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SARS: BEST PRACTICES FOR IDENTIFYING AND CARING FOR NEW CASES

HEARING

BEFORE THE

PERMANENT SUBCOMMITTEE ON INVESTIGATIONS

OF THE

COMMITTEE ON
GOVERNMENTAL AFFAIRS
UNITED STATES SENATE

ONE HUNDRED EIGHTH CONGRESS

FIRST SESSION

JULY 30, 2003

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SARS: BEST PRACTICES FOR IDENTIFYING AND CARING FOR NEW CASES

WEDNESDAY, JULY 30, 2003

U.S. SENATE,
PERMANENT SUBCOMMITTEE ON INVESTIGATIONS,
OF THE COMMITTEE ON GOVERNMENTAL AFFAIRS,
Washington, DC.

The Subcommittee met, pursuant to notice, at 9:03 a.m., in room SD–342, Dirksen Senate Office Building, Hon. Norm Coleman, Chairman of the Subcommittee, presiding.

Present: Senators Coleman, Collins, Levin, and Pryor.

Staff Present: Raymond V. Shepherd, III, Staff Director; Joseph V. Kennedy, Chief Counsel; Mary D. Robertson, Chief Clerk; Kristin Meyer, Staff Assistant; Caroline Lebedoff, Intern; Brittany Stevenson, Intern; Elise J. Bean, Minority Staff Director and Chief Counsel; Christopher Kramer, Minority Professional Staff Member; Priscilla Hanley (Senator Collins); John Meyer (Senator Specter); Anne Schmidt (Senator Coleman); David Berrick (Senator Lieberman); Rebecca Mandell (Senator Lautenberg); Reanne Brown (Senator Durbin); and Tate Heuer (Senator Pryor).

OPENING STATEMENT OF SENATOR COLEMAN

Senator COLEMAN. Good morning. We are going to call this hearing to order. It is a pleasure to be here with our distinguished Chairman, Senator Collins—thank you for being here—and distinguished Ranking Member, Senator Levin. This is the second in a series of hearings by this Subcommittee aimed at helping the Nation respond to the threat of SARS. At the first hearing on May 21, the Subcommittee heard testimony from a number of witnesses at the national, State, and local levels. The first panel consisted of three internationally known experts in epidemiology: Dr. Julie Gerberding, currently head of the CDC; Dr. Anthony Fauci, currently head of the National Institute of Allergy and Infectious Diseases; and Dr. Michael Osterholm, Director of the Center for Infectious Disease Research and Policy at the University of Minnesota.

Each of these experts testified that it was their opinion that the Nation would face additional outbreaks of SARS during the regular flu season this fall and winter. For example, Dr. Osterholm testified that: ". . . I am convinced that with the advent of early winter in the Northern Hemisphere in just 6 short months, we will see a resurgence of SARS that could far exceed our experience to date. If this projection is correct, we have every reason to believe that this disease may show up in multiple U.S. cities as we continue to travel around the world in unprecedented numbers and speed."

"Imagine now the possibility of simultaneous SARS outbreaks in multiple U.S. cities. You may ask how likely is this to occur. Honestly, no one knows. But, as a student of the natural history of infectious diseases, I am convinced that like the early days of the HIV epidemic, the worst of SARS is yet to come."

If Dr. Osterholm and the other experts are correct in their assumptions that the worst of SARS is yet to come—and I believe they may very well be—then it is incumbent upon us to take immediate and urgent measures to protect our Nation from this potential crisis.

Soon after that hearing, I requested that the General Accounting Office undertake a survey of best practices for identifying and treating SARS. Because of the short time frame for preparing for new cases, I asked that the study be completed by the end of July. At today's hearing, GAO will release the results of the study. We will also hear from the Centers for Disease Control and Prevention about the work they are doing to properly inform and work with local agencies.

I am especially concerned with the adequacy of response at the local level. There is a consensus that the quality of the first response is crucial to preventing any single case from leading to a more generalized outbreak. Local agencies must maintain a proper state of vigilance so they can quickly identify new cases. They must also know what to do when a new series of cases arise in order to prevent further transmission. At the same time, local communities need to be properly educated so they can protect themselves in a rational manner.

A case of SARS implies that a large number of coworkers, schoolmates, and social friends and their families might potentially be infected. As soon as they learn that the parent of a schoolmate has SARS, parents will want to know whether they should keep their children home, send them to class wearing masks, or take other precautions. The lack of education can make it difficult for people to properly protect themselves from transmission. But it can also lead to a sense of panic and overreaction, stalling the economic activity on which all employment depends.

I have a further statement, and what I am going to do is I enter the full statement into the record.

The bottom line is this: We have got to make sure that local health officials are properly informed. They need to know what to do. They need to remain vigilant. We need to make sure that the average citizen can intelligently respond to SARS when it appears in his or her community. It was Franklin Roosevelt who said that the greatest thing we have to fear is fear itself, and I believe with SARS it is the sense of the unknown. We still do not know, as I understand it, all the causes of SARS and all the treatments for SARS and all the things we are doing, are they the right things to do. So there is a lot of unknown out there, and that generates greater fear.

Then, finally—and clearly it is why we are here today—we need to have national and regional plans for dealing with SARS, particularly if there is a large-scale outbreak. And as I looked at the GAO report, though there are many good things that are going on and much preparation that has happened, there is still a concern about

the adequacy of the health care system to meet a widespread outbreak. And so there are challenges before us. I want to commend those agencies and folks who have been dealing with SARS.

CDC has done a tremendous job. I have talked to folks at the local level. They are very thankful. The GAO responded very quickly, and for that we are very appreciative.

This is a challenge. We are moving quickly. We are trying to do the right thing, but challenges lie before us, and this is an important hearing.

[The prepared statement of Senator Coleman follows:]

PREPARED OPENING STATEMENT OF SENATOR COLEMAN

Good morning and thank you for attending the second in a series of hearings by this Subcommittee aimed at helping the Nation respond to the threat of SARS. At the first hearing on May 21, the Subcommittee heard testimony from a number of witnesses at the national, State, and local levels. The first panel consisted of three internationally known experts in epidemiology: Dr. Julie Gerberding, currently head of the CDC; Dr. Anthony Fauchi, currently head of the National Institute of Allergy and Infectious Diseases; and Dr. Michael Osterholm, Director of the Center for Infectious Disease Research and Policy at the University of Minnesota.

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If these experts are correct in their assumptions that the worst of SARS is yet to come, and I believe they may very well be, then it is incumbent upon us to take immediate and urgent measures to protect our Nation from this potential crisis.

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I am especially concerned with the adequacy of response at the local level. There is a consensus that the quality of the first response is crucial to preventing any single case from leading to a more generalized outbreak. Local agencies must maintain a proper state of vigilance so they can quickly identify new cases. They must also know what to do when a new case arises in order to prevent further transmission. At the same time, local communities need to be properly educated so they can protect themselves in a rational manner.

A case of SARS implies that a large number of coworkers, schoolmates, and social friends and their families might potentially be infected. As soon as they learn that the parent of a schoolmate has SARS, parents will want to know whether they should keep their children home, send them to class wearing masks, or take other precautions. The lack of education can make it difficult for people to properly protect themselves from transmission. But it can also lead to a sense of panic and overreaction, stalling the economic activity on which all employment depends.

Intelligent education requires several steps. First, local doctors need to know how to recognize that new cases of SARS are appearing and need to know whom to turn to for information and support. At the national and international level, agencies must continue to develop information about the characteristics of SARS in order to treat patients and prevent its spread. The World Health Organization, the National Institutes of Health, and the Centers for Disease Control and Prevention perform

this role well. Last, the information these agencies develop must be transmitted back to mayors, hospital administrators, and airport officials so that doctors, airline attendants, researchers, and average citizens know how and what to do in order to protect themselves. Today's hearing is focused on this last step.

I believe we face three primary tasks. The first is to make sure that local health officials are properly informed about the need to remain vigilant against possible SARS cases. Although no new cases have been reported recently, most experts believe that SARS has established itself in the population and reemerge. Unfortunately, its symptoms resemble those of other respiratory flues and tuberculosis. Unless local doctors remain mindful of the possibility of SARS, the first cases may not be isolated in time to prevent further transmission.

Second, we need to make sure that the average citizen can intelligently respond to SARS when it appears in his or her community. Individuals need to know what precautions to take at various stages of an outbreak. They also need to know what the true status of risk is, so that they do not over respond. In Asia the indirect economic costs of SARS far exceeded the direct costs of combating the disease.

Finally, we need regional and national plans for dealing with a large-scale outbreak of SARS. We saw in Toronto that SARS can quickly overwhelm even a modern health care system if the first cases are not quickly contained. When this happens, regional and national resources must be available to fill in the gap. Dr. Kanof will testify about some of the hurdles we face in developing such a plan. I am pleased that CDC is currently working hard to overcome these.

I want to take this opportunity to commend both of the organizations before us for their previous role in dealing with SARS. I have repeatedly heard of the great assistance that the CDC has provided to local agencies searching for information on SARS. With respect to this disease, it is hard to think of how the agency could have responded better. Doctors Gerberding and Hughes deserve our great appreciation for the great work that they and their staff have performed under tremendous pressure. In the report being released today and in previous reports and testimony, GAO has played a valuable role in keeping Congress informed of this fast-breaking development. Today's report was completed in a very short time frame and I appreciate Dr. Kanof's support in making it happen.

Senator COLEMAN. With that, I would turn to the distinguished Ranking Member, Senator Levin.

OPENING STATEMENT OF SENATOR LEVIN

Senator LEVIN. Thank you, Mr. Chairman.

First, let me commend you for holding this hearing to push for the development of best practices for responding to SARS cases before there is an immediate or imminent problem. For the reasons you gave, this is a problem which has not gone away and will not go away readily. It needs to be addressed in many ways, and advanced planning now can save lives and prevent future confusion and unnecessary costs.

SARS is a disease which we cannot afford to ignore. Its global impact has already been significant. Cases have been reported in approximately 30 countries. Almost 1,000 individuals have died while hundreds more have suffered and recovered. Hospitals' quarantine facilities and health resources have been strained. Global travel has been disrupted and just recently restored. That is going to increase the potential threat of SARS.

Economists are struggling to evaluate SARS' economic impact on China and on Canada. Experts are warning of a possible SARS epidemic in developing regions of the world where health care systems are not equipped to deal with rapid large-scale infection.

Here in the United States, we have so far avoided having to deal with high levels of infection. But as I put it at the last hearing, while we can try to isolate SARS patients, we cannot isolate our Nation from this disease. SARS has already made its way across our borders in several instances, and it is crucial that we establish

best practices for identifying, treating, and halting this illness. While we can hope for the best, we must prepare for the worst if we are going to avoid it.

Despite positive steps to deal with the virus, important problems and questions remain unanswered. Health officials responding to reported SARS cases need better guidance on how best to protect their communities and our country, without implementing measures that may be costly or excessive. For example, they must determine an appropriate degree of screening for hospital patients and staff, determine how best to handle patients suspected of carrying the disease, and establish plans in the event of a SARS outbreak involving multiple patients. They need to know how to communicate what is happening in their local communities to the Nation's SARS specialists. In addition, health officials must decide how best to inform the public about the disease without causing undue concern or panic.

We also need to deepen our understanding of the disease itself. We need to develop a rapid, accurate testing procedure for SARS, determine how the disease is transmitted, and identify high-risk populations. Individuals need to know whether they have or are likely to contract the disease. Doctors need to be able to quickly diagnose and treat their patients. And health officials need to know whether their communities are at risk for high rates of infection.

I look forward to the testimony of the General Accounting Office today and to the testimony of the Centers for Disease Control. The American public will hopefully be better prepared to stop future SARS cases from occurring because of the work of the witnesses and others that you mentioned, Mr. Chairman, and I believe also because of the work of the Subcommittee itself.

Thank you.

Senator COLEMAN. Thank you very much, Senator Levin.

It is now my pleasure to turn to the distinguished Chairman of the Committee on Governmental Affairs, Senator Collins.

OPENING STATEMENT OF CHAIRMAN COLLINS

Chairman COLLINS. Thank you very much, Mr. Chairman, and thank you for calling this hearing. You have been a real leader in the Senate in our efforts to deal with the SARS epidemic, and this hearing is the second that you have held on this issue. It is important that we make sure that our local communities are properly prepared to respond to an outbreak of SARS because, after all, it is the health care workers and others who are on the front lines who will first encounter the disease.

SARS has proven itself to be a formidable global threat. There is no cure for this deadly, highly contagious virus that has spread throughout Asia and into parts of Europe, Canada, and the United States. To date, there have been more than 8,400 probable cases of SARS reported in 29 countries, and more than 800 people have died.

In an age of international travel, diseases know no boundaries. Quick action on the part of the Centers for Disease Control and Prevention as well as by our State and local health officials has resulted in a relatively low number of SARS cases in the United States so far, with, fortunately, no deaths. Moreover, no new out-

breaks of the disease have been reported in recent weeks, and travel alerts have been lifted from many cities in Asia and in Canada.

I was, however, in Beijing at the height of the SARS epidemic. I saw firsthand what happens when the local, provincial, and Federal response is slow, inadequate, and uncoordinated.

There is much good news lately to report about SARS, but we should not rest easy. I believe that we are dealing with a sleeping giant, and I was very disturbed by the testimony that the Subcommittee heard at its first hearing on SARS in May. The Director of the Center for Infectious Disease Research at the University of Minnesota told the Subcommittee that the disease has now seeded itself in a significant number of humans as to make its elimination impossible. He then went on to tell us that he was convinced that, like the early days of the HIV epidemic, the worst of SARS is yet to come—the point made by the Subcommittee's Chairman.

Virtually all of the public health experts who testified agreed with his prediction that there will be a resurgence of SARS with the onset of the flu season next winter that could far exceed our experience with the disease to date. We must be prepared.

While there is absolutely no evidence that SARS is part of any planned biological or terrorist attack, our institutional capability to deal with such an epidemic is the same whether it is the consequence of a terrorist attack or a naturally occurring event. In fact, a major side benefit of all of our efforts to strengthen our homeland defense capabilities should be an improved ability to respond to all kinds of epidemics.

Since physicians, nurses, and other health care workers on the front lines are likely to be the first individuals to encounter cases of an emerging infectious disease like SARS, it is critical that they have the support and information that they need from Federal agencies such as the CDC to identify and effectively contain such an outbreak. I therefore want to commend the Chairman for his efforts to try to identify ways that we can help those on the front lines in our local communities to protect our citizens.

Once again, thank you for convening this hearing.

Senator COLEMAN. Thank you very much, Senator Collins.

I would now like to welcome our first witness at today's important hearing, Dr. Marjorie E. Kanof, Director of Clinical and Military Health Care Issues for the U.S. General Accounting Office. As I mentioned in my opening statement this morning, she is here to release the results of the GAO study that I requested of national best practices for identifying and treating SARS cases. While officials from global health agencies have indicated that for the moment SARS appears to be stabilized, there is a concern that this is simply the lull before the storm and, to reflect upon Chairman Collins' words, that what we have here is what could be phrased as "a sleeping giant" that we have to be prepared for.

With that in mind, I look forward to hearing the results of the GAO study as I believe it is essential for the health care community to be prepared. I am hopeful that this study will be widely used by the health care community.

Before we begin, pursuant to Rule 6, all witnesses who testify before this Subcommittee are required to be sworn. Dr. Kanof, at this time, I would ask you to please stand and raise your right hand.

Do you swear that the testimony you give before this Subcommittee will be the truth, the whole truth, and nothing but the truth, so help you God?

Dr. KANOF. I do.

Senator COLEMAN. Thank you, Dr. Kanof, and with that you may proceed.

TESTIMONY OF MARJORIE E. KANOF, M.D.,[1] DIRECTOR, HEALTH CARE-CLINICAL AND MILITARY HEALTH CARE ISSUES, U.S. GENERAL ACCOUNTING OFFICE

Dr. KANOF. Good morning, Mr. Chairman and Members of the Subcommittee. I am pleased to be here today as you consider infectious disease control measures to help contain the spread of SARS should future outbreaks occur. Although the current outbreak is believed contained, the fact that SARS is a type of coronavirus, the source of many common colds, leads many to suggest that SARS could be seasonal and, as such, could recur in the fall and winter months.

SARS transmission is most likely spread through person-to-person contact. Experts agree that infected individuals are contagious when symptomatic, a time when they are most likely to seek medical attention and come into contact with health care workers. In fact, one unique characteristic of the SARS outbreak was the high rate of infection among health care workers who, before the institution of specific protective measures, may have become infected while treating patients with SARS. The SARS outbreak in Asia demonstrated that the disease can also spread rapidly in the community.

Currently, there is no definitive test to identify SARS during the early phase of the illness, which complicates diagnosing the disease. As a result, early diagnosis of SARS relies more on interpreting individuals' symptoms and identification of travel to locations with SARS transmission. The symptoms of SARS are similar to other respiratory illnesses, such as the flu and pneumonia. Although SARS did not infect large numbers of individuals in the United States, the possibility that SARS may re-emerge raises concerns about the ability of public health officials and health care workers to prevent the spread of SARS in the United States.

My remarks this morning will focus on the infectious disease control measures that were practiced within health care and community settings for the containment of SARS and the initiatives and challenges in preparing for a possible SARS resurgence.

Infection disease control experts all emphasize that well-established infectious disease control measures, case identification and contact tracing, transmission control, and exposure management played a pivotal role in containing the spread of SARS in both the health care and community settings. No new measures were introduced. Instead, experts said strict compliance with and added vigilance to enforce use of the current measures was sufficient.

For SARS, case identification within health care settings includes screening individuals for fever, cough, and travel to a country with active cases of SARS. In California and New York, States

[1] The prepared statement of Dr. Kanof appears in the Appendix on page 30.

with high numbers of potential SARS cases, emergency room staff used questionnaires to screen incoming patients, and an individual identified as a potential SARS case was given a surgical mask and moved into a separate area for further medical evaluation.

Toronto, which experienced a much greater prevalence of SARS than the United States, used somewhat different practices. At the height of their outbreak, everyone entering a hospital was asked screening questions and had their temperature checked before they were allowed to enter. As a further measure, Toronto health officials established SARS assessment clinics, also known as "fever clinics," that they used as screening centers instead of hospital emergency rooms or other outpatient clinics.

Contact tracing was important for the identification of individuals at risk for SARS and for implementation of appropriate measures to reduce their possible spread of the disease to others.

In New York City, teams interviewed each possible SARS case in order to identify contacts, and then they called each contact to advise them of the symptoms, provide information about the risks of SARS, and to ensure that the contacts were following infection control measures. Each contact received three to five routine calls during a 10-day period.

Transmission control measures, or the spread of the disease, was similar for both health care settings and in the community. According to several experts, the simple things your mother taught you, such as washing your hands and covering your mouth and nose with a tissue when sneezing or coughing, are effective in reducing the spread of SARS.

Hospital transmission control guidelines included routine standard precautions, including hand washing, contact precautions such as gown and gloves, and airborne precautions such as an isolation room and the use of an N–95 disposable respirator for individuals entering the room.

Hospitals in the United States generally saw few SARS patients, one or two patients at a time, so they were able to manage the SARS patients in available isolation rooms with available staff. Because of the greater prevalence of SARS in Toronto, however, all 22 acute-care hospitals were directed to have SARS units in which they had staff who only cared for SARS. Health department officials in Toronto later designated four hospitals in the city to be SARS hospitals.

The use of face masks or N–95 respirators was recommended as an effective means of transmission control. In Canada, however, health care workers used an additional level of protective equipment, almost a total body protective system, when conducting high-risk procedures such as respiratory intubation.

Transmission control guidelines for community settings incorporated many of the same measures for containing the spread of SARS in the hospital. In addition, SARS patients were advised to continue infectious disease measures for 10 days after their symptoms had abated and to remain in their homes during this time period.

Exposure management practices, isolation and quarantine, occurred in both health care and home settings. In Toronto, isolation was typically used in the hospital, even in cases where individuals

were not ill enough to require hospitalization. In the United States, home isolation was used, unless an individual required hospitalization for medical treatment. Similarly, quarantine guidance was based on the prevalence of SARS in the community. CDC advised individuals who were exposed but not symptomatic to monitor themselves for symptoms. Individuals were not instructed to remain in their homes. In contrast, Toronto, which experienced a very high level of person-to-person transmission, required individuals who did not have symptoms but had been in close contact with SARS-infected individuals to stay in their homes and avoid public gatherings for 10 days.

Toronto health workers were restricted to a work quarantine. They were allowed to travel to and from work alone in their own vehicles, but they were not allowed to visit public places.

Effective communication among health care professionals and the general public reinforced the need to adhere to all of these infectious disease control measures. According to health officials, rapid and frequent communication of crucial information about SARS were vital components of their efforts to contain the spread of disease.

But how do we prepare for a resurgence of SARS? While no one knows whether there will be a resurgence, Federal, State, and local health care officials agree that this is necessary to prepare for the possibility of a large-scale resurgence. As part of these preparations, CDC, along with State and local health associations, are involved in developing SARS-specific infectious disease control guidelines. These preparations will also improve the health care system's capacity to respond to other infectious disease controls. Implementing these plans, however, may prove difficult due to limitations in both hospital and workforce capacity.

We recently reported that most hospitals lack the capacity to respond to large-scale infectious disease outbreaks. Most emergency departments have experienced some degree of overcrowding, and therefore, may not be able to handle a large influx of patients during a potential outbreak of SARS, especially if SARS recurs during the peak season for flu.

Few hospitals have adequate staff, medical resources, and equipment needed to care for the potentially large number of patients that may seek treatment. In addition, the monitoring of individuals placed under isolation and quarantine may strain resources if widespread isolation and quarantine are needed. Follow-up with isolation and quarantine individuals requires additional health care and community resources. In Canada, it was the police and the Red Cross that were helping purchase and deliver food to those under isolation or quarantine.

In conclusion, the global spread of SARS was contained through an unprecedented level of international scientific collaboration and the use of well-established infection control measures that had been used effectively in the past to control diseases such as tuberculosis and smallpox. Worldwide disease surveillance will facilitate prompt identification of a resurgence of SARS which would allow rapid implementation of infectious disease control measures, which would in turn reduce both the spread of SARS and the risk of a large outbreak.

Preparations are underway, and they do encompass in large part approaches similar to those for pandemic influenza plans, and they are also a component of more general bioterrorism preparedness plans. However, should a large-scale outbreak occur in the near term, limitations in the capacity of our Nation's health system to undertake effective and rapid implementation of the infectious disease control measures could prove problematic.

A major SARS outbreak would necessitate rapid escalation of infectious disease control resources, including health care workers, emergency room and hospital capacity, and the requisite control and support equipment.

Mr. Chairman, this completes my statement. I would be happy to respond to any questions you have.

Senator COLEMAN. Thank you very, much, Dr. Kanof, and let me say that it is very gratifying to have empirical data that says doing what mother taught us is a good thing. I feel very uplifted. I am sure my mom will give me a call after this to say, "See, I told you so."

Let me make a couple of observations. I get a sense that the things in this post-September 11 world, the stuff that we did—concerns about anthrax, concerns about bioterrorism—really have in many ways kind of formed the basis for having a system in place that gives us at least a high state of readiness. Is that a fair assumption?

Dr. KANOF. Absolutely.

Senator COLEMAN. But in the end, your conclusion is that should a large-scale outbreak occur in the near term, there are limitations that could prove problematic—staffing, worker limitations, health care capacity limitations, or equipment limitations.

What is necessary? Is there a minimum standard that we should have at the national level to say here is what we need to do to deal with this? How do we address that limitation issue better?

Dr. KANOF. In the previous work that we have done in which we looked at seven cities and we looked at the preparedness of each of these cities, one key observation was that, in fact, the more frequently a city or a community had, unfortunately, encountered previous natural disasters, be it a hurricane or even an infectious disease, they were, in fact, better prepared to respond to ongoing challenges. So I think that is an important observation to make.

The other observation we made in the previous study was that, in fact, not every city and community had gone through preparedness drills, which is something that a few cities have done. There have been some more done recently during the summer, but it was really key to have overcome the barrier of not wanting to do a preparedness drill, because an important factor in being prepared is not just at the hospital but also have you established all the right connections to both the public health department, the police, the firemen, other communities, and in certain borders, other States. And so it is important to think about initiating more of these initiatives.

In terms of resources, what we have found in our previous study was that hospitals lacked equipment, that most hospitals had only one ventilator for 100 staff beds, that they only had one protective suit, that they only had one isolation bed. Half the hospitals had

six ventilators for 100 beds, three or less protective suits, and four isolation beds.

So there is a significant need within communities to have the proper equipment.

Senator COLEMAN. One of the concerns that I saw as a mayor in looking at the resource issue and talking to my colleagues was all of us looking for the same thing at the same time. Would it be your recommendation that States set up some kind of regional perspective so that we have pooling of equipment? I think it would be probably impossible for every community to have all the resources that they needed. There are no specific recommendations to that effect in this report, just kind of observations of the state of readiness. Would that be a recommendation to proceed in that manner?

Dr. KANOF. Well, in fact, what we have included in the report—is a SARS preparedness checklist that, in fact, has been developed between the State and the communities and CDC, that, in fact, highlights many of those issues that you have just discussed.

Senator COLEMAN. And I was going to compliment you on that checklist. I would hope that folks would then use that checklist. That was a very clear and focused and thorough kind of formula for determining are we prepared and what do we need. So I would hope that folks take a look at that checklist. I think it is extremely well done.

What has been the impact of SARS on hospitals? And, in particular, is there a higher level of fear among health care workers because of the high incidence of SARS among health care workers?

Dr. KANOF. The health care workers that we spoke to in Toronto clearly had a higher level of concern than similar health care workers we have spoken to in the United States. But, clearly, there is a big difference between walking into a hospital where you know you have very ill patients. But I think among health care workers that we have spoken to, it is a heightened level of concern in your differential diagnosis of when you are seeing a patient, but, more importantly, in your own appropriate use of protective measures such as masks, gloves, and hand washing.

You referred back to HIV and AIDS. There was a time that we drew blood as health care workers without wearing gloves, something that I think most people would not do today under normal circumstances. And so I think among health care workers there is just a heightened realization that protective measures are important.

Senator COLEMAN. In the last outbreak—the first incidence, really, of SARS, we knew where it came from—China and those areas that had larger contact with China—New York, California, and Toronto, centers of focus. If, in fact, going back to Dr. Osterholm's comment from our last hearing, saying that SARS has now embedded itself in the population, does the dynamic change in terms of state of readiness? In other words, I represent Minnesota—now if SARS is embedded in Toronto, it is no longer looking at a Beijing-to-Minneapolis connection, now it is Maine to Canada, now it is Minnesota to Canada. Would that be a correct assumption? Does that mean that health care workers across the board in any community have to have this higher level of readiness as we enter the cold and flu season?

Dr. KANOF. I think that gets to the unknown and that we do not know exactly what will happen, but I think that clearly recommendations that have come from the CDC and other public health departments would stress that, as we enter the flu season, as you see individuals and you establish triage centers in almost every emergency room, clinic, physician's office, that you need to ask certain questions.

You are right, we might not be able to ask have you recently traveled to a SARS transmission country, since we might not have known that. But it needs to be quickly in individuals' differentials, and when they have a suspect case—I think the difficulty with SARS is we do not have a test that says you have it—they need to immediately begin protective control measures and alert the public health surveillance system, because what we are really going to need to do is be on alert to understand where there is a trigger event.

Senator COLEMAN. And it is interesting that the three Senators here, Senator Levin, Senator Collins, and I, we all represent border States. I have been on that bridge between Michigan and Canada. It is a very thin line. So I think for all of us there it is a heightened level of concern.

Let me then ask a final question at this point in time. It is a resource question. Do we have enough resources? What recommendations would you make for this body, for this Congress today as we look to the future, knowing what we know and knowing what we do not know when it comes to the issue of resources?

Dr. KANOF. Well, I think we have in numerous reports actually looked even closer on the health care delivery, to determine if the public health systems are prepared. We have noted many times that there are significant limitations in our resources in the public health department and the health care delivery system, be it electronic disease surveillance, be it electronic databases in which to capture the information. We have highlighted that there is a deficiency in the number of health care workers, and we have highlighted numerous times the shortages at hospitals of basic equipment. And so all of those put together, we have highlighted the need to both ensure that there are sufficient resources and that there have been Federal dollars that have been given specifically for bioterrorism and specifically for hospital preparedness. The question, though, is: Is that enough, and how much more is available to give?

I think what's critical, though, is ensuring that communities know how to share their resources.

Senator COLEMAN. Thank you, Dr. Kanof. And I again want to thank the GAO for the expeditious manner in which they pulled together all this information and the work that they did, and particularly the checklist that you mentioned. I think that could be very helpful. Thank you.

With that, I will turn to Senator Levin.

Senator LEVIN. Thank you, Mr. Chairman.

I would like to ask about that checklist. I am afraid I have not seen it. Could you describe how that checklist relates to policy positions of CDC? For instance, does CDC recommend a particular policy on screening and then the checklist relates to a specific rec-

ommended policy? Is there a recommended policy by CDC on isolation and then the checklist relates to that policy? How does that work?

Dr. KANOF. Dr. Hughes can also answer that question, but the CDC, through their website and through their health alert system, basically have published guidelines. They have revised those guidelines as we have learned more about SARS specifically for situations in terms of when do you do isolation, when do you quarantine, and when do you use gowns and gloves.

This checklist includes all that type of information at a high level, but a large part of this checklist, because it was also done with ASTHO, the Association of State and Territorial Health Officials, and the National Association of County and City Health Officials, goes through some really broader issues, such as the legal and policy issues. For example, agreements have been obtained with State health insurers, Medicare programs and health care product and service providers, for cooperation during an epidemic. It talks about authority. Do you have the authority that you need for isolation and quarantine? It talks about surge capacity and talks about do you have established relationships with communities adjacent to you and public health officials.

Senator LEVIN. I have the checklist now in front of me, but does it say that you should do those things, you should have in place X policy or you should have a relationship with—the one you just read——

Dr. KANOF. It recommends.

Senator LEVIN. It does make the recommendation and then asks whether or not that recommendation has been carried out.

Dr. KANOF. Yes.

Senator LEVIN. It is connected to the recommendations. Have these checklists been compiled by that association or by anybody else?

Dr. KANOF. I am sorry. Have they been?

Senator LEVIN. Been compiled, have we gotten the return of these so we can say 38 percent of the public health entities in our States have this, 28 percent do this? Do we have any ideas statistically?

Dr. KANOF. No. What has been done in the past is that for bioterrorism preparedness, those preparedness plans were, in fact, sent to HHS and, in fact, they came before money was released, and so people have evaluated those. But I am not aware of anybody looking to see if we have checked each State, each community for their infectious disease plan.

Senator LEVIN. So, for instance, CDC has made a recommendation, or there has been a recommendation that has been worked out between our national people and the State and local people on isolation. If that is on the website, we do not have any idea as to what percentage of public health entities in the States have adopted that recommendation.

Dr. KANOF. I am not aware of that at all.

Senator LEVIN. Would that be helpful if we could learn that to see how well prepared we are, if we could perhaps ask the CDC, for instance, to make some kind of spot check assessment as to what percentage of recommendations have been adopted?

Dr. KANOF. I think it would be—it is always helpful, whether it is done on a Federal or the State level, but people should be checking to make sure that there is a level of preparedness. It is similar almost to the report that we did just about a year ago. We looked to see were people prepared.

Senator LEVIN. The Chairman asked you about research dollars, and I want to ask that question in a slightly different way. Could you compare the research dollars that we are devoting to SARS to research dollars on other kinds of diseases? Is there any way of telling us how many dollars are being devoted to SARS, or that it is 10 percent as much as we are doing on some other infectious disease?

Dr. KANOF. We could get back to you with the answer,[1] but I do not know that off the top of my head.

Senator LEVIN. That would be helpful to us, I believe.

On the border question, which the Chairman also raised, have we made an assessment as to the adequacy and the appropriateness of checking at our borders? Is it spotty? Is it consistent? Are there clear guidelines for trying to identify people somehow or other, asking questions perhaps of people coming in from areas that have seen a large number of infections? Is there any kind of a coherent national policy at our borders?

Dr. KANOF. That is an excellent question and one that we did not look at in great detail. I can tell you that CDC clearly, again, did have individuals at key locations. They were at the airports. They did provide information at all key sites. But we did not look, so I cannot tell you the status.

Senator LEVIN. Thank you very much, and thank you, Mr. Chairman.

Senator COLEMAN. With that, I will turn the questioning and the gavel over to Senator Collins, and I will be back literally in 5 minutes. I have one other hearing where I have to take care of some business. Senator Collins.

Chairman COLLINS [presiding]. Thank you, Mr. Chairman.

Doctor, quick action on the part of the CDC and our State and local health officials has so far resulted in a relatively low number of SARS cases in the United States. I believe that to date we have had about 40 probable cases and not a single victim in the United States has died.

Why do you believe that the American experience has been so different from that in Canada?

Dr. KANOF. Well, I think part of it, to quote many scientists and physicians asked that question that we interviewed was somewhat luck and somewhat timing in that if we understand the epidemiological spread of this disease, there was a physician who treated SARS patients who was in a hotel room in Hong Kong, and several individuals acquired the disease from that individual, and one of them, or perhaps two, landed in Toronto as opposed to directly in the United States. And so Toronto was experiencing illness that we now recognize as SARS before it was really known that there was SARS and before we really knew that you needed to have all the health care precautions that you did.

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[1] See Exhibit No. 6 which appears in the Appendix on page 165.

We were very fortunate in that we did not get that first wave per se and that we were actually on alert in a time period after Toronto.

Chairman COLLINS. Similarly, why has the infection rate among health care workers been so much higher in Canada? Does it all go back to that one physician and where he happened to be?

