

After-Action Report

Navigating the Storm: Report and Recommendations from the *Atlantic Storm* Exercise

BRADLEY T. SMITH, THOMAS V. INGLESBY, ESTHER BRIMMER, LUCIANA BORIO,
CRYSTAL FRANCO, GIGI KWIK GRONVALL, BRADLEY KRAMER, BETH MALDIN,
JENNIFER B. NUZZO, ARI SCHULER, SCOTT STERN, DONALD A. HENDERSON,
RANDALL J. LARSEN, DANIEL S. HAMILTON, and TARA O'TOOLE

Atlantic Storm was a tabletop exercise simulating a series of bioterrorism attacks on the transatlantic community. The exercise occurred on January 14, 2005, in Washington, DC, and was organized and convened by the Center for Biosecurity of UPMC, the Center for Transatlantic Relations of Johns Hopkins University, and the Transatlantic Biosecurity Network. *Atlantic Storm* portrayed a summit meeting of presidents, prime ministers, and other international leaders from both sides of the Atlantic Ocean in which they responded to a campaign of bioterrorist attacks in several countries. The summit principals, who were all current or former senior government leaders, were challenged to address issues such as attaining situational awareness in the wake of a bioattack, coping with scarcity of critical medical resources such as vaccine, deciding how to manage the movement of people across borders, and communicating with their publics. *Atlantic Storm* illustrated that much might be done in advance to minimize the illness and death, as well as the social, economic, and political disruption, that could be caused by an international epidemic, be it natural or the result of a bioterrorist attack. These lessons are especially timely given the growing concerns over the possibility of an avian influenza pandemic that would require an international response. However, international leaders cannot create the necessary response systems in the midst of a crisis. Medical, public health, and diplomatic response systems and critical medical resources (e.g., medicines and vaccines) must be in place before a bioattack occurs or a pandemic emerges.

Authors from the Center for Biosecurity of the University of Pittsburgh Medical Center (UPMC), Baltimore, Maryland: Bradley T. Smith, PhD, is an Associate; Thomas V. Inglesby, MD, is Deputy Director; Luciana Borio, MD, is a Senior Associate; Crystal Franco is an Analyst; Gigi Kwik Grönvall, PhD, is an Associate; Beth Maldin, MPH, is an Associate; Jennifer B. Nuzzo, SM, is an Analyst; Donald A. Henderson, MD, MPH, is a Distinguished Scholar; and Tara O'Toole, MD, MPH, is Director. At the time the exercise was conducted, Bradley Kramer and Ari Schuler were Analysts, and Scott Stern was an Intern. Ari Schuler is now with Raydiance, Inc., Orlando, Florida. Bradley Kramer is now at the University of Maryland Medical School, Baltimore. Scott Stern is now at American University, Washington, DC.

Authors from the Center for Transatlantic Relations of the Johns Hopkins University, Washington, DC: Esther Brimmer, PhD, is Deputy Director; and Daniel S. Hamilton, PhD, is Director.

Author from the Institute for Homeland Security, Alexandria, Virginia: Colonel Randall J. Larsen (USAF, retired) is the Founding Director.

A*TLANTIC STORM* was a ministerial-level exercise convened on January 14, 2005, in Washington, DC.¹ The purposes of the exercise were to illuminate the political and strategic challenges that leaders will face during a major bioterrorism crisis, to demonstrate the importance of international cooperation and preparation in responding to such events, and to increase political and scientific interest in improving international biosecurity.

Atlantic Storm portrayed bioterrorist attacks using variola major—the virus that causes smallpox—in multiple European and North American cities. The exercise illustrated the international challenges that would arise in the wake of a major bioterrorist attack or a naturally occurring pandemic of infectious disease. This report describes the design, assumptions, and structure of *Atlantic Storm*, conveys key comments and observations from the exercise participants, and offers recommendations for action arising from the exercise.²

EXERCISE DESIGN

Context of the Exercise

Atlantic Storm was designed to run in real time from 9:00 AM to 4:00 PM on January 14, 2005, and was based on the actual geopolitical conditions on that date. The ex-

¹*Atlantic Storm* was designed, organized, and convened by a team from the Center for Biosecurity of the University of Pittsburgh Medical Center (UPMC; <http://www.upmc-biosecurity.org>) and the Center for Transatlantic Relations of the Johns Hopkins University (<http://transatlantic.sais-jhu.edu>). The *Atlantic Storm* Executive Committee was composed of: Tara O'Toole, Thomas Inglesby, and Brad Smith of the Center for Biosecurity; Daniel Hamilton and Esther Brimmer of the Center for Transatlantic Relations; and Randall Larsen of the Institute for Homeland Security. The Executive Committee also served as the control team during the exercise. Brad Smith was the *Atlantic Storm* Project Director. (The full list of project staff can be found at: <http://www.atlantic-storm.org/about/participants.html>.) In addition, the Transatlantic Biosecurity Network (TBN) played a critical role in the development of the exercise. The TBN was first convened by the Atlantic Storm Executive Committee in 2002; it is a group of experts in health, security, and transatlantic relations from nations in North America and Europe, as well as from the European Union (EU), the World Health Organization (WHO), and the North Atlantic Treaty Organization (NATO). (The full list of TBN members can be found at: <http://www.atlantic-storm.org/about/network.html>.) The exercise was financially supported by the Alfred P. Sloan Foundation, the German Marshall Fund of the United States, and the Nuclear Threat Initiative.

