of Smallpox Vaccinations, 1968: National Surveillance in the United States," *New England Journal of Medicine* 281 (1969): p.1201 and J.M. Lane, et al., "Complications of Smallpox Vaccination, 1968: Results of Ten Statewide Surveys," Journal of Infectious Diseases 122 (1970): p. 303. The numbers for the national survey were 49 serious adverse reactions, 14 life-threatening, and 1 death per million). While the Redefining Readiness study places the number at risk of developing serious illness from the vaccine as high as 20 percent, that number is derived from historical data on the number of individuals developing adverse reactions that caused them to consult a physician, including fever, lesions, etc., but many of these were not considered medically serious. See "Smallpox Vaccinations and Adverse Reactions," *Morbidity and Mortality Weekly Report* 52.BR-4 (February 21, 2003): p. 4, 8.

[69]The Strategic National Stockpile contains oral antibiotics sufficient to provide a post-exposure 60-day regimen to approximately 41.5 million individuals. The SNS also holds intravenous antibiotics to treat approximately 831,000 symptomatic anthrax patients. We also have 5 million doses of the anthrax vaccine on hand, and the HHS has contracted for 5 million additional doses of AVA by mid-2007. HHS has also contracted for 75 million doses of a "next generation anthrax vaccine" and expects the first delivery of 25 million doses by October 2009, according to the Congressional testimony of Gerald W. Parker, Principal Deputy to the Assistant Secretary, Office of Public Health Emergency Preparedness, HHS, before the Committee on Government Reform Subcommittee on National Security, Emerging Threats, and International Relations, May 9, 2006, accessed March 6, 2007 at <http://www.hhs.gov/asl/testify/t060509a.html>.

[70]The costs of delay in distribution are carefully calculated in Dena Bravata, et al., "Reducing Mortality from Anthrax Bioterrorism: Strategies for Stockpiling and Dispensing Medical and Pharmaceutical Supplies," *Biosecurity and Bioterrorism* 4.3 (2006): p. 244.

[71]Our current plans presume that confirmed cases of smallpox will trigger a campaign of universal vaccination. Vaccination is likely to be useful if received at any time within the first 120 hours or so of exposure. But it is well established that it is more useful the earlier it occurs within the 120 hour window. Falkenrath, op. cit. p. 136. See also Trust for America's Health, "Ready or Not: Protecting America's Health from Diseases, Disasters and Bioterrorism" (2006): p. 14, accessed March 6, 2007 at <http://healthyamericans.org/reports/bioterror06/BioTerrorReport2006.pdf> reporting CDC's assessment that only 16 of 54 jurisdictions (the states, plus New York City, Los Angeles County, Chicago

and Washington, D.C.) were rated "green" or "green minus" in their preparedness to distribute the Strategic National Stockpile.

[72]As a comprehensive University of Minnesota Center for Infectious Disease Research and Policy fact sheet states, "Immunity to variola virus generally develops within 8 to 11 days after vaccination. Since the incubation period for smallpox averages about 12 days, vaccination soon after exposure (i.e., within 4 days) may confer some immunity to exposed persons and reduce the likelihood of a fatal outcome." The fact sheet further states that "Studies on the utility of postexposure vaccination have shown conflicting results" and in particular "How late after exposure individuals can be vaccinated and not become ill is unclear." University of Minnesota Center for Infectious Disease Research and Policy, "Smallpox: Current, comprehensive information on pathogenesis, microbiology, epidemiology, diagnosis, treatment, and prophylaxis" accessed May 3, 2007 at <http://www.cidrap.umn.edu/cidrap/content/bt/smallpox/biofacts/smllpx-summary.html>. One study suggests that a delay of diagnosis of five days (120 hours) could result in a 30 percent increase in the number of individuals affected, see Martin Meltzer, et al., "Modeling Potential Responses to Smallpox as a Bioterror Weapon," *Emerging Infectious Diseases* 7.6 (2001): p. 959.

[73]Three competing priorities need to be reconciled: a "sinking ship" model (the most vulnerable members of the population go first, like women and children on a sinking ship), a utilitarian model (those who perform the most important function go first), and a risk model (those most likely to have been exposed get priority). We stress that it not only important that these priorities be established, but also that they be broadly accepted. More effort has gone into the former than the latter.

There have been some commendable initiatives to debate priorities in the context of a potential influenza epidemic. For example, the Department of Health and Human Services' National Vaccine Advisory Committee (NVAC) and Advisory Committee on Immunization Practices (ACIP), as part of the department's "Pandemic Influenza Plan," have made unanimous recommendations respecting use of vaccines and antiviral drugs in an influenza pandemic. The groups propose four tiers, with subtiers within them. At the highest level of prioritization, Tier 1A, are those involved in vaccine and antiviral manufacturing and health care workers likely to be in direct contact with patients. Tier 1B consists of those at highest risk because of their medical histories or conditions, such as those with a history of influenza hospitalization. At Tier 1C are pregnant women, household contacts of immunocompromised individuals unable to be vaccinated, and household contacts of infants. At Tier ID are pandemic-related public health responders and key government leaders. At Tier 2A are those 65 years of age and older. Tier 2B is composed of critical infrastructure-related personnel. At Tier 3 are a broader circle of government decision makers and providers of mortuary services. Finally, Tier 4 consisted of healthy individuals not included in any of the above categories. "HHS Pandemic Influenza Plan," Appendix D: NVAC/ACIP Recommendations for Prioritization of Pandemic Influenza Vaccine and NVAC Recommendations on Pandemic Antiviral Drug Use, accessed December 12, 2006 at <http://www.hhs.gov/pandemic-flu/plan/appendixd.html>. See also the recommendations of the Minnesota Health Care Ethics Center, Dorothy Vawter, et al., "Allocating Pandemic Influenza Vaccines in Minnesota: Recommendations of the Pandemic Influenza Ethics Work Group," (2006), accessed March 6, 2007 at <http://www.stolaf.edu/mnethx/PanFluReport.pdf>.

[74]A CDC public engagement pilot project on pandemic influenza asked 100 citizens in Atlanta to deliberate on how a limited initial supply of pandemic influenza vaccine should be distributed. It tested those results against additional public views in

Oregon, Nebraska, and Massachusetts. From this it concluded that citizens wanted the first doses of vaccine to be given to those essential for ensuring the functioning of society, before vaccine was used to minimize death. However, they were extremely worried about the growth of this "essential" circle, and wanted it drawn as narrowly as possible. See Roger Bernier, "Handout: The Public Engagement Pilot Project on Pandemic Influenza (PEPPPI)," 2006 National Immunization Conference (March 8, 2006), accessed March 6, 2007 at <http://cdc.confex.com/cdc/nic2006/techprogram/P11639.HTM>.

[75]The rationale is best articulated in the plans for influenza vaccination. See U.S. Department of Health and Human Services, "HHS Pandemic Influenza Plan" Supplement E (2005). For a critique of this approach, see Ezekiel J. Emanuel and Alan Wertheimer, "Who Should Get Influenza Vaccine When Not All Can?" *Science* 312.5775 (2006): p. 854.

[76]In past health epidemics, riots and public anger have followed rumors that treatment was unequal or biased against a class, ethnic, or minority group. See, for example, W.G. Edison, "Confusion, Controversy and Quarantine: the Muncie Smallpox Epidemic of 1893," *Indiana Magazine of History* 86 (1992): p. 374, and Judith Walzer Leavitt, "Public Resistance or Cooperation? A Tale of Smallpox in Two Cities," *Biosecurity and Bioterrorism* 1.3 (September 2003): p. 185. Walzer notes that when the population of Milwaukee felt that authorities were treating rich and poor differently during the smallpox outbreak of 1894, riots ensued.

[77]The New York Academy of Medicine conducted telephone interviews with a random sample of 2,545 adults, asking, among other things, how they would respond to government directions to receive vaccinations in the wake of a smallpox attack. The study concluded that distrust of government instructions would make "26 percent of the population afraid to go to the vaccination site." Lasker, Roz, "Redefining Readiness: Terrorism Planning Through the Eyes of the Public," New York Academy of Medicine, (2004). We discuss this study in more detail in Part III.

[78]Ibid. p. 8. Many, of course, are worried not just about the vaccination site, but about the safety of the vaccine. The New York Academy of Medicine observed that four months after the targeted completion of the government's campaign to vaccinate 440,000 health care workers against smallpox, only one in twelve of these people were vaccinated (p. 2).

[79]Because a smallpox victim normally takes more than ten days to become infectious, there will be a window after an initial attack in which those on a vaccination line would normally not be contagious. But this assumes normalcy — those exposed to a heavy dose of smallpox near an attacker's release site might much more rapidly become infectious. Moreover, after this first window, if smallpox were prevalent in the population, many of those in line might already be infected.

[80]We note, for example, that when a single incident of smallpox was found in New York City in 1947, leading to the infection of 12 others, the city led a massive campaign for vaccination, and millions of New Yorkers (the numbers are disputed, but are placed at between 2.5 and 6 million out of a city population of 7.8 million) heeded the call. Thousands waited in enormous lines for hours to receive their vaccination — outcry was prompted only by the city running out of vaccine. See Kent A. Sepkowitz, "The 1947 smallpox vaccination campaign in New York City, revisited," letter, *Emerging Infectious Disease* (May 2004) accessed March 6, 2007 at <http://www.cdc.gov/ncidod/EID/vol10no5/03-0973.htm>. These efforts did not, however, have to deal with quite so open a media or concerns about environmental contamination.

[81]A number of federal programs aim to expand the base of trained medical personnel from which medical facilities could draw. The Medical Reserve Corps brings together practicing and retired health professionals, as well as interested lay volunteers, to address ongoing health needs in their communities as well as prepare for disaster response. There are 459 MRC units nationwide, composed of well over 82,000 individuals (reported from just 278 of those MRCs). Nearly all are credentialed medical professionals, although some MRCs accept laypeople. For instance, New York City's MRC (the second largest MRC unit with 4,748 participants) has the following skill breakdown: 1,071 physicians, 174 physician assistants, 1,346 registered nurses, 155 licensed practical nurses, 162 nurse practitioners, 700 mental health professionals, 160 pharmacists, 182 dentists, 223 EMT/Paramedics, 12 veterinarians, 562 other.

Because many of these individuals are practicing health professionals, they may not all be available as surge capacity in the case of a disaster. MRC units have no standardized training, but their licenses and credentials are checked, and they are asked to participate throughout the year in local public health needs. Further information on MRCs can be found at: <http://www.medicalreservecorps.gov> (accessed March 6, 2007).