Dr. KANOF. Unfortunately, in large part, yes. It goes back to unfortunate lessons we have learned from Canada. We understand now the significance of the respiratory spread, and so while in Canada, individuals might have been using masks and gloves as individuals got sicker and required more intensive care and health care workers were having potentially either more intense exposure to some of the virus or during procedures such as intubation not being protected, more individuals got exposed.

Also, in Canada, not knowing initially about the disease, they did not have a system in place to contact everyone who had been taking care of a patient, which is why they began to create SARS units and SARS-dedicated staff so you knew who was, therefore, at a potential risk and could then track them to make sure they were not getting ill.

Chairman COLLINS. During the SARS outbreak in Toronto, more than 10,000 people were quarantined in their homes. In addition, many health care workers were work-quarantined; in other words, they were allowed to travel to and from work in their vehicles, but they were not allowed to visit public places.

How difficult would it be for Federal, State, and local public health authorities to impose the same kind of quarantine restrictions here in the United States should we be faced with a massive outbreak of SARS? Do you think that would be accepted in the United States? Do you think we have the knowledge and the resources to implement a significant quarantine?

Dr. KANOF. The lessons learned from Toronto are really very interesting. I think you can break your question into two parts. One is: Do you have the authority? Then, how do you monitor? And then, even more importantly, but how do you provide resources? It is one thing to tell someone they need to stay in their home, but how do you get them all that they need?

I think one of the things in the checklist that is very important is that States are supposed to be checking to make sure that they do have the authority. Information to date appears that States do have the authority from a health protection point of view to do isolation and quarantine as appropriate, and States are, I know, actively looking to make sure that extends to SARS.

The bigger issue, though, is how do we mobilize the resources so that for Toronto, as you talked about the work quarantine, we learned that they went so far to have supermarkets within the hospital so that as you are asking the health care workers to come and not go anywhere else, they could at least obtain the basic supplies that they need. And I think that you are asking an important question that extends beyond just the health care delivery system, but the community needs to begin working now to ensure that resources are available to supply individuals when you ask them to stay at home.

Chairman COLLINS. What do you think the response of the American public would be to a quarantine order similar to what was imposed in Toronto?

Dr. KANOF. I probably would hope, just as you would hope, that as necessary, people would understand the need to do that. And I think that an important message learned from Toronto was the communication, was the actual explaining to individuals the need for why this was appropriately done.

Chairman COLLINS. I mentioned in my opening statement that there is no evidence that SARS was part of a planned bioterrorism attack but that it, indeed, arose from natural sources. But the capability of State and local health officials to deal with such an epidemic should be the same whether or not it is due to a bioterrorist attack or whether it is a naturally occurring phenomenon.

In fact, I think there are a lot of lessons that can be learned from the SARS outbreak, including how quickly and rapidly it spread to 29 countries, that would help us better respond to a planned attack.

Could you comment on whether or not you see capabilities that we have developed for homeland security assisting us in dealing with a naturally caused epidemic like SARS?

Dr. KANOF. I think we believe they are all intertwined, and, in fact, not focusing too much on this checklist, but many are really sub-components of a general bioterrorism plan, and that resources that have gone out already to both local communities and hospitals in response to bioterrorism preparedness will definitely assist them to prepare for any infectious disease, be it a bioterrorism threat or a real infectious disease threat.

Chairman COLLINS. The CDC has been widely credited with an effective response to the SARS epidemic. When I was in Beijing and travelling through Asia, CDC experts were in all of the cities that our congressional delegation visited. They were at all of the public health meetings, providing their expertise and assistance, which was particularly critical in China, where a slow reaction on the part of officials allowed the epidemic to be more serious than it otherwise would have been.

This contrasts to the anthrax attacks back in 2001 when the CDC was widely criticized for putting out conflicting and inconsistent guidance, and even contradictory information.

Do you think that the CDC has learned and incorporated lessons from its experience with anthrax that it applied to the SARS epidemic? Why do you think the performance was so different?

Dr. KANOF. I think CDC has significantly learned from the anthrax. I think they are continuing to learn and improve on a regular basis. But I think key observations that you can make the contrast to, but for SARS, they now have an emergency response team and an emergency response room. Eight hundred people, I think, were involved in the United States or around the world from the CDC for helping contain SARS.

But I think more importantly what they learned is the importance of rapid communication, and I think Dr. Gerberding is quoted as saying she knows that needs to be out there and to tell the facts as you know them and to keep increasing your knowledge and sharing those facts on a regular basis, not just to physicians but

to hospitals and to the public. And I think that is what you have seen here with SARS, not just in the United States but throughout the world.

So there were significant lessons learned that we saw with SARS.

Chairman COLLINS. Thank you, Doctor. Senator Pryor.

OPENING STATEMENT OF SENATOR PRYOR

Senator PRYOR. Thank you, Senator Collins. Thank you for your leadership, and also to Senator Coleman and Senator Levin, I appreciate them bringing this very important issue to our attention and keeping us focused on it.

Let me ask, if I may, a few questions about the spread of SARS and our preparedness for it. First I would like to focus on rural issues, rural versus urban. Do you think that it is likely, more likely, that SARS will start in urban areas and spread out into rural areas, or vice versa?

Dr. KANOF. Again, I think we will learn about SARS as we get more experience with SARS. But I think the key is that close-to-close—person-to-person contact plays an important role in transmission of SARS. And so the density of the population clearly is an important factor in the transmission of SARS. And so, again, if one were to follow that logic, and the density of a city in which there is more close-to-close contact would put that city at potentially higher risk. That is one side of the equation.

What you need to ensure, though, is that the health care delivery system, both in the city and the rural, though, have equal awareness, equal training, equal connections with the public health system so that if they suspect an individual has SARS, they can tap in equally quick to the appropriate resources.

Senator PRYOR. Given that you have just gone through this study to try to help the government get a handle on this issue, do you feel that you can disseminate the information that you have and disseminate it effectively to the health care community around the country?

Dr. KANOF. That we can disseminate the information?

Senator PRYOR. Right.

Dr. KANOF. I think that we are helping inform Congress, and that in turn will help disseminate that information. I think key for the dissemination of the information is really that is the critical role of the CDC and the State and local communities. And what we have seen is that there is active work on all those agencies' part, all those Federal, State, and local agencies, in order to obtain information.

Senator PRYOR. Has CDC seen your report here? And do they agree with it? Are they going to use the guidelines therein?

Dr. KANOF. Well, in fact, we do not have any new guidelines in our report.

Senator PRYOR. OK. So you are taking information from the CDC.

Dr. KANOF. Absolutely.

Senator PRYOR. Perfect. OK.

Now, one thing I have noticed in just the last few months is a number of stories about medical conditions that are spreading

around the country and around the world. Just a few, of course, are SARS and another one is monkeypox and another one is West Nile virus. In fact, when I was home in my State of Arkansas this last weekend, there were stories in the paper about the State possibly confirming the first West Nile virus case in a human in Arkansas, and actually, as I sit here today, I am not sure whether that was confirmed or not.

But in your work and in your research into this issue, are there other diseases and potential threats out there that we, as policymakers, need to know about, things that really have not hit the headlines yet like SARS has? Are there other diseases on the horizon that we need to be focused on and be getting ourselves prepared for?

Dr. KANOF. I think the answer to that is yes, but if you ask me what they are, my answer to you will be I do not think we know.

Senator PRYOR. Ask the CDC? [Laughter.]

Dr. KANOF. It would be an interesting question to ask them. I just think, though, that we are a global economy, and travel and the world at large is introducing new diseases on a regular basis. And I think that is the significance of disease surveillance, and it is not disease surveillance limited to the United States, but it is disease surveillance for the world.

Senator PRYOR. One last line of questions in terms of your research and what you have been doing on this issue, and that is the impact on hospitals and the preparations that hospitals need to have in place in order to be prepared to address SARS if it does re-emerge and the expense involved in that. Is it your sense that American hospitals generally are prepared for this and that they have the protocols in place and the training and the equipment that they need to handle a re-emergence of SARS?

Dr. KANOF. We did not look at hospital preparedness for SARS. We have, though, in previous work looked at hospital preparedness for other infectious disease. And there is evidence that they are prepared in terms of having plans, and there is evidence that they have trained their staff in terms of infectious disease. But there is definite concern that they do not have enough of the resources, both equipment, protective equipment, and staff, to handle a large-scale outbreak of any infectious disease that would require hospitalization.

Senator PRYOR. OK.

Dr. KANOF. And the point is that I think it extends beyond the hospital. It goes throughout the health care delivery system.

Senator PRYOR. I tend to agree with that as well. Senator Coleman, that is all I have.

Senator COLEMAN [presiding]. Thank you very much, Senator Pryor.

One last question, Dr. Kanof, and I apologize if it was addressed in my absence, but it is following up on preparedness of rural areas. I look at Toronto, and, first, two questions. One, in the Toronto situation, was everything focused in the metropolitan area there, or were there experiences that rural hospitals had in trying to deal with SARS? Are you aware of that?

Dr. KANOF. I am not aware of that.

Senator COLEMAN. And it would kind of then tie into the second part of that question. Within this country, any sense of the level of preparedness in smaller towns and rural communities?

Dr. KANOF. I think, to go back to a previous answer, I think we will have more of a risk of, let's say, SARS in a large city as opposed to rural areas just because of the transmission of close-to-close contact.

What we do know, though, from Toronto is that they did share information in terms of signs and symptoms with surrounding areas, with the United States, and I think that is really what is most critical for rural areas in the United States, that they, too, are trained to recognize signs and symptoms, that they do have limited resources but we ensure that they have basic resources in case they do see an individual with SARS, but that most importantly they are connected to their local and State and Federal public health departments so that they are getting all the information that they need.

In Tennessee, they are trying to figure out how do I get information out to all physicians in rural areas where they do not have E-mail, and they are working to see if people have fax machines and maybe they can get information to them through their fax machines.

So I think that is what we really need.

Senator COLEMAN. Thank you very much, Dr. Kanof.

Senator Pryor, any follow-up?

Senator PRYOR. No, thank you.

Senator COLEMAN. Thank you very much.

I would now like to call our second witness. I welcome Dr. James M. Hughes, the Director of the National Center for Infectious Disease at the Centers for Disease Control and Prevention in Atlanta, Georgia. Thank you, Dr. Hughes. I appreciate your attendance at today's hearing. I look forward to your testimony on what the CDC is doing to help communities apply the lessons learned from this Spring.

I am also eager to hear about your plans for developing contingency plans to handle a large-scale outbreak this fall.

Pursuant to Rule 6, all witnesses who testify before this Subcommittee are required to be sworn. At this time I would ask you to rise and please raise your right hand.

[Witness sworn.]

Senator COLEMAN. Thank you very much, Dr. Hughes.

Dr Hughes, before you proceed with your testimony, I want to make a public note of the work that the CDC has done. I talk to folks at the local level. There has been a lot of outreach, a lot of communication, and within the health care community a deep sense of appreciation for the way in which the CDC has dealt with SARS to date. So I want to express my thanks for your efforts.

STATEMENT OF JAMES M. HUGHES, M.D.,[1] DIRECTOR, NATIONAL CENTER FOR INFECTIOUS DISEASES, CENTERS FOR DISEASE CONTROL AND PREVENTION, U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, ATLANTA, GEORGIA

Dr. HUGHES. Thank you very much, Mr. Chairman. Good morning. Senator Pryor, good morning.

Thank you for convening this important hearing on critical issues regarding Severe Acute Respiratory Syndrome, or SARS. I very much appreciate the opportunity to appear before you today on behalf of CDC. I would like to briefly update you on the status of the outbreak, the worldwide response to this emerging global microbial threat, and CDC's involvement in collaborative efforts to prepare for the potential recurrence of SARS.

As we have seen recently, infectious diseases continue to threaten our Nation's health. The emergence of SARS, the first reported outbreak of monkeypox in the Western Hemisphere, and this year's first cases of West Nile encephalitis are strong reminders that infectious diseases respect no boundaries and that national and global health are inextricably linked. They also clearly indicate the need for continued vigilance in our efforts to address emerging infections.

In early 2003, the first cases of what would later be called SARS began to be reported to the World Health Organization (WHO) from several countries in Asia. SARS spread globally in a matter of weeks, primarily infecting health care workers and family members of index patients, but also resulting in community transmission in several areas. As of its latest update on July 11, WHO had received reports of more than 8,400 cases and more than 800 deaths among individuals from nearly 30 countries.

As of July 29, 159 suspect and 33 probable cases of SARS had been reported in the United States. These current numbers are based on a recent change in the U.S. surveillance case definition for SARS as recommended by the Council of State and Territorial Epidemiologists. The revised case definition allows for exclusion of cases whose convalescent serum specimens tested negative for evidence of SARS-associated coronavirus infection. With this change, the number of reported cases decreased by more than 50 percent—from greater than 400 to a little less than 200.

Although the global response to SARS has highlighted many priorities for the future, it also represents extraordinary collaboration among the clinical, scientific, and public health communities worldwide. WHO's coordination of the global response provided an opportunity for international assistance and rapid sharing of critical information that helped to minimize the spread of SARS and to rapidly identify the causative agent. At CDC, more than 800 individuals were mobilized to help respond to the outbreak.

The U.S. response involved intense collaborations among public health officials at the local, State, and national levels, the clinical and academic communities, members of professional organizations, and industry representatives. Existing collaborations have been strengthened, and new ones have been formed both nationally and globally.

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[1] The prepared statement of Dr. Hughes appears in the Appendix on page 61.

Despite these successes, much remains to be done. Although we do not know if SARS will reappear, we must avoid complacency and use this time to address future priorities. Toward this end, the World Health Organization held a global conference on SARS in June in Kuala Lumpur, Malaysia. More than 1,000 individuals highly involved in the SARS response attended the conference to share data and experiences, review lessons learned, and develop recommendations to address critical issues.

At CDC we are developing an after-action plan to identify gaps and assess priority action areas. We are also developing a research agenda to help build the scientific base to ensure that the global clinical and public health communities have the necessary knowledge and tools to meet the challenges of SARS. Priority research areas include early detection and prompt reporting of cases, improved testing and treatment, increased understanding of the disease, efforts to prevent transmission, and effective communications.[1]

We have established a SARS preparedness task force comprising the following teams:[2] Surveillance, clinical, laboratory, special studies, information technology, communication and education, and preparedness and response for communities and for the public health and health care systems. These teams are collaborating with many other national and international partners to develop effective response mechanisms that can rapidly and efficiently detect the introduction of SARS into the United States and that can be easily adapted to meet a range of local needs.

In mid-March, within 1 week of WHO's first global advisory on SARS, the Institute of Medicine of the National Academy of Sciences published a comprehensive report describing the spectrum of microbial threats to national and global health, factors affecting their emergence or resurgence, and measures needed to address them effectively. This report, "Microbial Threats to Health: Emergence, Detection and Response,"[3] emphasizes the need for increased capacity at the local, State, and national levels to detect and respond to national and global microbial threats, both naturally occurring and intentionally inflicted. As indicated in the report and clearly reinforced by the emergence of SARS, strong global public health systems, robust health service infrastructures, and adequate surge capacity and expertise that can be rapidly mobilized and deployed remain our best defenses against any disease outbreak.

Thank you very much for your attention. I will be happy to answer any questions you may have.

Senator COLEMAN. Thank you very much, Dr. Hughes. Dr. Hughes, first a question about the redefinition of SARS. Actually what I am focused on is mortality. You mentioned there were 8,400 cases, 800 deaths. Those 8,400 cases, were they under the old definition?

Dr. HUGHES. Yes, they were. And those 8,400 cases included only the U.S. probable cases. So the U.S. probable cases made up only about 74 of those 8,400.

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[1] See Exhibit No. 1a which appears in the Appendix on page 74.
[2] See Exhibit No. 1b which appears in the Appendix on page 75.
[3] See Exhibit No. 3 which appears in the Appendix on page 149.

Senator COLEMAN. I guess my question is, do we have a good estimate of what the level of mortality is for SARS, percentage?

Dr. HUGHES. The level of mortality is directly related to age. The older people are, the higher the mortality rate. Evidence from Toronto and heavily impacted areas in Asia suggests that for people over 60 the mortality rate can be 50 percent or more.

Senator COLEMAN. How does that compare to pandemic flu and some other diseases?

Dr. HUGHES. A mortality rate of 50 percent or more would be substantially higher than the mortality rate that follows influenza epidemics that occur each year. But as you know, there are about 36,000 people in an average year in this country that die of influenza.

Senator COLEMAN. Getting back to influenza, one of the things—I know we dealt with severe outbreaks of severe pandemic flu. I would guess it is kind of the same level of preparedness. If you are prepared for one, would it be fair to say you would be prepared for dealing with SARS?

Dr. HUGHES. I think there are many lessons from the SARS experience that are directly relevant to the thinking along preparedness for the next influenza worldwide epidemic or pandemic which we absolutely know will occur. We simply do not know when. Back in February when we first heard about these unexplained cases of pneumonia in South China, shortly thereafter we heard about some cases of influenza in Hong Kong caused by the H5N1 influenza virus similar to the one that caused the bird flu outbreak back in 1997. We were actually initially concerned that the outbreak in South China might be influenza, but laboratory studies rapidly ruled that out.

This experience with SARS though shows how critical it is that surveillance systems be strengthened around the world so that these new problems can be rapidly detected. It certainly applies to influenza because we know that the more lead time we have when the next pandemic begins, the better, because it will give us time, hopefully, to develop a new influenza vaccine directed against the pandemic strain.

Senator COLEMAN. I am just wondering though if you can tie in the preparation for re-emergence of SARS into the pandemic flu planning? As I look at that I recall last year, I believe there was a report by an Association of State Health Officials that only 12 States have completed a pandemic flu response plan. I am wondering whether it goes to the question that the Ranking Member Senator Levin talked about, regarding the checklist. Have we compiled or do we know who is actually prepared and who is not? Can you help me get an understanding of—do we have a sense of how many States truly have a good planning process for SARS? Is the lack of preparation for pandemic flu, is that something that gives us cause for concern?

Dr. HUGHES. I think that the Association of State and Territorial Health Officials and the National Association of County and City Health Officials have done a terrific job in developing this checklist for preparedness as it relates to SARS. I think in doing that, we have worked with them and they have drawn from some of the bioterrorism preparedness thinking as well as some of the influenza

pandemic thinking and planning that has been going on a number of years.

Actually there are 53 elements on this checklist. I doubt that there is a jurisdiction in the country anywhere that could put a yes in all 53 boxes. This checklist includes things that ought to be in place, and if they are in place for SARS, we are going to be much better off in dealing with pandemic flu or a bioterrorism attack. Progress has been made, but as we have heard, there is much that remains to be done.

Senator COLEMAN. What is the plan for the distribution of that checklist?

Dr. HUGHES. We will be working with, and talking frequently with ASTHO and NACCHO officials in terms of not only sharing this with their membership, but then as suggested in some of the previous conversation I think the need to assess where we currently are and then monitor progress is important.

Senator COLEMAN. Talk to me a little bit about early detection. My sense is that early detection is not an easy thing to do. That we are still not really sure what it is that we need to see in order to be positive that it is SARS. With that lack of certainty, the difference between SARS and a cold or the flu, tell me what you mean by early detection and how effective you think it is.

Dr. HUGHES. That question is right on the mark. SARS, when it presented, you may remember the initial reports out of South China were that this was a community-acquired atypical pneumonia. We see atypical pneumonias in the United States all the time, particularly in the wintertime, and there is a broad range of causes. But even in research studies that are done looking at people who have atypical pneumonia, only about 50 percent will actually have a specific cause identified using the broad range of techniques currently available. So that right there is, in and of itself, a research priority even before SARS came along.

The problem now, if SARS returns in the winter, the problem is going to be sorting out patients with acute respiratory disease who either contact their health care provider or are present for medical care. So it is important that we look, and we are with others, very closely at the clinical manifestation of SARS. Hopefully we will be able to come up with a clinical description that is more precise, or an algorithm maybe that helps clinicians make a better judgment in terms of whether they might be dealing with a case of SARS or not.

Clearly, this is where we go back to the global surveillance. We do not have any evidence that the virus is circulating in this country at this time. It could be but we do not have any evidence that it is. We do not know the source of it in South China. The evidence suggests that the virus probably originated in an animal species there. It has been found in a couple of exotic animals in South China. But the original source in nature has not been identified.

The more warning we have, the better, of course, if it does resurge. So we are working with Chinese public health officials and others in Asia, along with WHO, to try to support them in strengthening surveillance efforts there, at the same time that we are trying to strengthen surveillance efforts here. We and others are working to develop better, more sensitive, more specific rapid

early diagnostic tests, not only for SARS, but if we had rapid tests for the other agents that cause atypical pneumonia we could at least know a subset of the people that we do not have to worry about because they have another specific cause, and be able to focus in on those cases of unknown etiology.

So a long-winded response but a big research agenda with absolutely direct, concrete public health relevance and urgency.

Senator COLEMAN. How close are we to that research giving us the capacity to measure what it is we have, whether it is SARS or something else?

Dr. HUGHES. There is some very promising, innovative research going on. We currently have antibody tests, and we have RT–PCR, these rapid molecular amplification techniques that need further evaluation and refinement. We have deployed those in State public health laboratories but they are not yet at a stage where they can get out into the clinical laboratory settings for use which is where we really need them. So this is urgent but I cannot sit here and tell you that we will have these this week or next month or in time for the next flu season.

Senator COLEMAN. You stated, if SARS returns in the winter, and you note there is no evidence it may, that it is a seasonal condition. Do you disagree with Dr. Osterholm's statement at the first hearing where he said, "I am convinced that with the advent of early winter in the Northern Hemisphere in just 6 short months we will see a resurgence of SARS that could far exceed our experience to date?"

Dr. HUGHES. I think, like Dr. Osterholm, that we are at the beginning of the experience of SARS, not at the end. I think we will encounter it again. I think it is important to point out to you, it might not wait till winter, because we do not know the animal reservoir. We do not know how it got into people in South China. We do not know that it could not get back into people there sooner than the wintertime. So we are not going to be complacent here in the next few months while we are in the hot season. We have to be alert and vigilant now, but move as rapidly as we can for increased preparedness in the fall and winter because of the reasons we have talked about.

Senator COLEMAN. When we talk about fall and winter, again, coming from a cold weather State, I think the reality is in the winter we tend to be grouped indoors in closer spaces versus in the summer we celebrate being outside. But it is that close contact that creates a great potential for an outbreak.

Dr. HUGHES. Yes, but I had the opportunity to go to that meeting in Kuala Lumpur that I mentioned and I passed through Singapore which is right on the equator and they had a very dramatic SARS outbreak there. So it is not going to be a problem just limited to colder climates in the winter-time, I am afraid.

Senator COLEMAN. Thank you. Senator Pryor.

Senator PRYOR. Thank you, Mr. Chairman. Let me ask a question or line of questions about China specifically. I promise you, I do not ask this in any way to criticize China or to cast any disparities on China and how they responded to SARS. But I would like to hear your thoughts on lessons learned from China, maybe some of the mistakes they made or some things that we should be pre-

pared for so we can handle this in the event that we do see an outbreak here. What have we learned from China?

Dr. HUGHES. Clearly, we have learned that the earlier a new and unusual problem is recognized to be something unique, the easier it is to confront and control. There is no question that there were major delays in recognition, and particularly in reporting of that occurrence.

After it was recognized, some laboratories studies were done in China. There was some laboratory evidence, as I understand it, that supported the possibility that this illness was caused by an organism that is called *Chlamydia pneumoniae,* which is one of a number of organisms that we have in this country that does in fact cause atypical pneumonia. But it would have been unusual, I think, for a community-wide outbreak or outbreaks as they occurred in South China to have been caused by *Chlamydia pneumoniae.* So I think they were misled by that. They underestimated the gravity. They perhaps did not realize they were dealing with a new problem and then they obviously had major communication problems as well.

So lessons are vigilance, sensitive surveillance supported by adequate laboratory capacity that allows you to rule in or rule out agents. By ruling out common agents, that leads you quickly to the suspicion that you may be dealing with something unusual. That's what happened with hantavirus pulmonary syndrome in the United States. You may recall back in 1993 in the Southwest a severe acute respiratory syndrome, when it was recognized, with a very high fatality rate where basic laboratory studies looking for common agents were negative. So very rapidly we and others got on to the fact that this was something unusual and moved quickly to identify the cause.

That approach and the approach used here with SARS, once it was recognized to be unusual—you are familiar with the incredible levels of international collaboration and the rapidity with which this agent was identified and characterized.

So in the modern age where we do have the tools—now, not every laboratory has these tools, but we need to continue to support and make sure that at the State and national levels these tools exist to rapidly recognize new infections when they occur.

Senator PRYOR. You mentioned surveillance in your testimony, and I noticed in some of the budget numbers that we have seen here in Washington, I believe the House has about $80 million for global surveillance of disease, and I believe the Senate version has $130 million for global surveillance of disease. Are you familiar with those numbers?

Dr. HUGHES. Not those specific numbers, but I know that there are amounts in the bills.

Senator PRYOR. How do you watch this disease? How do you monitor it? What is that money used for and how can we use that money best and most strategically?

Dr. HUGHES. We and the World Health Organization are thinking about that and trying to work with the countries in Asia as well. We have had very close collaboration, I think you realize, with the Canadians. We have learned a lot from their experience. We have been to their meetings, they have been to ours. We had

a liaison representative assigned to Health Canada and they to CDC throughout this. So we have learned a lot from the Canadian experience.

We have worked closely, as you have heard, with colleagues in the countries in Asia. We have tried to help them assess surveillance needs. We have shared reagents with them. In some cases we have shared the virus or viral RNA with them, because they need to have in place surveillance systems for atypical pneumonia and that needs to be backed up by laboratory support at the national level. Of course, laboratory capacity at the national level in those countries varies quite a bit. It is quite substantial in Singapore and Hong Kong but less so in other parts of Asia.

We have been talking with the Chinese about collaborating with them to strengthen their field epidemiology training program that they have and build up the laboratory capacity that is linked to that.

This allows me to make what I think is another important point and it is just dramatically illustrated by the discussion this morning. For many years there has been quite a gulf in this country between the world of clinical medicine and the world of public health. Whether you are dealing with bioterrorism or antibiotic resistance or West Nile or SARS, we have to break down some of those traditional barriers. We have made a lot of progress. So there are a lot of opportunities provided now with this attention to SARS that we need to capture, and that will help with surveillance both in this country and in other countries as well.

Senator PRYOR. A few moments ago I asked the previous witness a similar question to this and that is, I said I noticed in a lot of the media reports, etc., that there are other diseases out there that seem to be spreading through various populations, monkeypox is one, SARS is another, West Nile is another disease out there. Those have received some media attention and some public focus but what other things are out there that we need to be concerned about as policymakers? What do we need to be preparing for?

Dr. HUGHES. Thank you very much for asking that question. I would refer you to this Institute of Medicine report on Microbial Threats to Health.[1] They have a long list of many things that could keep you up at night, but I will tell you some of the things that I worry about. Obviously, I am extremely concerned about the threat of bioterrorism and we experienced that with a small attack involving anthrax, and we are intimately familiar with the consequences of that.

West Nile, we saw the dramatic sweep through much of the country last year. We are early in the season but it looks like we are at a level more or less similar to where we were this time last year, so we need to be prepared for that.

Now in terms of other things that we have not talked about that I personally worry about, we have alluded to pandemic influenza. That next pandemic will occur and we need to be better prepared to detect early and respond to that.

On top of that, I worry about antibiotic resistance, a major problem in health care settings and increasingly in community settings

[1] See Exhibit No. 3 which appears in the Appendix on page 149.

as well. It did not get much attention last year because of everything else that was going on, but for the first time in this country we found two cases of infection with a fully vancomycin-resistant strain of *Staphylococcus aureus.* You have been hearing perhaps for a few years about some strains of *Staph. aureus* that have had intermediate susceptibility to vancomycin, which is often the last line of antibiotic defense against that organism. Last year we found two cases for the first time that were fully resistant. Fortunately, they were susceptible to other antibiotics. But if we get a multiply-resistant *Staph. aureus* strain that is truly resistant to vancomycin then you are back in the 1920's in terms of dealing with people with common staphylococcal infections.

The vector-borne and zoonotic disease arena is obviously a hot one. In addition to West Nile, dengue remains a global problem. There is always the possible threat of introduction of yellow fever into Asia. In a way we were lucky we got West Nile. We would not want to get Japanese encephalitis which is a genetically somewhat similar virus and a big problem in Asia that could be introduced into the United States.

So the bottom line is, we live in a global village. We could encounter any infectious disease at any time that occurs anywhere else in the world, and a lot of our recent experience drives that home.

Senator PRYOR. Thank you, Mr. Chairman. That is all I have.

Senator COLEMAN. Thank you very much, Senator Pryor.

Dr. Hughes, a question about when SARS would recur. You have mentioned we are still not sure exactly how it got started. Is there a sense that once it is in the human population that it is dormant until something triggers it?

Dr. HUGHES. I do not think we have evidence that it is dormant. The illness itself, the people who are infected with it have evidence of viral activity in the first and particularly in the second week. Those who develop severe respiratory disease then may go on and be on ventilators for a prolonged period of time and some of them will die. The virus then, over time, disappears from those people though. We do not currently have evidence that I am aware of that there is any chronic carriage of the virus, although there are follow-up studies in progress to assess that possibility.

We do not have evidence that there is much, if any, asymptomatic infection that occurs. But I think we have to keep an open mind and say the jury is still somewhat out on that it. We do not know in nature, as I have said, where it originated. To my mind, the most likely scenario would be that it jumps from animals back into people and spreads that way again.

We have learned that in contrast to other coronaviruses that have been previously recognized, this virus survives a bit longer in the environment so you have to consider the possibility that there could be an environmental source. It does not survive indefinitely, but that is just another little complication of this microbe.

Senator COLEMAN. Last comment, a concern again about rural areas. If somebody from Canada had a virus and brought it to Minneapolis-St. Paul and went to a concert at the Excel Energy Center in St. Paul and somebody from Hawley, Minnesota, a little town in the west, were to be there, they would bring it back to their com-

munity. Do you have a sense of confidence that folks in our rural communities have the level of preparedness that they need today to deal with this?

Dr. HUGHES. I think it starts with awareness. So we need to focus on rural as well as urban areas in terms of the professional education and the public education that needs to be done. That is one scenario that could occur, a person from a rural area sitting in the row in front of somebody from an affected area who is ill at the time could easily take it into a rural area. People from rural areas, obviously, travel to Asia also. So there is no assurance that—rural areas are certainly not immune to this, and probably on balance are less prepared to deal with it. Because of just the nature of the population not being as concentrated, one would hope if you had good surveillance in place, if it did occur in a rural area you would pick it up early when there might only be one or a couple of cases and therefore it would be easier to deal with.

Senator COLEMAN. When we had the outbreak of SARS I know there were efforts made to educate airline passengers, kind of a proactive outreach. Do you have in your communication, education SWAT team, do you have that same kind of planning to get out there and proactively educate should the outbreak recur?

Dr. HUGHES. Yes, we do. We have not talked very much about this here today, but we were very active in working with Customs, Immigration, Agriculture, and other Federal colleagues in ports of entry in the United States to give information to passengers who were returning from SARS-affected areas. We actually distributed over 2.7 million of these health alert multi-language cards to people. We actually know that a number of people—I cannot give you precise numbers—but we know that a number of patients with suspect or probable SARS actually went to their physicians and showed them this card and said, I am here because I have been there and I have this card and maybe you ought to think of this. So that helped.

We have other approaches to providing travel alerts and travel advisories to outgoing travelers. So we have systems in place to do that. We work closely with the airlines and the airline unions. I think there is more work to be done in that area to be better prepared for the next time this occurs. So there is progress, there are conversations, there is communication but there is more to be done.

Senator COLEMAN. Dr. Hughes, I appreciate you noting that you are not going to be complacent at this time and that we will be doing the best we can to be ready for the next time.

Dr. HUGHES. Thank you.

Senator COLEMAN. Thank you. With that, the record of this hearing will be kept open for 30 days for additional questions and comments. Some of my colleagues may be in touch with you, Dr. Hughes, or Dr. Kanof, with some additional concerns and questions. So with that, thank you for your participation. Thank you for your good work.

This hearing is adjourned.

[Whereupon, at 10:33 a.m., the Subcommittee was adjourned.]

APPENDIX

PREPARED STATEMENT OF SENATOR FRANK R. LAUTENBERG

Thank you, Mr. Chairman, for holding today's hearing on State and local preparedness as it relates to Severe Acute Repository Syndrome—SARS.

Mr. Chairman, one thing that struck me at the last hearing the Subcommittee held on SARS was that all of the witnesses attributed the absence of a widespread outbreak here in the United States, to some extent, to *luck*.

New Jersey, my State, is developing guidelines for enhanced preparedness for an outbreak based on the CDC's recommendations. The three key elements to breaking the cycle of transmission are: (1) early detection; (2) intense surveillance; and (3) isolation.

New Jersey followed this plan during the first SARS outbreak and did it well. But luck was involved, too, and I don't want to rely on luck. Sometimes, luck runs out.

There is a lull in the SARS epidemic right now but we must remain *vigilant*: The resurgence in late May of cases in Toronto where the disease was thought to have been contained is a sobering reminder of the resilience of SARS and its capacity to surprise us.

Disease prevention requires more than bolstering State and local preparedness and other domestic capabilities—as vital as all of that is. It also requires training experts in epidemiology in other countries and coordinating with agencies around the world.

Diseases don't respect borders. If SARS persist in Asia for the long-term, it will continue to threaten us here in the United States. As Barry Bloom, dean of the Harvard School of Public Health, wrote in a recent issue of *Science,* "The lesson here is that it is time to support a *global* war on disease."

Thank you, Mr. Chairman.