²Additional exercise information and materials, as well as a multimedia presentation—*Virtual Atlantic Storm*—can be found at: www.atlantic-storm.org.

ercise scenario simulated a summit of transatlantic leaders meeting in the first few hours after discovery of bioterrorist attacks in Europe. In the scenario, the international leaders were to have met in Washington, DC, on January 14, 2005, for a “Transatlantic Security Summit” to discuss international cooperation in the response to catastrophic terrorism and the proliferation of weapons of mass destruction. On the eve of the summit, as leaders are assembling in Washington, smallpox cases are reported in Germany, the Netherlands, Sweden, and Turkey. The assembled leaders decide to discuss a transatlantic response before returning to their home countries to deal with the emerging crisis.

Summit Principals

The principals in attendance at the summit (Table 1) included the Presidents of the European Commission, France, and the United States; the Chancellor of Germany; the Prime Ministers of Canada, Italy, the Netherlands, Poland, Sweden, and the United Kingdom; and the Director-General of the World Health Organization. *Atlantic Storm* focused on the transatlantic community of Europe and North America, because this region presents a “best case” scenario for international response to bioterrorism: The transatlantic community is perhaps the most closely aligned socially, economically, politically, and strategically of any region on the globe and has a history of working together through multilateral organizations such as NATO and the EU. These nations also are among the wealthiest and have medical and public health systems that are advanced compared to those in other parts of the world.

The summit principals were played by current and former international leaders, all of whom are highly accomplished public servants who had held the same or other high-level positions in their respective governments (Table 1). The nations and organizations included in the exercise represent the political, economic, and geographic diversity of the transatlantic community and are members of the various strategic alliances in the region.

The *Atlantic Storm* principals played their roles as if they themselves were serving in these positions at that particular moment. Their input was not scripted. In this article, statements made by the principals while in their roles are distinguished from comments made during the moderated discussion after the exercise concluded, when the principals were no longer in character.

On the evening of January 13, the principals were given short situation briefings and background memos, but they were unaware of what was going to occur when they took their seats at 9:00 AM the following morning. More than 100 people observed the exercise, including leaders in medicine, public health, and national security;

TABLE 1. SUMMIT PRINCIPALS: ROLES AND PLAYERS IN *ATLANTIC STORM*

<i>Role</i>	<i>Player</i>	<i>Biography</i>
Prime Minister of Canada	Barbara McDougall	Former Foreign Minister of Canada
President of the European Commission	Erika Mann	Member of the European Parliament
Chancellor of Germany	Werner Hoyer	Member of the German Bundestag, Former Deputy Minister of Foreign Affairs of Germany
President of France	Bernard Kouchner	Member of the European Parliament, Former Minister of Health of France, Founder of Médecins Sans Frontières
Prime Minister of Italy	Stefano Silvestri	Former Deputy Minister for Defense of Italy
Prime Minister of the Netherlands	Klaas de Vries	Former Minister of Interior of the Netherlands
Prime Minister of Poland	Jerzy Buzek	Member of the European Parliament, Former Prime Minister of Poland
Prime Minister of Sweden	Jan Eliasson	Ambassador of Sweden to the U.S., Former Undersecretary General for Humanitarian Affairs at the United Nations
President of the United States	Madeleine Albright	Former Secretary of State of the United States
Prime Minister of the United Kingdom	Sir Nigel Broomfield	Former Ambassador of the UK to Germany
Director-General, World Health Organization	Gro Harlem Brundtland	Former Prime Minister of Norway, Former Director-General of the World Health Organization

Note: Full biographies of all players are available at: <http://www.atlantic-storm.org/about/participants.html>.

members of the international media; and government of officials from both sides of the Atlantic.³

Information Flow during the Exercise

Throughout the exercise, the summit principals received information in a number of formats. Briefings were delivered to the entire group by the Summit Staff. (The Summit Staff represented the collective staffs of each nation and organization at the summit and were played by members of the *Atlantic Storm* control team; see footnote 1.) Periodically, simulated news broadcasts

from the fictional “Global News Network (GNN)” were shown on large screens to give the group a sense of what their publics were seeing on television. Summit participants received individual written bulletins from their “national advisors” (i.e., the *Atlantic Storm* control team) describing emergent events in their home countries and offering recommendations. The summit participants also were able to ask written questions of their national advisors and of the Summit Staff. These questions were addressed by the *Atlantic Storm* control team.

These tools were used during the exercise to inform the participants and trigger key points of discussion, but participant conversation was free-flowing and unscripted. The GNN videos and the reported actions of countries not represented by players in the exercise were not meant to predict exactly what would occur in such a crisis, but

³A complete list of *Atlantic Storm* observers is available at: <http://www.atlantic-storm.org/about/observers.html>.

rather to reflect one reasonable set of events that could follow in the wake of bioterrorist attacks on the transatlantic community.

Exercise Assumptions and Bioterrorist Agent Selection

A document explaining all assumptions and scenario design decisions was distributed at the end of the exercise on January 14, 2005 (it is available on the *Atlantic Storm* website). A few key scenario assumptions are described below.

The *Atlantic Storm* scenario was structured around a fictitious deliberate outbreak of smallpox in Europe and North America. The organizers used the best available medical and epidemiological data on smallpox to build a conservative version of an outbreak that was then used to drive the exercise. It is important to note that the primary goal of *Atlantic Storm* was not to “model” a smallpox outbreak; rather, it was intended to illuminate strategic challenges to the international community’s ability to collectively respond to a bioterrorist attack or other large-scale epidemic. A number of diseases could have been chosen to drive the exercise, but the organizers used smallpox for the following reasons:

- Smallpox is caused by a virus that can spread from person to person in droplets, creating a self-propagating epidemic. This illustrated the unique nature of a bioweapon attack, which can cause pervasive epidemics that evolve and worsen over weeks or months.
- There is a vaccine that is effective in preventing smallpox. For a number of other diseases that could result from bioterrorist attacks or natural pandemics—such as avian influenza or SARS—there are currently no licensed vaccines and limited or no supplies of therapeutics.
- While there is an effective smallpox vaccine, global supplies are limited and some countries have far more than others. The scarcities and inequities forced the summit principals to debate whether they would be willing to share scarce resources in the midst of a crisis.