Citizen Corps, the umbrella group under which the MRC is located, also has Citizen Emergency Response Teams of laypeople training for disaster preparedness. Over 200,000 individuals have taken part in CERT's 20-hour training courses, which include very basic medical response training. CERT is a nationwide training program, however, the participation of individuals in these teams after attending the course varies widely across the nation. For more information on CERT, including the issues covered in the CERT course, see <http://www.citizencorps.gov/cert/about.shtm> (accessed March 6, 2007).

The Natural Disaster Medical System includes 35-member Disaster Medical Assistance Teams of physicians, nurses, pharmacists, and paramedic providers, as well as Disaster Mortuary Operational Response Teams to provide mortuary services, and Veterinary Medical Assistance Teams to provide veterinary service. There are 55 operational Disaster Medical Assistance Teams across the United States, which are registered and maintain an MOA with DHS. For more information, see: <http://www.oep-ndms.dhhs.gov/> (accessed March 6, 2007).

The Emergency System for Advance Registration of Volunteer Health Professionals (ESAR-VHP) is intended to accomplish what its name implies, but is just getting underway. There is likely to be significant overlap between these programs, as well as between these capacities and other first responder and military capacities that might be called into action during an emergency scenario. For more information see <http://www.hrsa.gov/esarvhp/> (accessed March 6, 2007).

[82]Credible assessments of surge capacity are difficult to assemble and inconsistent from jurisdiction to jurisdiction. A commendable recent effort has been made to introduce standard concepts and terms, first in a May, 2006 Academic Emergency Medicine consensus conference on "The Science of Surge" and then in an issue of Academic Emergency Medicine devoted to this topic. The discussion in that journal distinguishes between "health system daily surge" and the "extraordinary surge" in demand that would be associated with catastrophic events. The extraordinary surge "is larger scale, is more complex, and has incremental nonlinear multicomponent interactions with capacity compared to its simpler cousin, daily surge . . . . The broader public health system is frequently involved, as are community infrastructure, regional (even national) assets, and political institutions. In fact, in some scenarios, the E[mergency] D[epartment] may play only a modest role in a catastrophic event and in some may not play any role that is fundamentally different than for daily surge." Gabor Kelen and Melissa McCarthy, "The Science of Surge," *Academic Emergency Medicine* 13.11 (November 2006): p. 1090. Using this new terminology, our discussion is about extraordinary surge demand after a catastrophic bioterror event, the limited capacity likely to be available to meet it, and the consequent deficit in our surge capacity.

[83]As of January 2005, American hospitals had an estimated 109,000 vacant positions for registered nurses — meaning that 8.1 percent of all registered nurse positions were vacant as of December 2004. In 2005, 40 percent of hospitals reported that it was more difficult to recruit nurses than in 2004. While rising unemployment has led some older workers to reenter the hospital workforce, the general registered nurse population is aging and retiring, leading to estimates of far larger shortages in the future. See "Taking the Pulse: The State of America's Hospitals," American Hospital Association (2005). These findings are drawn from 700 hospital surveys returned by 4,800 hospital CEOs. Further information on the projected future shortage of nurses, and the methodology behind these labor projections, can be found on the fact sheet and data sites provided by the American Association of Colleges of Nursing, <http://www.aacn.nche. edu/Media/FactSheets/NursingShortage.htm> (accessed March 6, 2007).

[84]Appendix A describes calculations that underlie this paragraph.

[85]During this period, emergency room visits grew by 26 percent. See *Hospital-Based Emergency Care: At the Breaking Point,* National Academies Press, (June 14, 2006): p. 1. To demonstrate the impact within a single state: in all of Minnesota, there are 16,414 licensed hospital beds — over the past 20 years, 3,000 beds and 36 hospitals have been lost. John L. Hick, Medical Director of the Minnesota Department of Public Health, "No Vacancy: Healthcare Surge Capacity in Disasters," PowerPoint Presentation, (July 22, 2004) accessed March 6, 2007 at < www.ama-assn.org/ama1/pub/upload/ mm/415/hick.ppt >.

[86]S.J. Weiss, et al., "Estimating the Degree of Emergency Department Overcrowding in Academic Medical Centers: Results of the National ED Overcrowding Study (Nedocs)," *Academic Emergency Medicine* 11.1 (2004): p. 38. Also see V.M. Bradley, "Placing Emergency Department Crowding on the Decision Agenda," *Journal of Emergency Nursing* 31.3 (2004): p. 247.

As an illustration, we note that the emergency department of Inova Hospital in Fairfax, Northern Virginia's only hospital with Level 1 trauma ability and one of the largest emergency departments in the Washington, D.C. region, just underwent an expansion that nearly doubled its size. With the expansion, Inova now has 58 spaces where patients can be treated, 43 emergency treatment rooms with beds, 12 emergency pediatric rooms, and hallway space that can accommodate up to 22 more patients — enabling it to take, at maximum, 135 patients at a time. With the expansion, they expect to be able to care for 85,000-90,000 patients a year, or approximately 300 patients per day. See Lisa Rein, "The Wait is Over," *The Washington Post,* November 17, 2005, p. VA03.

[87]For a comprehensive and current review of the literature on ambulance diversion and the use and misuse of this data as indicators of crowding, see Julius Cuong Pham, et al., "The Effects of Ambulance Diversion: A Comprehensive Review," *Academic Emergency Medicine* 13.11 (November 2006): p. 1220ff.

[88]*Hospital-Based Emergency Care: At the Breaking Point,* National Academies Press (June 14, 2006): p. 201.

[89]We define the National Capital area as incorporating the District of Columbia, including its four military hospitals and two specialty hospitals, as well as the Northern Virginia counties of Arlington, Loudon, Fairfax, and Prince Williams, and Maryland's Montgomery and Prince George's Counties. Numbers are drawn from the District of Columbia Hospital Association and Virginia Health Information Statistics, which detail operating staffed beds, and the Maryland Annual Report on Licensed Acute Care Hospital Bed Capacity, which details licensed beds — the operational, staffed number

may be slightly lower. Emergency visits per day are calculated in the Appendix — these numbers are drawn from the annual visits to the eight public hospitals in Washington, D.C., and the hospitals in the Maryland National Capital Region. Virginia hospital numbers are extrapolated from Inova statistics and equivalent estimations based on emergency department size at other northern Virginian hospitals. For further information on these statistics, see Appendix A.

[90]A 2003 study claims that 50.3 percent of all emergency room visits were urgent or emergent, requiring care within 15 minutes to one hour, while an additional 33 percent were characterized as semi-urgent, requiring care within 1 to 24 hours. Just 12.8 percent were characterized as non-urgent, with 17.7 percent unknown. Our highly optimistic estimate thus assumes the freeing of all but the most urgent cases — a very difficult prospect to imagine, as one study found that 82 percent of non-urgent clients still see their cases as requiring urgent care. See L.F. McCraig and C.W. Burt, *National Hospital Ambulatory Medical Care Survey: 2003 Emergency Department Summary,* National Center for Health Statistics (2005); and J.M. Gill and A.W. Riley, "Nonurgent Use of Hospital Emergency Departments: Urgency from the Patient's Perspective," *Journal of Family Practice* 42.5 (1996): p. 491; both cited in "Hospital-Based Emergency Care: At the Breaking Point," p. 34 and 38. We note that it is consistent with these observations that hospital admissions were reduced by "a modest 12 percent" when restrictions were imposed during the SARS outbreak in Toronto. Michael Schull, et al., "Surge Capacity Associated with Restrictions on Nonurgent Hospital Utilization and Expected Admissions during an Influenza Pandemic: Lessons from the Toronto Severe Acute Respiratory Syndrome Outbreak," *Academic Emergency Medicine* 13.11 (November 2006): p. 1228, 1230.

[91]Not all of these hundred thousand would present themselves to emergency rooms on the same day. The bulk might spread over two to four days. But these numbers are still a multiple of those that might be adequately processed. As we observe below, these numbers are likely to be greatly amplified by the worried well.

[92]Each required staffing from existing local capacity as well as 40,000 square feet of enclosed space and an enabling environment (for example, loading docks, electrical power source systems, climate control, communications, and information technology support). See Michael O. Levitt, Secretary of HHS, Testimony before the Committee on Health, Education, Labor and Pensions of the U.S. Senate, (March 16, 2006).

[93]The experience in Houston with those displaced from Katrina suggests the magnitude of emergency medicine that can be provided when the providing region has not itself been hit. The emergency clinic erected near Houston four days after the hurricane saw 2,000 patients in its peak first day and a total of 15,000 patients over 15 days. See John L. Hopper, "A Safety Net that Held Strong, Breaking the Fall of 15,000," *Houston Chronicle,* September 18, 2005, accessed March 6, 2007 at http://www.chron. com/disp/story.mpl/special/05/katrina/3359332.html; and Kimberly Barbour, et al., "From Despair to Hope: BCM Responds to Katrina," *Solutions Magazine* 1.3 (Fall 2005) accessed March 6, 2007 at <http://www.bcm.edu/solutions/v1i3/katrina.htm>.

[94]Worried well numbers are very difficult to calculate, and we address the accuracy of these estimates at length in Part III.

[95]Evidence on illness and absenteeism of nurses and doctors during an epidemic is scattered. John Barry describes a military hospital in the influenza epidemic of 1918: ". . . 70 out of 200 nurses were already sick in bed themselves, with more falling ill each hour." John Barry, *The Great Influenza,* (Penguin Group, 2004): p. 189. Yet in the Spanish Flu epidemic of 1918-1919, volunteer nurses and retired nurses came to the aid of cities around the country, with 1,500 volunteering before the Red Cross even found

the money to pay them; Alfred Crosby, *America's Forgotten Pandemic: The Influenza of 1918,* (2nd Ed. Cambridge University Press, 2003): p. 51.

Poll data would predict absentee rates between one in five and one in three. Dan Hanfling, et al., "Will They Come To Work? Evaluating Healthcare Workforce Knowledge and Intent Regarding Hospital Disaster Response," presented at the MidAtlantic Society for Academic Emergency Medicine conference, September 23, 2005, reports: "When asked if they would report to the hospital to work, 32 percent (95 percent CI: 28-37 percent) reported that they would not do so if there were radiologically contaminated patients in the hospital. 27 percent (95 percent CI: 23-32 percent) would not report for work if there were chemically contaminated patients in the hospital, and 34 percent (95 percent CI: 30-39 percent) would not report for duty if there were biologically exposed patients in the hospital." (This survey was conducted in December, 2004). This is consistent with a study of registered nurses in Colorado in which 112 nurses were surveyed and 91 surveys were returned. 73 percent of those who responded said they would enter the facility where they were employed if it was under quarantine but needed the staffing. 36 percent of the nurses polled were unwilling to report to another local care facility under quarantine if it was not their normal place of employment but needed staff assistance. Mary Moorehouse and James I. Burns, "Disease Surveillance and Response: Using Surveys to Iteratively Hone Questions for Future Research," NDMS Conference, Dallas (2004).