United States General Accounting Office

GAO

Testimony

Before the Permanent Subcommittee on Investigations, Committee on Governmental Affairs, U.S. Senate

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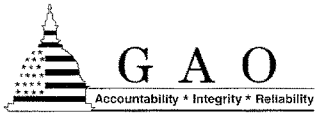
SEVERE ACUTE RESPIRATORY SYNDROME

Established Infectious Disease Control Measures Helped Contain Spread, But a Large-Scale Resurgence May Pose Challenges

Statement of Marjorie E. Kanof
Director, Health Care—Clinical
and Military Health Care Issues



GAO-03-1058T

July 30, 2003

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Highlights

Highlights of GAO-03-1058T, a report to the Permanent Subcommittee on Investigations, Committee on Governmental Affairs, U.S. Senate

SEVERE ACUTE RESPIRATORY SYNDROME

Established Infectious Disease Control Measures Helped Contain Spread, But a Large-Scale Resurgence May Pose Challenges

Why GAO Did This Study

SARS is a highly contagious respiratory disease that infected more than 8,000 individuals in 29 countries principally throughout Asia, Europe, and North America and led to more than 800 deaths as of July 11, 2003. Due to the speed and volume of international travel and trade, emerging infectious diseases such as SARS are difficult to contain within geographic borders, placing numerous countries and regions at risk with a single outbreak. While SARS did not infect large numbers of individuals in the United States, the possibility that it may reemerge raises concerns about the ability of public health officials and health care workers to prevent the spread of the disease in the United States.

GAO was asked to assist the Subcommittee in identifying ways in which the United States can prepare for the possibility of another SARS outbreak. Specifically, GAO was asked to determine 1) infectious disease control measures practiced within health care and community settings that helped contain the spread of SARS and 2) the initiatives and challenges in preparing for a possible SARS resurgence.

What GAO Found

Infectious disease experts emphasized that no new infectious disease control measures were introduced to contain SARS in the United States. Instead, strict compliance with and additional vigilance to enforce the use of current measures was sufficient. These measures—case identification and contact tracing, transmission control, and exposure management—are well-established infectious disease control measures that proved effective in both health care and community settings. The combinations of measures that were used depended on either the prevalence of the disease in the community or the number of SARS patients served in a health care facility. For SARS, case identification within health care settings included screening individuals for fever, cough, and recent travel to a country with active cases of SARS. Contact tracing, the identification and tracking of individuals who had close contact with someone who was infected or suspected of being infected, was important for the identification and tracking of individuals at risk for SARS. Transmission control measures for SARS included contact precautions, especially hand washing after contact with someone who was ill, and protection against respiratory spread, including spread by large droplets and by smaller airborne particles. The use of isolation rooms with controlled airflow and the use of respiratory masks by health care workers were key elements of this approach. Exposure management practices—isolation and quarantine—occurred in both health care and home settings. Effective communication among health care professionals and the general public reinforced the need to adhere to infectious disease control measures.

While no one knows whether there will be a resurgence of SARS, federal, state, and local health care officials agree that it is necessary to prepare for the possibility. As part of these preparations, CDC, along with national associations representing state and local health officials, and others, is involved in developing both SARS-specific guidelines for using infectious disease control measures and contingency response plans. In addition, these associations have collaborated with CDC to develop a checklist of preparedness activities for state and local health officials. Such preparation efforts also improve the health care system's capacity to respond to other infectious disease outbreaks, including those precipitated by bioterrorism. However, implementing these plans during a large-scale outbreak may prove difficult due to limitations in both hospital and workforce capacity that could result in overcrowding, as well as potential shortages in health care workers and medical equipment—particularly respirators.

www.gao.gov/cgi-bin/getrpt?GAO-03-1058T.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Marjorie E. Kanof at (202) 512-7101.

Mr. Chairman and Members of the Subcommittee:

I am pleased to be here today as you consider effective infectious disease control measures to help contain the spread of Severe Acute Respiratory Syndrome (SARS) should future outbreaks occur. SARS is a highly contagious respiratory disease that infected more than 8,000 individuals in 29 countries principally throughout Asia, Europe, and North America and led to more than 800 deaths as of July 11, 2003. Due to the speed and volume of international travel and trade, emerging infectious diseases such as SARS are difficult to contain within geographic borders, placing numerous countries and regions at risk with a single outbreak. SARS quickly became a worldwide health problem, prompting the World Health Organization (WHO) to issue a global alert for the first time in more than a decade—an alert that was cancelled on July 5, 2003. Although the outbreak is currently believed to be contained, the fact that SARS is a type of coronavirus—the source of some common colds—leads many to suggest that SARS could be seasonal and as such could recur in the fall and winter months.

Although all the modes of SARS transmission may not have been identified, the disease is most likely spread through person-to-person contact. Experts agree that infected individuals are contagious when symptomatic—a time during which they are more likely to seek medical attention and come into contact with health care workers. One unique characteristic of the SARS outbreak was the high rate of infection among health care workers, who—before the institution of specific protective measures—may have become infected while treating patients with SARS. The SARS outbreak in Asia demonstrated that the disease can also spread rapidly in the community, outside of hospital settings.

While SARS did not infect large numbers of individuals in the United States, the possibility that it may reemerge raises concerns about the ability of public health officials and health care workers to prevent the spread of the disease in the United States. To assist the Subcommittee in identifying ways in which the United States can prepare for the possibility of another SARS outbreak, my remarks today will focus on 1) infectious disease control measures practiced within health care and community settings that helped contain the spread of SARS and 2) the initiatives and challenges in preparing for a possible SARS resurgence.

My testimony today is based on the review of documentation about infection control practices and guidelines, as well as descriptions about the origin of SARS and its spread. In addition, we spoke with leading

national and international disease experts—most of whom were involved in either the investigation of SARS or in the treatment of patients with SARS. Specifically, we spoke with experts in infectious diseases, epidemiology, clinical medicine, and occupational safety from the Centers for Disease Control and Prevention (CDC) and WHO. We also spoke with public health officials of Health Canada and Toronto Public Health because Canada had the highest prevalence of SARS cases in North America. We interviewed state and local public health officials in California and New York—both of which had the greatest number of SARS cases reported in the United States. These officials represented the California Department of Health Services, the New York State Department of Health, and the New York City Department of Health and Mental Hygiene. We also spoke with hospital infectious disease experts in each of these states. In addition, we spoke with national infectious disease experts, hospital epidemiologists, and representatives from the National Association of County and City Health Officials (NACCHO) and the Association of State and Territorial Health Officials (ASTHO). We also used our previous work on the capacity of the public health system to respond to both bioterrorism and emerging infectious diseases.[1] We conducted our work in July 2003 in accordance with generally accepted government auditing standards.

In summary, infectious disease experts emphasized that no new infectious disease control measures were introduced to contain SARS in the United States. Instead, strict compliance with and additional vigilance to enforce the use of current measures was sufficient. These measures—case identification and contact tracing, transmission control, and exposure management—are well-established infectious disease control measures that proved effective in both health care and community settings. The combinations of measures that were used depended on either the prevalence of the disease in the community or the number of SARS patients served in a health care facility. For SARS, case identification within health care settings included screening individuals for fever, cough, and recent travel to a country with active cases of SARS. Contact tracing, the identification and tracking of individuals who had close contact with someone who was infected or suspected of being infected, was important for the identification and tracking of individuals at risk for SARS.

[1]U.S. General Accounting Office, *SARS Outbreak: Improvements to Public Health Capacity Are Needed for Responding to Bioterrorism and Emerging Infectious Diseases*, GAO-03-769T (Washington, D.C.: May 7, 2003).

Transmission control measures for SARS included contact precautions, especially hand washing after contact with someone who was ill, and protection against respiratory spread, including spread by large droplets and by smaller airborne particles. The use of isolation rooms with controlled airflow and the use of respiratory masks by health care workers were key elements of this approach. Exposure management practices—isolation and quarantine—occurred in both health care and home settings. Effective communication among health care professionals and the general public reinforced the need to adhere to infectious disease control measures.

While no one knows whether there will be a resurgence of SARS, federal, state, and local health care officials we interviewed agree that it is necessary to prepare for the possibility. As part of these preparations, CDC, along with national associations that represent state and local health officials, and others, is involved in developing both SARS-specific guidelines for using infectious disease control measures and contingency response plans. In addition, these associations have collaborated with CDC to develop a checklist of preparedness activities for state and local health officials. Such preparation efforts also improve the health care system's capacity to respond to other infectious disease outbreaks, including those precipitated by bioterrorism. However, implementing these plans may prove difficult due to limitations in both hospital and workforce capacity. A large-scale SARS outbreak could create overcrowding, as well as shortages in health care workers and in medical equipment—particularly respirators.

Background

SARS is an emerging respiratory disease that has been reported principally in Asia, Europe, and North America. SARS is believed to have originated in Guangdong Province, China in mid-November 2002. However, early cases of the disease went unreported, which then delayed identification and treatment of the disease allowing it to spread. On February 11, 2003, WHO received its first official report of an atypical pneumonia outbreak in China. This report stated that 305 individuals were affected by atypical pneumonia and that 5 deaths had been attributed to the disease. SARS was transmitted out of the Guangdong Province on February 21, 2003, by a physician who became infected after treating patients in the province. Subsequently, the physician traveled to a hotel in Hong Kong and began suffering from flu-like symptoms. Days later, other guests and visitors at the hotel contracted SARS. As infected hotel patrons traveled to other countries, such as Vietnam and Singapore, and sought medical attention for their symptoms, they spread the disease throughout each country's

hospitals as well as in some communities. Simultaneously, the disease began spreading around the world along international air travel routes as guests from the hotel flew homeward to Toronto and elsewhere.

Description of Severe Acute Respiratory Syndrome

Scientific evidence indicates that SARS is caused by a previously unrecognized coronavirus.[2] Transmission of SARS appears to result primarily from close person-to-person contact[3] and contact with large respiratory droplets emitted by an infected person who coughs or sneezes. After contact, the incubation period for SARS—the time it takes for symptoms to appear after an individual is infected—is generally within a 10-day period. Clinical evidence to date also suggests that people are most likely to be contagious at the height of their symptoms. However, it is not known how long after symptoms begin that patients with SARS are capable of transmitting the virus to others. There is no evidence that SARS can be transmitted from asymptomatic individuals.

Currently, there is no definitive test to identify SARS during the early phase of the illness, which complicates diagnosing infected individuals. As a result, the early diagnosis of SARS relies more on interpreting individuals' symptoms and identification of travel to locations with SARS transmission. SARS symptoms include fever, chills, headaches, body aches, and respiratory symptoms such as shortness of breath and dry cough—making SARS difficult to distinguish from other respiratory illnesses, such as the flu and pneumonia. The initial symptoms can be quite mild, and gradually increase in severity, often peaking in the second week of illness. In some individuals, the disease might progress to the point where insufficient oxygen is getting to the blood.

CDC has established for health care providers criteria used for the identification of individuals with SARS, called case definitions.[4] In the absence of a definitive diagnostic test for the disease in its early phase,

[2]The coronavirus is one of a group of viruses that are responsible for some but not all common colds. They are so named because their microscopic appearance is that of a virus particle surrounded by a crown.

[3]Close contact is usually defined as having cared for, lived with, or having direct contact with bodily secretions of an infected individual.

[4]See Centers for Disease Control and Prevention, Department of Health and Human Services, *Updated Interim U.S. Case Definition for Severe Acute Respiratory Syndrome (SARS)* (Atlanta, Ga.: July 16, 2003).

reported cases of SARS are classified into two categories based on clinical and epidemiologic criteria—"suspect" and "probable." These case definitions continue to be refined as more is learned about this disease. A "suspect" case of SARS includes the following criteria:

- high fever,
- respiratory illness, and
- recent travel to an area with current or previously documented suspected transmission of SARS,[5] and/or
- close contact within 10 days of the onset of symptoms with a person known or suspected to have SARS.

A "probable" case of SARS includes the following criteria:

- all the criteria for "suspect" cases and
- evidence in the form of chest x-ray findings of pneumonia, acute respiratory distress syndrome (ARDS), or an unexplained respiratory illness resulting in death with autopsy findings of ARDS.

The final determination of whether cases meeting the definitions for "suspect" and "probable" SARS are due to infection with the SARS virus is based on results of testing a blood specimen obtained 28 days after the onset of illness.

Furthermore, there is no specific treatment for SARS. In the absence of a rapid diagnostic test, it can be very difficult to distinguish clinically between individuals with SARS and individuals with atypical pneumonia. Therefore, CDC currently recommends that individuals suspected of having SARS be managed using the same diagnostic and therapeutic strategies that would be used for any patient with serious atypical pneumonia. In mild cases of SARS, management at home may be appropriate, while more severe cases may require treatment, such as intravenous medication and oxygen supplementation, that necessitates hospitalization. In 10 to 20 percent of SARS cases, patients require mechanical ventilation.[6] As of July 11, 2003, the mortality rate for SARS

[5]The last date for illness onset is 10 days (i.e., one incubation period) after removal of a CDC travel alert. To be considered a suspect case, an individual's travel would have occurred on or before the last date the travel alert was in place.

[6]Mechanical ventilation involves artificial ventilation of the lung using means external to the body. A mechanical ventilator is a machine that generates a controlled flow of gas (a mixture of oxygen and air) into a patient's airways.

was approximately 10 percent, but the mortality rates in individuals over 60 years of age approached 50 percent.

As of July 11, 2003, WHO reported that there were an estimated 8,427 "probable" cases from 29 countries, with 813 deaths from SARS. China, Hong Kong, Singapore, Taiwan, and Canada reported the highest number of cases. As of July 15, 2003, the United States identified 211 SARS cases in 39 states (including Puerto Rico), with no related deaths. Of these cases, 175 are classified as "suspect" cases, while 36 are classified as "probable."[7] In the United States, 34 of the 36 "probable" cases contracted SARS through international travel. However, in the other affected countries, SARS spread extensively among health care workers. For example, of the 138 diagnosed cases in Hong Kong as of March 25, 2003, that were not due to travel, 85 (62 percent) occurred among health care workers; among the 144 cases in Canada as of April 10, 2003, 73 (51 percent) were health care workers.

General Infectious Disease Control Measures

In the United States, the Healthcare Infection Control Practices Advisory Committee (HICPAC), a federal advisory committee made up of 14 infection control experts, develops recommendations and guidelines regarding general infectious disease control measures for CDC. Important components of these infectious disease control measures are the following: case identification and contact tracing, transmission control, and exposure management.

Case Identification and Contact Tracing. Case identification and contact tracing are considered by health care providers to be important first steps in the containment of infectious diseases in both the community and health care settings. Case identification is the process of determining whether or not a person meets the specific definitions for a given disease. Generally, health care providers interview patients in order to obtain the history, signs, and symptoms of the patient's complaint and perform a physical examination. Tests, such as blood tests or x-rays, can be performed to provide additional information to help determine the diagnosis. Public awareness of the symptoms of a disease can help case identification to the extent that individuals who believe they exhibit the

[7]Additionally, on July 16, 2003, CDC revised the case definition to exclude individuals with negative test results for SARS coronavirus. This resulted in 207 previously identified SARS cases (169 suspect cases and 38 probable cases) being removed from the count of SARS cases in the United States.

symptoms seek medical attention. Contact tracing involves the identification and tracking of individuals who may have been exposed to a person with a specific disease.

Transmission Control. Transmission control measures decrease the risk for transmission of microorganisms through proper hand hygiene and the use of personal protective equipment, such as masks, gowns, and gloves. These measures also include the decontamination of objects and rooms. The types of transmission control measures used are based on how an illness is transmitted. For example, some categories of transmission are as follows:

- Direct contact: person-to-person contact (e.g., two people shaking hands) and physical transfer of the microorganism between an infected person and an uninfected person.
- Indirect contact: contact with a contaminated object, such as secretions from an infected person on a doorknob or telephone receiver.
- Droplet: eye, nose, or mouth of an uninfected person coming into contact with droplets (larger than 5 micrometers) containing the microorganism from an infected person, for example an infected person sneezing without covering his/her mouth with a tissue.
- Airborne: contact with small droplets (5 micrometers or smaller) or dust particles containing the microorganism, which are suspended in the air.

Exposure Management. Exposure management is the separation of infected individuals from noninfected individuals through isolation or quarantine. Isolation refers to the separation of individuals who have a specific infectious illness from healthy individuals and the restriction of their movement to contain the spread of that illness. Quarantine refers to the separation and restriction of movement of individuals who are not yet ill, but who have been exposed to an infectious agent and are potentially infectious.

The success of these infectious disease control measures—case identification and contact tracing, transmission control, and exposure management—depends, in part, on the frequent and timely exchange of information. Public health officials and health care providers need to be informed about any modifications of existing infectious disease control measures, the geographic progression of an outbreak, and reports of disease occurrence. Likewise, elevating public knowledge about an infectious disease and its symptoms will enable infected individuals to seek medical attention as soon as possible to contain the spread.

Experts Recommend Case Identification and Contact Tracing, Transmission Control, and Exposure Management Measures To Prevent the Spread of SARS

Infectious disease experts emphasized that existing infectious disease control measures played a pivotal role in containing the spread of SARS in both health care and community settings. The combinations of measures that were used depended on either the prevalence of the disease in the community or the number of SARS patients served in a health care facility. No new measures were introduced to contain the SARS outbreak in the United States; instead, experts said strict compliance with and additional vigilance to enforce the use of current measures was sufficient. The successful implementation of all of the infectious disease control measures depended, in part, on effective communication among health care professionals and the general public.

Timely Case Identification and Contact Tracing of SARS Cases Was Critical But Difficult

To prevent the spread of SARS, public health authorities worked to identify every individual who might have been infected with the disease. Rapid identification of these individuals was critical, but the lack of an effective and timely diagnostic test that could be used during the early stages of the disease to identify those who actually had SARS was an obstacle in halting its spread. Experts acknowledged that identification of individuals who might have been infected with the SARS virus was likely to include many people who did not have SARS because the case definition of an individual with SARS is not highly specific and the disease resembles other respiratory illnesses, such as pneumonia and the flu. The long incubation period for SARS provided health care workers the opportunity to identify cases and close contacts of infected individuals before those who actually had the SARS virus could spread the disease to others.

An important part of case identification is screening individuals for symptoms of a disease. CDC recommended that when individuals called for appointments and as soon as possible after the individual arrived in a health care setting, all individuals should be screened with targeted questions concerning SARS-related symptoms, close contact with a SARS suspect case patient, and recent travel. For SARS, public health and hospital officials in California and New York said hospital emergency room or other waiting room staff routinely used questionnaires to screen incoming patients for fever, cough, and travel to a country with active cases of SARS. They said that hospitals' signs in various locations generally used by incoming patients and visitors also included these criteria and asked individuals to identify themselves to hospital staff if they met them. According to these officials, an individual identified as a potential SARS case generally was given a surgical mask and moved into a separate area for further medical evaluation. CDC officials said that these

measures were also important for physicians in private practice. The New York City and California health departments used e-mail health alert notices to inform private physicians, such as family practitioners and pediatricians, about these case identification procedures. These notices directed physicians to information posted on the health departments' Web sites. In addition, officials from these health departments provided information about SARS case identification, among other topics, during local meetings for members of the medical community, including physicians in private practice.

Toronto, which experienced a much greater prevalence of SARS than the United States, used somewhat different case identification practices. At the height of the outbreak in Toronto, everyone entering a hospital was required to answer screening questions and to have their temperature checked before they were allowed to enter. Toronto public health department officials said this heightened screening was useful for case identification and had an added benefit of educating staff and visitors about SARS symptoms. As a further measure, Toronto health officials established SARS assessment clinics, also known as fever clinics; persons suspecting they might have SARS were asked to go to the clinics rather than directly to hospital emergency rooms to avoid infecting other individuals. However, officials acknowledged several limitations to using these assessment clinics. Because there was no follow-up to an initial assessment, some SARS cases that were in the early stages were not identified, but later these individuals went to hospital emergency rooms. Other difficulties included finding physicians to staff the clinics and implementing hospital-level infectious disease control measures at these separate clinics. For example, some clinics were set up in non-hospital locations—one assessment clinic was set up in a tent near a hospital emergency room entrance, while another was situated in a hospital ambulance bay where emergency personnel transfer patients into the hospital.

Contact tracing—the identification and tracking of individuals who had close contact with a "suspect" or "probable" case—is an important component of case identification. Contact tracing to identify individuals at significant risk for SARS required significant local health department resources. In New York City, four teams from the communicable disease bureau, comprised of either a physician or nurse and several field workers, interviewed each suspect or probable case in order to identify contacts. They then called each contact to advise them of their exposure and provided information on monitoring for symptoms of SARS and receiving treatment if necessary. The calls were also to ensure that the contacts

were following infection control measures in the home. Each contact received routine calls during a 10-day period—an average of four calls each from a team member. A New York City health department official characterized the process of contact tracing as labor and time intensive. Standardized forms and electronic contact and case databases helped the teams manage contact tracing. Additionally, routine weekly meetings with other health department divisions ensured that if assistance was needed from these departments, they would be up-to-date. Furthermore, New York City developed procedure manuals that would allow staff from other departments to be trained quickly if needed to assist members of the communicable disease bureau. The health department official emphasized that the electronic database created to log information about SARS contacts was an important tool to facilitate contact tracing. Toronto officials agreed that daily contact tracing required a large amount of resources. Adding to Toronto's difficulties, its health department did not have an electronic case or contact database, but had to rely on separate paper files for each individual.

Multiple Transmission Control Measures Used to Contain Spread

Experts recommended a combination of transmission control measures because not all modes of SARS transmission are known. The primary mode of transmission is direct person-to-person contact, although contact with body fluids and contaminated objects, and possibly airborne spread, may play a role. Therefore, multiple infection control practices that are used for each type of transmission are included in SARS infection control guidelines. Some combination of practices was recommended for both health care settings and in the community, with more intensive infection control procedures recommended for health care settings. According to several experts, the simple "things your mother taught you," such as washing your hands and covering your mouth and nose with a tissue when sneezing or coughing were effective in reducing the spread of SARS.

CDC prepared SARS guidelines for transmission control measures for both inpatient (such as hospitals) and outpatient (such as physician offices) health care settings.[8] These recommendations combined what the CDC calls "standard" hospital transmission control measures with transmission

[8]See Centers for Disease Control and Prevention, Department and Health and Human Services, *Updated Interim Domestic Infection Control Guidance in the Health-Care and Community Setting for Patients with Suspected SARS* (Atlanta, Ga.: May 1, 2003).

control measures specific to contact and airborne transmission. For the inpatient setting, the guidelines included:

- Routine standard precautions, including hand washing. In addition to standard precautions, CDC recommended eye protection—such as goggles or a face shield.
- Contact precautions, such as the use of a gown and gloves for encounters with the patient or his/her environment.
- Airborne precautions, such as an isolation room with negative pressure relative to the surrounding area,[9] and the use of an N-95 filtering disposable respirator for persons entering the room. The CDC guidelines suggested that if an isolation room was not available, patients should be placed in a private room, and all persons entering the room should wear N-95 respirators (or respirators offering comparable protection) to protect the wearer from particles expelled by a sick person, such as in coughing or sneezing. CDC recommended that, where possible, a test to ensure that the N-95 respirators fit properly should be conducted. If N-95 respirators were not available for health care personnel, then surgical masks should be worn. Generally, the material of N-95 respirators is designed to filter smaller particles than a surgical mask, and they also are designed to seal more tightly to the face.

The health department and hospital officials we spoke with said they generally adopted these CDC guidelines for transmission control in inpatient settings. Officials said one of the most effective practices to contain SARS was frequent hand washing with soap and water. CDC guidelines also allow the use of waterless alcohol-based hand rubs after coming in contact with "suspect" or "probable" SARS patients or their environments. Additionally, a hospital and a health department official said careful cleaning of SARS patient rooms was an important hygiene measure.

Inpatient facilities in the United States generally saw few SARS patients. In New York and California, the hospital officials stated that because of the small number of cases that were seen in each hospital, usually only one or two at a time, the hospitals were able to manage SARS patients in available isolation rooms. Because of the greater prevalence of SARS in Toronto, all 22 acute care hospitals were directed to have a SARS unit with negative pressure to the rest of the hospital, individual rooms, and specific staff

[9]Negative pressure rooms generally are private rooms in which air flow is from the hallway into the room, and then outdoors.

who only cared for SARS patients. Toronto health department officials later were able to designate four hospitals as SARS hospitals and direct all SARS patients to these four facilities.

The use of face masks or N-95 respirators was highly recommended by experts as an effective means of transmission control for SARS in inpatient settings. In one study of health care workers who had extensive contact with SARS patients in five Hong Kong hospitals, researchers found that no health care worker who consistently used either type of face covering became infected.[10] Experts also noted that the use of N-95 respirators and isolation rooms was especially important for high-risk medical procedures, such as intubation, where a patient's secretions are likely to be transformed into a fine spray and spread for a longer distance than large droplets.[11] Officials cautioned, however, that there can be difficulties in the use of N-95 respirators. One public health official said that compliance may be limited in hospitals in several ways—either staff has never been properly fitted for the respirators, or some staff who were fitted many years ago should have a more recent fitting. In Canada, Ontario's health ministry directed health care workers in the province (which includes Toronto) to employ an additional level of protective equipment when conducting high-risk medical procedures that was not recommended in the United States. For example, health care workers used a protective system that included a hood, a full-face respirator, and a complete body covering such as long-sleeved floor-length gowns and gloves.

The CDC guidelines for outpatient settings included the same standard and contact precautions outlined for inpatient settings. Reflecting the different types of facilities likely available in a physician office compared to a hospital, for example, outpatient guidelines did not advocate the use of specialized isolation rooms. Instead, for outpatient settings, the guidelines advised health care personnel to separate the potential SARS patient from others in a reception area as soon as possible, preferably in a private room with negative pressure relative to the surrounding area. At the same time, the guidelines said that a surgical mask should be placed

[10]See W.H. Seto, et.al., *Effectiveness of precautions against droplets and contact in prevention of nosocomial transmission of severe acute respiratory syndrome (SARS)*, The Lancet (Vol. 361, May 3, 2003), pp. 1519-20.

[11]Generally, intubation is the introduction of a tube into an individual's airway to facilitate breathing.

over the patient's nose and mouth—if this was not feasible, the patient should be asked to cover his or her mouth with a disposable tissue when coughing, talking, or sneezing.

Transmission control guidelines for community settings incorporated many of the same types of measures for containing the spread of SARS as recommended for health care settings.[12] CDC published SARS transmission control guidelines for two community settings—the workplace and households. The workplace guidelines recommended frequent hand washing with soap and water or waterless alcohol-based hand rubs. Along with handwashing, guidelines for household transmission control included the following:

- Infection control precautions should be continued for SARS patients for 10 days after respiratory symptoms and fever are gone. SARS patients should limit interactions outside the home and should not go to work, school, out-of-home day care, or other public areas during the 10-day period.
- During this 10-day period, each patient with SARS should cover his or her mouth and nose with a tissue before sneezing or coughing. If possible, a person recovering from SARS should wear a surgical mask during close contact with uninfected persons. If the patient is unable to wear a surgical mask, other people in the home should wear one when in close contact with the patient.
- Disposable gloves should be considered for any contact with body fluids from a SARS patient. Immediately after activities involving contact with body fluids, gloves should be removed and discarded, and hands should be washed. Gloves should not be washed or reused, and were not intended to replace proper hand hygiene.
- SARS patients should avoid sharing eating utensils, towels, and bedding with other members of the household, although these items could be used by others after routine cleaning, such as washing or laundering with soap and hot water.
- Frequent use should be made of common household cleaners for disinfecting toilets, sinks, and other surfaces touched by patients with SARS.

[12]See Centers for Disease Control and Prevention, Department of Health and Human Services, *Interim Guidance on Infection Control Precautions for Patients with Suspected Severe Acute Respiratory Syndrome (SARS) and Close Contacts in Households* (Atlanta, Ga.: Apr. 29, 2003).

Exposure Management Used to Prevent SARS Spread

Exposure management methods such as isolation and quarantine are important infectious disease control measures. These measures were particularly effective for SARS because of its long incubation period during which infected individuals could be isolated before they become contagious. In fact, experts stated that isolation of infected individuals and quarantine measures used for exposed individuals were critical for the containment of SARS.

Isolation of SARS infected individuals occurred in both health care and home settings. In Toronto, patients were typically isolated in the hospital—even in cases where individuals were not ill enough to need hospitalization. During the height of Toronto's outbreak, all 22 acute care hospitals were directed to have separate SARS units. On the other hand, in the United States, individuals were hospitalized only if they needed intensive medical treatment. According to an infectious disease expert who consulted with the CDC, this practice was prompted by concerns that grouping SARS cases together, such as in a hospital ward, could increase the likelihood of spread to both health care workers and other hospital patients.

For home isolation in New York City, each patient and contact was given detailed information that included instructions on what to do if ill, reminders of the importance of calling ahead before going to a physician's office or other health care settings, and information on how to travel to a health care setting without coming in contact with others. These instructions also included guidelines for transmission control measures to be used in the home. For all probable cases, the New York City health department conducted a home assessment to ensure that a SARS patient could be adequately isolated at home, which included the need for such things as adequate ventilation and bathrooms that would not be shared by noninfected individuals.

Quarantine of exposed individuals was based on different parameters, depending on the number of "suspect" or "probable" SARS cases in the community. CDC officials said the agency's guidance reflected the fact that there was little or no transmission of SARS in the United States, and therefore quarantine was less warranted because there were so few cases in a community. CDC's guidance advised individuals who were exposed but not symptomatic to monitor themselves for symptoms—such as fever, a cough, and difficulty breathing, and further advised home isolation and medical evaluation if symptoms began. CDC officials also advised transfer to a hospital only if the illness became severe.

In contrast, Toronto, which experienced a high level of person-to-person transmission, used a more conservative quarantine standard. Individuals who did not have symptoms but had been in contact with SARS infected individuals were ordered to stay in their homes and avoid public gatherings for 10 days. Thousands people were asked to undergo quarantine in their homes in the Toronto area. During the outbreak, exposed Toronto health care workers were restricted to "work quarantine"—they were only allowed to travel to and from work alone in their vehicles, but they were not allowed to have visitors or visit public places. Quarantine efforts in Toronto again required a high level of resources. Daily phone calls required 60 staff per 1,000 people who were quarantined in the Toronto area; these staff worked 7 days a week to follow up with twice-daily calls to each individual.

Success in Implementing Infectious Disease Control Measures Depended on Rapid and Frequent Communication

According to health officials, rapid and frequent communications of crucial information about SARS—such as the level of outbreak worldwide and recommended infectious disease control measures—were vital components of the efforts to contain the spread of SARS. Since March 2003, health organizations have shared extensive SARS-related information and guidelines with health care workers. For example, WHO scheduled numerous press briefings that updated the health community about the status of international SARS containment and prevention efforts. WHO, with CDC support, sponsored a videoconference broadcast globally to discuss the latest findings of the outbreak and prevention of transmission in health care settings (which was also available for computer download). CDC activated its Emergency Operations Center and devoted over 800 medical experts and support personnel worldwide to provide round-the-clock coordination and response to the SARS outbreak. CDC also had regular conference calls and information-sharing sessions with various medical professional associations and state and local health departments and laboratories.

At the state level, the California health department utilized the California Health Alert Network to send e-mails with SARS information (often based on CDC information) to all local health departments and many hospitals and physicians. The New York City health department hosted a symposium specifically for health care workers, to share the latest available SARS information. Hospital officials we spoke with also offered training seminars for their health care personnel on the signs and symptoms of SARS, recommended screening questions, and appropriate infectious disease control measures. Furthermore, hospitals kept their

patients informed about SARS via posters and flyers throughout their facilities, especially in emergency room waiting areas.

Health organizations maintained open and frequent communications in the community setting to facilitate the containment of SARS. For example, in a 2-week period early in the SARS outbreak, CDC conducted nine telephone press conferences with the media to keep the public informed about the latest SARS information, including numbers of "suspect" and "probable" SARS cases, laboratory and surveillance findings, travel advisories, and CDC's efforts nationally and worldwide. CDC also distributed more than two million health alert notices to travelers entering the United States from China, Hong Kong, Singapore, Taiwan, Vietnam, or Toronto. These cards, printed in eight languages, asked individuals to monitor their health for at least 10 days and to contact their health care provider if they exhibited SARS symptoms. A state and a local health official also stressed the importance of informing and educating the general public in workplaces and schools on the signs and symptoms of SARS, an effort which was intended to foster self-identification, minimize panic, and assuage fears of being infected.

Public health officials also concurred that collaboration between federal, state, and local health agencies as well as the medical community was crucial in containing the spread of SARS. Through the collaboration of all the appropriate players, coordination of prevention activities could be maintained, roles could be identified and assigned, available resources could be shared, and subsequent evaluations could be conducted. For instance, the Toronto health department maintained active communications with its local, provincial, and national governments in regard to isolation and quarantine practices, travel jurisdictions, and other SARS-related matters. The health department published directives for all Toronto area health care providers, outlining their SARS-related roles and responsibilities. The health department also maintained ongoing contact with identified liaisons at Toronto hospitals where SARS patients were hospitalized. Furthermore, the city of Toronto activated its local emergency operations center, which brought together emergency medical services, police, and community neighborhood planners to work together to contain SARS. Throughout Toronto's efforts, numerous briefings and teleconferences were organized to keep all players abreast about the latest SARS information in the community.

Federal, State, and Local Health Officials Are Preparing for a Possible SARS Resurgence, But Implementing Plans May Pose Challenges if the Resurgence Is Large-Scale

While no one knows whether there will be a resurgence of SARS, federal, state, and local health care officials we interviewed agree that it is necessary to prepare for the possibility. As part of these preparations, CDC, along with national associations that represent state and local health officials, and others, is involved in developing SARS-specific guidelines for using infectious disease control measures and contingency response plans. In addition, these associations have collaborated with CDC to develop a checklist of preparedness activities for state and local health officials. Such preparation efforts also improve the health care system's capacity to respond to other infectious disease outbreaks, including those precipitated by bioterrorism. However, implementing these plans may prove difficult due to limitations in both hospital and workforce capacity. A large-scale SARS outbreak could create overcrowding, as well as shortages in medical equipment (including N-95 respirators) and in health care personnel, who are at higher risk for infection due to their more frequent exposure to a contaminated environment.