The bioterrorist attacks portrayed in *Atlantic Storm* occurred between January 1 and 4, 2005, in enclosed public spaces in Istanbul, Frankfurt, Warsaw, Rotterdam, New York, and Los Angeles. Variola major, the virus that causes smallpox, was disseminated covertly using small aerosol sprayers. Based on the assumptions used regarding the incubation and diagnosis of early smallpox cases, this resulted in a staggered discovery of cases on January 13 and 14, 2005, first in Europe, then in North America.

Attack locations were chosen to represent a mixture of EU and NATO memberships to see which international organization(s), if any, would be called on to help man-

age the events. The organizers wanted to illustrate the challenges of maintaining economic stability while trying to control the spread of an epidemic. Thus, some attack locations were key nodes of international travel and/or commerce (e.g., the port of Rotterdam). The attacks were staggered so that initial cases would be recognized first in Europe. This created a dynamic in which North American countries were unaffected at the outset of the exercise, and the leaders of the initially unaffected countries would have to weigh competing pressures to assist their allies and to protect their own populations.

Because the events of *Atlantic Storm* take place on a single day, less than 2 weeks after the attacks, there had not been enough time for transmission of smallpox from first-generation (i.e., those infected in the attacks) to second-generation victims during the exercise. There had also not been enough time since the attacks for deaths from smallpox to have occurred. The increase in the number of smallpox cases reported throughout the course of the exercise was due to reports accumulating from affected countries—the victims were first-generation smallpox cases being discovered by public health authorities—not the result of spread of the disease from person to person.

To provide the transatlantic leaders at the summit with estimates of the future course of the epidemic, the Summit Staff provided projections of the number of secondary and tertiary cases that may occur within 30 days. In calculating these figures, a conservative disease transmission rate of 1 to 3 was chosen for the first to second generation of cases—that is, one infected person would, on average, infect three others.⁴ For the second to third generation, a transmission rate of 1 to 0.25 was assumed, taking into account estimates of the positive effects of vaccination and other disease control efforts that could be employed in the weeks following discovery of the epidemic.

Smallpox Vaccine

On the day of the exercise, actual total global stockpiles of smallpox vaccine amounted to 720 million doses—enough to vaccinate approximately 10% of the global population. Only 9 countries had enough vaccine for their entire populations. Most countries had little or no vaccine (Table 2). Even under emergency conditions, the global smallpox vaccine manufacturing capacity was estimated to be 40 million doses per month (Table 3).⁵

⁴The U.S. Centers for Disease Control and Prevention state that most experts agree that one infected person could infect 5–6 others. CDC. *What We Learn about Smallpox from Movies—Fact or Fiction*. Atlanta: CDC; 2004. Available at: <http://www.bt.cdc.gov/agent/smallpox/disease/movies.asp>. Accessed August 4, 2005.

⁵All figures were determined using the best available open-source materials and were up to date as of January 14, 2005.

TABLE 2. NATIONAL SMALLPOX VACCINE STOCKPILE ESTIMATES (AS OF JANUARY 14, 2005)

<i>Nation</i>	<i># doses (millions)</i>	<i>% population covered</i>
United States	300	100
Germany	100	100
United Kingdom	80	100
France	60	100
Netherlands	20	100
Czech Republic	10	100
Israel	7	100
Denmark	6	100
Singapore	4	100
South Africa	30	70
Malaysia	15	65
Austria	3	40
Switzerland	3	40
Japan	31	25
Korea (Rep. of)	10	20
Canada	6	20
Greece	2	20
Spain	6	15
Ireland	<1	15
Norway	<1	15
Italy	5	10
Belgium	1	10
Hungary	1	10
Sweden	1	10
Iran	2	5
Australia	<1	5
Poland	<1	5
India	6	1
Croatia	<1	1
Slovakia	<1	1
Turkey	<1	1
World Health Organization	2.5	NA
Total	approx. 720	10

Note: Countries shaded in gray were participants in the *Atlantic Storm* summit.

Exercise Structure and Storyline

The summit participants reacted to the scenario and debated international response options from 9:00 AM to approximately 4:00 PM. Throughout the day, the total number of reported first-generation smallpox cases rose from 51 cases in four European countries at 9:00 AM to 3,320 cases throughout Europe and North America at 1:30 PM—with projections indicating the possibility of 660,000 cases worldwide within 30 days. Ultimately, the outbreaks were discovered to be the result of covert attacks on transportation hubs and centers of commerce in six cities: Istanbul, Rotterdam, Warsaw, Frankfurt, New York, and Los Angeles.

During the exercise, the summit principals debated a series of key issues that included:

- How should nations in the transatlantic community work together to respond to this new type of security threat?
- Is this a public health crisis or an international security crisis, or both?
- What is the role of multilateral organizations such as NATO, the EU, and the UN?
- Should NATO's mutual defense clause ("Article 5") be invoked?
- How will domestic political pressures affect the ability of leaders to work together internationally?