On the other hand, DiGiovani, et al., report that "[a]lthough Killian, in a seminal paper published 50 years ago, raised the possibility that emergency personnel might abandon their jobs and tend, instead, to the needs of their families during a community disaster, Quarantelli investigated the response of over 6,000 emergency workers in 150 tornadoes, floods, hurricanes, and earthquakes between 1964 and 1974, and found no evidence that these workers abandoned their official responsibilities." *Op. cit.* report, unnumbered, p.2.

[96] As the Department of Homeland Security, "National Response Plan, Biological Incident Annex" 2004, p. 3, recites: "A biological incident may be distributed across multiple jurisdictions simultaneously, requiring a non-traditional incident management approach. This approach could require the simultaneous management of multiple 'incident sites'. . ."

We think California's "Little Hoover Commission" raised the right issues when it wrote that "Catastrophes stand apart. During catastrophes, most or all infrastructure is damaged and may be inoperable. Residents in impacted communities — including emergency responders — are unable to undertake normal roles. Large numbers of residents and responders are victims. Most or all traditional functions — including government operations — are completely or partially shut down. Local mutual aid strategies are ineffective, because of the distribution of impacts on neighboring jurisdictions and communities. . . Catastrophes require different operating procedures. The loss of functional infrastructure halts the use of traditional communication, transportation and power networks. Local responders familiar with community needs and resources often are unavailable, necessitating reliance on external responders with little knowledge of local geography, cultures and possibly languages. Resource demands far outstrip supplies, creating competition and political pressure for scarce response capacity." State of California, Little Hoover Commission, *Safeguarding the Golden State: Preparing for Catastrophic Events,* (2006): p. 14.

[97] As described in endnote 34, present goals are to extend treatment capacity by an additional 500 patients per million residents. In New York City, for example, this implies a surge capacity adequate to treat some 4,000 additional patients.

[98] Hospital grants from the Health Resources and Services Administration's Bioterrorism Hospital Preparedness Program in 2002 were typically between $5,000 and $10,000 (although occasional hospitals received $50,000-$100,000 from other federal sources, generally the Department of Justice)——see the National Institute of Medicine study "Hospital-Based Emergency Care: At the Breaking Point" National Academies Press (2006): p. 219; and Megan McHugh, et al., "How Prepared Are Americans for Public Health Emergencies? Twelve Communities Weigh In," *Health Affairs* 23.3 (2004): p. 202. The average grant of $5,000-$10,000 is not enough to equip even a single critical care room, or to retrofit an airborne infection unit for one hospital; see J.L. Hick, et al., "Health Care Facility and Community Strategies for Patient Care Surge Capacity," *Annals of Emergency Medicine* 44.3 (2004): p. 253.

[99] See also, Falkenrath, op. cit., p. 133: "The most pressing question in the aftermath of a terrorist attack is going to be "Will they strike again?"

[100] Martin Cetron, "Personal and Workplace Protective Measures for Pandemic Influenza," presentation at conference sponsored by the Alfred P. Sloan Foundation, Columbia University (June 5-6, 2006). Dr. Cetron is the Director for the Division of Global Migration and Quarantine at the Centers for Disease Control and Prevention.

[101] Richard Danzig, "The Dark Side of the Moon . . ." op. cit. The airport problem has benefited from extended consideration of the San Francisco Airport as a case study. Efforts are being made to extrapolate from that study to other airports. See generally, "An Action Plan to Reopen a Contaminated Airport," *Science and Technology Review* (December 8, 2006) accessed March 6, 2007 at <http://www.llnl.gov/str/Dec06/Raber.html>. Still, the relevant action plans are very rudimentary and where best developed, as in San Francisco, ibid. reports that the planners still anticipate that restoration would take at least three to six months. Subways have received less attention. We are aware only of plans in some municipalities to wash subway cars with bleach and water. The best overview of the wide area decontamination problem is National Research Council, *Reopening Public Facilities After a Biological Attack: A Decision-Making Framework,* National Academies Press (2005) accessed March 6, 2007 at <http://www.nap.edu/catalog/11324.html>.

[102] Larry Wein, et al., "HEPA/Vaccine Plan for Indoor Anthrax Remediation" *Emerging Infectious Diseases* 11 (2005): p. 69, 71. In fact, this appears to be an under-estimate because further review by Professor Wein corrected an error in which he had used feet rather than meters in his calculations. As corrected, Prof. Wein estimates that the clean-up time would be on the order of 314 years. Personal communication from Professor Wein to Richard Danzig, April 2007.

[103] The National Research Council's Reopening Public Facilities report, op. cit. was a product of its Committee on Standards and Policies for Decontaminating Public Facilities Affected by Exposure to Harmful Biological Agents. The Committee reflected the problems in consensus by subtitling its report: "How Clean Is Safe?"

[104] Risk communication experts discuss a communication "see-saw" in which if experts voice positive comments, listeners are apt to consider the negative, and vice-versa. Thus, if experts are more cautious, the public will feel more reassured and more apt to return to normal, while experts who seem premature in their "all-clear" will generate more worry and suspicion on the part of citizens. Such findings are a basic part of reverse psychology.

[105] On the importance of this consideration for citizen psychologies, see A.Y. Shalev, "The Israeli Experience of Continuous Terrorism (2000-2004)" in J.J. Lopez-Ibor, et al., eds., *Disasters and Mental Health,* (Willey & Sons, 2004).

[106]Though this advice is often associated with the ready.gov web site, it in fact was presented in ill-advised oral statements made to the press by apparently ill-prepared government officials. There were dramatic increases in sales of duct tape, plastic wrap, and other "protective" supplies the day after spokesperson recommendations to stockpile these goods. See Jeanne Meserve, "Duct tape sales rise amid terror fears" CNN.com, (February 11, 2001), accessed March 6, 2007 at <http://www.cnn.com/2003/US/02/11/emergency.supplies/>. For the ready.gov site advice, see <http://www.ready.gov/america/faq.html> (accessed March 6, 2007). As another example of web advice, the NOVA website offers a set of frequently asked questions and answers on bioterrorism. Among these are queries on the use of masks, the stockpiling of Cipro and other drugs, and other self-protective measures. The answers, drawn from the Red Cross and CDC, are discouraging about the prospects for self-protection, but suggest some measures laypeople could take; see <http://www.pbs.org/wgbh/nova/bioterror/faq.html>. Davis, et al., op. cit. provided a reference card for individual actions in the wake of attacks.

[107]We are not unique in urging these investments. Intensified efforts to prepare for a possible influenza pandemic have prompted some concern about deficiencies in our attention to "non-pharmacological" opportunities. See particularly, Stephen Morse, et al., "Next Flu Pandemic: What to Do Until the Vaccine Arrives" *Science* 314 (November 10, 2006): p. 929, noting that "producing and distributing a vaccine will take at least four to six months currently" and that non-pharmacological interventions "ironically similar to those used in 1918" will be imperative. We decry the "thin science base" for evaluating measures such as hand-washing, mask-wearing, and social distancing. They also note that "[t]he Centers for Disease Control and Prevention (CDC) recently awarded grants to study non-pharmacological interventions in community settings. Although a commendable start, the CDC program so far represents $5.2 million in a total proposed pandemic influenza budget of $7.1 billion." Ibid.

We believe that there would be great benefit from an effort that evaluated particular measures (like the use of hand-washing) as part of a broader strategy to assess citizen needs and opportunities for coping with extraordinary threats of infectious disease, whether arising naturally or as a result of terrorism.

[108]"[P]eople are information hungry following receipt of warnings. . . .there is an information void caused by uncertainty, particularly when rare or unfamiliar events are about to occur." Dennis Mileti and John H. Sorensen, "Communication of Emergency Public Warnings: A Social Science Perspective and State-of-the-Art Assessment," FEMA (1990): p. 86.

[109]As noted in endnote 18, we believe this work is an appropriate mission for "Homeland Security Advanced Research Projects Agency" (HSARPA) within the Department of Homeland Security, for the Department of Health and Human Services which has announced a new overarching bioterrorism strategy, or for the "National Interagency Biodefense Campus" (NIBC). The NIBC is currently being planned for Fort Detrick to coordinate, integrate, and facilitate collaboration between five broad program areas related to defense against biological threats, including efforts under the Department of Defense; the Department of Homeland Security; the Centers for Disease Control and Prevention and the Integrated Research Facility under the auspices of National Institutes of Health, both under the Department of Health and Human Services; and the Department of Agriculture. For more information, including details of the various programs intended to be housed on the campus and its planned physical layout, see "National Interagency Biodefense Campus (NIBC) at Fort Detrick," accessed May 4, 2007 at <http://www.detrick.army.mil/nibc/nibc01.cfm>.

[110]See Danzig, op. cit. (2005); Richard Danzig, "Lidar as a Lifeline in Confronting Bioterrorism," *Bulletin of the American Meteorological Association* (June 2006): p. 731; and Shane Mayor and Richard Danzig, "Lidar as a Means of Locating and Thwarting an Urban Biological Aerosol Attack: A Concept of Operations and a Technology Assessment," (forthcoming, 2007). See also, Thomas Warner, et al., "The Pentagon Shield Field Program: Toward Critical Infrastructure Protection," *Bulletin of the American Meteorological Society* 88, 2 (February 2007): p. 167-176, accessed May 4, 2007 at <http://ams.allenpress.com/archive/1520-0477/88/2/pdf/i1520-0477-88-2-167.pdf>.

[111]In fact, if advice that would be marginally useful is not prepared and provided, there will be a tendency to retrospectively over-value that advice by inflating the imagined consequences "if only" that advice had been available.