Federal, State, and Local Health Officials Are Preparing for the Possibility of Future Outbreaks

At the federal level, CDC has begun contingency planning for a SARS outbreak, having convened a task force of infection control experts who are responsible for developing SARS-specific guidelines and recommendations, which address various infection control measures. The task force plans to publish its guidelines and recommendations by September 2003. CDC is collaborating with several professional associations, such as the Council of State and Territorial Epidemiologists, ASTHO, and NACCHO, to develop these response plans that vary according to the prevalence of the disease and the type of setting (i.e., health care or community) in which control measures need to be implemented.

At the state and local levels, health departments are also in the process of developing contingency response plans for SARS. To facilitate this, ASTHO and NACCHO, in collaboration with CDC, published a checklist for state and local health officials to use in the event of a SARS resurgence. The SARS preparations have been modeled after a checklist designed for pandemic influenza. The checklist encompasses a broad spectrum of preparedness activities, such as legal issues related to isolation and quarantine, strategies for communicating information to health care providers, and suggestions for ensuring other community partners such as law enforcement and school officials are prepared (see app. I for a copy of the checklist).

In specific local preparedness efforts, California and New York, which had the highest number of SARS cases in the United States, are also preparing for a large-scale SARS outbreak. For example, California health department officials said they were developing a plan for surge capacity by considering staff rotations or details of health department specialists to maintain a high level of response during a potential SARS outbreak.[13] Similarly, officials with the New York City health department said they had created a formal procedure manual, which outlines the roles of reallocated staff from various teams in the department, to help contain a large-scale SARS outbreak.

Limitations in Hospital and Workforce Capacity Make Implementing Infectious Disease Control Measures Difficult in the Event of a Large-Scale SARS Outbreak

While hospital officials we spoke with stated that they are taking steps to ensure that they have the necessary preparations to address a large-scale SARS outbreak, hospitals may still be limited in their capacity to respond. Because of the inability to precisely determine if someone has SARS, many people may be treated who do not have the virus. In the event of a large-scale outbreak, this imprecision may result in severe overcrowding in health care settings—especially if a SARS resurgence occurs during a peak season for another respiratory disease like influenza. This could strain the available capacity of hospitals. For example, public health officials with whom we spoke said that in the event of a large-scale SARS outbreak, entire hospital wards (along with their staff) may need to be used as separate SARS isolation facilities. Moreover, certain hospitals within a community might need to be designated as SARS hospitals.

We recently reported that most hospitals lack the capacity to respond to large-scale infectious disease outbreaks.[14] Most emergency departments have experienced some degree of crowding and therefore, in some cases, may not be able to handle a large influx of patients during a potential outbreak of SARS or another infectious disease. Few hospitals have adequate staff, medical resources, and equipment, such as N-95 respirators, needed to care for the potentially large numbers of patients

[13]Surge capacity is the ability of the health care system to handle a large number of patients.

[14]U.S. General Accounting Office, *SARS Outbreak: Improvements to Public Health Capacity Are Needed for Responding to Bioterrorism and Emerging Infectious Diseases*, GAO-03-769T (Washington D.C.: May 7, 2003).

that may seek treatment.[15] We reported that in the seven cities we visited, hospital, state, and local officials indicated that hospitals needed additional equipment and capital improvements—including medical stockpiles, personal protective equipment, quarantine and isolation facilities, and air handling and filtering equipment—to enhance preparedness. According to our survey of over 2,000 hospitals,[16] the availability of medical equipment varied greatly among hospitals, and few hospitals reported having the equipment and supplies needed to handle a large-scale infectious disease outbreak. Half the hospitals we surveyed had, for every 100 staffed beds, fewer than 6 ventilators, 3 or fewer personal protective equipment suits, and fewer than 4 isolation beds.

Workforce capacity issues may also hinder implementation of infectious disease control measures. Health officials noted that there is a lack of qualified and trained personnel, including epidemiologists, who would be needed in the event of a SARS resurgence. This shortage could grow worse if, in the event of a severe outbreak, existing health care workers became infected as a result of their more frequent exposure to a contaminated environment or became exhausted working longer hours. Workforce shortages could be further exacerbated because of the need to conduct contact tracing. According to WHO officials, an individual infected with SARS came into contact with, on average, 30 to 40 people in Asian countries—all of whom had to be contacted and informed of their possible exposure. In contrast, New York City health department officials said that infected individuals came into contact with 4 people on average.

In addition, the monitoring of individuals placed under isolation and quarantine may strain resources if widespread isolations and quarantines are needed. For example, follow-up with isolated or quarantined individuals requires significant resources. Officials of the New York City

[15]Shortages in N-95 respirators occurred during the SARS outbreak because of the high demand. CDC officials said that shortages in the United States may have been due to high demand in other countries, particularly when WHO recommended that health care workers in all affected countries use N-95 respirators.

[16]Between May and September 2002, we surveyed over 2,000 short-term, nonfederal general medical and surgical hospitals with emergency departments located in metropolitan statistical areas. (See U.S. General Accounting Office, *Hospital Emergency Departments: Crowded Conditions Vary among Hospitals and Communities*, GAO-03-460 (Washington, D.C.: Mar. 14, 2003) for information on the survey universe and development of the survey.) For the part of the survey that specifically addressed hospital preparedness for mass casualty incidents, we obtained responses from 1,482 hospitals, a response rate of about 73 percent.

Department of Health and Mental Hygiene said that they made home visits to SARS cases when officials became concerned that these individuals were not following infection control measures or were not remaining in their homes. Similarly, Canadian public health officials said that they, and in some cases Canadian police, made home visits to check compliance with quarantine orders. These officials also described the difficulty in providing necessary resources (food, medicines, masks, and thermometers) to individuals under isolation or quarantine. In Canada, police and the Red Cross had to help deliver food to those under isolation or quarantine.

Concluding Observations

The global spread of SARS was contained through an unprecedented level of international scientific collaboration and the use of well-established infection control measures that have been used effectively in the past to control diseases. Although questions remain about SARS, especially about the ways it can be transmitted, many lessons were learned that could be helpful to the United States in the event of a resurgence. Lessons to carry forward are the importance of early identification of infected individuals and their contacts, the effectiveness of safety precautions to control transmission and ensure the protection of health care workers, and the need to use, in some cases, isolation and quarantine. Swift and unfettered communication among heath care workers, public health officials, government agencies, as well as the public provided the essential backbone to support ongoing efforts to contain the disease.

Although SARS is currently believed to be contained, now is the time to prepare for the possibility of a future outbreak. Some preparations are already underway and encompass, in large part, approaches similar to those for pandemic influenza and are also part of general bioterrorism preparedness. Worldwide disease surveillance would facilitate prompt identification of a resurgence of SARS, allowing rapid implementation of infectious disease control measures that would reduce both the spread of SARS and the risk of a large outbreak. Should a large-scale outbreak occur in the near term, limitations in the capacity of our nation's health system to undertake effective and rapid implementation of infectious disease control measures could prove problematic. A major SARS outbreak would necessitate rapid escalation of infectious disease control resources including health care workers, emergency room and hospital capacity, and the requisite control and support equipment.

Mr. Chairman, this completes my prepared statement. I would be happy to respond to any questions you or other Members of the Subcommittee may have at this time.

Contact and Staff Acknowledgments

For more information regarding this testimony, please contact Marjorie Kanof at (202) 512-7101. Bonnie Anderson, Karen Doran, John Oh, Danielle Organek, and Krister Friday also made key contributions to this statement.

Appendix I: SARS Preparedness Checklist

THE ASSISTANT SECRETARY OF DEFENSE

1200 DEFENSE PENTAGON
WASHINGTON, DC 20301-1200

HEALTH AFFAIRS

JUL 23 2003

Ms. Marjorie E. Kanof
Director, Health Care-Clinical and Military Health Care Issues
U.S. General Accounting Office
441 G Street, N.W., Washington D.C. 20548

Dear Ms. Kanof:

This is the Department of Defense (DoD) response to the Draft Report, GAO-03-928 "DEFENSE HEALTH CARE: Oversight of the TRICARE Civilian Provider Network Should Be Improved," dated July 2, 2003 (GAO Code 290203).

Thank you for the opportunity to review and comment on this draft report. Access to healthcare is one of my highest priorities. We appreciate your review and recommendations for improvements in measuring and monitoring of network adequacy that would result in demonstrated enhancements to our current efforts. We are very pleased to note that GAO did not uncover any specific instances of inadequate networks that had not already been identified and addressed by the Lead Agents, the managed care support contractors, and TRICARE Management Activity staff.

The implementation of the next generation of TRICARE contracts (T-Nex) will address many of the points raised in your report. T-Nex will enhance the reporting of information about network adequacy as well as powerful financial incentives for contractors to optimize the direct care system, maximize the extent of civilian provider networks, and achieve the highest level of beneficiary satisfaction. Taken together these enhances will ensure the highest quality and access for TRICARE beneficiaries.

Overall, although I concur with the findings of the audit, improvements are already being implemented by my office. Strong oversight of the civilian provider networks is necessary and should be continuously monitored for improvements. A number of initiatives are being considered with the intent of improving beneficiary access to the civilian networks. Detailed DoD comments on the report recommendations are provided in the enclosure. Also provided are several technical comments for your consideration to strengthen the report.

Although oversight can and will be improved, I do find the title of the report misleading in that it might lead some to conclude that GAO finds TRICARE networks inadequate in some respects, which is not the case. Access problems for TRICARE beneficiaries are rare and typically relate to a lack of specialty providers in a rural area rather than a TRICARE unique problem. Finally, I believe that our current approach to assuring network adequacy is working, but I endorse your suggestions for improving it. Our approach under T-Nex will mirror GAO's recommendations.

☐ 7. I have identified any deficiencies in my jurisdiction's laws and procedures on quarantine, isolation and related capacities and initiated steps to have those deficiencies corrected.

☐ 8. I know what provisions are in place, if any, for compensation of persons with economic or health injury resulting from needed SARS control measures and for limitation of liability of health care providers and agencies.

AUTHORITY

☐ 9. My state has an executive SARS epidemic planning committee that oversees the planning process, in cooperation with local health agencies.

☐ 10. My state has identified the authority responsible for declaration of a public health emergency and for officially activating our plan during a SARS epidemic.

☐ 11. My jurisdiction has identified key stakeholders responsible for development and implementation of specific components of the SARS epidemic plan, including enforcement of isolation, quarantine, and closure and decontamination of premises.

☐ 12. My jurisdiction's elected officials, appointed officials, and other agency heads know their respective responsibilities in the event of an epidemic.

☐ 13. My jurisdiction has a command system in place (e.g., the Incident Command System) to govern roles and responsibilities during a multi-agency, multi-jurisdictional event.

☐ 14. I am familiar with the controlling authority over intrastate and interstate modes of transportation, should these need to be curtailed during an epidemic (e.g., airplanes, trains, ships, highways).

☐ 15. My staff has relationships with health authorities of adjoining counties or states and with federal agencies to ensure effective communication during a public health emergency.

☐ 16. My jurisdiction has identified an overall authority in charge of coordinating different medical personnel groups during an epidemic.

☐ 17. I know personally the key individuals from the state and local authorities who will assist in maintaining public order and enforcing control measures, if needed, during an epidemic.

☐ 18. I am familiar with the procedure for enlisting the National Guard's assistance during a public health emergency.

SURGE CAPACITY

☐ 19. I know how to access current recommendations on treatment of cases and prevention of transmission in the hospital, long-term care and home care settings.

☐ 20. My jurisdiction's emergency response planning has involved health care product and service providers to determine how to best prevent and control disease spread and manage the health care of the population during an epidemic.

☐ 21. I am familiar with the required protocol for securing needed emergency healthcare services and supplies during a public health emergency.

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Source: National Association of County and City Health Officials

☐ 22. My jurisdiction has identified ways to augment medical, nursing, and other health care staffing to maintain appropriate standards of care during an epidemic.

☐ 23. My jurisdiction has identified ways to augment public health laboratory, epidemiology and disease control staffing to meet emergency needs and in the event public health workers are affected by an epidemic.

☐ 24. My jurisdiction has a process to recruit and train medical volunteers for provision of care and vaccine administration during a public health emergency.

☐ 25. My jurisdiction has identified alternate facilities where overflow cases from hospitals and well persons needing quarantine away from home can be cared for and has developed processes with Emergency Medical Services to assess, communicate, and direct patients to available beds.

☐ 26. My jurisdiction has identified facilities for outpatient and inpatient care of children with SARS and their families.

☐ 27. My jurisdiction's epidemic plan addresses the mechanics of how isolation and quarantine will be carried out, such as providing support services for people who are isolated or quarantined to their homes or temporary infirmary facilities and protection for workers providing these services.

☐ 28. My jurisdiction has a plan for ensuring that appropriate personal protective equipment, including N-95 or higher level respirators, is made available for persons whose job requires exposure to people with SARS, and that needed training and fit-testing are provided.

☐ 29. My jurisdiction has a plan for dealing with mass mortality, including transportation and burial of bodies.

☐ 30. My jurisdiction has a plan for providing mental health services to mitigate the impact of a SARS epidemic.

COMMUNICATIONS AND EDUCATION

☐ 31. I have conveyed the importance of epidemic preparedness, and its overlap with bioterrorism preparedness, to my jurisdiction's chief executive and to other state and local law and policy makers.

☐ 32. I know personally the key individuals from public health agencies, the medical community, and the political community with whom I will need to communicate during an epidemic.

☐ 33. My jurisdiction has begun educating the public on epidemic SARS to instill acceptance of the epidemic response (including quarantine and isolation) and to optimize public assistance during an epidemic.

☐ 34. My jurisdiction has opened a regular channel of communication and begun educating health care providers (including first responders) and their organizations and unions on epidemic SARS (including diagnosis, treatment, and management of cases and contacts to prevent transmission).

☐ 35. My jurisdiction has opened a regular channel of communication and begun educating chief executive officers of health care organizations on epidemic SARS (including management of patients in health care settings, health care worker protection, physical facility needs, voluntary or forced furloughs of exposed workers, etc.).

☐ 36. My jurisdiction has established a multi-component communications network and plan for sharing of timely and accurate information among public health and other officials, medical providers, first responders, the media and the general public.

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Source: National Association of County and City Health Officials

☐ 37. My jurisdiction has begun identifying and planning to produce and provide education and information materials for media, providers, the public, and occupational groups whose duties may expose them to SARS, in appropriate languages and in forms suitable for limited literacy populations.

☐ 38. Whoever is selected as the primary public spokesperson for my jurisdiction during an epidemic is ready to clearly and consistently answer the following types of questions:

- ☐ How is the SARS-associated coronavirus (SARS-CoV) transmitted?
- ☐ How long are people infectious after they have SARS?
- ☐ What is isolation? What is quarantine?
- ☐ What is the justification for isolation of cases and quarantine of contacts?
- ☐ What is the legal authority for isolation of cases and quarantine of contacts?
- ☐ What is the difference between a probable and a suspected SARS case?
- ☐ Who should be tested for the SARS-associated coronavirus?
- ☐ What can members of the public do to protect themselves?
- ☐ In the event a vaccine or antiviral treatment become available, what specific priority groups might be vaccinated or treated first?

☐ 39. My jurisdiction has identified the most effective media to get messages out to the public during an epidemic (e.g., TV, radio, print media, internet, Web sites, hotlines).

☐ 40. My jurisdiction has planned how to coordinate state, local, and federal public messages and ensure they are consistent and timely.

LABORATORY AND SURVEILLANCE

☐ 41. In the event of a SARS epidemic, I will have available daily counts of key community health indicators, such as numbers of emergency department visits, hospital admissions, deaths, available hospital beds and staff, facility closings, numbers of contacts being traced and numbers under quarantine.

☐ 42. The public health laboratory that serves my jurisdiction can test for the SARS-associated coronavirus by serology and/or PCR.

☐ 43. My state has identified those labs that can test for the SARS-associated coronavirus.

☐ 44. The public health laboratory that serves my jurisdiction has linked to clinical laboratories and provided training on the use of SARS tests, biosafety, specimen collection, packing and shipping, and rule-out testing.

☐ 45. Public health laboratories in my state have computerized record-keeping to help with data transmission, tracking, reporting of results to patients and facilities, and analysis during an epidemic.

☐ 46. My jurisdiction has determined how to assess and document the spread and impact of disease throughout the population, including special populations at risk (such as health care workers and first responders), during a SARS epidemic, including enhancements to routine surveillance.

☐ 47. My jurisdiction has computerized record-keeping for cases, suspected cases, contacts, and persons under public health isolation or quarantine orders to help with data transmission, tracking and analysis during an epidemic.

Source: National Association of County and City Health Officials

☐ 48. My jurisdiction's epidemiology staff, in cooperation with other public health agencies, has the capacity to investigate clusters of SARS cases, to determine how disease is being transmitted, to trace and monitor contacts, to implement and monitor quarantine measures, and to determine whether control measures are working.

☐ 49. My jurisdiction has plans for educating health care providers about recognition and reporting of SARS, about the current case definition, and about sources of current information on all aspects of SARS.

PREPAREDNESS IN OTHER AGENCIES

☐ 50. The emergency response system is ready to deal with epidemic SARS as called for in an all-hazards or epidemic plan.

☐ 51. My jurisdiction has carried out a community-wide epidemic SARS table-top or field exercise, to train on and evaluate its epidemic plan.

☐ 52. Community partners such as hospitals, EMS services, law enforcement agencies, health care practitioners, environmental hygiene/remediation services, news media, schools, and colleges know what part they are expected to play during an epidemic and are prepared to do so.

☐ 53. The law enforcement and court system in this jurisdiction are prepared to enforce isolation and quarantine orders and to promptly adjudicate appeals to public health orders, as provided by statute.

Information about SARS is available from the Centers for Disease Control and Prevention at

www.cdc.gov/ncidod/sars/

Worldwide information about SARS is available from the World Health Organization at

www.who.int/csr/sars/en/

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Source: National Association of County and City Health Officials

VACCINATION / ANTIVIRALS

At present (May, 2003), there is neither a vaccine nor effective antiviral chemotherapy available for SARS. The items below will become relevant when one or both of these become available.

- ☐ V1. My jurisdiction has identified the method(s) of epidemic vaccine and antiviral delivery (i.e., public sector, private sector, or a combination of these two) that will be most efficient for the jurisdiction, and developed and tested methods for mass administration.
- ☐ V2. I know whether my state statutes provide for providing or requiring vaccination or treatment during an infectious disease emergency, and know how to implement them in my jurisdiction to help control an epidemic.
- ☐ V3. My jurisdiction has the infrastructure in place to vaccinate or treat at-risk and hard-to-reach populations during a SARS epidemic.
- ☐ V4. My jurisdiction's epidemic plan outlines a process for identifying essential workers (those people whose jobs/skills are critical for maintenance of public safety and an efficient epidemic response) and "highest risk" groups who will need to receive priority vaccination and/or antiviral prophylaxis.
- ☐ V5. My jurisdiction has developed a documentation process for administered epidemic vaccine and antiviral doses, with recall capacity if more than one dose is required to induce immunity.
- ☐ V6. My jurisdiction has determined how adverse vaccine or medication side effects will be documented, in cooperation with local health agencies, during a mass or targeted vaccination or prophylactic treatment campaign.
- ☐ V7. My jurisdiction has compiled a list of health care workers and institutions that will assist in mass vaccination or prophylactic treatment during an epidemic or other public health emergency.
- ☐ V8. My jurisdiction has identified ways to secure and protect a limited supply of essential medicines, supplies, equipment and vaccines.
- ☐ V9. My jurisdiction has developed and tested, through a simulated exercise, a plan for mass or targeted immunization, prophylactic treatment, and clinical care including: accepting delivery of large quantities of vaccine, drugs, supplies or equipment (e.g., as part of the Strategic National Stockpile); storing and handling vaccine, drugs, supplies or equipment; setting up and staffing clinics; administering vaccine or antiviral drugs; and educating the public, media, and medical providers.

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Source: National Association of County and City Health Officials

Related GAO Products

SARS Outbreak: Improvements to Public Health Capacity are Needed for Responding to Bioterrorism and Emerging Infectious Diseases. GAO-03-769T. Washington, D.C.: May 7, 2003.

Smallpox Vaccination: Implementation of National Program Faces Challenges. GAO-03-578. Washington, D.C.: April 30, 2003.

Infectious Disease Outbreaks: Bioterrorism Preparedness Efforts Have Improved Public Health Response Capacity, but Gaps Remain. GAO-03-654T. Washington, D.C.: April 9, 2003.

Bioterrorism: Preparedness Varied across State and Local Jurisdictions. GAO-03-373. Washington, D.C.: April 7, 2003.

Hospital Emergency Departments: Crowded Conditions Vary among Hospitals and Communities. GAO-03-460. Washington, D.C.: March 14, 2003.

Homeland Security: New Department Could Improve Coordination but Transferring Control of Certain Public Health Programs Raises Concerns. GAO-02-954T. Washington, D.C.: July 16, 2002.

Homeland Security: New Department Could Improve Biomedical R&D Coordination but May Disrupt Dual-Purpose Efforts. GAO-02-924T. Washington, D.C.: July 9, 2002.

Homeland Security: New Department Could Improve Coordination but May Complicate Priority Setting. GAO-02-893T. Washington, D.C.: June 28, 2002.

Homeland Security: New Department Could Improve Coordination but May Complicate Public Health Priority Setting. GAO-02-883T. Washington, D.C.: June 25, 2002.

Bioterrorism: The Centers for Disease Control and Prevention's Role in Public Health Protection. GAO-02-235T. Washington, D.C.: November 15, 2001.

Bioterrorism: Review of Public Health Preparedness Programs. GAO-02-149T. Washington, D.C.: October 10, 2001.

Bioterrorism: Public Health and Medical Preparedness. GAO-02-141T. Washington, D.C.: October 9, 2001.

Bioterrorism: Coordination and Preparedness. GAO-02-129T. Washington, D.C.: October 5, 2001.

Bioterrorism: Federal Research and Preparedness Activities. GAO-01-915. Washington, D.C.: September 28, 2001.

West Nile Virus Outbreak: Lessons for Public Health Preparedness. GAO/HEHS-00-180. Washington, D.C.: September 11, 2000.

Combating Terrorism: Need for Comprehensive Threat and Risk Assessments of Chemical and Biological Attacks. GAO/NSIAD-99-163. Washington, D.C.: September 14, 1999.

Combating Terrorism: Observations on Biological Terrorism and Public Health Initiatives. GAO/T-NSIAD-99-112. Washington, D.C.: March 16, 1999.

Testimony
Before the Permanent Subcommittee on Investigations
Committee on Governmental Affairs
United States Senate

CDC Preparedness Planning for Severe Acute Respiratory Syndrome (SARS)

Statement of
James M. Hughes, M.D.
Director
National Center for Infectious Diseases
Centers for Disease Control and Prevention
Department of Health and Human Services

For Release on Delivery
Expected at 9:00 AM
on Wednesday, July 30, 2003

Good morning, Mr. Chairman and Members of the Committee. I am Dr. James M. Hughes, Director, National Center for Infectious Diseases, Centers for Disease Control and Prevention (CDC). Thank you for the invitation to participate today in this timely hearing on a critical public health issue: severe acute respiratory syndrome (SARS). I will update you on the status of the spread of this emerging global microbial threat, on CDC's response in collaboration with the World Health Organization (WHO) and other domestic and international partners, and on CDC's activities to prepare our nation for potential future epidemics of SARS.

As we have seen recently, infectious diseases are a continuing threat to our nation's health. Although some diseases have been conquered by modern advances, such as antibiotics and vaccines, new ones are constantly emerging, such as West Nile encephalitis, vancomycin-resistant *Staphylococcus aureus* (VRSA) infection, hantavirus pulmonary syndrome, and monkeypox. SARS is a dramatic reminder that we must always be prepared for the unexpected. SARS also indicates that infectious diseases know no boundaries and that fulfilling CDC's domestic mission–to protect the health of the U.S. population–requires global awareness and collaboration with domestic and international partners to prevent the emergence and spread of infectious diseases.

A Global Outbreak

In early 2003, cases of severe atypical pneumonia of unknown etiology began to be reported from several countries in Asia. This new disease, designated SARS by WHO, spread globally in a matter of weeks, infecting primarily health care workers and other close contacts of index patients but also resulting in community transmission in several areas. As of its latest update of July 11, WHO has received reports of more than 8,000 cases and 800 deaths among individuals from nearly 30 countries. In addition to its

devastating health impact, the SARS outbreak has also had far-reaching social and economic consequences.

In the United States, the Council of State and Territorial Epidemiologists, in consultation with CDC, recently recommended a change in the U.S. SARS case definition to allow for exclusion of cases whose convalescent serum specimens tested negative for evidence of SARS-associated coronavirus (SARS-CoV) infection. Convalescent serum specimens are those that were collected more than 21 days after illness onset [1]. The recommendation to exclude these cases is based on scientific data which indicate that over 95% of SARS patients mount a detectable antibody response in convalescent serum. With this change, the number of SARS cases in the United States decreased by half: from 344 suspect and 74 probable cases reported on July 15 to 175 suspect cases and 36 probable cases as of July 21. Exclusion of these SARS CoV-negative cases provides a more accurate indication of the magnitude of the epidemic in the United States.

A Global Response

Since late February, CDC has provided assistance to WHO in the investigation of and response to this multi-country outbreak. SARS presents a major challenge, but it also serves as an excellent illustration of the intense spirit of collaboration among the global clinical, scientific, and public health communities to combat a global epidemic. Significant accomplishments to minimize the spread of SARS, including identification of the causative agent, were made in record time. Coordination of international assistance and national responses by WHO provided an opportunity for the United States and

[1] On July 18, 2003, CDC revised the laboratory criteria in the SARS case definition to require that convalescent serum be collected >28 days after symptom onset, instead of >21 days after symptom onset.

other countries to participate in international field teams and teleconferences and to share laboratory findings through the WHO secure laboratory website.

Domestically, CDC's response to the outbreak was coordinated through the new Director's Operations Center, which facilitated widespread participation by diverse individuals throughout the agency. Topic-specific response teams were formed to enable researchers to rapidly obtain, assess, and share large amounts of information about the illness. Rapid dissemination of this information was facilitated through CDC's web site, regular press conferences, and global videoconferences as well as regular communications and teleconferences with state epidemiology and laboratory personnel and with clinicians, virologists, the academic community, and professional organizations and groups, such as the Healthcare Infection Control Practices Advisory Committee. Because of these response efforts, existing collaborations have been strengthened and new ones formed both nationally and globally, including new liaisons with the transportation industry and airline unions. Now that reporting of new cases has slowed, CDC and these global and domestic partners are taking the opportunity to assess lessons learned from the outbreak and response and to develop and enhance response plans for future SARS epidemics.

Preparedness Planning

We do not know if SARS will reappear, but we must assume that it will. Possible sources of the virus include the original animal reservoir or other SARS-infected animals, unrecognized transmission in humans, or persistent infection in humans. Since other respiratory viruses are seasonal, it is possible that SARS may be more likely to reestablish infection and spread during respiratory virus season: fall, winter, and spring. Whether or not SARS returns, there will be a need to have in place a system to

quickly detect an introduction into the United States on the one hand, while considering the importance of not causing unnecessary concerns over non-SARS cases.

In June, more than 1,000 individuals highly involved in the worldwide SARS response attended the WHO Global Conference on SARS to review scientific knowledge and lessons learned and to develop priorities for future action. Recommendations were made in several critical areas including epidemiology for public health, surveillance and response coordination, clinical management and diagnosis, reducing transmission in health-care settings, laboratory and environmental issues, and zoonotic disease research. CDC will play an important role in addressing these recommendations and will also assist WHO in conducting an evaluation of the effectiveness of control measures used by other countries to limit the international and community spread of SARS.

Within the agency, CDC is preparing for the possible return of SARS and the different levels of spread that might be associated with resurgence of SARS. We are fortunate to be able to incorporate the direct experience of CDC staff who served in areas heavily-affected by the SARS epidemic as well as numerous expert international collaborators who successfully battled serious SARS outbreaks in Canada, Vietnam, Singapore, China, Taiwan, and elsewhere. We are developing an after-action plan to assess priority areas for future action. We have established a SARS preparedness task force that includes the following teams: clinical; surveillance; laboratory; special studies; information technology; communication and education; and response and preparedness for community, public health, and healthcare systems. These teams are preparing for the possible return of SARS with active and ongoing consultation and collaboration with other federal partners, state and local health officials, and professional organizations

and societies. The response activities will be adapted to the level of global and local SARS activity and designed to efficiently and quickly detect introduction of SARS into the United States. I will describe in additional detail some of the major issues that the preparedness plan will address and that are particularly germane to the topic of today's hearing.

Infection Control Measures

Transmission of the SARS coronavirus (SARS CoV) in healthcare settings was a major factor in the spread of disease during the global SARS epidemic earlier this year. In those areas where extensive outbreaks occurred, early SARS transmission occurred predominantly within healthcare facilities among healthcare workers, patients, and visitors. For example, 77% of patients identified in the first phase of the outbreak in Toronto acquired SARS in the healthcare setting. The impact of healthcare-associated transmission was magnified by the fact that hospitalized patients, because of their high prevalence of underlying diseases, appeared to be more susceptible to severe illness and death following infection with SARS CoV. In addition, secondary transmission from infected healthcare workers to their close contacts was common, and appears to have contributed to community spread in some countries.

Beginning early in the course of the SARS outbreak, CDC rapidly developed, disseminated, and updated numerous infection control documents providing guidance for preventing SARS CoV transmission in healthcare facilities and other settings. These documents were based on knowledge gained through the clinical, epidemiologic, and laboratory investigations performed by CDC staff and public health and clinical collaborators both in the U.S. and in SARS-affected areas around the world. In addition, expert clinical and infection control consultation, utilizing the Healthcare

Infection Control Practices Advisory Committee, was sought and input incorporated into each document. These guidance documents were updated frequently as new information became available. The information was disseminated through several channels of communication, including CDC's website, *Epi-X* communications, Health Alert Notices, rapid publications in the *Morbidity and Mortality Weekly Report*, press conferences, webcasts targeted toward clinicians and public health officials, regular telephone conferences with clinician groups and state and local health departments, and regular communication and collaborative work with WHO and other governmental health agencies.

Although CDC's infection control guidance served the needs of the United States healthcare system well during the course of the outbreak, the United States was fortunate in having only a very limited number of cases and no significant clusters of person-to-person transmission domestically. Our infection control guidance must be comprehensive and address the possibility of more extensive domestic transmission of SARS CoV in the future.

To this end, the contingency plan will provide guidance for the healthcare system and for state and local health agencies that will allow for a varying intensity of response based upon the level of SARS CoV activity within an individual healthcare facility and within the surrounding community. In the absence of any recognized SARS activity, the recommendations will include specific preparedness measures that will allow healthcare facilities to respond rapidly should SARS recur. As the incidence and risk of SARS increases, the level of infection control response will be graded to ensure that vigorous containment measures are effectively instituted. Clearly, SARS containment measures within healthcare facilities interface with community containment measures. The

preparedness plan will fully integrate healthcare-based infection control and community-based prevention and containment strategies, including isolation and quarantine, as needed. Experience with the recent epidemic indicates that these measures are effective in controlling transmission when they are implemented aggressively.

Laboratory

Throughout the response to SARS, CDC laboratory scientists have collaborated closely with colleagues from laboratories in Asia, Europe, and elsewhere to share findings so that they can all learn from each other's work. They have exchanged reagents and sharing specimens and tissues to conduct additional testing. In April 2003–one month into the international SARS response–CDC announced that our laboratorians had sequenced the genome for the coronavirus believed to be the cause of SARS. These results and those from other laboratories confirmed that the SARS coronavirus is a previously unrecognized virus and furthered efforts to develop new and rapid diagnostic tests, antiviral agents and vaccines. These discoveries reflect significant and unprecedented achievements in science, technology, and international collaboration.

CDC will build on these achievements and collaborations, as diagnosis both of SARS and of infections with other respiratory pathogens will be critical to efficiently and rapidly identify introductions of SARS while minimizing unnecessary concerns and social and work disruptions. CDC is refining our existing SARS diagnostics and working with commercial, academic and federal partners to develop better, rapid, and reliable diagnostics. This is particularly crucial to be able to confirm SARS and rapidly rule out other causes of illness. We have also provided diagnostics to public health laboratories and are cooperating with private industry as they develop diagnostics that would be available on a wider scale. Finally, we are characterizing SARS isolates to monitor

changes in the virus that may be associated with alterations in the clinical and epidemiologic features of the virus and that can help monitor transmission patterns.

Containment Measures

CDC routinely works with federal agencies, state and local health departments, travel industry and other organizations to prevent the introduction of communicable diseases into the United States. We are responsible for providing guidance on responses at U.S. borders, including issuance of travel alerts and advisories, distribution of health alert notices, response to arriving ill travelers, notification and follow-up of potentially exposed passengers on public conveyances, and arrival and departure restrictions on travelers. CDC has eight fully staffed quarantine stations in the United States. Quarantine inspectors serve as important guardians of health at borders and ports of entry into the United States, routinely responding to illness in arriving passengers and ensuring that the appropriate medical or procedural action is taken. During the investigation of and response to the SARS outbreak, CDC, in collaboration with the Department of Homeland Security's Bureau of Customs and Border Protection (BCBP), issued travel advisories to airline passengers traveling to SARS-affected areas and distributed over 2½ million health alert notice cards to airline passengers on over 11,000 flights arriving in the United States from these areas.