TABLE 3. ESTIMATED SMALLPOX VACCINE PRODUCTION CAPACITY (AS OF JANUARY 14, 2005)

<i>Company</i>	<i>Country of production</i>	<i>Production capacity (million doses/year)</i>	<i>Production capacity (million doses/month)</i>
Acambis/Baxter	United States/Austria	100	8.3
Bavarian-Nordic	Denmark/Germany	150	12.5
RIVM	Netherlands	2–4	0.16–0.30
Kaketsuken	Japan	10–20	0.83–1.6
Total Production (Combined)		274	22.8
Combined Emergency Production (Estimated)		480	40

- How should limited medical resources be shared among nations when, for instance, some countries have enough vaccine to cover an entire population but many more do not?
- Can the World Health Organization serve as the “honest broker” to distribute pooled stocks of vaccine and other medical resources?
- Should leaders restrict the movement of people within their nations and across national borders to control the spread of disease? What would be the economic consequences?
- What messages should be conveyed to the public and the media?

After debating these key issues and deciding on their collective message to the public, the summit principals convened a mock press conference with journalists from Europe and North America.⁶ While still in their roles as international leaders, the summit participants made a joint statement to their publics and then responded to questions from the press.

At the conclusion of the mock press conference, the exercise ended and the summit participants stepped out of their roles. To reflect on the day’s events, the participants joined in a moderated discussion led by Nik Gowling of the British Broadcasting Corporation. The *Atlantic Storm* participants discussed their experiences during the day, lessons learned from the exercise, and what steps could be taken to improve biosecurity preparedness, response, and international coordination to confront such challenges in the future.

⁶The media in the mock press conference were played by current and former members of the international press. A full list of media participants is available at: <http://www.atlantic-storm.org/about/mock.html>.

RECOMMENDATIONS

Based on the observations and comments of *Atlantic Storm* participants, as well as the exercise organizers’ own analyses, the following recommendations are offered for improving national and international efforts to cope with large-scale biological attacks or naturally occurring pandemics. These recommendations are primarily intended for U.S. government, and science and health leaders, but they have relevance to leaders in other nations and to international organizations.

- 1. The U.S. should work with the international community to plan for coordinated responses to major bioattacks and epidemics. Such plans should include strategic and operational detail commensurate with other major international security agreements and organizations.**

“For someone who has been around in the security and defense fields in its traditional sense for many years, this was quite a surprising and breathtaking exercise. . . . This is something I think a very small minority of politicians in Europe are aware of. . . .” (Werner Hoyer, after conclusion of the exercise)

Atlantic Storm showed that a set of highly accomplished political leaders were largely unfamiliar with the political and strategic stakes that might be associated with biological attacks or natural pandemics—for example, how to respond to mutual defense requests, how to balance national interests with the objective of ending an international epidemic, and the like—and they were not prepared to respond effectively at the pace and on the scale demanded by the crisis.

Many of the participants in *Atlantic Storm* concluded during or after the exercise that some of the key preexisting multilateral frameworks, such as NATO and the EU,

were limited in their ability to cope with the unique challenges posed by a bioweapon-induced spread of epidemic disease.⁷ There was much debate about the applicability of NATO, given its traditional military focus, when Turkey called on NATO to invoke the “Article 5” mutual defense clause and provide vaccine to help the nation respond to the outbreak in Istanbul. (Turkey is not a member of the EU and therefore the exercise designers decided to have Turkey use its membership in NATO to seek aid.)

“I can understand why Turkey has asked for the activation of Article 5 of NATO, Turkey not being yet inside [the] European Union. . . . The problem, of course, is that it is not necessarily a military response that we should give. We should give a political response to Turkey, for the moment.” (Prime Minister of Italy, played by Stefano Silvestri, responding to a request from Turkey to activate NATO’s “Article 5” mutual defense clause to provide support and vaccine to combat the outbreak in Istanbul)

“I think Turkey needs our solidarity. No question about that. What does that mean for Article 5? Article 5 is not a good response to the health situation they’re facing.” (Chancellor of Germany, played by Werner Hoyer, responding to Turkey’s request to NATO for smallpox vaccine to combat the outbreak in Istanbul)

Political, medical, and public health leaders could greatly reduce the chance for miscalculation and increase the chances for useful international cooperation if issues—such as the roles of major international organizations and how national requests for assistance to the international community should be made, evaluated, and acted on—were determined and examined well in advance. Joint planning for traditional international security contingencies has occurred in NATO and other security alliances for decades. Planning with that degree of rigor and strategic and operational detail, but now for international response to epidemics, is what is needed to cope with potential biotreats of international consequence.

“We live in a time of new threats. . . . What we now see is that health and security go together, so we have to combine them, and I think the lesson we should draw from this . . . is that we don’t have the organizational structures to deal with the new threats.” (Jan Eliasson, after conclusion of the exercise)

“The question for the century [is] . . . we have a globalized economy and globalized society, but we don’t yet

have globalized, effective institutions to deal with the questions that come out of the globalization process.” (Sir Nigel Broomfield, after conclusion of the exercise)

In *Atlantic Storm*, one example of the paralyzing effect that a lack of effective international planning for biotreats can have occurred when participants came to realize that many problems that they had assumed would have been resolved by straightforward scientific data were in fact complicated issues about which scientists from different countries and organizations disagreed and for which political decisions would ultimately need to be made.