[112]"Apparently no controlled studies assess the efficacy of mask use in preventing transmission of influenza viruses. . . . In case-control studies conducted in Beijing and Hong Kong, wearing masks in public was independently associated with protection from SARS in a multivariate analysis. One study found a dose-response effect. Methodological limitations of the studies (e.g., retrospective questionnaire design) limit drawing conclusions," World Health Organization Writing Group, "Nonpharmaceutical Interventions for Pandemic Influenza, National and Community Measures," *Emerging Infectious Diseases* (January 2006) accessed March 6, 2007 at <http://www.cdc.gov/ncidod/EID/vol12no01/05-1371.htm>. One recent study notes that DHS has received numerous comments and inquiries regarding infection control recommendations relating to mask and respirator use, but that authoritative responses are hampered by insufficient data regarding infection modes and a corresponding lack of scientific consensus, and that the Internet and media contain a large amount of incorrect, incomplete, and confusing information on this subject. "Interim Guidance on Planning for the Use of Surgical Masks and Respirators in Health Care Settings during an Influenza Pandemic," (October 2006), <http://www.pandemicflu.gov/plan/healthcare/maskguidancehc.html>. As this paper was being prepared for publication, CDC issued "Interim Guidance for the Use of Facemasks and Respirators in Public Settings during an Influenza Pandemic." The guidance is billed as a "best estimate" pending the results of "studies. . .underway. . .to learn more about whether masks and respirators can provide protection from influenza and how people would use such devices." As a result, the guidance contains repeated caveats, suggesting that "masks and respirators *may* help prevent some spread of influenza" and that if used "correctly and consistently *could* help protect people" (emphasis added). The guidance is an important step towards providing concrete recommendations that citizens could turn to in the event of an influenza epidemic or other natural or terrorist-induced disease outbreak, but the caveats highlight the urgent need for scientific study of these issues. "Interim Guidance Issued for the Use of Facemasks and Respirators in Public Settings During an Influenza Pandemic," Press Release, May 3, 2007, accessed May 4, 2007 at <http://www.cdc.gov/od/oc/media/pressrel/2007/r070503.htm>.

[113]Elaine Larson of Columbia University, a leading researcher in hand-washing, has observed the dearth of studies on hand-washing in homes. Of the more than 17 hand-washing studies she has classified, only two relate to the home environment in a developed country, and neither deal with flu. A third, undertaken in a Pakistani squatter community, tested 300 households given plain soap, and found that over a year-long trial, soap-using households had a 50 percent lower pneumonia rate in children under 5. Stephen P. Luby, et al., "Effect of Handwashing on Child Health: A Randomised Controlled Trial," *Lancet* 366.9481 (July 16-22, 2005): p. 225. See also Elaine Larson, et al., "Effect of Antibacterial Home Cleaning and Handwashing Products on Infectious Disease Symptoms: A Randomized, Double-Blind Trial" *Annals of Internal Medicine* 2.140-5 (March 2004): p. 321.

[114]The Alfred P. Sloan Foundation has financed a number of workshops to begin considering the issue of building filtration and protection. See, "Workshop on Reducing the Vulnerability of Buildings to Chemical, Biological, and Radiological Attacks," Conference, National Institute of Building Sciences (2002) accessed March 8, 2007 at <http://www.nibs.org/MMC/mmcactiv10.html>; and the Homeland Security for Buildings conference held by ASHRAE; a DVD of the conference is available at <http://www.ashrae.org/publications/detail/14906> (accessed March 8. 2007). CDC has also published two useful papers on this topic: "Guidance for Protecting Building Environments from Airborne Chemical, Biological, or Radiological Attacks," *DHHS NIOSH* 2002.139 (May 2002) accessed March 8, 2007 at <http://www.cdc.gov/niosh/bldvent/2002-139.html> and "Guidance for Filtration and Air-Cleaning Systems to Protect Building Environments," *DHHS NIOSH* 2003.136 (April 2003) accessed March 8, 2007 at <http://www.cdc.gov/niosh/docs/2003-136/default.html>. This burgeoning field needs to be integrated with the mainstream of bioterror mitigation and preparation activity.

[115]Morse, op. cit.: "Although many suggestions seem just common sense (such as keeping a sick family member in a separate room with a closed door), there is no systematic evaluation of best practices for 'home infection control.' A starting point might be modifying experience from health-care settings for the home."

[116]David Heyman of CSIS writes: "What we must recognize is that in the midst of a crisis where social interactions must be limited, political and other public leaders will be expected to decide — and explain — how to best implement restrictive measures... Without operational guidance... critical decisions will be rushed or careless, with potentially devastating consequences." Heyman's monograph, "Model Operational Guidelines for Disease Exposure Control," draft manuscript, CSIS (November 2, 2006), accessed March 8, 2007 at <http://www.csis.org/media/csis/pubs/051102_dec_guidelines.pdf> is an excellent overview of the state of the field.

[117]For more information on research catalyzed by pandemic influenza concerns, see endnote 95.

[118]World Health Organization Writing Group "Nonpharmaceutical Interventions for Pandemic Influenza, National and Community Measures," (January, 2006) accessed March 8, 2007 at <http://www.cdc.gov/ncidod/EID/vol12no01/05-1371.htm>. See also the companion document, World Health Organization Writing Group, "Nonpharmaceutical Interventions for Pandemic Influenza, International Measures," (January 2006) accessed March 8, 2007 at <http://www.cdc.gov/ncidod/EID/vol12no01/05-1370.htm>.

[119]"Surveillance Report," *Eurosurveillance Weekly Release* 11.10 (October 12, 2006), accessed March 8, 2007 at <http://www.eurosurveillance.org/ew/2006/061012.asp#1#1>. The ECDC report may be found at <http://www.ecdc.eu.int> (accessed March 8, 2007).

[120]One set of efforts should be to evaluate the applicability of preventive mechanisms now considered for contagion to circumstances involving the widely disseminated presence of anthrax (an infectious, but non-contagious, pathogen). For example, because anthrax persists if not exposed to sunlight or extensive decontamination effort, and because infectious spores are larger than viruses, masks may be relevant to protection in the wake of an anthrax attack even if it is determined that they are less than helpful in the case of influenza. See Sakae Inouye, et al., "Masks for Influenza Patients: Measurement of Airflow from the Mouth," *Japan Journal of Infectious Disease* 59 (2006): p. 179, accessed March 8, 2007 at <www0.nih.go.jp/JJID/59/179.pdf>.

[121]We benefited in the construction of this list from a workshop convened by Richard Garwin and Stephen Morse and sponsored by the Alfred P. Sloan Foundation in New York City on June 6, 2006.

[122]At the above conference, Manfred Green, head of the Israeli CDC, suggested that even if non-fitted, surgical masks were shown to be useful in preventing the spread of disease, they are limited as a strategy because children are the primary sources of influenza contagion and it would be quixotic to attempt to have ill, coughing, uncomfortable children wear masks persistently and properly. If this is the problem, it may be amenable to some inventive approaches, because children should be more persuadable than other populations, for example by the actions of television heroes.

[123]Key to understanding the helpfulness of protective measures is also understanding the transmission of the diseases from which protection is sought, and here too there are considerable research needs. A recent *Lancet* study observed that despite decades of research and "vast clinical experience in human beings," there is continued "vocal debate" about how influenza is transmitted. Reviewing the extant literature, we observed that 1) there was no direct evidence of influenza infection over long distances; 2) although there is "no evidence to support... airborne influenza transmission in the natural state," some studies have found airborne transmission "under certain experimental conditions... [this] leaves open the possibility that influenza could be an opportunistic airborne pathogen"; 3) substantial evidence supports transmission via droplets; 4) although influenza "has long been thought to be transmitted by direct and indirect contact" and has been shown to survive on surfaces, no study could be found that showed "that contact with contaminated surfaces could result in transmission." We therefore question studies that call for the use of N95 respirators in healthcare settings to limit aerosol transmission, particularly in light of various shortcomings of the respirators. That said, given uncertainties regarding the potential for opportunistic airborne transmission (see point 2 above), they suggest that the use of respirators may be reasonable "during high-risk clinical procedures." Brankston G, Gitterman L, Hirji Z, Lemieux C, Gardam M. "Transmission of influenza A in human beings" *The Lancet Infectious Diseases* 7,4 (April 1, 2007): p. 257-265.

[124]The National Academy of Sciences' Institute of Medicine sponsored a "Committee on the Development of Reusable Facemasks for Protection During Pandemic Influenza." The committee issued its final report, "Reusability of Facemasks During an Influenza Pandemic: Facing the Flu" on April 27, 2006. The report noted that "if effective vaccines and anti-viral medications do not exist or are not available in adequate quantities during a pandemic situation, respirators and medical masks could help prevent or slow influenza transmission; [however], efforts to produce and stockpile sufficient supplies of disposable masks and/or respirators may fall short in the event of a pandemic, [requiring] potential reuse of medical masks and N95 respirators." After two meetings and review of information provided by manufacturers and the technical literature, the committee concluded that "very little is currently known regarding the potential to disinfect and reuse either medical masks or respirators. Fundamental research both in the epidemiology of influenza and in the material properties of medical masks and respirators is needed before methods of disinfection and reuse can be developed." Finally, the committee concluded that "respirators can be reused" in some circumstances, but "reuse should be considered an option only in circumstances in which adequate supplies simply cannot be obtained." The report's bottom line is highlighted in the report's preface: "Although "more research is needed to answer the questions" is often regarded as a scientist's way of dodging an answer, in this case it is the only rational response. More research is needed" (emphasis in original). Committee on the Development of Reusable Facemasks for Use During an

Influenza Pandemic "Reusability of Facemasks During an Influenza Pandemic: Facing the Flu," National Academies Press (2006), accessed May 4, 2007 at <http://www.nap.edu/catalog.php?record_id=11637> (registration required) and "Reusability of Facemasks During an Influenza Pandemic: Facing the Flu," summary, Institute of Medicine of the National Academies, accessed May 7, 2007 at <http://www.iom.edu/CMS/3740/32033/34200.aspx>.

[125] For instance, an intriguing study tests a handmade mask made from a t-shirt cut and rolled to provide a decent fit and a measurable level of protection from an aerosol. See Virginia M. Dato, et al., "Simple Respiratory Mask," letter, *Emerging Infectious Diseases,* 12.6 (June 2006): p. 11033.

[126] Research on the effects of hand-washing is summarized in Appendix II, World Health Organization Writing Group, "Nonpharmaceutical Interventions for Pandemic Influenza, National and Community Measures," *Emerging Infectious Diseases* (January 2006) accessed March 8, 2007 at <http://www.cdc.gov/ncidod/EID/vol12no01/05-1371.htm>.

[127] DARPA has created an "Immune Building Toolkit" that provides a blueprint for top-of-the-line protection for key government buildings using filtration systems. The project, described in a publicly available PowerPoint presentation at <http://www.natick.army.mil/soldier/JOCOTAS/ColPro_Papers/Alving.pdf> (accessed March 8, 2007) is too costly and cumbersome for home use and for most businesses. However, components might be adaptable for use in commercial buildings, and once commoditized, could conceivably become less expensive. See generally, P.J. Hitchcock, et al., "Improving performance of HVAC systems to reduce exposure to aerosolized infectious agents in buildings; recommendations to reduce risks posed by biological attacks," *Biosecurity and Bioterrorism* 4.1 (2006).

[128] See for example the encouraging report by Jayanta Haldar, et al., "Polymeric Coatings that Inactivate Both Influenza Virus and Pathogenic Bacteria," *Proceedings of the National Academy of Sciences* 103-47 (November 21, 2006): p. 1767.