As part of CDC's preparedness planning process, state and local public health officials will be provided guidance on the implementation of containment measures in the event of a resurgence of SARS. These will address isolation of cases, tracing and monitoring of contacts, and implementation of individual and community-based quarantine measures. To enhance quarantine stations' capacities, CDC is contracting for field staff assistance to be assigned to the eight Quarantine Stations and their subports. The

guidance will also address essential preparedness activities for isolation and quarantine, including legal authorities, personnel and facility requirements, enforcement plans, and coordination with public and private partners.

In preparation for a potential reemergence of SARS globally and in the United States, CDC is (1) developing a database of emergency contact information for our public health partners, other government agencies, and industry constituents, such as airlines and cruise lines; (2) expanding our list of memoranda of agreement with local healthcare facilities where travelers suspected of having quarantinable diseases can be evaluated and isolated; and (3) collaborating with industry partners to develop mechanisms for obtaining locating information so that travelers who might be infected or exposed to SARS can be notified, isolated, or quarantined promptly.

Communications

Rapid and accurate communications are crucial to ensure a prompt and coordinated response to any infectious disease outbreak. Thus, strengthening linkages and communication among clinicians, emergency rooms, infection control practitioners, hospitals, pharmaceutical companies, and public health personnel has been of paramount importance to CDC for some time.

CDC recognizes the necessity of an informed public in reaching our public health goals, and we continue to expand its communications mission accordingly. During the recent SARS outbreak we consciously broadened our media relations to include a series of scheduled news conferences. These media events expanded upon our established teleconference format to accommodate both distant and on-site media representatives, including the capability for live telecasts. This model proved highly effective and will

likely be employed in any future SARS outbreak. Through CDC's Emergency Communications System, we have the capacity to expand rapidly and efficiently our communications outreach beyond the news media. ECS teams provide tailored, consistent messages to specific constituencies, including state and local public health partners, clinicians groups, and affected communities.

We are also strengthening the communications channels with our international partners, including WHO, which benefits Americans and the global community in that it reduces confusion among travelers and helps people assess personal risk from SARS. Additionally, optimal international communication demonstrates the essential level of collaboration so vital to minimizing the spread of disease and developing the tools to identify, treat, and ultimately prevent it.

Public Health Research

Despite the successes of the SARS response thus far, many questions about the virus and the illness remain unanswered, and much remains to be done. CDC is committed to continuing to help build the scientific base that will ensure that the global public health community is adequately prepared to meet the challenges of SARS and is expanding its SARS research program. This expanded program will complement research supported by the National Institutes of Health (NIH) and help develop the strategies and tools needed to quickly report cases and track global transmission of the virus; interrupt transmission and treat or prevent disease; rapidly detect infection and monitor evolution of the virus; better understand the natural history of SARS to develop more effective prevention and treatment strategies; and adequately and promptly inform public health officials, clinicians and other healthcare workers, policy makers, and the public about SARS and guide appropriate responses to the outbreak.

CDC's research program will also take advantage of ongoing collaborations and cooperation with its partners in other federal agencies, academic institutions, and private industry, providing a bridge between basic science research and public health programs. A broad-based and well coordinated research program is essential for quickly and efficiently controlling SARS and mitigating its global impact. The proposed research agenda will also strengthen the infrastructure and linkages needed to effectively respond to other emerging or reemerging global microbial threats, such as pandemic influenza.

Emerging Global Microbial Threats

Since 1994, CDC has been engaged in a nationwide effort to revitalize national capacity to protect the public from infectious diseases. Progress continues to be made in the areas of disease surveillance and outbreak response; applied research; prevention and control; and infrastructure-building and training. However, SARS provides striking evidence that a disease that emerges or reemerges anywhere in the world can spread far and wide. It is not possible to adequately protect the health of our nation without addressing infectious disease problems that are occurring elsewhere in the world.

In March, the Institute of Medicine (IOM) published a report describing the spectrum of microbial threats to national and global health, factors affecting their emergence or resurgence, and measures needed to address them effectively. The report, *Microbial Threats to Health: Emergence, Detection, and Response*, serves as a successor to the 1992 landmark IOM report *Emerging Infections: Microbial Threats to Health in the United States*, which provided a wake-up call on the risk of infectious diseases to national security and the need to rebuild the nation's public health infrastructure. The recommendations in the 1992 report have served as a framework for CDC's infectious

disease programs for the last decade, both with respect to its goals and targeted issues and populations. Although much progress has been made, especially in the areas of strengthened surveillance and laboratory capacity, much remains to be done. The new report clearly states the need for increased capacity of the United States to detect and respond to national and global microbial threats, both naturally occurring and intentionally inflicted, and provides recommendations for specific public health actions to meet these needs. The emergence of SARS, a previously unrecognized microbial threat, has provided a strong reminder of the threat posed by emerging infectious diseases. Summaries of the new report have been provided to the Subcommittee.

Conclusion

The SARS experience reinforces the importance of global surveillance, to have prompt reporting, and to have this reporting linked to adequate and sophisticated diagnostic laboratory capacity. It underscores the need for strong global public health systems, robust health service infrastructures, and expertise that can be mobilized quickly across national boundaries to mirror disease movements. As CDC develops, disseminates, and implements plans to strengthen the nation's public health capacity to respond to SARS in the future, we will collaborate with state and local health departments, academic centers and other federal agencies, health care providers and health care networks, international organizations, and other partners. A strong and flexible public health infrastructure is the best defense against any disease outbreak.

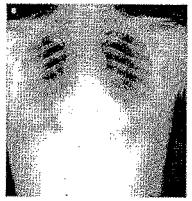
Thank you very much for your attention. I will be happy to answer any questions you may have.

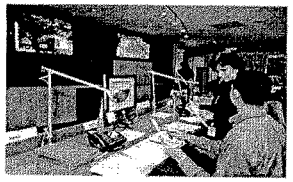
Permanent Subcommittee on Investigations

EXHIBIT #1a

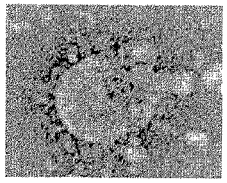
SARS Priority Areas

Early Detection and Prompt Reporting





Testing and Treatment

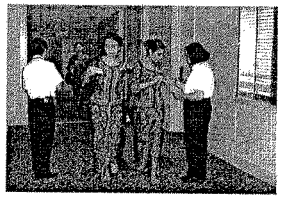


Preventing Transmission

Understanding the Disease

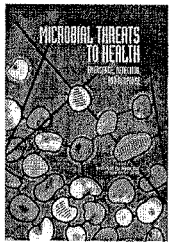
Science July 18, 2003.

Communications



CDC
SARS
Research
Agenda

CDC SARS
Preparedness Planning



Surveillance

Clinical

Laboratory

Special Studies

Information Technology

Communication
and
Education

Preparedness
and
Response

Permanent Subcommittee on Investigations
EXHIBIT #1b

PROTECTING THE NATION'S HEALTH IN AN ERA OF GLOBALIZATION

CDC's Global Infectious Disease Strategy

DEPARTMENT OF HEALTH & HUMAN SERVICES · USA

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DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION

Permanent Subcommittee on Investigations
EXHIBIT #2

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Tommy G. Thompson, *Secretary*

CENTERS FOR DISEASE CONTROL AND PREVENTION
Jeffrey P. Koplan, M.D., M.P.H., *Director*
David Fleming, M.D., *Deputy Director for Science and Public Health*
Stephen B. Blount, M.D., M.P.H., *Director, Office of Global Health*

National Center for Infectious Diseases
James M. Hughes, M.D., *Director*

National Center for HIV, STD, and TB Prevention
Harold Jaffe, M.D., *Acting Director*

National Immunization Program
Walter A. Orenstein, M.D., *Director*

Epidemiology Program Office
Stephen B. Thacker, M.D., M.Sc., *Director*

Public Health Practice Program Office
Edward L. Baker, M.D., M.P.H., *Director*

The following CDC staff members prepared this report.
Scott F. Dowell, M.D., M.P.H., National Center for Infectious Diseases
Alexandra M. Levitt, Ph.D., National Center for Infectious Diseases

With input from the Global Infectious Diseases Strategy Working Group
Jay McAuliffe, M.D., Office of Global Health
Kenneth Castro, M.D., National Center for HIV, STD, and TB Prevention
Eugene McCray, M.D., National Center for HIV, STD, and TB Prevention
Stephen Cochi, M.D., M.P.H., National Immunization Program
Stephen Hadler, M.D., National Immunization Program
Mark White, M.D., Epidemiology Program Office
Michael Malison, M.D., M.P.A., Public Health Practice Program Office

Protecting the Nation's Health in an Era of Globalization: CDC's Global Infectious Disease Strategy

Atlanta, Georgia, 2002

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PREFACE

Since 1994, CDC has been engaged in a nationwide effort to revitalize national capacity to protect the public from infectious disease. Progress continues to be made in the areas of disease surveillance and outbreak response; applied research; prevention and control; and infrastructure-building and training. These efforts are intended to provide protection against endemic diseases like tuberculosis and hepatitis C, as well as against whatever new or drug-resistant diseases arise.

Although safeguarding U.S. health is a domestic goal, its achievement requires international action and cooperation. This is because U.S. health and global health are inextricably linked. As the AIDS epidemic has illustrated, a disease that emerges or reemerges anywhere in the world can spread far and wide. With increased rates of air travel and international trade, infectious microbes have many opportunities to spread across borders, whether carried by businessmen and tourists, by mosquitos that "hitchhike" on airplanes, or by exotic animals imported as pets or livestock. Microbes have additional opportunities for spread on international shipments of fruits, meats, fish, or vegetables.

The international dimension of the effort to combat infectious diseases is reflected in CDC's growing international role. Whenever a new, highly dangerous, drug-resistant, or reemerging disease is detected anywhere on the globe, U.S. citizens, as well as foreign governments, have come to rely on CDC to provide assistance and public health information. Established diseases such as HIV/AIDS, tuberculosis, and malaria, as well as vaccine-preventable diseases such as polio, demand increasing attention and resources as well. This increased international engagement has stimulated CDC to rethink its infectious disease priorities, keeping in mind that it is far more effective to help other countries control or prevent dangerous diseases at their source than try to prevent their importation.

This document, *Protecting the Nation's Health in an Era of Globalization: CDC's Global Infectious Disease Strategy,* represents an important advance in defining CDC's evolving global mission and in considering how CDC and its international partners can work together to improve global capacity for disease surveillance and outbreak response. We look forward to working with our many partners throughout the nation and the world as we put this strategy into practice.

Jeffrey P. Koplan, M.D., M.P.H.
Director
Centers for Disease Control and Prevention

EXECUTIVE SUMMARY

It is not possible to adequately protect the health of our nation without addressing infectious disease problems that occur elsewhere in the world. In an age of expanding air travel and international trade, infectious microbes are transported across borders every day, carried by infected people, animals, and insects, and contained within commercial shipments of contaminated food. "Old" diseases such as malaria, measles, and foodborne illnesses are endemic in many parts of the globe, and new diseases such as acquired immunodeficiency syndrome (AIDS; caused by the human immunodeficiency virus (HIV))—as well as new forms of old diseases such as multidrug-resistant tuberculosis (TB)—can emerge in one region and spread throughout the world.

Moreover, unforeseen disease problems continue to appear. Recent examples include vancomycin-resistant infections of *Staphylococcus aureus* in the United States and Japan, avian influenza in Hong Kong, a new disease called Nipah virus encephalitis in Malaysia, and outbreaks of dengue fever in Texas and West Nile encephalitis in New York. Increased CDC engagement in efforts to improve global disease surveillance and outbreak response will help us detect new or unusual diseases of any kind and respond to health emergencies of any kind—including both naturally occurring and intentionally caused outbreaks.

Left unchecked, today's emerging diseases can become the endemic diseases of tomorrow. This is what happened with HIV/AIDS, which spread from a remote part of Africa to all other continents 20 years ago, and is now entrenched all over the world, necessitating a major international control effort.

Because U.S. and international health are inextricably linked, the fulfillment of CDC's domestic mission—to protect the health of the U.S. population—requires global awareness and strategic thinking. This document, *Protecting the Nation's Health in an Era of Globalization: CDC's Global Infectious Disease Strategy*, describes how CDC and its international partners can collaborate to prevent the emergence and spread of infectious diseases.

U.S. Investment in Global Public Health

The United States must participate more fully in combating infectious disease threats around the world. These efforts will yield multiple benefits:

- **Protecting the health of U.S. citizens at home and abroad.** Controlling disease outbreaks as well as dangerous endemic diseases wherever they occur prevents those diseases from spreading internationally, saving lives and dollars. U.S. citizens cannot be adequately protected from diseases such as measles, HIV/AIDS, and tuberculosis if our public health efforts are restricted to persons residing within our borders.

- **Furthering U.S. humanitarian efforts.** The potential for saving human lives by preventing infectious diseases overseas is tremendous. Every year, an estimated three million infant and child deaths are prevented by vaccination and other preventive health measures. Many families and communities, including refugees and displaced people, also benefit from international investigations that lead to prompt control of outbreaks.
- **Providing diplomatic and economic benefits.** Because health is an area of concern for all nations, international projects that address infectious disease issues can open avenues of communication and ease tensions between the United States and other nations. Improvements in global health will also enhance the U.S. economy and contribute to global prosperity. Reductions in disease burden will promote economic growth in nations that represent growing markets for U.S. products. Investments in global health will also reduce U.S. healthcare costs by decreasing the number of cases of imported diseases and by eradicating diseases currently included in childhood vaccination programs.
- **Enhancing security.** Slowed economic growth fueled by poor health and disease can impede democratic development and political transitions in poor and former communist nations, contributing to military conflicts and humanitarian emergencies. The HIV/AIDS pandemic is already destabilizing poorer nations, damaging their economic, social, political, military, and educational infrastructures, and creating vast numbers of orphans. The recent intentional releases of biologic agents in the United States have also intensified international concerns about bioterrorism. Due to the ease and frequency of modern travel, an intentionally-caused outbreak that begins anywhere in the world can quickly become an international problem. A contagious bioterrorist agent such as smallpox can spread rapidly from person to person and from country to country. A noncontagious agent such as anthrax can be spread by unexpected methods, including international mail. The United States must be prepared to work with other nations to prevent illness and deaths caused by acts of bioterrorism.

Although the United States participates in health projects in many parts of the world, much more can be done, at relatively low cost, with political will, national leadership, and a clearly articulated global strategy.

CDC's Role in Promoting Global Public Health

CDC, which is dedicated to the prevention and control of disease and the promotion of health, works by invitation in many different jurisdictions, including U.S. states and cities and other nations. Throughout its history, CDC has provided international leadership in public health, serving as a technical consultant to the World Health Organization (WHO) and ministries of health on projects that address infectious disease problems related to endemic diseases, wars, famines, or other disasters. Many of these projects have been funded and coordinated by the U.S. Agency for International Development (USAID). CDC has also supported research and public health education on diseases of regional or international importance, provided resources and leadership for the smallpox eradication effort, and established long-term collaborative research partnerships with several developing nations. While considerable effort has been devoted to these international activities, CDC's primary focus has remained on domestic health.

In recent years, however, CDC's overseas role has expanded rapidly. Global polio eradication (http://www.cdc.gov/nip/global) and HIV/AIDS control programs (http://www.cdc.gov/nchstp/od/gap) have led to substantial investments of CDC personnel and financial resources, as have a succession of complex international emergencies. Between 1990 and 2000, CDC provided outbreak assistance on an ad hoc basis to nations in Asia, Africa, Europe, and Latin America to help investigate outbreaks of unknown, highly dangerous, and highly infectious diseases, and provided diagnostic support for hundreds of local investigations around the globe.

Although there are no formal structures and designated resources for international outbreak response, U.S. citizens—as well as foreign governments—have come to rely on CDC to provide outbreak assistance and pub-

lic health information whenever a new or reemerging disease threat is detected anywhere on the globe. Outbreak assistance by CDC would also be required if an intentionally caused outbreak occurred at home or abroad.

CDC's growing presence overseas presents new opportunities and new challenges. This document—developed in consultation with public and private sector partners, at home and abroad—represents an active effort to further define CDC's evolving global mission. It considers how CDC and its international partners can work together over the long term to improve the capacity to detect, control, and prevent infectious diseases. CDC's ongoing efforts to strengthen U.S. domestic public health infrastructure are critical to the success of these international collaborations.

Six Priority Areas

Protecting the Nation's Health in an Era of Globalization: CDC's Global Infectious Disease Strategy defines CDC's global infectious disease priorities in six areas, selected in consultation with global public health partners. In looking towards the future, CDC envisions increased activity and progress in each area:

1. International Outbreak Assistance.
An underlying principle of the global strategy is the recognition that international outbreak assistance is an integral function of CDC. Supporting this function will require augmenting, updating, and strengthening CDC's diagnostic facilities, as well as its capacity for epidemiologic investigation overseas. In the future, CDC must also be prepared, as a matter of routine, to offer follow-up assistance after each acute emergency response. Such follow-up will assist host-country ministries of health to maintain control of new pathogens when an outbreak is over.

2. A Global Approach to Disease Surveillance.
In the years ahead, regional surveillance networks should expand, interact, and evolve into a global "network of networks" that provides early warning of emerging health threats and increased capacity to monitor the effectiveness of public health control measures. CDC will help stimulate this process by providing technical assistance, evaluating regional progress, and working with many partners to strengthen the networks' telecommunications capacities and encourage the use of common software tools and harmonized standards for disease reporting.

3. Applied Research on Diseases of Global Importance.
A research program on diseases that are of global importance, including some that are uncommon in the United States, is a valuable resource, both for humanitarian reasons and because of the dangers represented by some imported diseases. CDC's laboratorians, epidemiologists, and behavioral scientists will maintain an active research program to develop tools to detect, diagnose, predict, and eliminate diseases of global or regional importance. When a new disease threat is reported anywhere in the world, CDC's laboratorians and field investigators will be available to help answer questions about disease transmission, treatment, control, and prevention.

4. Application of Proven Public Health Tools.
There is often a long delay between the development of a new public health tool and its widespread use. CDC will intensify efforts to couple applied research with research on ways to promote the use of newly developed tools for disease control ("implementation research"). CDC will help identify the most effective tools and actively encourage their international use, applying expertise and resources in laboratory research, public health policy, program management, and health communications to overcome scientific, financial, and cultural barriers.

5. Global Initiatives for Disease Control.
CDC will make sustained contributions to global initiatives to reduce the prevalence of HIV/AIDS in young people by 25% and reduce deaths from tuberculosis and malaria by 50% by 2010. CDC will also work with the Global Alliance for Vaccines and Immunization to reduce infant mortality through enhanced delivery and use of new and underutilitzed vaccines against respiratory illnesses and other childhood diseases. CDC and its partners will also consult on future international priorities for disease control, elimination, and eradication efforts—as well on monitoring for antimicrobial resistance and planning for pandemic influenza—and help evaluate progress through the collection and analysis of disease surveillance data.

6. Public Health Training and Capacity Building.
CDC will encourage and support the establishment of International Emerging Infections Programs (IEIPs) in developing countries—centers of excellence that integrate disease surveillance, applied research, prevention, and control activities. The IEIP sites will partner with Field Epidemiology Training Programs (FETPS) and other institutions to strengthen national public health capacity and provide hands-on training in public health. Over time, they may help to strengthen capacity in neighboring countries as well as within the host country.

Implementation of specific objectives in these six areas will help realize CDC's vision of a world in which U.S. citizens and people throughout the world are better protected from infectious diseases.

Partnerships and Implementation

CDC's global infectious disease strategy was prepared by the National Center for Infectious Diseases, in collaboration with other CDC centers and offices, including the Office of Global Health, the National Center for HIV, STD, and TB Prevention, the National Immunization Program, the Epidemiology Program Office, and the Public Health Practice Program Office. Many global health organizations and agencies provided consultation and assistance during its development.

The strategy will be implemented incrementally over the next five years, as funds become available, beginning with the highest priorities for 2001-2002 (Box 1). As CDC carries out this strategy, it will coordinate with foreign governments, international organizations (including WHO, the Joint United Nations Programme on AIDS [UNAIDS], and the United Nations Children's Fund [UNICEF]), other U.S. agencies (including USAID, the National Institutes of Health [NIH], the Food and Drug Administration [FDA], the Department of Defense [DoD], the Department of State, the Department of Veterans Affairs [DVA], the U.S. Department of Agriculture [USDA], the National Oceanic and Atmospheric Administration [NOAA], and the National Aeronautics and Space Agency [NASA]), professional societies, research institutions, and schools of public health, medicine, nursing, and veterinary science. CDC will also participate in international coalitions that support disease eradication efforts and other regional and global health initiatives. These coalitions may include national and local nongovernmental organizations, community-based and faith-based organizations, and communities of color. Other implementation partners will include pharmaceutical and biotechnology companies, non-governmental organizations that address health problems, and development agencies, development banks, foundations, and other organizations that aim to reduce poverty by reducing the incidence of endemic diseases. Website addresses for selected organizations and health publications and reports referred to in this document are provided in Appendix A.

Box 1

Implementation Priorities, 2001-2002

International Outbreak Assistance
Dedicate specific resources—epidemiologic, diagnostic, and logistic—to international outbreak investigations.

A Global Approach to Disease Surveillance
Work with WHO and other partners to provide technical assistance to regional networks in Africa, Asia, and Latin America that can fill gaps in global disease surveillance and become components of a global network of networks.

Applied Research on Diseases of Global Importance
Establish two or more long-term, on-site research collaborations in developing countries to test new strategies for disease control and prevention.

Application of Proven Public Health Tools
Work with a developing-country partner to launch a demonstration project that employs three or more proven public health tools to prevent and control infectious diseases, depending on local priorities.

Global Initiatives for Disease Control
Work with foreign ministries of health and WHO to complete the eradication of polio and guinea worm disease.

Help implement HIV/AIDS control programs on all continents through CDC's Global AIDS Program.

Work with the Roll Back Malaria partnership to help implement and monitor disease control and prevention programs in areas with high rates of transmission.

Work with the Stop TB Initiative to improve global surveillance, prevention, and medical management of TB, including multidrug-resistant TB, in areas with high rates of transmission.

Establish population-based surveillance centers to monitor the impact of vaccine use on diseases targeted by the Global Alliance for Vaccines and Immunization. These surveillance centers may become the nuclei of future International Emerging Infections Program sites.

Public Health Training and Capacity Building
Establish the first International Emerging Infections Program as a partnership among a ministry of health, CDC, a Field Epidemiology Training Program, and one or more local universities or medical research institutes. An initial priority will be to establish training in field epidemiology, applied laboratory science, and public health management.

INTRODUCTION

It is not possible to adequately protect the health of our nation without addressing infectious disease problems that are occurring elsewhere in the world. In an age of expanding air travel and international trade, infectious microbes are transported across borders every day, carried by infected people, animals, and insects (Box 2), and contained within commercial shipments of contaminated food (Box 3). "Old" diseases such as malaria, measles, and foodborne illnesses are endemic in many parts of the globe, and new diseases such as acquired immunodeficiency syndrome (AIDS; caused by the human immunodeficiency virus (HIV))—as well as new forms of old diseases such as multidrug-resistant tuberculosis (TB)—can emerge in one region and spread throughout the world.

Old diseases, as well as new ones, can travel. For example, between July 1999 and January 2000, 56 people in southern Texas fell ill with dengue fever, a mosquitoborne tropical disease endemic to South and Central America and parts of Asia. Seventeen of those people acquired their illness in the United States. In 1999, two Boy Scouts in New York State acquired malaria—eliminated as an endemic disease problem in the United States a half century earlier—from mosquitos at a summer camp in a rural area of Suffolk County. In August and September, 1999, six people in the northeastern United States and a Canadian visiting New York City died from West Nile encephalitis, a viral disease also transmitted by mosquitos. The West Nile virus, which is carried by migratory birds in Asia, Africa, and Europe, had never before been reported in the Western Hemisphere.

These outbreaks present new challenges for U.S. public health agencies at the local, state, and federal levels. They also remind us that millions of people live in tropical areas where mosquitoborne diseases like malaria and dengue are a fact of everyday life.

Because U.S. and international health are inextricably linked, fulfilling CDC's domestic mission—to protect the health of the U.S. population—requires global awareness and strategic thinking. This document, *Protecting the Nation's Health in an Era of Globalization: CDC's Global Infectious Disease Strategy*, describes how CDC and its international partners can collaborate to prevent the emergence and spread of infectious diseases.

The urgency of the situation is illustrated by the emergence of unforeseen disease problems in recent years. These include multidrug-resistant *Streptococcus pneumoniae* throughout the world and vancomycin-resistant *Staphylococcus aureus* in the United States and

Box 2

Infectious Diseases Do Not Recognize Borders

From a public health point of view, domestic and international health are inextricably linked. Examples of disease spread from continent to continent include

- HIV/AIDS—This disease apparently emerged in central Africa in the 1950s or earlier[1] and spread through most of Africa, Asia, Europe, and the Americas during the 1970s and 1980s.

  Because the AIDS virus weakens an individual's immune defenses, an individual with HIV/AIDS may become coinfected with malaria, tuberculosis (TB), or pathogens that cause diarrhea or pneumonia.

- TB—During the 1980s, this age-old scourge, which had been nearly eliminated in the West by antibiotic treatment, reemerged–sometimes in a multidrug-resistant form—in cities around the world, including in the United States. By 2000, approximately 46% of newly identified U.S. TB cases originated in other countries.

  The spread of TB has been hastened by lack of public health surveillance for this disease and by the concurrent HIV/AIDS epidemic.

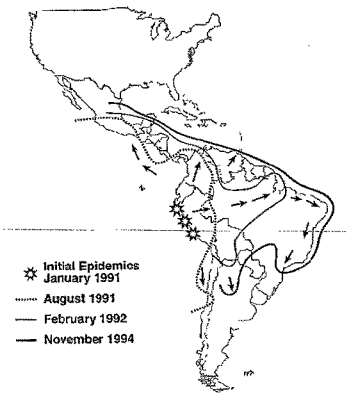
- Malaria—Although malaria was eliminated in the United States as an endemic disease by the 1960s (through swamp-draining and vector control programs), approximately 1,500 cases of malaria are reported in the United States each year. One-half occur in U.S. travelers to malaria-endemic countries and the other half occur among foreign nationals who enter the United States already infected.

  Over the past 15 years, more than 80 people in the United States were infected by local transmission within our borders. In other countries, the spread of malaria has been augmented by the spread of antimalarial drug resistance, and many parasite strains are increasingly resistant to preventive antimalarial drugs taken by travelers.

- West Nile encephalitis—This mosquitoborne viral disease carried by migratory birds in Asia, Africa, and Europe, caused 79 cases of encephalitis and 7 deaths in the northeastern United States in 1999.

  Because the West Nile virus had never before been detected in the Americas—and because it had been mentioned by an Iraqi defector as an organism of interest to the Iraqi bioweapons program—it was speculated that a strain of West Nile virus isolated in New York City might have been deliberately engineered and disseminated to harm U.S. citizens. However, the scientific evidence suggests that the outbreak was caused by a naturally occurring viral strain.[2]

- *Vibrio cholerae* O1, El Tor biotype—A virulent strain of cholera has caused an ongoing pandemic that has lasted 40 years and affected more than 75 countries.



Geographic extent of the Latin American cholera epidemic over time, since its beginning in January 1991. Lines represent the advancing front of the epidemic at different times. Since 1995, most Latin American countries have reported diminishing numbers of cases. Cholera has not yet reached the Caribbean.

Adapted from: Tauxe RV, Mintz ED, Quick RE. Epidemic cholera in the New World: translating field epidemiology into new prevention strategies. Emerging Infectious Diseases 1:141-6, 1995.

Box 2

Beginning in 1961, *Vibrio cholerae* O1, El Tor biotype spread from Indonesia through most of Asia into eastern Europe and Africa. From North Africa it spread to the Iberian Peninsula and into Italy in 1973. In the late 1970s, small outbreaks occurred in Japan and in the South Pacific.

In January, 1991, epidemic cholera appeared in Peru and spread rapidly through most of Latin America, causing over 1,000,000 cases by 1994. This was the first time in 100 years that a cholera pandemic had reached the New World.

- **Salmonellosis**—A multistate outbreak carried by contaminated mangoes grown in Brazil caused 79 cases of *Salmonella* Newport infections in 13 states in 1999.

  The outbreak was detected and investigated using PulseNet, the U.S. early warning system for foodborne diseases (page 36). PulseNet linked 78 cases in 22 states by comparing the molecular fingerprints of the isolates. Once mangoes were implicated as the common exposure for these cases, FDA traced the source of the mangoes back to a single farm in Brazil. The mangoes had been dipped in warm water in a new process designed to kill fruit-fly larvae before exportation. Unfortunately, the processing water may have been contaminated with *Salmonella*.

- **Coccidioidomycosis**—Outbreaks caused by *Coccidioides immitis*, a soil-dwelling fungus common in arid and semiarid parts of the Western Hemisphere, were reported in 1996 in Washington State and in 2000 in Pennsylvania.

  The outbreaks occurred among church mission groups who visited endemic regions of northern Mexico to undertake construction projects. Infected individuals experienced a severe influenzalike disease with fever, chills and cough. Fungal disease was not initially suspected.

- **Influenza spread on cruise ships**—A 1997 outbreak of the A/Sydney strain of influenza occurred among people on a cruise that made stops in Canada and New England.

  The A/Sydney strain had been isolated in Australia too late in the year to be included in the vaccine formulated for the fall/winter flu season in the Northern Hemisphere. Therefore, the cruise ship passengers had not been immunized against it.

- **Measles**—Fifty-six of the 87 cases of measles identified in the United States in 2000 were traced to importations of the virus from outside our borders. Twenty-six were direct importations, 18 were secondary cases, and 8 involved viruses whose DNA sequences suggested a foreign origin.

  Comprehensive surveillance and genetic sequencing of all identified strains of the virus allow for tracing of the outbreak strains to the country of origin. The finding that indigenous measles transmission can be interrupted in the United States is an important impetus for supporting a global measles elimination campaign.

- **Polio**—Eliminated from the Western Hemisphere since 1991, paralytic polio was again identified in Haiti and the Dominican Republic in 2000, and attributed to waning immunization coverage rates in those countries.

  Unless immunization coverage can be strengthened in other neighboring countries, diseases thought no longer to be a risk for U.S. children may be imported by travelers.

Box 3

Factors That Facilitate the International Spread of Foodborne Disease

- **Globalization of the food supply, particularly of perishable foods, like fresh produce**
  U.S. citizens can now eat fresh fruits and vegetables all year round, produced in both Northern and Southern Hemispheres. However, some fresh foods may be contaminated during picking, packaging, transport, or delivery. CDC and FDA are working together to reduce the risk to U.S. consumers.

- **The development of new food production industries in developing nations to meet the needs of the export market**
  This includes growing nonindigenous fruits and vegetables that may be susceptible to contamination by indigenous microbes. For example, raspberries were recently introduced into Guatemala with U.S. support as a potentially valuable commercial crop. Some of the exported raspberries were found to be contaminated with *Cyclospora,* a waterborne protozoan parasite not previously associated with foodborne disease. *Cyclospora* outbreaks associated with these raspberries were reported in the United States and Canada.

- **Centralized processing of human and animal foods, followed by widespread distribution**
  If an ingredient used in an animal feed, for example, is contaminated with a strain of *Salmonella,* that strain can be quickly disseminated to food animals around the world. Or, if ground beef is contaminated with *E. coli* O157:H7 at a factory, hamburgers sold at fast-food restaurants in many locations (as well as packages of frozen meat sold at grocery stores) may transmit infection.

- **Expanded U.S. market for "ethnic" foods**
  There is increased familiarity with—and preferences for—foods from different countries, due to international travel by U.S. citizens, the growing ethnic diversity of our population, and our many immigrant communities. A recent outbreak of typhoid fever was associated with imported frozen mamey fruit pulp, popular among Central Americans living in Florida. Outbreaks of gastroenteritis caused by antibiotic-resistant *Salmonella* have occurred in people who ate traditionally-prepared Mexican cheese made from raw milk and sold informally.

- **Increased international travel**
  International tourists and business travelers often develop "traveler's diarrhea," caused by foodborne bacteria that generally do not affect local adults, most of whom have acquired immunity from repeated childhood exposures.

Japan (Box 4), avian influenza in Hong Kong (Box 5), a new disease called Nipah virus encephalitis identified in Malaysia, as well as the introduction of West Nile encephalitis into North America (Box 2).

Windows of opportunity for disease control may also close. For example, had smallpox not been eradicated before the global HIV/AIDS epidemic, one of the world's crowning public health successes might have been impossible to achieve. There is now evidence that immune suppression such as that caused by HIV/AIDS may lead to a lack of response to smallpox vaccination or (in some cases) to disseminated vaccinia infection that may be life-threatening.

Left unchecked, today's emerging diseases can become the endemic diseases of tomorrow. This is what happened with HIV/AIDS, which emerged in a remote part of Africa during the 1970s, spread throughout the world during the 1980s, and is now entrenched on all continents, creating widespread devastation. During the 2000s, HIV/AIDS has become the target of a major international control effort (Box 6).

Box 4

International Spread of Antimicrobial Resistance

Drug-resistant pathogens are a growing menace to all people, regardless of age, sex, or socioeconomic background. They endanger people in affluent, industrial societies like the United States, as well as those in less developed nations. Many pathogens of international importance are becoming resistant to standard therapies, including bacteria that cause pneumonia, ear infections, and meningitis (e.g., *Streptococcus pneumoniae*); food and waterborne infections (e.g., *Salmonella* and *Shigella*); sexually transmitted diseases (e.g., *Neisseria gonorrhoeae*); the human immunodeficiency virus that causes AIDS; and the parasites that cause malaria (*Plasmodium* spp.). Other examples of clinically important microbes that are rapidly developing drug-resistance include *Mycobacterium tuberculosis;* bacteria that cause skin, bone, lung, and bloodstream infections (e.g., *Staphylococcus aureus*) and urinary tract infections (e.g., *Escherichia coli*); and pathogens transmitted in health care settings (e.g., enterococci and *Klebsiella*).