“Scientists have different opinions, and we must make a political decision on this. . . .” (Prime Minister of Poland, played by Jerzy Buzek, during the discussion of whether vaccine can be safely diluted to produce additional doses)

Early in the exercise, the summit principals were presented with the conflicting conclusions of U.S. and European health experts on the advisability of diluting existing smallpox vaccine stocks to produce additional doses. The principals were told that they had the option of diluting existing smallpox vaccine stockpiles fivefold, thus increasing the global stocks from approximately 700 million to 3.5 billion doses—enough for half the world’s population. Based on two small scientific studies, senior U.S. health officials had indicated that the U.S. could safely dilute its vaccine stockpiles fivefold in a crisis.⁸

⁸Two U.S. tests of diluted vaccine found it to produce the same vaccination scars as were produced by vaccination with full-strength vaccine: Frey SE, Couch RB, Tackett CO, et al. Clinical responses to undiluted and diluted smallpox vaccine. *N Engl J Med* 2002 Apr 25;346(17):1265–1274; Talbot TR, Stapleton JT, Brady RC, et al. Vaccination success rate and reaction profile with diluted and undiluted smallpox vaccine: a randomized controlled trial. *JAMA* 2004 Sep 8;292(10):1205–1212. Scarring is an indirect measure of effectiveness, but it is the only metric possible, because humans cannot ethically be infected with smallpox to test immunity resulting from vaccination with diluted vaccine. After announcing the results of the first of these two studies in March 2002, then-Secretary Thompson of the U.S. Department of Health and Human Services said: “We now know that in the unlikely event of an intentional release of smallpox, our stockpile of smallpox vaccine can be expanded fivefold as we had planned.” Dr. Anthony Fauci, Director of the National Institute of Allergy and Infectious Diseases, concurred: “These encouraging results suggest that we can do more with less and thereby extend our capacity to contain a potential smallpox outbreak.” See NIAID study results support diluting smallpox vaccine stockpile to stretch supply [press release]. Bethesda, Md: National Institutes of Health; March 28, 2002. Available at: <http://www2.niaid.nih.gov/newsroom/releases/smallpox.htm>. Accessed August 4, 2005.

⁷For a discussion of the challenges faced by the EU with respect to biosecurity, see: Sundelius B, Grönvall J. Strategic dilemmas of biosecurity in the European Union. *Biosecure Bioterror* 2004;2(1):17–23.

However, after evaluating the American data and initiating their own studies, experts in the European Commission did not recommend that EU member states dilute their vaccine stockpiles, because diluted vaccine had never been used in a real smallpox outbreak and because dilution could increase the chances of ineffective vaccinations when used on large numbers of people in a crisis.⁹ After being briefed on the conflicting policies, the *Atlantic Storm* principals did not come to a decision as to whether they would pursue dilution of their vaccine stockpiles—a decision that would have had a tremendous impact on their strategic options for response.

2. The U.S. and its allies should strengthen their own national plans to respond to biotreats and encourage other countries to do the same.

A number of the participants in *Atlantic Storm* were surprised by the wide range in national smallpox vaccine stockpiles: Some countries had enough for all their citizens, but some had enough for 1% or less.

“When I saw the list [of vaccine stocks], that was a shock to me, how little prepared many countries are, even rich Western countries, to address this kind of problem.” (Klaas de Vries, after conclusion of the exercise)

There are no accepted metrics to judge a country’s ability to handle the array of potential biotreats, but it is clear that some countries have made major investments in these efforts and some have made few to none. What *Atlantic Storm* illustrated—as do many real-world potential pandemics crises, such as a future SARS or avian influenza pandemic—is that it is in the explicit interest of the U.S. and other countries for there to be as few “weak links” as possible in the international community’s ability to mount an effective public health response.

Highly contagious diseases will eventually affect nations in other parts of the world, resulting in widespread illness or death and affecting regional or global economies.¹⁰ It is in the enlightened interest of the global community for all countries to be committed to at least a minimum set of bio-preparedness plans, responses, and assets. Developed countries should plan to take leadership roles in an international response to epidemics and prepare to send expertise and resources to the places in the world where they are most needed to quell the epidemic.

⁹Gouvras G. Policies in place throughout the world: actions by the European Union. *Int J Infect Dis* 2004;852:521–530.

¹⁰The worldwide impact of a bioterror attack was illustrated in *Atlantic Storm* by a GNN news segment and by requests to the summit principals for assistance and vaccine from nations in the developing world.

To provide an incentive to build public health emergency response capacity, requirements for membership in existing multilateral organizations such as NATO or the EU could be modified to include adherence to medical and public health standards for infectious disease surveillance and reporting, as well as epidemic response. If such standards were added to the traditional economic, political, and military standards for membership in such organizations, technical assistance programs would need to be developed to help some countries in their efforts to become more ready to cope with epidemics.

3. The U.S. should work with the international community to greatly augment the capacity of the World Health Organization (WHO) to respond to the health and medical consequences of biological attacks or pandemics.

“We must return to the WHO because we need an organization which does have the confidence and the trust of the people around the world, to come to fair decisions. . . . So, there is only one organization, in my view, who could take this up onto their shoulders politically, and that’s WHO.” (Chancellor of Germany, played by Werner Hoyer)

“In the world that’s coming up . . . we will need such organizations [as WHO] which have pre-allocated powers and responsibilities, and we don’t have to make them up in a hurry, because that is going to be the way of the future. . . .” (Sir Nigel Broomfield, after conclusion of the exercise)

Political, scientific, and health leaders have broad and serious expectations about WHO’s responsibilities, capacities, and resources in a crisis—expectations well demonstrated by the participants in *Atlantic Storm*.¹¹ While the scientists and health officials of WHO are highly capable, dedicated, and hard-working, *Atlantic Storm* showed that even experienced politicians have unrealistic notions of what WHO would be able to deliver in a crisis, given its current budgetary, political, and organizational limits.

¹¹These expectations have been confirmed in reality as well. The Global Health Security Action Group (GHSAG), which consists of Canada, France, Germany, Italy, Japan, Mexico, the UK, and the U.S., convened the *Global Mercury* exercise in September 2003 to test communication systems that would be used between the nations during a public health emergency. In the after-action report, GHSAG acknowledged that the WHO’s mandate made it an ideal candidate to be the hub of coordination during a global public health emergency, but there was concern about the WHO’s ability to successfully carry out this task. Report available at: http://www.hc-sc.gc.ca/english/media/issues/global_mercury/index.html. Accessed August 5, 2005.