[129] J.Y.C. Lo, et al., "Respiratory Infections During SARS Outbreak, Hong Kong, 2003," Emerging Infectious Diseases 11 (2005): p. 1738. Over 90 percent of Americans in a survey conducted by the Harvard School of Public Health responded that they would comply with movement controls. Robert Blendon, et al., "Pandemic Influenza Survey," Question 44, accessed March 8, 2007 at <http://www.hsph.harvard.edu/panflu/panflu_release_topline.doc>.

[130] "Steps to operationalize large-scale quarantine procedures on a national level have not yet been taken. Most communities — small and large — currently lack the resources to develop the necessary operational plans." Heyman, "Model Operational Guidelines for Disease Exposure Control," op. cit.

[131] David Heyman suggests a set of such guidelines in his, "Model Operational Guidelines for Disease Exposure Control," op. cit.; however, the data on when to engage in such drastic measures, and when to lift them, is scanty. According to the World Health Organization Writing Group: "Apparently no data or analyses exist for recommending illness thresholds or rates of change that should lead to considering closing or reopening schools." World Health Organization Writing Group, "Nonpharmaceutical Interventions for Pandemic Influenza, National and Community Measures," *Emerging Infectious Diseases* (January 2006) accessed March 8, 2007 at <http://www.cdc.gov/ncidod/EID/vol12no01/05-1371.htm>. This situation is changing, however, as a result of the high intensity focus on the risk of an avian flu epidemic. Historical studies of the use of these measures during the 1918 flu epidemic, combined with mathematical modeling by mathematicians such as Timothy Germann, are beginning

to suggest parameters for such movement controls. For examples of these models, see Neil M. Ferguson, et al., "Strategies for Containing an Emerging Influenza Pandemic in Southeast Asia," *Nature* (August 3, 2005) accessed March 8, 2007 at <http://www.nature.com/nature/journal/vaop/ncurrent/abs/nature04017.html>; Timothy R. Germann, et al., write on the Longini model, "Mitigation Strategies for Pandemic Influenza in the United States," *Proceedings of the National Academy of Sciences* (April 11, 2006), and for a computer simulation, see <http://www.lanl.gov/news/images/avianflu.shtml> (accessed March 8, 2007) and R. Freeman, et al., "A Mathematical Model for Forecasting the Global Spread of Pandemic Influenza Via Air Travel," *Epidemiology and Infection* (2003). The White House Homeland Security Council has commendably encouraged this work.

[132] More thinking and preparation needs to be undertaken for most quarantine options to be effective in the context of a catastrophic bioterrorist attacks in American cities. For example, how would isolation be encouraged or enforced in such situations? The threat of imprisonment does not seem realistic or compelling if there are many non-compliant contagious victims.

[133] In a study of 12 nationally representative U.S. communities, "Respondents noted the difficulty of keeping up with the public's demand for information following the anthrax scare. Call centers were "flooded", causing local public health agencies, first responders, and hospitals to consider making improvements to their systems." McHugh, op cit., p. 205.

[134] A Center for Disease Control "Pre-event Message Development Project" began in 2003 to support some work at St Louis University and the University of California at Los Angeles on developing messages that could be used in biological emergencies. Marsha Vanderford, "Breaking New Ground in WMD Risk Communication: The Pre-Event Message Development Project," *Biosecurity and Bioterrorism* (2004): p. 23. To be successful, however, we believe that messages must be grounded in research of the kind urged here.

[135] Lau, et al. suggest that more than 90 percent of the general public wore facemasks in public places (and, relatedly, more than 85 percent avoided visits to public places) during the epidemic in Hong Kong. Lau, J.T., Yang, X, Tsui, H, Kim, JH. "Monitoring community responses to the SARS epidemic in Hong Kong: from day 10 to day 62" *J Epidemiol Community Health* 57 (2003): p. 864-70, as cited in Lau, J.T., Tsui H., Lau, M., and Yang, X. "SARS Transmission, Risk Factors, and Prevention in Hong Kong," *Emerging Infectious Diseases* 10, 4 (April 2004), accessed May 4, 2007 at <http://www.cdc.gov/ncidod/EID/vol10no4/03-0628.htm#1>.

[136] The CDC estimates that in the case of pandemic influenza, at least 1.5 billion medical masks would be needed by the healthcare sector, and an additional 1.1 billion would be needed by the public, while the healthcare sector may need over 90 million N-95 respirators, assuming a 42 day outbreak. "Reusability of Facemasks During an Influenza Pandemic: Facing the Flu," National Academies Press, (2006): p. 17. Given its communicability, estimates of masks needed for a smallpox outbreak could be of a similar magnitude. While there are nearly 100 U.S. manufacturers of masks, almost all are produced in just 3 or 4 factories, all of which are already operating at full capacity and which have little to no ability to surge. (Statement of John Bailar, Chair of the CDC investigative team on the reusability of facemasks, made at the Alfred P. Sloan Foundation Conference on NPIs, June 5-6, 2006).

[137] Robert Blendon, et al., op. cit., Question 32. Half of the respondents reported they would look most to family for help, with 15 percent turning to government, 8 percent to friends, and the remainder to voluntary agencies and other resources. Ibid., Question 56.

[138]The *National Strategy for Pandemic Influenza Implementation Plan,* p. 112.

[139]Alan Kirschenbaum, *Chaos Organization and Disaster Management* (Marcel Dekker, 2004): p. 108.

[140]Ibid., p. 208 and see p. 177ff. The focus on "mothers" rather than "parents" is supported by social science research that points to mothers as the member of family units most frequently driven to take disaster preparedness action. E. Enarson and B.H. Morrow, eds., "The Neglect of Gender in Disaster Work: An Overview of the Literature," *The Gendered Terrain of Disaster: Through Women's Eyes* (Praeger, 1998): p. 11; and Julie M. Bateman and Bob Edwards, "Gender and Evacuation: A Closer Look at Why Women are More Likely to Evacuate for Hurricanes," *Natural Hazards Review* 3 (2002): p. 107, among other studies.

[141]See John M. Barry, *The Great Influenza: The Epic Story of the Deadliest Plague in History,* Penguin (2005) and David M. Oshinsky, Polio: An American Story, Oxford University Press (September 2006) for examples of home care in past American pandemics. In other countries, home care for virus outbreaks has been a matter of course, even during quite serious events such as filovirus outbreaks in Africa during the 1970s-1990s; see C.J. Peters, *The Virus Hunter: Thirty Years of Battling Hot Viruses Around the World,* Anchor (1998).

[142]Committee on the Future of Emergency Care in the United States Health Care System, "Hospital-Based Emergency Care: At Breaking Point," National Academies Press (2006): p. 214.

[143]See Sally J. Phillips and Ann Knebel, eds., "Providing Mass Medical Care with Scarce Resources, A Community Planning Guide," Agency for Healthcare Research and Quality, Publication 07-0001 (November 2006), accessed March 8, 2007 at <http://www.ahrq.gov/research/mce/>.

[144]See Terri Tanielian, et al., "The Path of Greatest Resilience," *RAND Review* (Summer 2002) accessed December 15, 2006 at <http://www.rand.org/publications/randreview/issues/rr.08.02/resilience.html>, discussing how natural support systems help individuals recover from trauma. During the SARS outbreak, one of the hardest things for patients to deal with was the isolation caused by the social stigmatization and the lack of visits allowed from family and friends. See L. Hawryluck, et al., "SARS Control and Psychological Effects of Quarantine," *Emerging Infectious Diseases* (2004). For anecdotal reports in Singapore, see Chua Mui Hoong, "A Defining Moment: How Singapore Beat Sars," *Institute of Policy Studies* (2004): p. 39, 67. For similar feelings of healthcare workers with SARS in Canada, see Gretchen Reynolds "Why Were Doctors Afraid to Treat Rebecca McLester?" *New York Times,* April 18, 2004, accessed May 4, 2007 at <http://query.nytimes.com/gst/fullpage.html?sec=health&res=9D07E7DE1E38F93BA25757C0A9629C8B63>.

There may even be physical benefits to being cared for by someone who cares overwhelmingly about a loved one's life, rather than a less emotionally involved professional. A study of a search and rescue effort after a gasoline explosion in Guadalajara, Mexico, reported that search efforts were not random — people searched first for those they knew, and the chances of a person surviving the blast was directly proportional to having someone who knew and cared about the victim searching for him or her. B.E. Aguirre, et al., "The Social Organization of Search and Rescue: Evidence from the Guadalajara Gasoline Explosion," *International Journal of Mass Emergencies and Disasters* 13 (1995): p. 93. Extrapolating from this and other cases, Schoch-Spana and Glass observe: "Social chaos does not occur in disaster situations because people tend to respond in accordance with their customary norms and roles

(e.g., the able-bodied assist the impaired, supervisors assume responsibility for the safety of those they supervise, and friends look out for friends). This finding suggests that plans for a response to bioterrorism should attempt, whenever possible, to recognize and capitalize on existing social relations. For example, if quarantine should be necessary, establishing cohorts of individuals who are already known to one other in some capacity might be better than creating clusters of strangers." Thomas Glass and Monica Schoch-Spana, op. cit. p. 2, accessed March 8, 2007 at <http://www.journals.uchicago.edu/CID/journal/issues/v34n2/011333/011333.html>.

This tendency for mutual caring apparently has deep genetic roots. People behave more altruistically towards those with whom they share greater genetic similarity and emotional closeness mediates this genetic predisposition. See, for example, J.D. Korchmaros and D.A. Kenney, "Emotional Closeness as a Mediator of the Effect of Genetic Relatedness on Altruism," *Psychological Science* 12.262 (2001). People will take risks for family members that they are unlikely to take for strangers.

[145]A July 2004 symposium of experts on public preparedness was sponsored by the American Red Cross, the George Washington University Homeland Security Policy Institute, the Department of Homeland Security and the Council for Excellence in Government. The symposium report, "Public Preparedness: A National Imperative" decried the fact that "specific advice on how to be better prepared is not reaching the public and is not breaking through other information that is presented to them. The information that is released to the public is vague . . ." (p. 13) and urged the creation of "clear compelling and easy-to-understand messages," (p. 21). "Public Preparedness: A National Imperative, Symposium Report" (2004) accessed March 8, 2007 at <http://www.gwu.edu/~dhs/reports/report_final.pdf>.

[146]Lawrence M. Wein, "Quantifying the Routes of Transmission and Assessing Non-Pharmaceutical Interventions for Pandemic Influenza," draft manuscript (2006). See also, Lawrence Wein, "Face Facts," *New York Times,* October 25, 2006, p. A19. For an interesting example of another quantitative approach to strategies for coping with a possible influenza epidemic, see Fischhoff, Baruch, et al., "Analyzing Disaster Risks and Plans: An Avian Flu Example" *Journal of Risk Uncertainty* 33:131-149 (2006).