CDC is working with many partners to help improve global capacity to detect and control drug-resistant infections. These efforts include working with WHO to provide quality control and proficiency testing for clinical laboratories in support of surveillance for emerging resistance problems. CDC is also working with FDA, NIH, USAID, DoD, USDA, and other U.S. agencies to develop Part II of the U.S. Public Health Action Plan to Combat Antimicrobial Resistance (http://www.cdc.gov/drugresistance/actionplan), which will serve as a blueprint for U.S. government activities to address international antimicrobial resistance issues. U.S. agencies and their partners will implement this blueprint in the context of WHO's *Global Strategy for the Containment of Antimicrobial Resistance* (http://www.who.int/emc/globalstrategy/strategy.html).

International Cooperation To Combat Infectious Diseases

The United States must participate more fully in combating infectious disease threats around the world. The urgency of expanding our contributions to infectious disease control was emphasized by an interagency working group of the National Science and Technology Council[3] (http://www.ostp.gov/CISET/html/toc.html).

There has also been an outpouring of interest in infectious disease issues in other nations, both in the developed and the developing world (Appendix B). In July 2000, at the summit meeting in Okinawa the Group of Eight Industrialized Nations pledged to reduce deaths from infectious diseases in poor countries, agreeing to a set of time-limited objectives (http://usinfo.state.gov/topical/econ/group8/summit00). The aim is to reduce the prevalence of HIV/AIDS among young people by 25%, and reduce the number of deaths due to TB and to malaria by 50% by 2010. These goals are based on global health initiatives endorsed by the World Health Organization (WHO) in its effort to address "diseases of poverty" in developing countries (Box 6). Another major initiative, spearheaded by the Global Alliance for Vaccines and Immunization (GAVI; http://www.vaccinealliance.org/), aims to increase developing country access to new and underutilitzed vaccines against hepatitis B, *Haemophilus influenzae* type b, and yellow fever, and to improve delivery of traditional childhood vaccines against measles and other diseases.

Box 5

Avian Influenza in Hong Kong

Influenza viruses are constantly mutating and evolving, and new strains keep emerging. Because few people have immunity to a new strain—and because influenza spreads easily from person to person—new strains can travel quickly around the world. If a strain is particularly virulent, it may cause a pandemic, like the 1918-19 "Spanish flu," which killed 20 million people, including 500,000 Americans.

The WHO International Influenza Surveillance Network, which includes 110 laboratories throughout the world (including a CDC-based WHO Collaborating Centre), gathers influenza isolates on all continents and collects data on new strains that have the potential for pandemic spread. In 1997, the government of Hong Kong made use of this network to identify a dangerous strain of avian influenza transmitted from chickens to humans that infected 18 persons and killed 6. The authorities feared that the strain (H5N1) might recombine with a human strain and become capable of human-to-human transmission and invited a CDC team to assist with control of the outbreak. Transmission stopped after the government of Hong Kong ordered the destruction of all chickens in Hong Kong that might be carrying the virus (see also Box 15).

This episode suggests that it may be possible to prevent influenza pandemics before they begin, or to mitigate the global impact of an influenza pandemic through early identification of a virulent strain and formulation of a strain-specific vaccine. What is required is continued international vigilance and cooperation (i.e., a global network) and—at the national level—the political will and resources to act on epidemiological and diagnostic evidence. Had the WHO network not been in place, or had the Hong Kong government been unable or unwilling to act, a virulent hybrid chicken/human strain of influenza for which virtually all people lack immunity—and for which there is no vaccine and few drug treatments—might have caused a massive global pandemic.

Our confidence that nations can come together to improve global health is reinforced by the success of the effort to eradicate smallpox, the interruption of measles transmission in the Americas, and the substantial progress made toward the worldwide eradication of polio (Box 7) and guinea worm disease.

U.S. Investment in Global Public Health

Promoting international cooperation to address emerging infectious diseases is a natural role for the United States, whose scientists and business leaders are important members of the biomedical research and telecommunications communities that provide the technical and scientific underpinning for infectious disease surveillance and control. The United States can continue to lead from its strengths in medical science and technology to help protect American and global health.

Moreover, our nation now has a window of opportunity to make public health investments that will pay increasingly valuable dividends in the years to come. As noted in the 1997 Institute of Medicine report, *America's Vital Interest in Global Health*[4] (http://www.nap.edu/books/0309058341/html), investments in international efforts to detect, control, and prevent infectious diseases can yield multiple benefits:

Box 6

Global Health Initiatives

Four major global health initiatives were launched between 1998 and 2000:

- **Roll Back Malaria,** a global strategy to reduce deaths from malaria by increasing access to prompt and effective treatment (including protective intermittent therapy for pregnant women) and prevention tools (including insecticide-treated bednets); by facilitating rapid response to malaria outbreaks; and by developing new products for the prevention and treatment of malaria.
- **Stop TB,** a global strategy to stop the spread of TB around the world. One of its objectives is to promote implementation of the directly observed therapy short-course strategy (DOTS). The effective implementation of DOT in NYC, in response to the epidemic in the late 1980s and early 1990s, has served as a model in this country and around the world.
- **International Partnership Against AIDS in Africa,** a UNAIDS-led effort to mitigate the effects of the growing HIV/AIDS epidemic. In 1999, as part of this effort, the U.S. government launched the Leadership and Investment for Fighting an Epidemic (LIFE) Initiative, which provides support to the hardest-hit countries for reducing HIV transmission, improving treatment of HIV/AIDS and opportunistic infections, and strengthening national capacities to collect disease surveillance data and manage national HIV/AIDS programs. The Global AIDS Program is the CDC component of the LIFE Initiative (see Box 21).
- **Global Alliance for Vaccines and Immunization** (GAVI), a global effort to strengthen childhood immunization programs and bring a new generation of recently licensed vaccines into use in developing countries. These include vaccines against hepatitis B, childhood meningitis, yellow fever, and respiratory infections, which are the leading cause of death in children under age five. Substantial resources for this purpose have been pledged by the Bill and Melinda Gates Foundation and the governments of Norway, Netherlands and the United States.

Targets for Disease Reduction

These targets for disease reduction were endorsed at the Group of Eight Industrialized Nations Summit in Okinawa in July 2000:

HIV/AIDS:	25% reduction in prevalence in young people by 2010
TB:	50% reduction in deaths by 2010
Malaria:	50% reduction in deaths by 2010

Box 7

The World Health Organization Global Polio Laboratory Network

Ascertaining whether a disease is still present in a given area (and, therefore, that further prevention efforts are needed) is a critical part of any disease eradication effort. The WHO Global Polio Laboratory Network uses molecular techniques to determine whether wild-type polio is circulating in areas undergoing eradication efforts. Since the worldwide campaign began, cases of polio have declined by 99% (from 350,000 cases to less than 3,000), and the number of countries in which polio is endemic has decreased from 125 to 20.

CDC began training Network virologists in 1986, soon after the Pan American Health Organization declared its goal of eliminating polio from the Americas. CDC will continue to train Network virologists for several more years, as new diagnostic methods are developed to meet the stringent surveillance criteria necessary to obtain certification of global polio eradication.

Protecting the health of U.S. citizens at home and abroad. Seeking to control disease outbreaks as well as dangerous endemic diseases wherever they occur prevents those diseases from spreading internationally, saving lives and dollars. In addition, CDC's support for outbreak investigations provides U.S. scientists with opportunities to focus on new or drug-resistant pathogens and consider how best to control, prevent, and treat them before they arrive on our shores. Outbreaks and endemic diseases in other countries also endanger U.S. travelers abroad.

In terms of U.S. health, it is far more effective to help other countries control or prevent dangerous diseases than try to prevent their importation, because it is neither efficient nor feasi-

ble to examine each person who enters or returns to the United States for evidence of infection, or to examine all imported goods for evidence of contamination. Some infections are asymptomatic, and some infected individuals may enter the country during the incubation period of a disease (the time between infection and the appearance of symptoms). Thus, diseases such as measles and TB continue to be imported.

Furthering U.S. humanitarian efforts. Disease prevention is an investment in the young people of the world and in our collective future. Every year, millions of infant and child deaths are prevented by vaccination and other preventive health measures. Many families and communities also benefit from international investigations that lead to prompt control of outbreaks. These include communities of refugees and displaced persons, who may be especially vulnerable to infectious diseases (see Box 13). CDC is also a major contributor to global efforts to eradicate polio (http://www.cdc.gov/nip/global) and dracunculiasis (guinea worm disease; http://www.cdc.gov/ncidod/dpd/parasites/guineaworm and http://www.cartercenter.org/guineaworm.html).

The potential for saving human lives by preventing infectious diseases overseas is tremendous. For example, an additional three million deaths could be prevented annually by wider worldwide use of childhood vaccines. Although the United States participates in international health projects in many parts of the world, much more can be done, at relatively low cost, with political will, national leadership, and a clearly articulated global strategy.

Investing in global health is an area in which global humanitarian needs and U.S. national interests coincide. For example, U.S. efforts to help the states of the former Soviet Union rebuild their collapsing public health infrastructures[5] will also help prevent the resurgence of dangerous diseases (e.g., polio, diphtheria, and drug-resistant TB) that can spread to the Americas. Similarly, U.S. efforts to help China improve surveillance for new strains of influenza may be crucial in preventing or controlling the next influenza pandemic (see Box 5).

Providing economic and diplomatic benefits. Improvements in global health can also enhance the U.S. economy in direct and indirect ways. Domestic health care costs can be reduced by decreasing the number of cases of imported diseases and by eradicating diseases currently included in childhood vaccination programs. For example, the U.S. saved $3 billion after investing $32 million in smallpox eradication, and promises to gain even greater cost savings if the global polio eradication effort is successful. Moreover, a reduction in the infectious disease burden in other countries helps improve the economic well-being of developing nations, which represent the fastest growing markets for U.S. products.

Organizations concerned with economic development, including the World Bank and the World Trade Organization (www.worldbank.org and www.who.int.inf-pr-2000/en/note2000-wha02.html), have concluded that disease reduction efforts are a necessary part of global development strategies (Box 8). Infectious diseases can sap the strength of a nation's workforce and deplete its medical resources, making it more difficult to participate in the global economy. Promoting political stability and sustainable development in developing nations is a major goal of U.S. foreign policy.

Because health is an area of concern for all nations, international projects that address infectious disease issues can open avenues of communication and ease tensions between the United States and other nations (Box 9). Investments in global health can also help advance specific U.S. foreign policy objectives, such as improving bilateral relationships with Vietnam, China, and the Palestinian Territories, and converting biological weapons plants in the Russian Federation and the newly independent states of the former Soviet Union to peaceful uses.

Enhancing security. Security experts, including members of the U.S. National Intelligence Council[6] (http://www.cia.gov/cia/publications/nie/report/nie99-17d.html) are concerned that large outbreaks like the HIV/AIDS pandemic may destabilize poorer nations. Slowed economic growth fueled by poor health and disease in developing and former communist countries may challenge democratic development and political transitions and contribute to

Box 8

Infectious Diseases and Economic Development

Infectious diseases like malaria and HIV/AIDS act as a massive societal brake, slowing both economic and human development.

Each year, malaria slows economic growth in several sub-Saharan African countries by as much as 1.3% per person per year.[7] Besides interfering with individuals' abilities to earn a living or attend school, malaria affects national economies by impeding trade, foreign investment, and commerce. It also interferes with children's mental and physical development and may encourage population growth when parents decide to have bigger families, knowing that some of their children may die young. According to one estimate,[8] if malaria had been eliminated 35 years ago, Africa's current annual gross domestic product would be $400 billion, rather than $300 billion—a loss that is nearly five times greater than all development aid provided to Africa last year.

According to a World Bank report,[9] HIV/AIDS may subtract an additional 1% a year from GDP growth in some sub-Saharan African countries, due to the continuing loss of skilled and unskilled workers in the prime of life. In South Africa, for example, HIV/AIDS may depress GDP by as much as 17% over the next decade, which is a dangerous burden for a young democracy. The HIV/AIDS pandemic is destabilizing several other hard-hit nations, damaging their economic, social, political, military, and educational infrastructures, and creating vast numbers of orphans.

humanitarian emergencies and military conflicts.

The recent intentional releases of biologic agents in the United States have also intensified international concerns about bioterrorism. Due to the ease and frequency of modern travel, an intentionally-caused outbreak that begins anywhere in the world can quickly become an international problem. A contagious bioterrorist agent such as smallpox can spread rapidly from person to person and from country to country. A noncontagious agent such as anthrax can be spread by unexpected methods, including international mail. The United States must be prepared to work with other nations to prevent illness and deaths caused by acts of bioterrorism.

CDC's Role in Promoting Global Public Health

As its name implies, CDC is dedicated to the control and prevention of disease. The agency grew out of efforts to control malaria in the southern United States and today retains a critical role in addressing domestic infectious disease threats. CDC is known in the United States for

- Working with state and local public health agencies to conduct disease surveillance
- Providing national leadership in times of public health crisis

Box 9

International Disease Control Efforts Can Create New Alliances

Mutual interest in addressing an outbreak or an ongoing infectious disease problem may provide the impetus for collaborations with countries who have not historically cooperated with the United States on public health projects, or with countries whose relationship to the United States is uncertain. One example is Hong Kong during the transfer of sovereignty from the United Kingdom to China (see Box 5).

At times, concern about disease outbreaks may be sufficiently strong to allow national antagonisms to be set aside in the interests of disease control. During the outbreak of Marburg hemorrhagic fever in 1998, for example, an international investigative team was permitted to enter a contested part of the Democratic Republic of the Congo. Similarly, an international guinea worm eradication team sponsored by the Carter Center received safe passage in southern Sudan in 1995, due to a specially negotiated cease-fire between the government of Sudan and rebel forces. Moreover, a polio eradication team was allowed to operate in civil war–torn Sri Lanka during 2 "Days of Peace for National Immunization" that were separated by 30 days of warfare. Three decades earlier, during the height of the Cold War, the United States and the Soviet Union agreed on the need to provide coordinated financial and technical support to the smallpox eradication effort.

- Diagnosing rare, highly dangerous, and previously unknown diseases
- Responding rapidly to requests for outbreak assistance
- Researching public health issues and translating the findings into practical tools for disease control and prevention
- Using surveillance data to drive public health action and inform strategic planning
- Integrating epidemiologic and laboratory expertise to address infectious disease problems
- Implementing programs for disease prevention and control
- Training public health workers

CDC works by invitation in many different jurisdictions, including U.S. states and cities and other nations. Throughout its history, CDC has also provided international leadership in public health, serving as a technical consultant to WHO and ministries of health on projects that address infectious disease problems related to endemic diseases, wars, famines, or other disasters. Many of these projects were funded and coordinated by the U.S. Agency for International Development (USAID). Through the Field Epidemiology Training Programs (see Box 24), the Epidemic Intelligence Service (http://www.cdc.gov/epo/dapht/eis), and other programs, CDC has

also supported research and public health education on diseases of regional or international importance. CDC helped lead the smallpox eradication effort in the 1960s, and established collaborative research stations (see Box 10) in Côte d'Ivoire, Guatemala, and Kenya in the 1980s and in Guinea, Botswana, Thailand, and Uganda in the 1990s. Although considerable effort has been devoted to these international activities, CDC's primary focus has remained on domestic health.

An evolving mission. In recent years, CDC's overseas role has expanded rapidly. Global polio eradication and HIV/AIDS control programs have led to substantial investments of CDC personnel and financial resources, as have a succession of complex international emergencies. Between 1990 and 2000, CDC provided rapid response teams to nations in Asia, Africa, Europe, and Latin America to help investigate outbreaks of unknown, highly dangerous, and highly infectious diseases (Appendix C), and provided diagnostic support for hundreds of local investigations around the globe. Some of these investigations involved epidemic diseases and others involved diseases that afflict refugees and other displaced persons. In many cases, CDC epidemiologists served as members of WHO-coordinated investigative teams supported by CDC-based WHO Collaborating Centre laboratories (Appendix D). In addition to helping with outbreak control, CDC provides on-going public health consultation by placing resident advisors and assignees with key partner agencies and by working with coalitions of national groups on emerging infectious disease issues.

CDC's growing presence overseas presents new opportunities and new challenges. This document, *Protecting the Nation's Health in an Era of Globalization: CDC's Global Infectious Disease Strategy,* represents an active effort to further define CDC's evolving global mission. It was developed in consultation with public and private sector partners at home and abroad. It considers how CDC and its international partners can work together over the long-term to improve capacity to detect, control, and prevent infectious diseases. This document builds on two ongoing efforts. First, it augments and amplifies the international component of the 1998 CDC plan *Preventing Emerging Infectious Diseases: A Strategy for the 21st Century*[10] (http://www.cdc.gov/ncidod/emergplan). CDC's ongoing efforts to strengthen U.S. domestic public health infrastructure are critical to the success of our international collaborations. Second, it fits within the larger framework of CDC's efforts to improve international health, as described in *Working with Partners To Improve Global Health: A Strategy for CDC and ATSDR*[11] (http://www.cdc.gov/ogh/pub/strategy.htm).

Box 10

Examples of CDC's Long-term Research Collaborations Overseas

CDC manages research collaborations (sometimes referred to as "field stations") in Côte d'Ivoire, Guatemala, Uganda, Guinea, Kenya, Botswana, and Thailand, and is establishing long-term collaborative projects that may form the basis for a permanent center in Vietnam. In general, CDC provides core funding for the field stations, and USAID and other donors provide additional support for both core activities and special projects.

The field station in Kenya is a collaborative effort between CDC and the Kenya Medical Research Institute (KEMRI). Most of the research takes place in western Kenya, in an area of intense, year-round malaria transmission and high incidence of HIV/AIDS. Major studies have

- Demonstrated that presumptive malaria treatment of pregnant women decreases the number of low birthweight babies born.
- Demonstrated that use of insecticide-impregnated bednets reduces mortality among children less than 2 years of age in areas of high transmission.
- Provided critical information about the immune response to malaria that is being used to design vaccines.

The field station is also studying the impact of coinfection with HIV and malaria, particularly in pregnancy. Other ongoing activities concern the development of immunity to vaccines among HIV-positive children, defining local spectrum of diarrheal diseases and antimicrobial resistance among diarrheal pathogens, and addressing the consequences of coinfection with HIV and schistosomiasis.

The field station in Guatemala–the Medical Entomology Research and Training Unit/Guatemala, or MERTU/G, is integrated into the Universidad del Valle and works closely with the Guatemalan Ministry of Health. MERTU/G has helped evaluate national prevention and control efforts related to malaria and onchocerchiasis. Research on leishmaniasis has led to improved clinical treatment regimens, and research on foodborne and waterborne diseases such as cholera has led to improved prevention methods. To reduce deaths due to Chagas disease—a significant health problem in Guatemala—the Guatemalan Ministry of Health and MERTU/G are conducting nationwide surveys to determine prevalence and risk factors; supporting field and molecular studies of the triatomine insect that carries the disease; and evaluating blood bank practices that may contribute to transmission through blood transfusions.

Future Directions: Capacity Building

The field stations have provided valuable opportunities for CDC scientists to participate in long-term, on-site research on selected diseases of importance in developing countries. Expansion of the field stations and strengthened ties with local ministries of health would facilitate additional opportunities to investigate endemic diseases, respond to new or emerging diseases, and provide a stable training center for epidemiologists and laboratory scientists from CDC and the local region. As part of CDC's global strategy, one of the existing field stations may also provide the nucleus of the first International Emerging Infections Program (page 53).

VISION FOR THE FUTURE

This document defines CDC's global infectious disease priorities in six areas, keeping in mind the intimate relationship between international and U.S. health, selected in consultation with global public health partners. In looking towards the future, CDC envisions increased activity and progress in each area:

1 International Outbreak Assistance.
CDC will maintain the capacity to identify and investigate a broad spectrum of human diseases and serve as an internationally recognized resource that helps maintain global awareness of new and emerging threats.

2 A Global Approach to Disease Surveillance.
Regional and disease-specific surveillance and response networks will increase in number and geographical area until they cover all parts of the world and monitor all infectious diseases of regional or global importance. The networks will link up with each other and evolve into a global "network of networks" that provides early warning of new health threats—including drug-resistant diseases—and increased capacity to monitor the effectiveness of public health control measures.

3 Applied Research on Diseases of Global Importance.
CDC's laboratorians, epidemiologists, and behavioral scientists will maintain an active research program to develop tools to detect, diagnose, predict, and eliminate infectious diseases of global or regional importance. When a new disease threat is reported anywhere in the world, CDC's laboratorians and field investigators will be available to help answer questions about disease transmission, treatment, control, and prevention.

4 Application of Proven Public Health Tools.
The worldwide burden of infectious diseases will be significantly reduced as currently available tools with documented efficacy are rapidly disseminated to the most severely affected populations. Research discoveries will be translated into practical treatments, vaccines, diagnostic tests, and disease prevention strategies that are ready for use by ministries of health and public health agencies. CDC's resources will be effectively marshaled to assist its partners in applying these tools in many countries, saving millions of lives.

5 Global Initiatives for Disease Control.
Sustained global efforts will reduce the prevalence of HIV/AIDS in young people by 25% and reduce deaths from TB and malaria by 50% by 2010. Infant mortality will be reduced in the

poorest countries through enhanced delivery and use of vaccines against respiratory illnesses and other childhood diseases. Polio and dracunculiasis will be eradicated worldwide, paving the way for future efforts to eliminate such diseases as measles, lymphatic filariasis, onchocerchiasis, Chagas disease, trachoma, rubella, and hepatitis B.

6 Public Health Training and Capacity Building.
An interconnected group of International Emerging Infectious Disease Programs (IEIPs) will integrate disease surveillance, laboratory studies, and prevention activities, and provide hands-on public health training in disease detection, program management, and outbreak investigation. The IEIP sites will partner with Field Epidemiology Training Programs (FETPS) and other institutions to perform population-based research on transmission of endemic and emerging diseases and conduct emergency surveillance whenever a new threat appears. The long-term goal of the IEIPs will be to develop sustainable, in-country human capacity to participate in national and regional efforts for disease surveillance and outbreak response.

Implementation of specific objectives in these six areas will help realize CDC's vision of a world in which U.S. citizens and all people everywhere are better protected from infectious diseases.

PARTNERSHIPS AND IMPLEMENTATION

This plan was prepared by CDC's National Center for Infectious Diseases, in collaboration with other major CDC centers and programs involved in addressing emerging infectious diseases. These include the Office of Global Health, the National Center for HIV, STD, and TB Prevention, the National Immunization Program, the Epidemiology Program Office, and the Public Health Practice Program Office. CDC has also worked with global organizations and agencies to develop this strategy. Website addresses providing additional information about partner organizations and health publications and reports referred to in this document are provided in Box 2 and throughout the text of the document.

The strategy will be implemented incrementally over the next five years, as funds become available, beginning with the highest priorities for 2001-2002 (Box 1). As CDC carries out this strategy, it will coordinate with foreign governments, international organizations (including WHO, the Joint United Nations Programme on AIDS [UNAIDS], and the United Nations Children's Fund [UNICEF]), other U.S. agencies (including USAID, the National Institutes of Health [NIH], the Food and Drug Administration [FDA], the Department of Defense [DoD], the Department of Veterans Affairs [DVA], the U.S. Department of Agriculture [USDA], the National Oceanic and Atmospheric Administration [NOAA], and the National Aeronautics and Space Agency [NASA]), professional societies, research institutions, and schools of public health, medicine, nursing, and veterinary science.

CDC will also participate in international coalitions that support disease eradication efforts and other regional and global health initiatives. These coalitions may include national and local nongovernmental organization (NGOs; e.g., Rotary International and CARE), community-based and faith-based organizations, and communities of color. In addition, CDC will work closely with groups that conduct or promote regional disease surveillance, such as the Caribbean Epidemiology Center (CAREC), the Asia-Pacific Economic Cooperation (APEC; see also Appendix E), and the Training in Epidemiology and Public Health Interventions Network (TEPHINET).

Other implementation partners include

- Pharmaceutical and biotechnology companies that develop vaccines, drugs, and rapid diagnostic tests
- NGOs that address related health problems (e.g., maternal and child health, environmental health, occupational health, and chronic illnesses)
- Development agencies, development banks, foundations, and other organizations that aim to reduce poverty by reducing the incidence of endemic diseases

As emphasized in *CDC's Working with Partners To Improve Global Health: A Strategy for CDC and ATSDR*[11] (http://www.cdc.gov/ogh/pub/strategy.htm), CDC's collaborative work overseas will be based on five approaches:

- CDC's activities will be rooted in sound science, bioethical principles, and local needs.
- The primary modality for action will be through partnerships with other institutions.
- CDC will work in technical areas in which it has established expertise and capability.
- CDC will pursue long-term bilateral relationships, because of their enhanced productivity.
- CDC will ensure that it has the workforce and administrative mechanisms required for full implementation of the infectious disease strategy.

PRIORITIES AND OBJECTIVES

Priority Area 1: International Outbreak Assistance

When a new, highly dangerous, or reemerging disease is detected anywhere on the globe—whether in a developing or industrialized country, in a close ally or a "nation of concern"—U.S. citizens, as well as foreign governments, often rely on CDC to provide outbreak assistance and public health information. CDC is unusual among public health institutions in its comprehensive capacity to identify a wide range of infectious bacteria, viruses, fungi, parasites, and rickettsia.

In past years, however, maintaining this capacity has not always been a priority. Attempts have been made to cut costs by reducing support for laboratory expertise on diseases that are currently uncommon in the United States, including zoonotic diseases like plague and leptospirosis. However, CDC's repeated experience with outbreaks of diseases once thought to be archaic or obscure—including a 1994 outbreak of plague in India, a 1995 outbreak of a virulent pulmonary form of leptospirosis in Nicaragua, and a 2000 outbreak of leptospirosis in Malaysian Borneo among athletes at an international competition (Box 11)—has underscored the value of having a comprehensive, integrated ability to identify and investigate most human diseases and to recognize new threats. However, gaps remain in CDC's repertoire of diagnostic tools in such areas as diseases caused by prions (e.g., new variant Creutzfeldt-Jakob

Outbreak of Ebola hemorrhagic fever, Uganda, 2000. The isolation ward of Gulu Municipal Hospital, Gulu, Uganda, during an outbreak of Ebola hemorrhagic fever in October 2000. There is no known drug treatment or vaccine for this disease, which is transmitted person-to-person through contact with infected bodily fluids and has a case-fatality ratio of 50–90%.

At the invitation of the Ugandan Ministry of Health, CDC sent several teams of scientists to Gulu to participate in a multinational WHO-coordinated response team. The response team helped bring the epidemic under control by providing assistance and consultation to help rapidly identify cases, provide safe care, and interrupt the spread of the virus.

Photographer: Daniel Bausch, Division of Viral and Rickettsial Diseases, National Center for Infectious Diseases, CDC

Box 11

An Outbreak of Leptopirosis Affecting Athletes from 26 Countries Reported by the GeoSentinel Disease Surveillance System

In September 2000, several athletes returning home from the EcoChallenge-Sabah 2000 multisport expedition race in Malaysian Borneo fell ill with leptospirosis, apparently contracted while swimming in a contaminated river. Leptospirosis causes severe fever, headache, chills, muscle pain, and cramps. Left untreated, it can lead to kidney and liver failure, meningitis, and death.

Three clinics that participate in GeoSentinel, the global surveillance network of the International Society of Travel Medicine (Appendix E), reported a cluster of acute febrile illness among Eco-Challenge racers and helped identity its cause. A clinic in London, England, reported four instances of suspected leptospirosis and queried other GeoSentinel sites for similar cases. Clinics in New York City and Toronto responded with reports of five more cases among the same group of athletes, and all communicated their findings to CDC. Further evaluation indicated that all cases were clinically compatible with leptospirosis.

Leptospirosis is contracted by coming into contact with or swallowing water contaminated with animal urine. During the 12-day Eco-Challenge race, approximately 300 athletes from 26 countries sailed on open ocean and then bicycled and hiked through torrential jungle rain and mud. After that, the racers swam and canoed in a storm-swollen river and waded through caves filled with bat guano. Analysis by CDC suggested that participating in the river swim was significantly associated with illness. At least 44% of the 155 U.S. participants were affected. Additional cases of leptospirosis were identified in athletes from several other countries as well.

disease, the human consequence of infection with bovine spongiform encephalopathy, or "mad cow disease"), and some areas require upgrading to remain effective (e.g., leptospirosis, yellow fever, diphtheria, anthrax, and helminthic diseases).

CDC frequently collaborates on international outbreak investigations conducted in partnership with host nations. CDC participation occurs on an ad hoc basis, in response to requests for assistance from foreign governments or WHO. There is no formal structure for this activity, nor are there designated resources. An underlying principle of the global strategy is the recognition that international outbreak assistance is an integral function of CDC. Supporting this function will require augmenting, updating, and strengthening CDC's diagnostic facilities, including laboratories that participate in the WHO Collaborating Centre network, as well as capacity for epidemiologic investigation overseas, including field logistics and data management.

Outbreak follow-up. In the future, as part of the global strategy, CDC will routinely offer to assist host-country ministries of health and WHO in assessing the public health situation in the aftermath of a major outbreak. If requested, CDC will send a dedicated prevention team to revisit the outbreak site and suggest additional strategies to improve disease surveillance and outbreak response. The team will share clinical and epidemiologic outbreak data with health authorities and work to strengthen local laboratories. The team may also sponsor local workshops or conferences to consider lessons learned from the outbreak, review local hospital resources, and discuss long-term surveillance efforts. These follow-up efforts will help maintain mutually beneficial relationships and research partnerships between CDC, WHO, and local health authorities (Box 12 and Priority Area 2).

Box 12

Follow-up Activities in the Aftermath of the 1994 Plague Outbreak in India

In September, 1994, rumored outbreaks of bubonic and pneumonic plague in western India caused widespread panic and extensive disruptions in international travel and trade. The Indian Ministry of Health authorized an investigation by a WHO international team that included scientists from CDC, the Russian Federation, and by the WHO South East Asia Regional Office. The work of this team was severely compromised by the inability of Indian laboratories to confirm plague cases by using standard diagnostic methods.

The lack of diagnostic capabilities arose because the Indian Ministry of Health, a former world leader in plague vaccines and diagnosis, believing that plague no longer existed in the country, had allowed its laboratory diagnostic infrastructure to deteriorate. At the suggestion of WHO, the government of India invited CDC team members to return to conduct field training exercises with Indian epidemiologists and hold workshops in plague microbiology at India's National Institute for Communicable Diseases (NICD). Later that year, microbiologists from NICD, the All-India Institute of Medical Science, and the Haffkine Institute in Bombay came to CDC's laboratory in Fort Collins, Colorado, as visiting scientists to learn techniques for confirming infection with *Yersinia pestis* (the causative agent of plague), procedures for preparing standardized diagnostic reagents, and new and advanced molecular methods for identifying and characterizing *Y. pestis* strains.

The relationships that developed among U.S. and Indian scientists during the 1994 outbreak and subsequent collaborations had lasting scientific and diplomatic effects. During the Cold War, India had maintained few contacts with the U.S. public health community, preferring to collaborate with Russian health officials, who (up until 1989) had sent regular shipments of plague diagnostic reagents to NICD. After 1994, however, India was more open to public health collaboration with the United States. For example, the Indian Ministry of Health worked closely with CDC when it renovated and modernized its national plague laboratory during the late 1990s, and also when it reorganized and computerized its national communicable disease surveillance system. The Indian Ministry of Health also played an active role in two regional and two global workshops on plague organized by WHO and CDC between 1996 and 2000.

International contacts made during the 1994 plague outbreak also led to working relationships with the Kazakh Institute for Research on Plague Control in Almaty, Kazakhstan, the Chinese Academy of Preventive Medicine in Beijing, and the Institute of Endemic Diseases Control and Research in Yunnan, China.

Objectives for Priority Area 1

Dedicate Resources to International Outbreak Assistance

- Facilitate CDC participation in international outbreak investigations by
  - Developing standard operating procedures for responding to governments' requests for outbreak assistance, in coordination with WHO
  - Identifying and purchasing equipment and reagents and increasing capacity for logistical support
  - Establishing standard procedures for distributing and tracking specimens for efficient testing at more than one CDC laboratory when the cause of an outbreak is unknown.
  - Maintaining an inventory of CDC personnel with expertise in diseases of regional or global importance
  - Maintaining a registry of disease specialists outside of CDC who have expertise in diseases of regional or global importance ("Active Reserves")
  - Developing research protocols that might be used during outbreak investigations for controlled trials of drug treatments or other public health interventions (see Priority Area 3)

Box 13

Outbreaks Among Refugees in Kosovo and the Sudan

Tularemia in Kosovo

In April and May, 2000, an epidemiologist and ecologist from CDC joined a WHO-led investigation of an outbreak of tularemia among displaced persons returning to damaged homes and farms in rural Kosovo. The illness, which affected 500 to 1,000 people, was characterized by fever, severe sore throat, enlarged lymph nodes in the neck, and abscess formation.

The people who fled from Kosovo in March 1999 had left behind unharvested crops and homes with unprotected stocks of food. Over the following months, the local populations of field mice and domestic rats increased exponentially. Returning refugees became ill after ingesting food and water contaminated with rodent excrement and carcasses containing the bacteria *Francisella tularensis*. The epidemic was halted by instituting simple sanitation measures.

Louseborne Relapsing Fever in the Sudan

In April, 1999, epidemiologists from CDC assisted WHO in investigating an apparent outbreak of hemorrhagic fever in southern Sudan among seminomadic tribes displaced by famine, civil war, and intertribal strife. The causative agent proved to be the spirochete *Borrelia recurrentis*, which is transmitted by body lice. The outbreak affected about 20,000 people and caused about 2,000 deaths before the diagnosis was established and disease control measures were implemented.