"The budget of the WHO has very considerable limitations. It's like a middle-sized hospital in England in total resources. . . . [I]f leaders at this level are realizing that you have a crisis and that you need the WHO to be doing important roles, they also will [have to] support, with extra budgetary resources, what's necessary." (Gro Harlem Brundtland, after conclusion of the exercise)

The 2004/2005 WHO biennial budget is \$2.8 billion, and WHO receives 70% of this amount through voluntary donations from nations, international organizations, NGOs, and private philanthropies.¹² David Byrne, Special Envoy for WHO, said recently that WHO is not seen as a serious negotiating partner by many countries, but instead is often put in the role of mendicant.¹³ The 2004/2005 WHO budget for bioterrorism preparedness is estimated to be only \$6.3 million. The Communicable Disease Surveillance and Response office in WHO employs about 30 people; its response arm, the Global Outbreak Alert and Response Network (GOARN), does not receive any funding from the WHO budget and therefore must raise funds to respond to crises like the recent plague outbreak in Congo.¹⁴ The reliance on voluntary donations for both GOARN and WHO as a whole results in a fragile financial situation for an organization that must have the flexibility to respond rapidly to emerging epidemics. This raises questions about WHO's capacity to respond to large disease epidemics that are occurring in multiple locations or that require sustained responses. This is a problem that needs to be addressed with much greater international financial commitment to WHO as well as greater political independence for the organization.

In May 2005, a revised version of the International Health Regulations (IHR, the agreement that governs WHO) was approved by the World Health Assembly.¹⁵

¹²World Health Organization. *Unaudited Interim Financial Report for the year 2004*. Available at: http://www.who.int/gb/ebwha/pdf_files/WHA58/A58_26Add1-en.pdf. Accessed August 5, 2005.

¹³International Conference on Biosafety and Biorisks, March 2–3, 2005, Lyon, France. Available at: <http://www.upmc-biosecurity.org/pages/events/biosafety/speakers/byrne/byrne.html>.

¹⁴The WHO's Global Outbreak Alert and Response Network (GOARN) is a voluntary technical partnership of more than 120 member states coordinated by WHO to provide multidisciplinary technical support to countries for outbreak response. The WHO budget does not provide support for GOARN. Most GOARN team members are funded by their home countries, but WHO must still raise funds to coordinate response efforts and provide transportation. During the 2005 outbreak of plague in the Congo, GOARN had to raise \$400,000 to ensure the safety and transportation of the responding team. International Conference on Biosafety and Biorisks, March 2–3, 2005, Lyon, France. Available at: <http://www.upmc-biosecurity.org/pages/events/biosafety/speakers/chu/chu.html>.

The new IHR will give WHO more flexibility to gather information and take actions independently of individual member states—authority that could have helped WHO take quicker action during the 2003 SARS epidemic when the Chinese government was not fully disclosing the scope of the crisis.

The previous IHR were first adopted in 1951 (and modified in 1973 and 1981) and required states to notify WHO of any human cases of cholera, plague, yellow fever, smallpox, relapsing fever, and typhus. The 1981 version shortened the list to include only cholera, plague, and yellow fever. The new regulations require states to report any outbreak of international public health significance, whether it is caused by old scourges such as plague or new pathogens such as SARS. If fully implemented when they come into force in 2007, the new IHR will be a significant step forward for WHO's ability to work effectively to manage global epidemics. However, states have the option to opt out of some or all of the IHR with minimal repercussions, so international leaders should work to ensure that all states fully agree to them.

In spite of the new IHR, some issues will not be remedied by a stronger WHO. For example, determining how to distribute scarce vaccines or medicines to the scores of countries whose citizens will live or die depending on the answer would require political decisions that are beyond the brief of any international organization. During *Atlantic Storm*, the summit principals hoped that WHO could serve as an independent "honest broker" for politically sensitive decisions such as how to distribute vaccine. In reality, it is likely that decisions with such large-scale implications could be made only by the national leaders that control these scarce medical resources.

"My experience over the last years is that the discussions at the general level about solidarity, about how to deal with the potential needs in a bioterrorist [attack], or in a recurrence by accident of smallpox, is easier to discuss at the general level than when you get into a situation where you have to make clear commitments." (Director-General of the World Health Organization, played by Gro Harlem Brundtland)

"So this is a very serious issue where I understand the responsibilities of the U.S. [to the international community], but my responsibilities are to my people first. . . ." (President of the United States, played by Madeleine Albright)

The challenges of international coordination of scarce medical resources are illustrated by the fact that, in real-

¹⁵World Health Assembly adopts new International Health Regulations [press release]. Geneva: World Health Organization; May 23, 2005. Available at: http://www.who.int/mediacentre/news/releases/2005/pr_who03/en/index.html. Accessed July 15, 2005.

ity, the European Union decided against having a shared stockpile of smallpox vaccine because of the difficulty of making decisions regarding vaccine allocation to multiple member states during a crisis. The member states “considered that an EU-level stockpile would not provide added value over the existing and planned national stockpiles, which provide more reassurance over the key issue of supply in time of need.”¹⁶ It is significant that the EU nations—which are so closely aligned that most share the same currency—were unable to come to an agreement on how to mutually share a security asset as critical as smallpox vaccine. It is likely that, without a dramatic international investment, medical countermeasures (i.e., medicines, vaccines, and medical diagnostic tests) for all types of infectious disease will remain limited for the foreseeable future. Thus, one of the key goals of international biosecurity efforts should be to find effective mechanisms by which nations can share these critical resources in emergencies.