[147]We also note that if home care is to be effective, it will demand more than simply advice. Outreach mechanisms, supplies, and support will be critical, as we attempt to address in our other four recommendations.

[148]They also will not be acceptable for the distribution of food and water and other essentials if they are in short supply after an attack. In that situation, or if people are forced to stay in place because of quarantine and isolation rules, the principles described here will be applicable to those goods as well.

[149]In past smallpox outbreaks, the sense that groups were being treated unfairly due to their socioeconomic status was a cause of riots; see endnote 76.

[150]A CDC pilot program, the Cities Readiness Initiative, provides grants to 21 major cities to develop mechanisms for distributing medicines and medical supplies from the Strategic National Stockpile during a large-scale health emergency. The general plan is for a series of staffed points of distribution. However, in the event that the point of distribution network is overwhelmed, "the grantee may elect to request staff and other resources from the federal Government to augment the POD network or to deploy elements of the United States Postal Service to complement the POD network with direct delivery of antibiotics to residences." We think that more emphasis should be given to direct delivery (whether by postal workers or others) as the primary mechanism of distribution. We also think that these systems need to address

[151]providing basic supplies (such as food) as well as medicines. For more information on the CDC program see <http://www.bt.cdc.gov> (accessed March 8, 2007).

[151]In fact, many people, claiming exceptional importance as health and emergency workers or as public officials, would receive supplies other than on a first-come, first-served basis and at places and times apart from mass distribution centers. As we described above, we expect that broad public awareness of this separate, but to them inaccessible, system risks creating dissension.

[152]Intolerance of lines will be compounded, as we noted above, when people realize that delays in vaccination or treatment enhance their risk.

[153]For more information on efforts to establish distribution mechanisms, see endnote 150, above.

[154]The Trust for America's Health has admirably provoked thought along this line by calling for a "State of Emergency Health Benefit." Op. cit., p. 63. By encompassing supplies and other services, our proposal goes further.

[155]Frederick M. Burkle, Jr., "Population-based Triage Management in Response to Surge-capacity Requirements During a Large-scale Bioevent Disaster," *Academic Emergency Medicine* 13.11 (November 2006): p 1118, 1121. Contrast the largely successful application of triage techniques after the 2005 London Underground attacks that used traditional explosives, as described in C. J. Alywin, et al., "Reduction in critical mortality in urban mass casualty incidents: analysis of triage, surge, and resource use after the London bombings on July 7, 2005" *Lancet* 368:2219-2225 (2006).

[156]Burkle, ibid. provides an excellent discussion of this set of issues with particular emphasis on population-based triage (i.e. categorization of the entire relevant population).

[157]We note that this common term is somewhat misleading. Though some of the worried well are simply worried, others are actually experiencing physical symptoms that are causing them discomfort, even though these symptoms are not physically derived from the pathogens unleashed in a biological attack. The field is considering other terms such as "disaster somatization reaction" and "multiple unexplained physical symptoms" as diagnoses. David P. Eisenman, et al., "Terrorism's Psychological Effects and Their Implications for Primary Care Policy, Research, and Education," *Journal of General Internal Medicine* 20 (2005): p. 772.

[158]To the same effect, see Stein, et al., op. cit., p. 414.

[159]See Fred Sidell, "U.S. Medical Team Briefing [on the results of the 1995 sarin attack on Tokyo subways]" Proceedings of the Seminar on Responding to the Consequences of Chemical and Biological Terrorism, Uniformed Services University of Health Sciences, Bethesda, MD (July 11-14, 1995), p. 230, cited in *Making the Nation Safer,* National Academies Press (2002): p. 47.

[160]As others have pointed out, biological attacks may particularly amplify the numbers of worried well because the attack is invisible and there is typically a substantial period between exposure and manifestation of symptoms. See H.C. Holloway, "The Threat of Biological Weapons. Prophylaxis and Mitigation of Psychological and Social Consequences," *Journal of the American Medical Association* 278 (1997): p. 425; Clete DiGiovanni, Jr., "Domestic Terrorism With Chemical or Biological Agents: Psychiatric Aspects," *American Journal of Psychology* 156 (October 1999): p. 1500; and Bradley Stein, "Emotional and Behavioral Consequences of Bioterrorism: Planning a Public Health response," RAND Corporation: University of Southern California, *Milbank Quarterly* 82.3 (2004): p. 413.

[161]Paul C. Allegra, et al., "Emergency Department Visits for Concerns Regarding Anthrax-New Jersey, 2001," Morbidity and *Mortality Weekly Report Supplement* (August 26, 2005): p. 163, accessed March 8, 2007 at <http://www.cdc.gov/mmwr/preview/mmwrhtml/su5401a26.htm>.

[162]J.M. Howelling, et al., "Screening for Inhalation Anthrax Due to Bioterrorism: Evaluating Proposed Screening Protocols," *Clinical Infectious Disease* 39.12 (December 15, 2004): p. 1842.

[163]An excellent discussion of self-diagnostic and triage systems occurred at a 2003 CDC-sponsored conference. Steven E. Locke, Michael D. McDonald, and Dori B. Reissman, "The Psychosocial Dimensions of Biodefense Preparedness and Response: A Call for Strategic Systems," Report Commissioned by the Center for Disease Control (2003) accessed March 8, 2007 at <http://www.psychosomatic.org/ed_res/CDCReport.pdf>. Any test that could be practical for lay use would have to be relatively cheap, simple, and qualify for a Clinical Laboratory Improvement Amendment (CLIA) waiver. FDA-CDRH Guidance for CLIA waived tests, "Draft Guidance for Industry and FDA Staff: Recommendations for Clinical Laboratory Improvement Amendments of 1988 (CLIA) Waiver Applications," (September 7, 2005).

[164]Andy Kessler, *The End of Medicine* (2006): p. 81. Kessler's irreverent description of efforts to develop improved imaging and diagnostic techniques provides a layman's perspective on this field.

[165]In 2002, the National Institutes of Health initiated Project Zebra. Present efforts include an extensive program run by George Poste at the Biodesign Institute of Arizona State University. See Martha Baer, et al., "How a Tiny Computer Chip Could Save Us From Biological Warfare," *Slate,* February 2, 2005, accessed March 8, 2007 at <http://www.slate.com/id/2112986/entry/2113001/>; Rocco Casagrande, "Technology Against Terror," *Scientific American* (2002): p. 82; "Project Seeks to Quicken Recognition of 'Horses' and 'Zebras,'" *Business Journal of Phoenix* (March 14, 2005); and Dr. Jeffrey Trent, President and Scientific Director, Translational Genomics Research Institute, "Project Zebra: Rapid Bioterrorism Detection and Response," Before the U.S. Senate Committee on the Judiciary Subcommittee on Terrorism, Technology, and Homeland Security, (May 11, 2004), accessed March 8, 2007 at <http://judiciary.senate.gov/testimony.cfm?id=1179&wit_id=3424>.

[166]Dr. Dan Hanfling has observed that anthrax patients treated at Fairfax Inova Hospital after the 2001 letter attacks presented with elevated heart rates. Hanfling, Dan, "From 'Reload' to 'Overload': The Emergency Department and an Alternative Care Model for Response to Bioterrorism," presentation at Defense Advanced Research Projects Agency, December 13, 2006.

[167]On automated systems, see generally USDA, *Bacteriological Analytical Manual,* Chapter 3: "Aerobic Plate Count" (2001) and Ian Wilson, "Use of the IUL Countermat Automatic Colony Counter for Spiral Plated Total Viable Counts," *Applied and Environmental Microbiology* 61, (August 1995): p. 3158. We are indebted to Terry Leighton for this suggestion and these references.

[168]As, for example, the prostate-specific antigen is now measured as an indicator of prostate cancer. For a survey of biomarker efforts now being commercialized, see Begley, Sharon, "The Rush to Biomarker Tests" *Wall Street Journal,* December 12, 2006, p D1.

[169]Again we emphasize the difficulty of the challenge. "To get biomarkers to be real, you have to have both specificity and sensitivity. Picking up on just one protein and not missing it . . . often a protein whose quantity is eight orders of magnitude lower than other stuff in your blood." Andy Kessler, op. cit., p. 232, quoting Dr. Don Lustin.

Nonetheless, Kessler and those he interviewed argue there is potentially rich reward in this line of effort. Moreover, some of our problems are self inflicted. "The government is not organized around discovery, not in early detection. . . . No master plan, no road map. . . . Early detection crosses over lots of disciplines, chemists, biologists, physicists, computer guys, and so on. If I ask someone to work on a project and. . .all he has to show is number 20 on some paper, that's not good enough. It ruins a person's career to work on these things. . . There's a need to industrialize research . . . The mind-set needs to change, and then we get a road map." Ibid. p 261-262, quoting Dr. Sam Hanash.

[170]See *National Strategy for Pandemic Influenza Implementation Plan,* p. 103 and HHS Pandemic Influenza Plan, Supplement 2, Appendix 6. The *National Strategy* suggests, as we do, that if these tests could be packaged for use in non-clinical settings they would be even more effective, and promises continued federal support for research in this area. The CDC recently issued a Request for Proposal (RFP-2006-Q-08478) for the development of a simple, rapid point-of-care test to distinguish a seasonal influenza virus strain from a pandemic influenza virus strain. The ten tests currently approved by the FDA are for seasonal, not pandemic, influenza.

We are indebted to Mary McBride of Livermore National Laboratories for a description of work at these laboratories on quick diagnostic tests. She may be contacted at mcbride2@llnl.gov.

[171]See for example, "A Fast, Sensitive Virus Detector," *Technology Review,* (MIT, January 9, 2007), accessed March 9, 2007 at <http://www.technologyreview.com/Nanotech/18028/>, describing a Dutch-developed laser reader that flows saliva or blood samples over a silicon substrate creating interference patterns that reflect pathogen-antibody interactions. On the other hand, there are strong disincentives to pursue inexpensive biomarker diagnostics rather than more lucrative drugs. See generally, Richard Barker, "Can the New Generation of Biomarkers Escape the Commodity Trap?" www.samedanltd.com (incomplete cite; hard copy on file with authors, available on request).

[172]States and localities receiving HHS bioterrorism funding are required to institute a program of public health communication and information dissemination. DHS funding requires that localities develop a Joint Information System concept, including plans for Joint Information Centers during an emergency. These are all hub-and-spoke models for communicating centrally created messages, generally through mass media.