- Strengthening the capacity of developing countries to identify outbreaks and to request WHO, CDC, or other outside assistance as needed

Strengthen Diagnostic Capacity

- Strengthen CDC laboratories (including CDC-based WHO Collaborating Centres) that can identify diseases that are rare or unknown, drug-resistant, or highly dangerous.

  This effort will include strengthening CDC's capacity to identify animal diseases that can affect humans, working in conjunction with USDA and other partners.
- Strengthen national public health laboratories in developing countries by providing diagnostic reference reagents, laboratory manuals, and training opportunities for laboratory scientists.

Strengthen Investigative Capacity at CDC

- Rebuild CDC's capacity to respond to international outbreaks.
- Maintain and expand epidemiologic expertise in a wide range of pathogens, helping to create a new generation of experts in infectious disease prevention and control.
- Strengthen international collaboration during investigations, working with many partners, including
  - WHO Global Alert and Response Network (Box 14; http://www.who.int/emc-documents/surveillance/docs/whocdscsr2003.pdf and http://www.who.int/emc-documents/surveillance/docs/whocdscsr2002.pdf).
  - European Programme for Intervention Epidemiology Training (EPIET; http://www.epiet.org/epiet).
  - U.S.-Mexico Border Infectious Disease Surveillance system (BIDS; http://www.r10.tdh.state.tx.us/obh/bids.htm).
  - Training Programs in Epidemiology and Public Health Interventions Network (TEPHINET http://asclepius.ic.gc.ca/tephinet/.
- Improve coordination among the Department of State, CDC, state and local agencies during investigations of infectious disease threats at U. S. ports of entry.

Box 14

WHO and CDC: Collaboration on International Outbreak Assistance

WHO and CDC work in close partnership to help control outbreaks that involve diseases of unknown cause, diseases with high fatality rates, and diseases that are likely to spread across borders:

- As an international entity, WHO is a critical partner in opening doors to U.S. scientists, facilitating U.S. participation in international efforts to identify new threats and contain potential pandemics. WHO also plays a special role in international press management, encouraging nations to share outbreak information while helping to minimize false rumors that cause damage to the trade and tourism industries of affected countries.
- CDC provides WHO with technical guidance, including diagnostic and epidemiologic support. Because WHO does not maintain laboratory resources of its own, it relies upon an international network of Collaborating Centres that includes more than 30 diagnostic laboratories located at CDC (Appendix D)

At the present time, WHO is strengthening its ability to facilitate international outbreak response efforts, as well as to support global health initiatives that address infectious diseases (see Box 6). As part of this effort, WHO is establishing a Global Alert and Response Network to promote prompt reporting of disease outbreaks and help coordinate offers of outbreak assistance—e.g., supplies, consultation, or on-site support—from public and private sector partners.

- Ensure that the United States is prepared to assist in investigations of international bioterrorist incidents.
- Continue to work with WHO and other partners to investigate epidemics that occur among refugees and displaced persons (Box 13).

Strengthen Control Efforts

- Strengthen CDC's capacity to provide prompt and effective epidemic control, by assigning epidemiologists to help monitor disease spread overseas, laboratory scientists to provide rapid diagnostic testing, and social and behavioral scientists to design and implement community education and mobilization efforts.
- Support efforts to provide supplies during outbreak emergencies by partners such as FDA, WHO, NGOs, pharmaceutical companies, multinational corporations, and other members of the private sector.

Offer Follow-Up

- Offer to conduct follow-up activities at the site of an outbreak, in collaboration with ministries of health, WHO, International Emerging Infections Programs (IEIPs; page 53), and existing national or donor-supported disease control programs. Activities may include
  - Sharing data to guide ongoing control programs
  - Improving infection control practices
  - Building laboratory capacity
  - Establishing ongoing surveillance for the outbreak pathogen
  - Implementing long-term prevention strategies through the application of proven health tools (see also Priority Area 4)

Priority Area 2: A Global Approach to Disease Surveillance

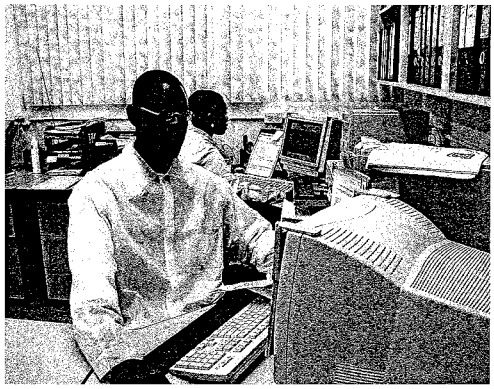
Stimulated in part by the AIDS pandemic, national and international groups, including the National Science and Technology Council in 1995 and the Group of Eight in 1997, have called for the establishment of a global system for disease surveillance and outbreak response. U.S. agencies are working with international partners to help achieve this goal.

Despite advances in public health telecommunications, however, the global implementation of this goal has not been straightforward. Notable progress has been made at the regional level, with the establishment of such international programs as the Caribbean Epidemiology Center's disease surveillance network, the Amazon and Southern Cone networks in South America, the Integrated Disease Surveillance and Epidemic Preparedness and Response Project in Africa, the Mekong Basin Disease Surveillance system in Southeast Asia, and the International Circumpolar Surveillance system in Alaska, Canada, Greenland, and the circumpolar regions of Europe. These and other fledgling networks (Appendix E) represent pioneering attempts to work across borders to enhance detection and control of outbreaks of known diseases while maintaining the flexibility to recognize new disease problems. The networks are testing many different approaches (e.g., syndromic surveillance, laboratory-confirmed disease-specific surveillance, hospital-based surveillance, and district-level surveillance), depending on local needs, cultural preferences, and human and technological resources.

In the years ahead, regional disease surveillance networks will grow in number and geographical scope. In the long run, regional and disease-specific networks should expand, interact, and evolve into a global "network of networks" that helps ensure early warning of new and reemerging threats and increased capacity to monitor the effectiveness of public health control measures

CDC can stimulate this process by providing technical assistance, evaluating regional progress, and working with WHO, other U.S. agencies, and other interested groups to strengthen the networks' telecommunications capacities and encourage the use of common software tools and harmonized standards for disease reporting. CDC can also help revise the International Health Regulations, which describe internationally-reportable diseases and syndromes. In addition, CDC will encourage linkages between regional networks and veterinary surveillance systems that monitor illnesses and epidemics among agricultural and feral animals. Several major outbreaks of zoonotic diseases (diseases of animals that also affect humans) involving agricultural animals have occurred in recent years (Box 15). CDC will also support disease surveillance efforts in tropical or heavily forested areas that are likely sources of human infection with unknown zoonotic or vectorborne diseases.

CDC's priorities in global surveillance will be balanced with the priorities of collaborating countries, and CDC's programs will be coordinated with the ongoing efforts of development agencies and NGOs that build disease surveillance capacity at the national level. CDC can best support both national and regional efforts by providing state-of-the-art diagnostic and epidemiologic tools; by developing surveillance standards and guidelines, and by creating new methods for predicting disease risk. CDC can also increase training opportunities by helping establish new or expanded Field Epidemiology Training Programs (FETPs), Public



Disease surveillance personnel at the Caribbean Surveillance System (CARISURV) of the Carribean Epidemiology Center (CAREC). CARISURV is an electronic disease surveillance system that serves 21 nations: Anguilla, Antigua & Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, British Virgin Islands, Cayman Islands, Dominica, Grenada, Guyana, Jamaica, Montserrat, Netherlands Antilles, St. Kitts & Nevis, St. Lucia, St. Vincent & Grenadines, Suriname, Trinidad & Tobago (host country), Turks & Caicos Islands.

CARISURV employs computer-based modules to:

- Track cases of measles as part of PAHO's campaign to eliminate measles in the Americas
- Track cases of HIV/AIDS
- Track cases of unusual or unexplained diseases reported by CAREC's Physician-Based Sentinel Surveillance system
- Compile weekly reports of notifiable diseases
- Maintain a database of deaths caused by infectious agents
- Help provide distance-learning courses for public health and medical personnel

A new module that facilitates hotel-based disease surveillance is under development.

CDC and the Walter Reed Army Institute of Research have worked with CAREC to provide CARISURV members with bioinformatics training, technical support, computer equipment, and public health software, including the Public Health Laboratory Information System (PHLIS) for reporting laboratory-confirmed cases of infectious disease. PHLIS was originally developed at CDC for use by U.S. state health departments.

Information Services Unit, CAREC.

Health Schools Without Walls (PHSWOW; http://www.tulane.edu/~phswow/), and Sustainable Management Development Programs (Priority Area 6, Boxes 16 and 24).

The surveillance data gathered by the regional networks will be used not only to detect outbreaks but also to evaluate global health initiatives (Priority Area 5) and to drive national public health programs and decision-making. Disease surveillance data are crucial, for example, in assessing the effectiveness of vaccination programs and the risk factors for underimmunization in a given area.

Objectives for Priority Area 2

Facilitate Regional Disease Surveillance

- Work with WHO and other partners to identify gaps in global disease surveillance by conducting a health situation analysis.
- Provide technical and material assistance to regional networks that can fill global gaps in disease surveillance.
- Host meetings that bring the leaders of regional surveillance networks together on a periodic basis to exchange experiences and methods and facilitate collaboration.
- Develop surveillance modules that can facilitate standardization of disease reporting among regional disease surveillance networks.

Box 15

Agricultural Costs of Controlling Zoonotic Diseases Carried by Food Animals

When a dangerous animal-borne disease spills over into the human population, a government may be forced to slaughter large numbers of food animals as a control measure, despite considerable economic costs.

This happened in 1999 when Malaysian health authorities were faced with an outbreak of encephalitis among farm workers that had a nearly 50% mortality rate. The cause of the outbreak turned out to be a previously unknown paramyxovirus called the Nipah virus, which is carried by swine. To control the outbreak, millions of pigs were slaughtered within a few weeks, severely harming the Malaysian meat industry. Two years before, a similar precautionary measure was taken by the government of Hong Kong, which arranged the culling of all 1.6 million chickens on Hong Kong Island and the New Territories to prevent chicken-to-human transmission of a virulent avian form of influenza (Box 5).

The costs of measures to control the outbreak of bovine spongiform encephalopathy (BSE, or "mad cow disease") in the United Kingdom and continental Europe, and the related outbreak of an invariably fatal human neurodegenerative disease (new variant Creutzfeldt-Jakob disease [nvCJD]) have also been high. Ingestion of beef containing the causative agent of BSE (a prion) can result in the development of nvCJD many years later. The export of live cattle and cattle products (other than milk) from the UK has been temporarily banned by the European Commission, and trade in these products has been affected on a global basis. Government officials have come under fire, and consumers across Europe have changed their eating habits due to concern over the spread of BSE. Control measures, including the slaughter of affected cows, have thus far cost the U.K. government an estimated 3.5 billion pounds (about 5 billion U.S. dollars).

The rapidly spreading outbreak of foot-and-mouth disease in Great Britain and continental Europe in 2001 threatens to dwarf the economic costs of the BSE epidemic and devastate the centuries-old British livestock industry. Foot-and-mouth disease does not infect humans but can be spread by travelers who have contaminated soil on their shoes or clothing or who carry contaminated food products. The St. Patrick's Day parade in Ireland was cancelled due to concerns about spreading the virus, and the British army has been drafted to help bury the carcasses of animals slaughtered because of potential exposure to the disease. Officials credit high-quality animal health surveillance and importation restrictions for the absence of foot-and-mouth disease in the United States, but remain concerned because similar measures have failed to contain the spread of the disease in continental Europe.

These examples demonstrate the potential impact an infectious disease outbreak can have on commerce as well as on human and animal health. If the United States were forced to destroy a significant number of cattle, sheep, pigs, or chickens to control an epidemic, the costs might easily rise into the billions.

Modules may cover sentinel disease surveillance, disease-specific surveillance, and syndromic disease surveillance.

- Help WHO strengthen WHO country and regional offices by providing CDC scientists, as needed, to assist with national and regional disease surveillance efforts.
- Assign epidemiologists and laboratory scientists from CDC to DoD laboratories in Indonesia, Kenya, and Thailand, in addition to those already in Egypt and Peru, to support DoD efforts to help strengthen regional disease surveillance (Appendix E).
- Engage nontraditional partners, such as medical missionary organizations and multinational corporations, in regional disease surveillance activities, particularly in regions that lack adequate public health infrastructures.

Use State-of-the-Art Tools

- Work with DoD, USAID, development banks, foundations, and other partners to provide public health agencies in developing countries with hardware (e.g., hand-held computers for field use), specialized software (e.g., EPI INFO 2000, PHLIS, and LITS+), and reliable Internet access to facilitate participation in regional infectious disease networks and training activities.
- Work with many partners to provide regional networks with field-friendly diagnostic tests (e.g., dipsticks).
- Work with WHO and other partners to develop laboratory standards for diagnostic testing and data standards for disease and syndrome reporting.

Promote New Paradigms for Global Disease Surveillance

- Establish mechanisms for regular information exchange between veterinary and agricultural organizations and public health agencies on new and re-emerging animal diseases that might affect humans.
- Work with NOAA, NASA, DoD, NIH, the National Science Foundation, and many other partners to create models that predict the risk of zoonotic and vectorborne disease by integrating climatic, environmental, veterinary, entomologic, and epidemiologic data. CDC can play a major role in providing epidemiologic data.
- Encourage the use of molecular methods for microbial subtyping and outbreak detection, such as PulseNet methods for the detection of foodborne disease outbreaks (see Surveillance for Foodborne and Waterborne Diseases).

Strengthen WHO's Disease-Specific Global Surveillance Networks

- Provide technical assistance to WHO-sponsored networks that monitor specific diseases of global importance, such as polio, measles, influenza, and TB (Appendix E).
- Work with WHO to help establish a global network for surveillance and control of plague, using the WHO Influenza Surveillance Network as a model.
- Work with WHO and other partners to help draft a new set of International Health Regulations (IHR) that includes a set of internationally-reportable diseases or disease syndromes.

Facilitate Surveillance for Foodborne and Waterborne Diseases

- Improve global surveillance for foodborne and waterborne diseases by
  - Establishing sentinel surveillance sites for foodborne and waterborne disease at International Emerging Infections Programs (IEIPs; page 53).
  - Working with PAHO and FDA to expand PulseNet—the U.S. early warning system for foodborne diseases—into a regional system for detecting outbreaks of foodborne disease throughout

the Americas. PulseNet compares the molecular fingerprints of bacterial isolates from many different sources. It can trace the source of an outbreak to shipments of contaminated food bought and consumed at different geographic locations. (See Box 2.)

- Establishing a mechanism for the regular exchange of surveillance information on foodborne diseases (e.g., salmonellosis, shigellosis, and *E. coli* O157:H7 infection), including PulseNet fingerprinting data, with European Union partners.

- Seek WHO approval for establishing a CDC-based WHO Collaborating Center for Salmonella Surveillance that provides support to WHO's Global Salmonella Surveillance system (Global Salm-Surv).

Facilitate Surveillance for Antimicrobial Resistance

- Provide technical assistance to help implement WHO's Global Strategy for the Containment of Antimicrobial Resistance (http://www.who.int/emc/globalstrategy/strategy.html).

- Work with other U.S. agencies to draft and implement Part II of the U.S. Public Health Action Plan To Combat Antimicrobial Resistance (Box 4), which will consider the role of the U.S. Government in addressing global resistance problems, such as the spread of multidrug-resistant TB.

- Increase the number of regional laboratories that conduct state-of-the-art testing for drug resistance, working through the WHO External Quality Assurance System and the WHO Collaborating Centre for Antimicrobial Resistance and using the new WHO/CDC laboratory manual for standardized susceptibility testing.

- In collaboration with WHO, the European Union, and other partners, explore the possibility of establishing an expert working group that sets international standards for detecting and reporting drug-resistant threats.

Box 16

A Growing Community of International Public Health Leaders

By fostering contacts between CDC staff and scientists from other countries (during outbreak investigations, scientific conferences, training courses, and disease prevention projects), CDC is helping build an international community of epidemiologists and laboratory scientists who are prepared to respond to emerging infectious disease threats, whenever and wherever they arise. Often linked by e-mail, as well as by phone and fax, these individuals are part of an informal network that shares outbreak alerts and research data and provides assistance and consultation during infectious disease emergencies.

In addition to these informal exchanges, CDC offers formal training programs in epidemiology (e.g., through Field Epidemiology Training Programs, the Public Health Schools Without Walls, and the Epidemic Intelligence Service), laboratory diagnostics (e.g., through fellowships and disease-specific training workshops), and public health management (e.g., through the Sustainable Management Development Program) that support the development of public health leaders around the world.

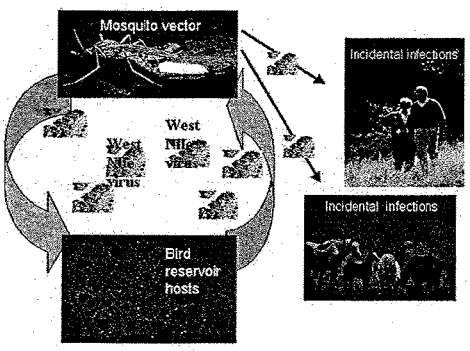
Priority Area 3: Applied Research on Diseases of Global Importance

CDC's researchers have a dual role. They not only identify the microbes, risk factors, and epidemiologic conditions that lead to outbreaks, but also conduct applied research on ways to detect, prevent, and control them. Maintaining a comprehensive diagnostic and investigative capacity goes hand-in-hand with maintaining a broad-based research program on endemic and epidemic diseases that includes studies in applied epidemiology, microbiology, and behavioral and social science.

A research program on diseases that are uncommon in the United States is a valuable resource, both for humanitarian reasons and because of the dangers represented by some imported diseases. Had scientists begun to study "slim disease"—now known as AIDS—when the syndrome was described in central Africa in the late 1970s,[12] the world health community might have learned much earlier how HIV is acquired and what can be done to prevent its spread.

An in-depth knowledge of a wide range of infectious pathogens can also facilitate the identification and characterization of new microbes that emerge in the United States. One example concerns hantavirus pulmonary syndrome (HPS), an often-fatal disease first identified in 1993 in the Four Corners region of the United States. In 1993 hantavirus research was a low priority in the United States, because hantavirus-associated disease had never before been recognized in the Western Hemisphere. However, a few laboratories supported by DoD had continued to collect information on a hantaviral disease called Korean hemorrhagic fever or hemorrhagic fever with renal syndrome (HFRS) that killed a significant number of United Nations troops during the Korean Conflict. Because of these HFRS studies, the CDC outbreak team in Four Corners was armed with sophisticated serologic and molecular tools that allowed them to diagnose HPS in a short time. Because it was known that the HFRS hantavirus is transmitted by rodents, the team rapidly honed in on the animal reservoir of the HPS virus and provided disease prevention guidelines to the people in the area.

Several fundamental precepts inform CDC's infectious disease



Life cycle of West Nile virus. West Nile encephalitis—which is carried by birds in Asia, Africa, and Europe and spread to humans by mosquito bite—has been recognized as a U.S. health threat since 1999. CDC is working with colleagues in Australia, the Czech Republic, France, Israel, Romania, and Russia to study the epidemiology, ecology, and pathogenesis of the West Nile virus and find ways to prevent and control its transmission.

From the CDC website: http://www.cdc.gov/ncidod/dvbid/westnile/birds&mammals.htm

research collaborations with other countries. First, the overriding purpose of CDC's research work overseas is to lead the way in demonstrating how individuals and governments can best prevent and control disease. Second, it is important for CDC to help strengthen international research capacity by supporting extramural research at home and abroad, through collaborations, cooperative agreements, and peer-reviewed grants. Third, CDC's research activities must be rooted in bioethical principles, respecting the needs and rights of human research subjects. Fourth, CDC must strive to engage new research partners, in addition to its traditional partners at universities and schools of public health. Research collaborators may include scientists from private companies, NGOs, and other U.S. agencies (e.g., NIH, FDA, DoD, NASA, NOAA, and USDA).

Long-term, on-site research collaborations are especially important, because it is often very difficult to study new and hazardous pathogens while an outbreak is in progress. Long-term partnerships with in-country research institutions may be mutually beneficial, facilitating collaborative field research and clinical studies, providing opportunities for technology transfer and training, and building international friendships and trust within the scientific and public health communities.

Objectives for Priority Area 3

Strengthen Overseas Research Collaborations by Establishing IEIPs

- Establish an inventory of existing and potential sites for long-term, on-site research collaborations to address infectious disease problems of regional importance. The inventory should evaluate:
  - How the site might fill geographical and disease-specific research gaps
  - The site's potential as a center for research training
  - Opportunities to engage multiple partners, including in-country partners (e.g., public health agencies and universities) and U.S. agency partners (e.g., NIH and DoD)
  - Opportunities to leverage resources and ensure sustainability
- Create International Emerging Infections Programs (IEIPs), using the information from the inventory described above. (See also Priority Area 6.)

Conduct Research on Vector-borne and Zoonotic Diseases

- Support the development of field-friendly diagnostic tests for the detection of zoonotic and vector-borne disease, as well as new methods for animal and vector control.
- Support research on the epidemiology, ecology, and pathogenesis of vectorborne and zoonotic diseases of current international concern, including malaria, West Nile fever, dengue fever, Nipah virus encephalitis, rabies, Q fever, leishmaniasis, typhus, plague, and Chagas disease.
- Search for the animal or insect reservoirs of Ebola and Marburg hemorrhagic fevers, working through the CDC-based WHO Collaborating Centre for Viral Hemorrhagic Fevers and collaborating with the South African National Institute of Virology and other partners.
- Investigate the relationship between environmental conditions and the emergence of zoonotic and vector-borne diseases.

Conduct Vaccine Research

- Encourage and support the development and evaluation of vaccines against diseases of global health importance (Boxes 17 and 18).
- Support research on ways to decrease the cost of expensive vaccines like conjugate *Haemophilus influenzae* type b and pneumococcal vaccines in developing countries (e.g., administering them less frequently or in lower doses).
- Help define the epidemiology and public health burden (illness, mortality, and cost) of vaccine-preventable diseases in developing countries, and monitor the declining burden of disease associated with widespread vaccination. (See also the next section.)

Conduct Research in Support of Global Initiatives for Disease Control

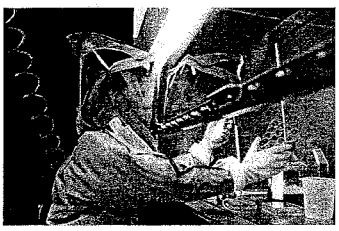
- Encourage and support basic research to improve our understanding of the genetics, physiology, and pathogenesis of parasites, bacteria, and viruses that cause illnesses targeted by global initiatives for disease control.

Box 17

CDC's Role in the Development of Vaccines Against Diseases of Global Importance

CDC supports the vaccine development goals of the Global Alliance for Vaccines and Immunization (GAVI), the International AIDS Vaccine Initiative, the DHHS Blueprint for TB Vaccine Development, and the Malaria Vaccine Initiative. Over the next 5 years, CDC will work with NIH, FDA, USAID, DoD, and many other public and private partners to help develop:

- A multistage vaccine against malaria, as part of the Malaria Vaccine Initiative, funded by the Bill and Melinda Gates Children's Vaccine Program
- A DNA-based vaccine against HIV/AIDS, in collaboration with the Emory Vaccine Center in Atlanta, Georgia
- Strain-specific vaccines against dengue and dengue hemorrhagic fever, in collaboration with Mahidol University in Salaya, Nakhonpathom, Thailand
- Conjugate vaccines against meningococcal meningitis group A, in collaboration with WHO and the Bill and Melinda Gates Children's Vaccine Program
- An Ebola vaccine, in collaboration with NIH
- Third generation vaccines against *Streptococcus pneumoniae* using proteins common to all pneumococcal serotypes. (Second generation conjugate vaccines are currently under evaluation [see Box 18].)



CDC vaccine researcher working in a biosafety level 4 (BSL-4) containment facility. BSL-4 laboratories are used for work on infectious agents for which there are no current vaccines or treatments (e.g., Ebola virus).

Box 18

CDC's Role in the Evaluation of Vaccines Against Diseases of Global Importance

Over the next 5 years, CDC will work with many different partners to help implement:

- Phase III trials in Thailand of an HIV vaccine based on the glycoprotein-20 antigen developed by the VaxGen company
- Studies to evaluate the effectiveness of 7-valent pneumoccocal conjugate vaccines on
  - Herd immunity among Native American communities that have high rates of invasive disease. This is a phase III, cluster-randomized trial of conjugate pneumococcal vaccine conducted in collaboration with Johns Hopkins School of Public Health.
  - Nasopharyngeal carriage of pneumococci in Alaska
  - Invasive pneumococcal disease throughout the United States, using the Active Bacterial Core Surveillance (ABCs) system.
- Phase III trial in the Gambia of a 9-valent conjugate pneumococcal vaccine against all-cause mortality and acute-respiratory-infection-specific mortality, conducted in collaboration with the Medical Research Council-Gambia, USAID, NIH, the Bill and Melinda Gates Children's Vaccine Program, and WHO's Vaccine Development, Vaccines and Biologicals program.
- USAID-supported Phase I trials of two vaccines against *Schistosomiasis mansoni,* conducted by the Schistosome Vaccine Development Project, a partnership involving the Government of Egypt, CDC, NIH/NIAID, NAMRU-3, academic centers, and private industry.
- A multisite rotavirus vaccine trial in Southeast Asian countries using an attenuated human rotavirus vaccine produced in India.

- Help develop and evaluate
  - Tools and strategies to prevent transmission of TB, malaria, and HIV/AIDS
  - Treatments for drug-resistant cases of TB, malaria, and HIV/AIDS
  - Improved methods for the detection of TB, HIV/AIDS-related opportunistic infections, and early-stage HIV infections
- Assess the impact of coinfection with HIV and malaria and with HIV and TB on disease control efforts.

Conduct Research on Foodborne and Waterborne Diseases

- Evaluate diagnostic strategies for foodborne and waterborne infections that are common in developing countries, but for which current diagnostic procedures are slow, expensive, or difficult.
- Conduct targeted research studies in sentinel IEIP sites (page 53) to determine the sources of, and risk factors for, specific foodborne and waterborne infections so that appropriate prevention measures can be developed.
- In collaboration with WHO and others, assess the efficacy, safety, and utility of vaccination to prevent selected foodborne and waterborne infections (e.g., typhoid fever) in combination with other prevention strategies. (See also Conduct Vaccine Research.)

Conduct Research on Diseases of Pregnant Women and Newborns

- Develop point-of-care diagnostic methods suitable for use in prenatal and obstetric healthcare settings in developing countries and provide quality assurance programs for their use.
- Field test new treatments and prevention measures, such as
  - Drug combinations for the treatment or prophylaxis of malaria in infants and in pregnant women, for use in areas in which chloroquine-resistance is common.
  - Simple and inexpensive regimens for the treatment and prevention of HIV/AIDs that can be administered to mothers and babies during labor and the first week of life.
- Explore ways to extend the benefits of intrapartum or neonatal prophylaxis (e.g., for prevention of HIV/AIDS and hepatitis C infection) to pregnant women with little or no prenatal care.
- Explore the effectiveness of perinatal application of topical antimicrobial agents in preventing neonatal sepsis and tetanus.
- Assess the relationship between particular maternal infections and low birthweight or preterm babies.

Conduct Research on Antimicrobial Resistance

- Encourage and support the development of drug susceptibility tests and surveillance systems to detect emerging resistance problems.
- Evaluate the impact of new vaccines (such as the conjugate pneumococcal vaccines) on the control of antimicrobial resistance and infection. (See also Conduct Vaccine Research.)
- Determine how disease prevention programs that include mass chemotherapeutic treatments can be optimized to minimize potential for the emergence of drug resistance. Examples include the use of praziquantel to prevent schistosomiasis, albendazole to prevent lymphatic filariasis, ivermectin to prevent onchocerchiasis, azithromycin to prevent trachoma, trimethoprim-sulfamethoxazole to prevent AIDS-associated opportunistic infections, and nevirapine or zidovudine to prevent mother-to-child transmission of HIV/AIDS.
- Encourage efforts by WHO and other partners to
  - Evaluate the quality of commercially available antibiotic stocks and determine whether low-potency stocks are hastening the emergence of drug-resistant strains of pneumococci, *Mycobacterium tuberculosis, Plasmodium* spp., *Neisseria gonorrhoeae,* or other pathogens.
  - Determine whether antibiotics purchased over the counter in developing countries (and often used in subtherapeutic doses) are hastening the emergence of drug resistance.

  FDA supports these efforts.

Conduct Research on Healthcare-Acquired (Nosocomial) Infections

- Develop methods for identifying nosocomial infections and reducing their transmission in hospitals with limited resources for infection control.
- Provide technical assistance to hospital staff in assessing risk factors for acquiring
  - *Mycobacterium tuberculosis* (e.g., transmitted from patients to health care workers or to other patients).
  - Nosocomial respiratory and enteric infections (e.g., inadequate barrier nursing practices)
  - Nosocomial bloodborne infections (e.g., re-use of medical devices or surgical equipment)

Conduct Research on Infectious Causes of Chronic Diseases

- Conduct research on infectious agents of international importance that cause or may cause chronic diseases (e.g., hepatitis B and C viruses and hepatocellular carcinoma, *Helicobacter pylori* and peptic ulcer disease or gastric carcinoma, *Chlamydia pneumoniae* and cardiovascular disease, and human papillomaviruses and cervical cancer)

Conduct Research on Sexually Transmitted Diseases

- Study the contribution of herpes simplex virus type 2 infection and other genital ulcer diseases on HIV transmission, and devise appropriate intervention strategies.
- Develop more standardized diagnostic reagents and assays for syphilis to enhance the capacity to control neonatal syphilis worldwide.
- Monitor the development of antimicrobial resistance among strains of *Chlamydia trachomatis* and devise appropriate alternative treatments.

Priority Area 4: Application of Proven Public Health Tools

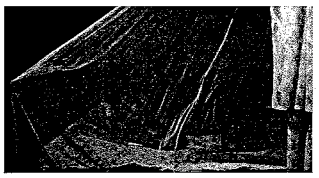
Another major priority for CDC is to translate research innovations into practical public health tools and ensure that they are disseminated widely and rapidly for the benefit of people all over the world. Examples of public health tools that have had a major impact on global infectious disease control are antibiotics, childhood vaccines, oral rehydration therapy, and vitamin supplements.

There is often a long delay between the development of a new public health tool and its widespread implementation. A country may lack the means to buy a new medical product or it may lack a public health delivery system and trained workers to administer it. There may be low demand, because the public is not informed about a new drug or vaccine, or low political interest, because the national government is not convinced that the drug or vaccine will be cost-effective.

CDC can use its experience in disease surveillance to demonstrate the value of public health tools to ministries of health and finance and to the public, using pilot studies, demonstration projects, and health education campaigns (Box 19). For example, CDC will continue to work with USAID, WHO, and other partners to demonstrate that mechanisms for the prevention or control of malaria (via vector control, chemotherapy, and insecticide-treated bednets) are ready for national or regional implementation, pending the availability of resources and political commitment (see Priority Area 5). CDC can also help development agencies, NGOs, and other partners address problems related to public health training and to drug or vaccine delivery (see also Priority Area 6).

As part of the global strategy, CDC will intensify efforts to couple applied research with research on ways to promote the use of newly developed tools for disease control ("implementation research"). CDC will help identify the most effective tools and actively encourage their international use, applying expertise and resources in laboratory research, public health policy, program management, and health communications to overcome scientific, financial, and cultural barriers.

Examples of new tools with the potential for significant worldwide impact include point-of-use disinfection and safe water storage to prevent waterborne diseases; auto-disable (one-use) syringes to prevent blood-borne transmission of hepatitis B and C viruses and HIV; and diethylcarbamazine and albendazole therapy to eliminate lymphatic filariasis.



Bednets protect children from malaria. Nightly use of insecticide-impregnated bednets[15] reduces childhood mortality by 20–30%, and use in one village protects children in neighboring villages by reducing the number of infectious mosquitos. Nevertheless, bednets are used by fewer than 10% of persons at risk, due to lack of knowledge, unavailability of bednets, and other logistical constraints.

Objectives for Priority Area 4

Promote Effective Drug Use

- Conduct implementation research and demonstration projects to promote the use of therapeutic drugs such as
  - Ivermectin to eliminate onchocerchiasis in West Africa and Central America
  - Diethylcarbamazine and albendazole or mebendazole therapy to eliminate lymphatic filariasis in the Americas
  - Single-dose azithromycin to eliminate blinding trachoma in endemic regions in Africa, Middle East, Asia, and Central America

- Single-dose nevirapine to prevent perinatal HIV transmission. (See also Priority Area 5.)
- Praziquantel to treat schistosomiasis

- Promote the widespread use of the directly observed therapy short-course strategy (DOTS) to treat TB. (See also Priority Area 5.)

Improve Immunization

- Use CDC resources to strengthen routine immunization services and to encourage the introduction of new and underutilized vaccines, including vaccines against hepatitis B, yellow fever, *Haemophilus influenzae* type b, and other childhood diseases. (See also Priority Area 5.)

Promote the Use of Proven Disease Prevention Strategies

- Work with ministries of health and PAHO to encourage the adoption of vector control measures to eliminate Chagas disease from Central America and reduce morbidity and mortality from dengue and dengue hemorrhagic fever (http://www.cdc.gov/ncidod/dpd/parasites/chagasdisease and http://www.cdc.gov/ncidod/dvbid/dengue).
- Work with private and public sector partners to promote widespread implementation of CDC's Safe Water System, which uses point-of-use disinfection and safe water storage to prevent cholera, dysentery, and other waterborne diseases (Box 20; http://www.cdc.gov/safewater).