4. Leaders in the U.S. and other countries need to be prepared to communicate effectively with the public during a crisis.

“We need to take steps that assure the people, reassure the people, but we can’t promise things we can’t deliver. . . . It’s impossible to close borders completely. . . . Therefore, to say we are going to close borders and then not be able to do it undermines our credibility. . . . We should look at steps that we can accomplish.” (President of the United States, played by Madeleine Albright)

In *Atlantic Storm*, the participants not only had to make difficult decisions, but they had to explain them to their people during a mock press conference. Many political and governmental leaders, otherwise steeped in the language of terrorism and national security threats and trade-offs, do not necessarily have a decision framework for or clear expectations about the nature of epidemics and what the public will expect and need in these situations. Leaders will not be able to command millions of citizens to do something against their will. But they will have the opportunity to persuade their citizens to take actions most likely to end the epidemic. There is ample evidence that citizens are not inclined to panic in these situations but rather are inclined to make their own choices about what will be best for them and their families based on the facts provided to them.¹⁷ The public will want to

know how they can act to help protect themselves and their communities, where they can receive the help they need, and whether and how decisions will be made to allocate scarce resources. The earlier that these conversations begin in advance of any crisis, the more likely it is that the public will be able to accept difficult information during an emergency and the easier it will be for leaders to maintain the confidence of their publics.

5. The absence of available medical countermeasures (i.e., drugs, vaccines, diagnostic tests), the inadequacies of health information systems, and the lack of mass distribution systems for medicines and vaccines will limit leaders’ capacities to deal with large-scale epidemics. Much more can and should be done now to build these resources to give international leaders more effective response options when they are faced with a large-scale bioterrorist attack or natural pandemic.

“For the EU it’s critical, because . . . the idea of open borders is so much with us, it’s so much part of our lifestyle and so much part of our identity. . . . Just to imagine we would close it . . . it would not be the European Union anymore.” (President of the European Commission, played by Erika Mann)

“It is not the idea to secure borders in the sense of making them tight. The idea must be to make crossing borders safe. Otherwise, we are going to destroy our economies within a few weeks.” (Chancellor of Germany, played by Werner Hoyer)

In *Atlantic Storm*, leaders viewed border closings and travel bans as an unattractive option for controlling the spread of disease, but, given the lack of vaccine or any other mechanism to control disease, they were forced to consider these measures. The significant negative economic and political repercussions of closings played a large role in their discussions. Leaders would be far less inclined to pursue such actions if there were ready supplies of vaccine or medicine that could be used to cope with and end large pandemics—and effective systems to get those countermeasures to the people who need them. But there is currently a critical lack of new medicines and vaccines for all infectious diseases, not just those that could be used as weapons.¹⁸ The U.S. and other nations

¹⁶Gouvras G. Policies in place throughout the world: actions by the European Union. *Int J Infect Dis* 2004;8(5):521–530.

¹⁷The Working Group on “Governance Dilemmas” in Bioterrorism Response. Leading during bioattacks and epidemics with the public’s trust and help. *Biosecur Bioterror* 2004;2(1):25–40.

¹⁸A recent study found that of the 506 new medicines being developed by the pharmaceutical and biotechnology industries, only 6 were antibiotics, and only 5 were non-HIV antivirals. Source: Spellberg B, Powers JH, Brass EP, Miller LG, Edwards JE Jr. Trends in antimicrobial drug development: implications for the future. *Clin Infect Dis* 2004 May 1;38(9):1279–1286.

need to make significant investments in bioscience, medicine and vaccine development, hospitals and public health, and integrated medical information systems. The ultimate goal should be to develop the tools and systems needed to eliminate the lethal effects of any large-scale epidemic, be it natural or the result of a bioterrorist attack. National and international investments should be directed toward four areas:

- **The U.S. and the international community need to create the capacity to rapidly develop and mass produce tens or hundreds of millions of doses of vaccines and medicines on short notice.**

In some ways *Atlantic Storm* was an easier set of problems to deal with than many other potential biothreats because there was enough smallpox vaccine for all U.S. citizens, and the same was true in eight other countries. For all other serious biothreats, no nation has a reserve of vaccine or medicine large enough to treat more than a minority of their own populations.

Given the global nature of the pharmaceutical and biotechnology industries, many of the assets required for biosecurity are located abroad and could be affected by the actions of foreign governments. The U.S. flu vaccine shortage in late 2004 resulted when a foreign regulatory agency shut down production at a plant in the UK that produced approximately half of the U.S. vaccine supply.¹⁹

During *Atlantic Storm*, the leaders felt a strong responsibility to protect their citizens first. It is conceivable that in the midst of an epidemic, a nation might choose to prevent the export of drugs and vaccines in order to satisfy the needs of the domestic population. The U.S. and other nations should work to develop both domestic capacities and international partnerships to produce medicines and vaccines critical for biosecurity—both during “peacetime” and in the midst of a crisis when production would need to surge to meet demand.

During *Atlantic Storm*, the lack of sufficient vaccine stocks and the severely limited capacity to produce new vaccine eliminated many of the strategic options that the leaders could have used to respond to the epidemic, thus forcing them to consider measures such as closing borders and large-scale quarantine that could have had severe economic, social, and political repercussions. Building the capability to rapidly develop and produce drugs and vaccines would free leaders from these strategic restraints and allow them to mount a far more effective, and less disruptive, response to a bioattack or a large-scale epidemic. This is of particular urgency now, be-

cause it is becoming increasingly clear that such large-scale industrial development and production processes will also be critical in rapidly responding to an avian influenza pandemic, should one occur.