[173]Borrowing terminology from the business marketing world, we note that both "push," content that is delivered to recipients who have been previously identified as potentially demanding it, and "pull," content that recipients must take initiative to acquire, is relevant here. Reverse 911 systems, an example of "push," are already established to call individuals in their homes and provide a message, in the voice of a trusted, often local, official, providing emergency information. However, these systems now have very limited capacities. A system in Berkeley City, for example, can make over 100 calls a minute, but this still requires an hour to contact just 6,000 people. A Community Alert Network can send 300 calls a minute in Delaware and has been used for emergencies from Amtrak derailment to hurricanes. A collateral complication is that cell phones do not now permit automatic access to their numbers for public uses. Text messages sent to cell phones are a promising means of rapidly and reliably distributing information to large numbers of recipients. For example, some institutions now utilize systems in which users sign up to receive alerts regarding events such as weather closures and traffic accidents. Unlike email, which requires considerably more time to distribute and requires users to be actively check

their email accounts at through computers or other mobile devices with internet connectivity, text messages are delivered to recipients automatically and wherever they are located, as long as they are carrying and have turned on their cell phones. For more information, see Li Yuan, Corey Dade, and Paulo Prada, "Texting When There's Trouble" *Wall Street Journal,* April 18, 2007, p. B1. An example of a "pull" approach is ready.gov, described in fn. 6.

[174]Albert May, "First Informers in the Disaster Zone: The Lessons of Katrina," Aspen Institute (2006): p. 10.

[175]It should be noted that though the psychological dimension is heightened by acts of terror, it is of course by no means absent in natural epidemics. A review of Toronto's recent experience with SARS head-lined its first "lesson learned": "Fear is Worse than the Disease, and Fear Drives Fear." The review group concluded: "The best remedy for fear of the unknown is timely, accurate, and practical information provided in a coordinated fashion by both the government and private sector leadership." Gene Matthews, "The Public/Private Response to Sudden Disease Outbreak," Report to the Alfred P. Sloan Foundation, CDC Foundation, Institute of Public Health Law (2005).

[176]We are here concerned with processes for communications with and amongst laypeople, not amongst experts. For imaginative and important efforts to improve the latter, see the reports of the Strong Angel demonstrations at <http://www.strongangel3.net/> (accessed March 9, 2007).

[177]Commenting on this paper, Dr. Dan Hanfling noted that XM Radio launched an Emergency Alert channel during the Florida hurricanes in the summer of 2004 and during Hurricane Katrina in 2005, and plays a role in the Integrated Public Alert Warning System directed by the Office of National Security Coordination within the Federal Emergency Management Agency. Currently, XM radio is under contract to place radios in all fifty continental U.S. State Emergency Operations Centers. "Broadcasting Public Health Messages and Health Alert Network Advisories: 'Live and Direct,'" 2007 NDMS Conference Abstract Submission, October 2006.

[178]May, op. cit., contrasts Katrina with 9/11 in this respect and offers numerous examples. See particularly p. 13 and p. 15ff.

[179]"A national information center provided real-time information on all casualties arriving and hospitalized in any of the 23 hospitals of the State National Emergency System. Furthermore, with computerized and telefax communication, a 24-hour telephone hotline service was made available to further provide information to the public," Sachs, et al., "Community Coordination and Information Centers During the Persian Gulf War," *Israeli Journal of Medical Science* 27.11-12 (1991): p. 696, 699. New York's State Department of Health has developed a Health Emergency Response Data System (HERDS) that includes a patient locator intended to enable hospitals and health departments to determine whether any person was admitted to a hospital or had been identified as a casualty.

[180]Higher figures are drawn from a graph in Paul Marks, "Pentagon Sets its Sights on Social Networking Websites," *New Scientist Tech* (June 9, 2006). Other estimates place MySpace at 70 million users and Xanga at 10 million. There is considerable fluctuation. Friendster rose to 20 million users and then lost market share to MySpace and recently stood at around 1 million. "MySpace, Facebook, and Other Social Networking Sites: Hot Today, Gone Tomorrow?" *Knowledge@Wharton* (May 3, 2006).

[181]On the role of bulletin boards as informal information-sharing and disaster response community-building tools, see Sarah Wheaten, "Campus Goes Online for Information and Comfort" *New York Times,* April 17, 2007; and Michelle Quinn and Alex Pham,

"Massacre at Virginia Tech: Reaction on Campus and the Internet: Students Trace a Tragedy Online," *Los Angeles Times,* April 17, 2007.

[182]See generally, Randall Stross, "Cellphone as Tracker: X Marks Your Doubts" *New York Times,* November 19, 2006, Business Section, p. 3; and David Pogue, "Cellphones that Track the Kids" *New York Times,* December 21, 2006, Business Day, p. C1.

[183]We are arguing for the creation of voluntary social networks that would offer citizens the opportunity to add a component of consequence preparedness and management to networks they create and manage themselves. Of course, shared data systems can perform other functions. For example, Portland, Oregon, has created a Connect and Protect system that enables users throughout the city to see and report alerts on disasters, crime, and other incidents in real time, and provides a GPS image of the area in question. See "Connect and Protect," accessed March 9, 2007 at http://www.rainsnet.org/programs/connect_protect/index.asp; and Gary Wolf, "Reinventing 911," Wired 13.12 (December 2005). Similar ideas are explored by Ben Shneiderman and Jennifer Preece, who advocate "community response grids" or CRGs "where residents could report incidents in seconds, receive emergency information, and request resident-to-resident assistance." They suggest that the cost of implementing such centers would be comparable to that of existing local 911 phone centers, with annual budgets of between $200,000 and $3 million. Ben Schneiderman and Jennifer Preece, "Public Health: 911.gov," *Science* 315.944 (2007). We are emphatically not advocating the often criticized use of networks to enable the government to spy on our own citizens. See e.g. Paul Marks "The Pentagon Sets Its Sights on Social Networking Websites," *New Scientist Tech* (June 9, 2006).

[184]The spread of GPS devices embedded in cell-phones offer particularly rich opportunities. Some of these devices can be programmed to retain "bread crumbs" indicating precise locations transited by cell-phone holders over the past thirty days. If police and other municipal employees carry these devices and are later shown to be infected, central computers with sophisticated epidemiological programs should be able to identify the likely places and times of infection.

[185]"Nearly three out of four Americans (72 percent) say they favor the establishment of a nationwide electronic information exchange that would allow a patient's health information to be shared with authorized individuals quickly, privately, and securely via the Internet." Markel Foundation Press Release, "Americans Support Online Personal Health Records," (October 11, 2005), accessed March 9, 2007 at <www.markle.org/resources/press_center/press_releases/2005/press_release_10112005.php>.

[186]While our recommendations for moving information into the hands of members of the public are drawn largely from the disaster and communications literature, insights from social network theory can assist in determining the individuals likely to have the largest impact within their communities. See Malcolm Gladwell, The Tipping Point: How Little Things Can Make a Big Difference, (Back Bay Books, 2002). See also John P. Scott, Social Network Analysis, (Sage Publications, March 2000).

[187]See, for example: Ronald W. Perry and Majorie R. Greene, *Citizen Response to Volcanic Eruptions: The Case of Mt. St. Helens,* (Irvington Publishers, 1983), quoted in Denis S. Mileti, "Factors Related to Flood Warning Response," U.S.-Italy Research Workshop on the Hydrometeorology, Impacts, and Management of Extreme Floods (November 1995). In a tabletop exercise positing the emergence of Rift Valley Fever, pluralities of all groups of respondents wanted health information from local public health authorities, or from medical experts in the community, and secondarily, from their local doctors, long before they sought such information from state or federal government sources; see: Clete DiGiovanni, et al., "A Prospective Study of the Reactions of Residents of an American

Community to a Bioterror Attack: Volume One: Executive Summary and Text of the Report," Defense Threat Reduction Agency, Reprinted Summary in *Emerging Infectious Diseases* 9.6 (2003): p. 708.

[188]For example, a study on the responses of African-Americans, Mexican-Americans, and Caucasians to hazard warnings found that white respondents were more likely to identify public authorities, such as police and fire departments, as well as mass media as credible sources of hazard information. African-Americans also considered public authorities credible, but they were more likely than whites to rely on social networks such as family and friends, while Mexican-Americans placed even more trust in these informal networks, and were more likely than other groups to enjoy neighborhood meetings as a source of information. R.W. Perry and M.K. Lindell, "The Effects of Ethnicity on Evacuation," *International Journal of Mass Emergencies and Disasters* 9 (1991): p. 47. E. Vaughan, "The Significance of Socioeconomic and Ethnic Diversity for the Risk Communication Process," *Risk Analysis* 13 (1995): p. 169, also found that African-Americans tend to distrust official information sources more than the Caucasian population.

[189]S.L. Cutter, et al., "En-gendered fears: Femininity and Technological Risk Perception," Industrial Crisis Quarterly 6 (1992): p. 5; A. Fothergill "The Neglect of Gender in Disaster Work: An Overview of the Literature" in E. Enarson and B. H. Morrow, eds., *The Gendered Terrain of Disaster,* (Praeger, 1998): p. 11; and Linda Borque and Lisa Russell, "Experiences During and Responses to the Loma Prieta Earthquake," California Governor's Office of Emergency Management, (July 1994). B. Aguirre, et al., "A Test of the Emergent Norm Theory of Collective Behavior," *Sociological Forum* 12.2 (1998): p. 301 looks at the 1993 World Trade Center evacuation. See also S. Cutter and K. Barnes, "Evacuation Behavior and Three Mile Island," Disasters 6 (1982): p. 116; A. Fothergill "Gender, Risk and Disaster," *International Journal of Mass Emergencies and Disasters* 14 (1996): p. 33. Julie M. Bateman and Bob Edwards, "Gender and Evacuation: A Closer Look at Why Women are More Likely to Evacuate for Hurricanes," *Natural Hazards Review* 3 (2002): p. 107.

[190]"[B]efore acting on information provided by official and media sources people search for additional information and interact informally to confirm reports they have received," Kathleen J. Tierney, et al., *Facing the Unexpected: Disaster Preparedness and Response in the United States,* (Joseph Henry Press, 2001): p. 39.

[191]Ibid, p. 84.

[192]Thomas Drabeck, "Disaster Warning and Evacuation Responses by Private Business Employees," *Disasters* 25.1 (2001): p. 76. Similar findings have been discovered for crime victims. Victims of crime often talk to someone immediately after the crime, and this interaction seems to have significant effect on their decision to report or not to report the crime. See generally, M.S. Greenberg and R.B. Ruback, *After the Crime: Victim Decision Making,* (Plenum, 1992). In the risk communication literature, this activity of "double-checking" is known as "confirming" and is widely emphasized. For a dissenting example, see L. Christenson and C. Ruch, "The Effect of Social Influence on Response to Hurricane Warnings," *Disasters* 4 (1980): p. 205, reporting that, in two experiments with taped simulated hurricane bulletins, neither the actions of an observable friend nor those of a spouse had any effect on the individual's response. We note, however, their study was not a study of actual disaster behavior.

[193]Redefining Readiness, op. cit., p. 10.

[194]Ibid, p. 21.

[195]D.S. Mileti, "Public Hazards Communication and Education: The State of the Art,"

Natural Hazards Research and Applications Information Center (2003). S. Nathe, et al., "Public Education for Earthquake Hazards," *Natural Hazards Informer* 2, (November 1999).

[196]The CDC and HHS have made some attempts to educate journalists about bioterrorism, such as the publication of "Terrorism and Other Public Health Emergencies: A Reference Guide for the Media," U.S. Department of Health and Human Services, accessed March 9, 2007 at <http://www.hhs.gov/emergency/mediaguide/PDF/>. Even more useful tools for rapid response by journalists have been prepared for pandemic flu—for example Pandemic Influenza Pre-Event Message Maps, accessed March 9, 2007 at <http://pandemicflu.gov/news/pre_event_maps.pdf> with quick guides and points that could be made by local news anchors, and the World Health Organizations WHO Handbook for Journalists: Influenza Pandemic, accessed March 9, 2007 at <http://www.who.int/csr/don/Handbook_influenza_pandemic_dec05.pdf>. The CDC has also invited journalists to some conferences on pandemic flu.

[197]The King County region of Washington, which includes Seattle, is seen as a best-practice community for its efforts to assist business preparedness for pandemic flu — efforts that could easily be adapted to bioterror preparedness. Aware of their significant business ties to the Pacific Rim and sensitized to the potential impact of public health problems by their experience with SARS, King County business leaders asked public health officials for assistance in preparing for pandemic flu. After an initial forum in SAFECO field with hundreds of businesses, the county identified a set of businesses as a sounding board for recurring contact; it created a "Business Emergency Network" that distributes information on disaster preparedness among its members; and it created streaming video of its forums and PowerPoint presentations made to businesses that can be downloaded from the website. Suggesting that businesses develop all-hazards points of contact would be a logical next step.

[198]A time-honored method for educating adults is through children. We may wish to consider efforts such as a "preparedness" scouting badge.

[199]The Department of Homeland Security has already developed a 20-hour all-hazards education programs for Community Emergency Response Teams (CERT) which could be expanded and targeted within communities to fit this purpose. Over 200,000 individuals have taken part in CERT's 20-hour training courses, which use a curriculum developed by the American Safety and Health Institute and include basic medical response and disaster training. CERT is a nationwide training program; however, the participation of individuals in these teams after attending the course varies widely across the nation. For more information on CERT, including the issues covered in the CERT course, see <http://www.citizencorps.gov/cert/about.shtm> (accessed March 9, 2007). For information on American Safety and Health Institute training curricula, see <http://www.ashinstitute.org/> (accessed March 9, 2007).

[200]Risk communicators claim that a "problem solving" approach is more effective than a "rule based approach" — in part because people like to feel that they have figured out for themselves what to do, with the help of experts. K.E. Rowan, "Why Rules for Risk Communication Are Not Enough: A Problem Solving Approach to Risk Communication," *Risk Analysis* 14 (1994): p. 365.

[201]Monica Schoch-Spana, et al., "Community Engagement: Leadership Tool for Catastrophic Health Events" *Biosecurity and Bioterrorism* 5, 1 (2007): p. 16-17, accessed May 4, 2007 at <http://www.upmc-biosecurity.org/website/resources/publications/2007_orig-articles/2007_article_pdfs/2007-04-04-communityengagementleadershiptool.pdf>.

[202]We note though that there are intermediate positions between laissez-faire and compulsory approaches. Ralph Gomery, the President of the Alfred P. Sloan Foundation, has suggested, for example, that large public businesses would be encouraged to take these actions if the SEC required them to disclose their activities of this type in annual reports.

[203]Danzig, op. cit. (2005).

[204]Robert Blendon, et al., "The Public and the Smallpox Threat," *New England Journal of Medicine* 1 (2003): p. 348.

[205]One out of every 8 Americans (that is, 35 million people) is over the age of 65. U.S. Census Bureau, Census 2000, Profile of General Demographic Characteristics for the United States (2000), Table DP-1.

[206]One in every twelve Americans (that is, 18.2 million people, 8.6 percent of the U.S. population) aged 16 or older has a condition that makes it difficult to go outside the home to shop or visit a doctor. Judith Walrop and Sharon M. Stern, U.S. Census Bureau, "Census 2000 Brief, Disability Status 2000." Ten percent of the 5-21 year old population of New York City and 25 percent of the 21-64 year old population are reported in the 2000 census as disabled. U.S. Census Bureau, 2000 Census, Profile of Selected Social Characteristics: 2000, Census 2000 Summary File (SF 3) DP-2 — Sample Data.

[207]Of the 281.4 million Americans enumerated in the 2000 census, 6.8 percent (19.2 million people) were under the age of 5 and 7.3 percent (20.5 million people) were between 5 and 9 years old. U.S. Census Bureau, Census 2000, "Profile of General Demographic Characteristics for the United States (2000)." Table DP-1.

[208]7.3 percent of those enumerated in the 2000 census were between the ages of 10 and 14. U.S. Census Bureau, Census 2000, "Profile of General Demographic Characteristics for the United States (2000)," DP-2.

[209]California's "Little Hoover Commission" calculated the magnitude of "vulnerable populations" in an emergency as "close to 5 million elderly, almost 4.5 million disabled, approximately 5 million living in poverty and 3.5 million with limited or no English ability." Op. cit., p. 12.

[210]Of the 7.5 million New Yorkers over the age of 5 enumerated by the 2000 census, nearly 1.8 million or 23.67 percent described themselves this way. U.S. Census Bureau, Profile of Selected Social Characteristics, District of Columbia (2000), Summary File 3. Of 8.8 million people enumerated in Los Angeles County over 2.5 million (28.9 percent of the total population) described themselves this way. Ibid., Profile of Selected Social Characteristics, Los Angeles County. It is hard to discern how many of these people have a functional grasp of English. On a national basis, the census recorded 8.1 percent (21.3 million people) of the total population as not speaking English "very well," but half of these described themselves as falling in the next best category — they judged that they spoke English "well." The other half described themselves as speaking English "not well" (7.6 million people) or "not at all" (3.4 million people). U.S. Census Bureau, Census 2000, Summary File 3, Tables P19, PCT13, and PCT14.

[211]This self-referential inclination is not unique to American bureaucracies and organizations. Alan Kirschenbaum offers the same indictment of Israeli consequence management in his study, *Chaos Organization and Disaster Management,* Marcel Dekker (2004). He concludes for example that ". . . preparedness definitions are primarily created to serve the internal needs of the organization and not its clients. . . ." (p.104) and "Scarce resources are primarily being used to prepare their own organizations and not the potential victims of disasters" (p.256).

[212]Avigador Haselkorn, "Deterrence Through Defense: Hardening the U.S. Civilian Population Against Terrorist Attacks," citing George H. Quester, "American Deterrence Theory and Homeland Defense," *Journal of Homeland Security* (October 18, 2000) accessed March 9, 2007 at <http://www.homelandsecurity.org/journal/Articles/Quester.htm> and Renee Garfinkel, "Surviving Disaster: What We Can Learn from Elderly Civilians' Surprisingly Successful Coping With Missile," *Traumatology* 5.3 (1999), accessed March 9, 2007 at <http://www.fsu.edu/~trauma/a5v5i3.htm>.

[213]National Fire Protection Association statistics. In 1971, there were over 12,000 deaths by fire. In 1974, Congress passed the Federal Fire Prevention and Control Act creating the U.S. Fire Administration, which works to both improve professional training, and to educate the public on making good risk-management decisions. By 2004 there were only 3,900 deaths by fire. While it is always difficult to determine causality, the Association attributes the reduction in part to better building construction, in part to better trained and dispersed fire services, and in part to better education of citizens regarding what to do during a fire; see <http://www.usfa.fema.gov/statistics/national/> (accessed March 9, 2007).

[214]The Trust for America's Health discusses some of the variables and makes its own estimates about hospital surge capacity in the course of an assessment about readiness for a possible influenza pandemic. Op. cit. p. 20ff.

[215]"Annual report on Licensed Acute Care Hospital Bed Capacity, FY 2004," Maryland Healthcare Commission (2004): p. 8.

[216]Calculated on a hospital by hospital basis from statistics available at "Virginia Health Information," Northern Virginia Hospitals, accessed March 9, 2007 at <http://www.vhi.org/hosp_acute.asp>.

[217]"2004 Utilization Indicators," District of Columbia Hospital Association (2004). Statistics are for the fourth quarter of 2004, and include the eight public hospitals in the District, the four military hospitals: VA Medical Center, Walter Reed Army Medical Center, Malcolm Grow Medical Center, and the National Naval Medical Center — as well as the Hadley Memorial Hospital and the National Rehabilitation Hospital). This number does not include the three psychiatric hospitals in Washington, which had 781 additional beds.

[218]"Annual report on Licensed Acute Care Hospital Bed Capacity, FY 2004," Maryland Healthcare Commission (2004). Numbers include Montgomery and Prince George's County.

[219]Moreover, of these total numbers, many beds are licensed for psychiatric care, substance abuse, and other uses which may make them unequipped, and therefore unsuitable, for a mass bioterror emergency situation.

[220]These numbers are similar enough to today's to serve as a rough rule of thumb — in 2005, the District of Columbia reported 426,266 emergency department visits, or approximately 1167 a day.

[221]Claudia Schur, et al., "Emergency Department Use in Maryland: A Profile of Users, Visits, and Ambulance Diversion," The Project HOPE Center for Health Affairs (April 2003).

[222]A 2003 study characterized just 12.8 percent of emergency department visits as non-urgent, with an additional 17.7 percent unknown. These numbers suggest that in extremis, emergency departments could free perhaps as much as a third of their staff for surge capacity treatment. Yet among non-urgent cases, one study found that 82 percent still felt that their cases required urgent care — suggesting that freeing such staff would be difficult. And given the overcrowding of many metropolitan emergency rooms discussed earlier, extra staff are unlikely to be available for surge.

See L.F. McCraig and C.W. Burt, "National Hospital Ambulatory Medical Care Survey: 2003 Emergency Department Summary," National Center for Health Statistics, (2005); and J.M. Gill and A.W. Riley, "Nonurgent Use of Hospital Emergency Departments: Urgency from the Patient's Perspective," *Journal of Family Practice* 42.5 (1996): p. 491; both cited in "Hospital-Based Emergency Care at the Breaking Point," op. cit., pages 34 and 38.

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