- **The U.S. and the international community should build medical and public health information systems that would provide leaders with enough situational awareness to make decisions and direct resources in response to a bioattack.**

In *Atlantic Storm*, leaders were provided with far more situational awareness than they would have had in a real crisis. They were given the locations and numbers of reported smallpox cases in almost real time, and they were constantly updated as information changed. If this had been a real bioattack or epidemic affecting cities in multiple countries, leaders would have had a great deal of trouble getting even this level of basic information.²⁰ This would be true not just for top national leaders, but for political, scientific, and health decision makers at all levels of the response system.

In the event of a bioattack, hospitals, health departments, emergency management agencies, mayors, governors, and federal agencies are not optimally organized to communicate with each other about location and number of victims; to request federal vaccine, drug, or equipment assets; or to plan for distribution of key resources. Information technology tools and platforms could be designed to share such information, and, if these systems are built correctly, they will have clear value to the routine functioning of hospitals. Given the early international ramifications of a bioattack as was seen in *Atlantic Storm*, these systems must include appropriate procedures for sharing information between nations.

- **The U.S. and the international community need to develop and widely disseminate rapid, point-of-care diagnostic technologies that allow doctors and nurses to easily identify victims of bioterror attacks.**

In *Atlantic Storm*, leaders had to consider whether to impose large-scale interventions such as quarantine, closing of borders, mass vaccinations, and the like. Part of their challenge related to the inability to easily distinguish infected people from the uninfected. People with smallpox,

¹⁹Enserink M. Influenza: crisis underscores fragility of vaccine production system. *Science* 2004;306:385.

²⁰*Global Mercury*, convened by GHSAG, identified serious weaknesses to international communications at both technological and policy levels. Additionally, the exercise illustrated that the bioterrorism response plans of many countries did not adequately integrate international response issues. Report available at: http://www.hc-sc.gc.ca/english/media/issues/global_mercury/index.html. Accessed August 5, 2005.

like many other diseases, show no symptoms, or nonspecific symptoms, for a period of time, and there are no widely available diagnostic tools to provide early diagnosis. There are promising technologies in development, but government investment plans in such technologies are not clear, and there is no strategic effort yet to drive the costs and simplicity to a point that hospitals or doctors' offices could begin to use them for both routine and emergency practice. This is a technology and strategic investment challenge that is tractable and, if addressed properly, could have a profoundly positive impact on routine healthcare delivery worldwide.

- **The U.S. and the international community need to develop the systems necessary to rapidly deliver vaccines and drugs to citizens in the event of a large-scale bioattack or a naturally occurring pandemic.**

Such systems would mean the difference between a community coping through crisis and a community fighting over scarce resources. But few cities or states in the U.S. appear to be capable of rapidly distributing vital medical resources in a crisis.²¹ The U.S. should strategically invest in (a) logistics for medical countermeasure distribution during a crisis, perhaps through public-private partnerships that use the retail industry's expertise and familiarity with each community;²² and (b) technologies that deliver vaccines or drugs more easily, and therefore with reduced logistical overhead, such as a simple skin patch that anyone could apply.

CONCLUSION

Atlantic Storm showed that even experienced international leaders, when faced with an unfolding epidemic and the resulting uncertainty, would have limited options

²¹Trust for America's Health. *Ready or Not: Protecting the Public's Health in the Age of Bioterrorism—2004*. Washington, DC: Trust for America's Health; 2004. Available at: <http://healthyamericans.org/reports/bioterror04/>. Accessed August 5, 2005.

²²Lien O, Franco C, Gronvall GK, Maldin B, Borio L. *Getting Medicine to Millions in a Public Health Emergency: Can Retailers Play a Role?* Available at: <http://www.upmc-biosecurity.org/misc/medicine/medicine.html> Accessed August 9, 2005.

and stark choices given the conditions that exist today. Preparation is essential: international leaders cannot be expected to build the requisite response systems in the midst of a crisis. The exercise made clear that there is much that can be done to improve overall biosecurity for both intentional and natural epidemics—a critical lesson given the growing possibility of an avian influenza pandemic. The U.S. should work with the international community to rapidly expand efforts to build necessary international response systems, agreements, and medical resources necessary to prevent deaths and avoid the severe social, economic, political, and security consequences they would now face in the wake of a large-scale epidemic, be it the result of a natural outbreak or a bioterrorist attack.

ACKNOWLEDGMENTS

The organizers of *Atlantic Storm* would like to thank all the exercise's summit principals for volunteering their time and for their courage to participate in such a challenging and public exercise. Their leadership on the issue of global biosecurity should be an inspiration to all.

The organizers would also like to thank the staffs of the Center for Biosecurity and the Center for Transatlantic Relations. Their tireless efforts over the 3-year *Atlantic Storm* project were critical to the success of the exercise. We would like to especially thank the following:

From the Center for Biosecurity: Kim Biasucci, Bruce Campbell, Molly D'Esopo, Joe Fitzgerald, Jackie Fox, Mary Beth Hansen, Penny Hitchcock, Tim Holmes, Elaine Hughes, Tasha King, Andrea Lapp, Tanna Liggins, Michael Mair, BJ Ottey, Monica Schoch-Spana, Eric Toner, Darcell Vinson, and Richard Waldhorn

From the Center for Transatlantic Relations: Chantal de Jonge Oudraat, Katrien Maes, and Jeannette Murphy

Additional information on the *Atlantic Storm* exercise can be found at: www.atlantic-storm.org.

Address reprint requests to:

Bradley T. Smith, PhD

Associate

Center for Biosecurity of UPMC

621 E. Pratt St., Suite 210

Baltimore, MD 21202

E-mail: bsmith@upmc-biosecurity.org