Box 19

Narrowing the Interval Between the Invention and Use of an Effective Public Health Tool

In the past, the time between the development of a new public health tool and its widespread use was often extremely long. For example, the tetanus toxoid vaccine, developed in 1926 and used to protect soldiers during World War II, was not widely administered to children in industrialized countries until the 1940s and 1950s, and did not reach high levels of coverage in developing countries until the mid-1980s, a 60-year interval.

Today, this gap is narrowing. After the hepatitis B vaccine was licensed in 1981, universal infant hepatitis B vaccination projects were initiated in many countries, including five U.S.-affiliated Pacific islands where HBV infection is highly endemic and HBV-induced chronic liver disease is a leading cause of death. After a decade of successful demonstration projects, routine childhood hepatitis B vaccination was recommended by the World Health Assembly for all countries. During the 1990s, more than 100 countries (including the United States) implemented hepatitis B immunization programs, although lack of financing hindered vaccine use in the poorest countries. In 2000, financial assistance for the purchase of hepatitis B vaccine became available through The Vaccine Fund, and the Global Alliance for Vaccines and Immunization (GAVI) targeted hepatitis B vaccine for universal introduction into developing countries by 2007.

The history of the hepatitis B vaccine provides a good example of how the gap in time between introduction and widespread use of a new public health tool can be shortened through strategic planning, a rapid sequence of efficacy studies and demonstration projects, active advocacy and funding. As future vaccines and other public health innovations are developed, it should be possible to narrow the gap further. CDC can play an important role in this area.

A man being immunized against hepatitis B virus. Expanded use of the hepatitis B vaccine will decrease mortality from cirrhosis, liver failure, and hepatocellular carcinoma, which is the 4th leading cause of cancer death worldwide.

Adapted from: Centers for Disease Control and Prevention. Preventing emerging infectious diseases: Addressing the issue of vaccine development and use. Atlanta, GA: U.S. Department of Health and Human Services, 2001.

Box 20

CDC's Safe Water System

In the poorest, least industrialized nations, diarrheal diseases caused by contaminated food and water remain a leading cause of death in childhood. Many of these deaths could be prevented by simple sanitation measures.

With assistance from ministries of health, funding from USAID and Rotary International, and special expertise from nongovernmental organizations and the private sector, CDC has developed a sustainable way to improve the safety of household drinking water. The components of CDC's safe water system, as implemented in pilot projects in Zambia, include

- **Water disinfection.** Population Services International (PSI) has marketed a locally produced disinfectant solution for water treatment (CLORIN) to communities in the southern, eastern, and western regions of Zambia. A CDC case-control study documented a 65% reduction of risk of cholera in Zambian households that use CLORIN.
- **Safe storage of water.** CDC, the Procter and Gamble Company, and Rotary International have contributed to the design of a narrow-mouthed vessel for safe storage of water. The mold for the new vessel was shipped to South Africa in January 2000, where vessels have been produced for use in Zambia, Madagascar, Kenya, Côte d'Ivoire, and Pakistan.
- **Social marketing.** PSI has trained public health workers in Lusaka, Kitwe, and Ndola, Zambia, on how to involve their communities in the safe-water effort.

USAID has increased funding for the safe water project in Zambia to permit nationwide coverage within the next few years, and the CARE/CDC Health Initiative is funding similar projects in western Kenya and in Antananarivo, Madagascar. Each CARE/CDC Health Initiative project will target a population of 200,000 people and combine the methods of the Zambian project with the community organizing techniques of CARE.

In the future, the elements of the Safe Water System may also be used to promote:

- Safe preparation of foods and beverages by street vendors
- Safe preparation of medications, such as oral rehydration solutions to treat cholera
- Safe preparation of formula for use by HIV-infected women who choose not to breast-feed their infants
- Handwashing and improvements in hygiene
- The addition of nutritional supplements to drinking water

A safe water storage vessel employed by participants in an ongoing Safe Water System implementation project in Homa Bay, Kenya, initiated in October 2000 in collaboration with CARE Kenya. The vessel was designed to eliminate a major source of diarrheal disease contamination that results when hands, cups, ladles, or other objects are dipped into open buckets to remove water for drinking. Because the local population in Homa Bay preferred to use vessels made of clay rather than plastic, CDC and CARE Kenya incorporated a narrow mouth, lid, and spigot into traditional clay pots to ensure safe water storage. The use of plastic vessels with similar characteristics, in combination with water disinfectants, has reduced diarrheal diseases by 30–50% in communities in Zambia, Pakistan, and Bolivia.[14]

Photographer: Bobbie Person, Office of Health Communication, National Center for Infectious Diseases, CDC

- Work with WHO and ministries of health in central African countries to provide training in hospital barrier nursing practices that prevent nosocomial spread of viral hemorrhagic fevers like Ebola and Marburg.
- Continue to support the Safe injection Global Network (SIGN) and work with development agencies and other partners to promote safe injection practices to prevent the spread of hepatitis B and C, HIV/AIDS, and other bloodborne diseases.
- Work with the Roll Back Malaria partnership to promote the use of insecticide-impregnated bednets for the prevention of malaria and other mosquitoborne diseases. (See Priority Area 5.)
- Work with ministries of health and WHO to provide public health education and mobilize communities to use proven public health tools.

Disseminate Diagnostic Tests

- Work through the WHO Collaborating Centre laboratory network to provide proven diagnostic reagents for the detection of endemic diseases to national public health laboratories and regional surveillance networks. (See Priority Area 1.)
- Work with WHO and donor agencies to provide national public health laboratories with state-of-the-art laboratory tests that measure antimicrobial resistance in *Mycobacterium tuberculosis* and other common bacterial pathogens, as well as in malaria parasites and in the AIDS virus. (See Priority Area 5.)
- Work with ministries of health to transfer technology for molecular subtyping of common bacterial pathogens (e.g., PulseNet techniques; page 36) to national public health laboratories for use in detecting outbreaks of foodborne diseases).

Use Surveillance Data To Direct Public Health Policy

- Work with ministries of health and ministries of finance, WHO, and NGOs to
  - Conduct disease surveillance to assess national public health needs and recommend specific public health tools to address them.
  - Demonstrate the use of specific surveillance methods for detecting outbreaks, for evaluating public health programs, and for driving public health decision-making.
- Work with global partners to evaluate the progress of global initiatives to combat malaria, TB, AIDS, and vaccine-preventable diseases. (See Priority Area 5.)

Priority Area 5: Global Initiatives for Disease Control

Dr. Gro Bruntland, Director-General of WHO, has said that "solutions, like problems, have to be global in scope." In accord with this idea, WHO is helping to coordinate major global initiatives to reduce deaths from malaria, TB, and HIV/AIDS—diseases that contribute to poverty and economic stagnation. This approach was endorsed by the Group of Eight Industrialized Nations at the Okinawa summit in July 2000. WHO is also helping to coordinate global initiatives to increase developing-country access to vaccines against acute respiratory diseases, yellow fever, hepatitis B, and other diseases, through the Global Alliance for Vaccines and Immunization (GAVI; http://www.vaccinealliance.org).

Although these global initiatives have clearly stated goals and are supported by multiple private and public sector partners (Box 6), the details of their implementation are still under discussion. Previous efforts to eradicate malaria by using a narrow approach to vector control ended in failure. Because no proven vaccines are yet available against malaria, TB, or AIDS, "one-shot" solutions are not feasible, and it will be necessary to employ multiple control strategies, including behavioral interventions that require a high degree of cooperation and trust in affected communities. The incidence of TB, HIV/AIDS, and acute respiratory infections is high in poor, war-torn, or post-Communist countries in which public health infrastructures have deteriorated. Moreover, emerging drug resistance complicates the treatment and control of each of these diseases.

A new priority for CDC will be to elevate the level of its participation in these and other global initiatives (Box 6). CDC and its partners will also consult on future international priorities for disease control, elimination, and eradication efforts—as well as for antimicrobial resistance monitoring and pandemic influenza preparedness planning—and help evaluate progress through the collection and analysis of disease surveillance data.

Increased participation in global health initiatives will require long-term partnerships with host countries, as well as improved coordination with public health partners throughout the world. CDC will build on its strengths in disease surveillance, laboratory science, and program evaluation to assist development agencies, international organizations, NGOs, and development banks that support international programs to strengthen healthcare systems and control disease. As a partner in the Global AIDS alliance (Boxes 6

Children from villages hard-hit by AIDS. Thirteen million children in sub-Saharan Africa have lost one or both parents to AIDS, and the number is expected to reach 40 million by 2010.[15] The number of AIDS orphans is also growing in Asia and Latin America.

Global efforts are underway to help these children and prevent further devastation from HIV/AIDS and other infectious diseases. These global initiatives involve complex alliances among public and private groups, health and trade experts, and national and international donor organizations.

Photographer: Bobbie Person, Office of Health Communication, National Center for Infectious Diseases, CDC

and 21), for example, CDC has a special opportunity to work with UNAIDS and USAID to implement HIV/AIDS control programs on all continents (http://www.unaids.org/africapartnership/files/mrpretoria.doc). As a partner in Roll Back Malaria (http://www.rbm.who.int), Stop TB (http://www.stoptb.org), and GAVI, CDC can contribute to the Shared Agenda for Health in the Americas (http://wbln0018.worldbank.org/external/lac/lac.nsf)[16] developed by PAHO, the Inter-American Development Bank, and the World Bank.

Increased participation in global health initiatives also will require additional staff to work on projects overseas, as well as to provide diagnostic support from CDC laboratories in the United States. Full participation in GAVI, for example, will require increased programmatic support and technical expertise in acute respiratory diseases, yellow fever, hepatitis B, and meningococcal meningitis. There remains a shortage of U.S. and world expertise in many infectious disease areas. (See also Priority Area 6.)

CDC staff will also continue to work with ministries of health, WHO, PAHO, USAID, and other partners on disease elimination or eradication campaigns. In addition, CDC staff will help further efforts to reduce illness and death from acute respiratory diseases and diarrheal diseases,

Box 21

The Global AIDS Program

Thirty-six million people worldwide have been infected with HIV, the virus that causes AIDS, and more than 21.8 million have died. Eighty-five percent of all AIDS deaths have occurred in the countries of sub-Saharan Africa. In at least five of these countries, more than 20% of adults are HIV-positive. Infection rates are also climbing in parts of Asia, Latin America, the Caribbean, and the former Soviet Union countries and Eastern Europe. Only a concerted global effort coordinated by WHO and led by the United States and other industrialized countries can stop this pandemic.

Through the Global AIDS Program (GAP), CDC is working with USAID and other DHHS agencies to assist ministries of health. In 2001, the program targeted 17 of the hardest-hit African countries (Angola, Botswana, Côte d'Ivoire, the Democratic Republic of the Congo, Ethiopia, Kenya, Malawi, Mozambique, Namibia, Nigeria, Rwanda, Senegal, South Africa, Tanzania, Uganda, Zambia, and Zimbabwe), as well as India, Brazil, Cambodia, Guyana, Haiti, Thailand, and Vietnam. GAP's mission is to implement the U.S. Leadership and Investment for Fighting an Epidemic (LIFE) Initiative, which is the U.S. contribution to the International Partnership Against AIDS in Africa and to AIDS efforts on other continents.

The goals of the Global AIDS program are to

- Reduce HIV transmission through primary prevention of sexual, mother-to-child, and bloodborne transmission
- Improve community and home-based care and treatment of HIV/AIDS, sexually transmitted infections, and opportunistic infections
- Strengthen national capacities to collect and use surveillance data and manage national HIV/AIDS programs

Additional information on the Global AIDS Program is available at http://www.cdc.gov/nchstp/od/gap

which—in addition to HIV/AIDS, TB, and malaria—are the leading infectious causes of death, worldwide. CDC will also continue to conduct applied research to improve our understanding of the genetics, physiology, and pathogenesis of microbes that cause illnesses targeted by global initiatives for disease control. (See Priority Area 3.)

Objectives for Priority Area 5

Establish a Solid Foundation for Global Initiatives

- Expand the cohort of public health professionals at CDC who have international expertise and can provide support for global initiatives to combat infectious diseases. (See also Priority Area 6)
- Help suggest international priorities for current and future global initiatives for disease control. Future initiatives might include antimicrobial resistance monitoring, pandemic influenza preparedness planning, and campaigns to control or eliminate measles, lymphatic filariasis, onchocerchiasis, trachoma, rubella, neonatal tetanus, or hepatitis B.
- Provide technical assistance to national health authorities in public health management of diseases targeted by global health initiatives, working through the Sustainable Management Development Program and other mechanisms. In some countries this will include integrating specialized HIV, TB, and STD surveillance programs into national surveillance and laboratory service systems for infectious diseases.
- Improve coordination among CDC personnel who work overseas in the same country or region.

Enhance Support for Disease Control, Elimination, and Eradication Programs

- Help complete the eradication of polio by 2005. The global effort to eradicate polio is led by WHO, in partnership with an international coalition that includes CDC, Rotary International, UNICEF, and the governments of many countries (http://www.cdc.gov/nip/global). The WHO Global Polio Laboratory Network (Box 7), which uses molecular techniques to determine whether wild-type polio is circulating in areas undergoing eradication efforts, should be expanded to include monitoring for other vaccine-preventable diseases, such as measles and rubella.
- Help complete the eradication of dracunculiasis, working in partnership with the Carter Center's Global 2000 Program, UNICEF, WHO, and other groups (http://www.cdc.gov/ncidod/dpd/parasites/guineaworm and http://www.cartercenter.org/guineaworm.html).
- Work with PAHO to complete the elimination of indigenous (i.e., non-imported) cases of measles in the Americas, and work with WHO, UNICEF, the UN Foundation, USAID, the American Red Cross, the International Federation of Red Cross and Red Crescent Societies (IFRC), and other partners to reduce by 50% by 2005 the nearly 900,000 annual measles deaths worldwide.[17]

Participate in the Roll Back Malaria Initiative

- Contribute to Roll Back Malaria (RBM; http://www.rbm.who.int) through full endorsement and active promotion of RBM strategies in malaria-endemic countries in sub-Saharan Africa, Southeast Asia, and the Americas. Although RBM strategies vary by region and by local malaria transmission dynamics, 90% of the world's malaria is in sub-Saharan Africa, where the strategies for malaria prevention and control include
  - Prompt effective case management of malaria illness
  - Prevention of malaria and its consequences in pregnancy, through prophylaxis or preventive intermittent treatment regimens with an effective antimalarial drug
  - Widespread use of insecticide-treated bednets, particularly by young children and pregnant women
  - Prompt recognition and management of malaria epidemics

- Conduct operations research on
  - Antimalarial drug efficacy and the management and prevention of antimalarial drug resistance
  - Malaria prevention in pregnancy
  - Transmission reduction through the use of insecticide-treated bednets and other strategies
  - Malaria assessment in complex emergencies, such as outbreaks that occur among refugees or outbreaks that occur after hurricanes or other natural disasters
  - Malaria diagnostics
  - Social attitudes and practices that facilitate or hinder the effectiveness of malaria control programs
  - Malaria surveillance, monitoring, and evaluation strategies
- Provide technical assistance to the African Integrated Malaria Initiative (http://www.usaid.gov/regions/afr/abic/sddev/sddspr96/sddspr96.htm; see also Appendix A), a USAID-sponsored initiative that enhances integrated malaria treatment and prevention in Kenya, Malawi, Zambia, and Benin by promoting the use of interventions in the home (e.g., insecticide-impregnated bednets), in healthcare facilities (e.g., chemoprophylaxis), and among pregnant women (e.g., protective intermittent chloroquine therapy, as recommended by the USAID Safe Motherhood Initiative). During 2001, the African Integrated Malaria Initiative will be extended to the Democratic Republic of the Congo, Nigeria, Senegal, and Uganda.
- Assist ministries of health in malaria control efforts and in the monitoring and evaluation of antimalarial drug efficacy. CDC is currently working on national malaria control programs in Kenya, Tanzania, Peru, and Nepal.

Strengthen the Stop TB Program

- Contribute to Stop TB (http://www.stoptb.org) by
  - Assigning an epidemiologist to WHO's Stop TB secretariat
  - Providing technical assistance to facilitate the use of the directly observed therapy short-course strategy (DOTS) for TB. (See also Priority Area 4)
  - Strengthening TB treatment programs in LIFE Initiative/Global AIDS Program countries (see below)
  - Supporting demonstration projects on the medical management of drug-resistant TB
  - Providing technical assistance to improve hospital TB control and detect hospital and community outbreaks in communities with high HIV prevalence
  - Assigning a medical officer to the International Union Against TB and Lung Diseases (IUATLD) to train a cadre of international TB experts, as a joint effort with USAID and WHO
  - Providing technical assistance and laboratory support to implement global antituberculosis drug resistance surveys
- Consult with ministries of health in Russia, Vietnam, and other countries on training issues related to TB diagnosis and treatment.
- Conduct operations research on
  - TB surveillance, program management, and program evaluation strategies
  - Multidrug-resistant TB treatment approaches and evaluation strategies
  - Treatment strategies for latent TB among persons with HIV infection
  - Factors that improve adherence to antituberculosis therapy
  - New diagnostic methods, drugs, and vaccine for TB

Expand the LIFE Initiative and Other International Efforts To Address HIV/AIDS

CDC will work with foreign ministries of health and public and private sector partners in countries targeted by the LIFE Initiative/Global AIDS Program (Boxes 6 and 21; http://www.cdc.gov/nchstp/od/gap) to

- Prevent primary transmission of HIV by
  - Expanding voluntary counseling and testing programs for youth and other vulnerable populations

- Building large-scale programs to reduce mother-to-child transmission
- Strengthening programs to reduce bloodborne HIV transmission
- Strengthening medical management of sexually transmitted infections (STIs)
- Supporting and strengthening national education and mobilization efforts for disease prevention

• Improve community and home-based care and treatment by
- Expanding and strengthening TB prevention and care
- Enhancing care and treatment of HIV/AIDS and AIDS-related opportunistic infections
- Exploring the innovative use of antiretroviral therapy

• Build public health and medical infrastructure by
- Expanding and strengthening surveillance for HIV, STIs, and TB
- Providing laboratory support for diagnosis and surveillance of HIV, STIs, TB, and opportunistic infections, as well as for HIV screening of blood supplies
- Expanding and strengthening public health information systems
- Providing training in managing and implementing HIV treatment and prevention programs (see also page 55).
- Enhancing evaluation of HIV/AIDS prevention and care programs.

Support Global Vaccine Initiatives

• Help GAVI partners (http://www.vaccinealliance.org/) develop and implement strategies to strengthen routine immunization services and monitor their effectiveness.

• Provide assistance to GAVI in assessing the burden of hepatitis B, yellow fever, *Haemophilus influenzae* type b, pneumococcus, rotavirus, meningococcus A, measles, and congenital rubella syndrome in developing countries and use this information to design, implement, and evaluate immunization programs against these infections.

• Support efforts by GAVI partners—including pharmaceutical companies, foundations and development banks—to develop and evaluate new vaccines that are needed in developing countries, and to promote their availability. (See also Priority 3.)

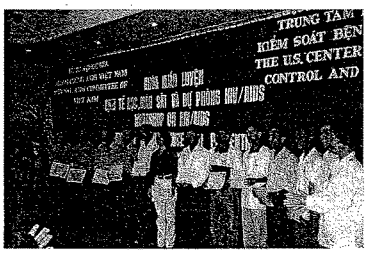
Priority Area 6: Public Health Training and Capacity Building

CDC's growing visibility as an international outbreak consultant has also led to increased participation in efforts to build global public health capacity. Although CDC is not a development agency, CDC has traditionally assisted USAID with the public health and research components of development projects (Box 22) and has consulted with private foundations and development banks on efforts to strengthen public health infrastructures (Box 23). Over the past decade, CDC has also helped strengthen healthcare systems in developing countries, working with hospital administrators and physicians to improve infection control practices and ensure safe blood supplies. CDC has also managed overseas field stations that facilitate on-site collaborative research on diseases of regional and global importance (Box 10). In addition, several foreign scientists enroll each year in CDC's Epidemic Intelligence Service and the Emerging Infectious Disease Laboratory Fellowship Program, which is a joint effort between CDC and the Association of Public Health Laboratories (APHL).

In recent years, in the aftermath of outbreaks and other infectious disease crises, CDC has responded to requests from more than 80 foreign governments for epidemiologic, laboratory, or research assistance to ensure preparedness for future emergencies. However, most of these efforts—which included training courses, research collaborations, program evaluations, health education campaigns, and the provision of laboratory reference support—were limited in scope and duration and were not integrated into a larger effort to build public health capacity.

As part of the global strategy, CDC will propose the establishment of a series of International Emerging Infections Programs (IEIPs) in developing countries—centers of excellence that will integrate disease surveillance, applied research, prevention, and control activities. Each site will represent a partnership between a ministry of health and CDC, with additional partnerships involving local Field Epidemiology Training Programs (FETPs) and one or more local universities or medical research institutes. The IEIP sites will build on existing CDC overseas activities to strengthen national public health capacity and provide hands-on training in public health. Over time, they may have a regional as well as a national impact on health.

The IEIPs will be broad-based public health collaborations between the ministry of health of the host country and CDC, with both parties contributing resources and reaching agreement on the priorities of the program. Each site will be built on existing CDC field capacity in that country. Some IEIPs may be based at research institutions



Presentation of certificates: Workshop on HIV/AIDS Epidemiology, Surveillance, and Prevention, May 2000, Nha Trang City, Khanh Hoa Province, Vietnam. Since Vietnam and United States renewed diplomatic relations, Vietnamese and U.S. scientists and public health workers have collaborated on workshops, training courses, and research projects that build national capacity to detect and prevent HIV/AIDS, TB, malaria, typhoid fever, influenza, hospital-acquired infections, plague, and dengue and dengue hemorrhagic fever.

Photographer: Nguyen Thi Thu Hong, HHS/CDC/Hanoi

Box 22

USAID and CDC: Collaboration on Capacity Building

The U.S. Agency for International Development (USAID) and CDC are longstanding partners in the effort to combat emerging diseases overseas. Twenty years ago, CDC and USAID collaborated with WHO and other partners to eradicate smallpox. Today, CDC and USAID are helping eradicate polio; reduce deaths from malaria, HIV/AIDs, TB, and acute respiratory infections; and improve global surveillance for emerging threats.

In many countries, CDC partners with USAID on evaluations of infectious disease problems related to wars, famines, or other disasters, as well as on development projects that involve epidemiologic or diagnostic research. CDC also helps implement USAID-supported programs in the four key areas of USAID's emerging infectious disease initiative:

- **Antimicrobial resistance:** Developing and implementing strategies and interventions for detecting, studying, and containing emerging resistance problems.
- **TB:** Working for a sustainable reduction in the incidence of TB among key populations in selected countries through by the introduction of directly observed therapy short-course strategy (DOTS; see Box 6).
- **Malaria:** Improving the diagnosis and treatment of malaria; promoting effective preventive strategies; addressing the challenges of malaria in pregnancy; containing malaria outbreaks; responding to malaria during complex emergencies; slowing the emergence and spread of drug-resistant malaria; and accelerating the development of tools for malaria control.
- **Disease surveillance and response:** Improving public health capacity to obtain and use good quality data for disease surveillance and effective response to infectious diseases.

As part of the global strategy, CDC will intensify its efforts to work with USAID to develop mutually reinforcing ways of working together at the country level to maximize the impact of U.S. investments in global health.

where CDC has long-standing collaborations. Others may be based at CDC field stations or adjacent to other U.S. institutions abroad, such as NIH's Tropical Medicine Research Centers or DoD's overseas laboratories. Each site will maintain close ties with WHO country and regional offices, and, if possible, will collaborate with one of the Field Epidemiology Training Programs (FETPs) that CDC has helped establish in more than 16 countries (Box 24).

The IEIPs will be modeled in part on the U.S. Emerging Infections Program (EIP; http://www.cdc.gov/ncidod/osr/EIP.htm) whose nine sites conduct population-based surveillance, provide emergency outbreak assistance, invest in cutting-edge research, and address new problems whenever they arise. Because the EIP sites combine specialized epidemiologic and laboratory expertise, they are able to go beyond the routine functions of local health departments to address important issues in infectious diseases and public health. For example, when "mad cow disease" was reported in the United Kingdom in 1996, the EIP surveillance sites were able to reassure the U.S. public within a short time that the disease had not spread to the United States.

Like the domestic EIPs, the International EIP sites will perform multiple functions, including research on endemic diseases and emergency surveillance when a new threat appears.

They will also provide disease surveillance data to ministries of health and finance to help assess the burden of specific diseases and evaluate the cost-effectiveness of national public health programs. Also like the EIPs, the IEIPs will incorporate preexisting sites (e.g., U.S. institutions, public health agencies, research institutions, and nongovernmental organizations); use the sites in an integrated fashion; and establish an international steering committee to provide guidance for core projects conducted at all of the IEIP network sites. Areas in which IEIP sites might play an especially important role are in surveillance for drug-resistant forms of malaria, TB, pneumonia, and dysentery. All of the sites will be linked by electronic communications to keep health experts around the world in close contact with one another.

The long-term goal of the IEIPs will be to develop sustainable, in-country capacity for disease surveillance, outbreak investigation, and research on diseases of regional or global importance by fostering the next generation of international public health leaders (Box 16). The implementation of this goal will require extensive scientific, human, and financial resources from both private and public sources, as well as sustained efforts over many years. However, the costs will be low in relation to potential benefits, in terms of both human health and increased global prosperity.

Objectives for Priority Area 6

Establish International Emerging Infections Programs (IEIPs)

- Help create International Emerging Infections Programs (IEIPs) that
  - Train local scientists and CDC personnel
  - Provide diagnostic and epidemiologic resources when outbreaks occur
  - Serve as platforms for regional infectious disease control activities
  - Conduct public health research of global importance
  - Disseminate proven health tools

Expand Training in Epidemiology, Public Health Management, and Laboratory Diagnostics

- Increase training opportunities for foreign scientists in epidemiology, public health management, and state-of-the-art laboratory techniques. For example, CDC will provide training in
  - PulseNet's methods for fingerprinting strains of foodborne bacteria (page 36)
  - Methods for identifying foodborne viruses
  - Drug susceptibility testing of pathogens of public health importance
  - DPDx, an Internet-based system to help confirm diagnoses of parasitic diseases
  - International public health management
  - Managing and implementing HIV treatment and prevention programs in Global AIDS Program countries (see page 52)
- Work through TEPHINET and other mechanisms to provide technical assistance to health authorities in countries that are establishing or expanding national schools of public health, new Field Epidemiology Training Programs (FETPs), new Sustainable Management Development Programs, or the Rockefeller Foundation-supported Public Health Schools Without Walls (PHSWOW). TEPHINET is a public health network network that links FETP and PHSWOW staff.
- Help increase the number of public health workers in developing countries who are trained in vaccine work by
  - Encouraging training efforts by foreign governments, foundations, and donor organizations (e.g., the WHO public health training project in Lyon, France)
  - Incorporating training components into such projects as the U.S.-India Vaccine Plan, the Egyptian Schistosomiasis Vaccine Development Project, and the HIV vaccine trials in Kenya and Côte d'Ivoire (Box 18)

Box 23

The World Bank and CDC Sign a Memorandum of Understanding

Infectious diseases are not just a result of, but also a *cause* of, poverty (see Box 8). In recognition of this fact, the World Bank, a leading global development lender, signed a memorandum of understanding with CDC in February 2001, to intensify joint efforts to prevent and control diseases that take a heavy toll in developing countries.

Under the agreement, CDC and the World Bank will collaborate on a broad range of global health activities, related to nutrition, maternal and child health, endemic diseases such as HIV/AIDS, TB, and malaria, public health, health surveillance, health policy and statistics, research, and healthcare technology. Over the next year, for example, CDC will transfer technical experts to the World Bank to help design, implement, and evaluate projects to control the spread of malaria in Africa and promote worldwide use of vaccines against many childhood diseases.

The memorandum will also facilitate previously established collaborations between the World Bank and CDC, including an ongoing project to upgrade the surveillance infrastructure for infectious diseases in Argentina and Brazil, from the local to the national level. That effort includes

- Training public health workers in epidemiology, management, and laboratory science
- Establishing electronic reporting networks and sentinel sites for disease surveillance
- Enhancing laboratory capacity
- Strengthening outbreak response
- Instituting measures to prevent the spread of TB and other priority diseases

  - Training national and regional health workers in vaccine program planning, monitoring, and evaluation as part of GAVI's effort to improve routine immunization services and to introduce new and underutilized vaccines into developing countries
- Provide training opportunities that increase international expertise in the detection and treatment of prenatal and perinatal infections.
- Expand the cohort of public health professionals at CDC who have international infectious disease expertise, by
  - Creating an inventory of CDC staff to identify gaps in international expertise
  - Developing an international infectious disease training program or seminar series for CDC staff, in collaboration with public health and medical schools
  - Establishing an exchange program that enables visiting scientists from other countries to work at CDC and vice versa
  - Working with the Association of Schools of Public Health and the Association of Teachers of Preventive Medicine to increase the number of graduate courses that cover global infectious disease issues
- Expand opportunities for training in-hospital infection control and clinical surveillance by providing
  - Train-the-trainer courses in hospital epidemiology
  - Technical assistance to hospital staff in designing and implementing programs to reduce transmission of nosocomial pathogens

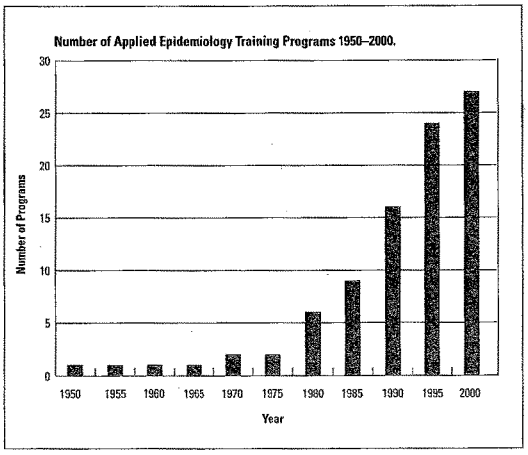
Box 24

Applied Field Epidemiology Training Programs

For more than 20 years, CDC has collaborated with ministries of health around the world to establish Field Epidemiology Training Programs (FETPs) for specialists in epidemiology. These programs are modeled on the Epidemic Intelligence Service, CDC's primary applied epidemiology training program, which was founded in 1951. Canada established a field epidemiology training program in 1975, and Thailand launched one in 1980, in collaboration with CDC and WHO. CDC partners who have helped establish other FETPs include the World Bank (Brazil), PAHO (a regional FETP in Central America), and USAID (Egypt, Jordan, Peru, Philippines, and Central America).

CDC has also provided consultants to **Public Health Schools Without Walls (PHSWOW)**, which helps post-graduate-level public health personnel attain the epidemiologic, managerial and leadership competencies required to run increasingly decentralized health systems. The PHSWOWs are funded by the Rockefeller Foundation with technical support from Tulane University. The first PHSWOW was launched in Zimbabwe in 1993 at the University of Zimbabwe; the second in Uganda in 1994 at Makerere University; and the third in Ghana in 1995 at the University of Ghana. In 1997, Vietnam started a PHSWOW in collaboration with the Hanoi School of Public Health.

As of 2000, in addition to EIS, there were 27 Applied Epidemiology Training Programs, including 20 FETPs, 4 PHSWOWs, and 3 other Applied Epidemiology Training Programs (the European Programme for Intervention Epidemiology Training [EPIET], the WHO Global Health Leadership Officers Programme [GHLOP], and the WHO/AFRO Programme d'Epidemiologie Pratique [PEP]). Of 19 programs over 4 years old, 18 (95%) continue to produce graduates. Thus far, it is estimated that the 27 Applied Epidemiology Training Programs have trained more than 900 international public health leaders in epidemiology and outbreak investigation. Approximately 420 more are currently in training.



- Consultation to USAID and other donor organizations on infectious disease projects that build infrastructure to improve the provision of prenatal and perinatal care in developing countries.

Enhance Availability of Guidelines and Other Publications

- In collaboration with WHO and international experts, draft regional health care guidelines on the judicious use of antibiotics, including antibiotics that are purchased over-the-counter. Regional health care guidelines can be used to mount public health education campaigns on antibiotic usage to help retard the development of drug resistance.
- Provide consultation to ministries of health in developing national guidelines for
  - Hospital infection control, including prevention of hospital-acquired pneumonia, TB, HIV/AIDS, and other nosocomial infections of local concern.
  - Management of exposures to bloodborne pathogens like HIV and hepatitis B and C.
- Disseminate new information on infectious disease issues through the *Morbidity and Mortality Weekly Report (MMWR)*, the *Emerging Infectious Diseases* journal, and the CDC website.

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ACRONYMS

AFRIMS	Armed Forces Research Institute of Medical Science, Bangkok, Thailand
AIDS	acquired immunodeficiency syndrome
AIMI	African Integrated Malaria Initiative
AMREF	African Medical and Research Foundation
APEC	Asia-Pacific Economic Cooperation
APHL	Association of Public Health Laboratories
ATSDR	Agency for Toxic Substances and Disease Registry
BIDS	U.S.-Mexico Border Infectious Disease Surveillance system
CAREC	Caribbean Epidemiology Center
DoD	Department of Defense
DOTS	directly observed therapy short-course strategy
DVA	Department of Veterans Affairs
ELISA	enzyme-linked immunosorbent assay
EPI	Expanded Programme on Immunization
EPIET	European Programme for Intervention Epidemiology Training
EIP	Emerging Infections Program
EWORS	Early Warning Outbreak Recognition System
FDA	Food and Drug Administration
FETP	Field Epidemiology Training Program
GAP	Global AIDS Program
GAVI	Global Alliance for Vaccines and Immunization
GHLOP	WHO Global Health Leadership Officers Programme
HIV	human immunodeficiency virus
HIV/AIDS	human immunodeficiency virus infection/acquired immunodeficiency syndrome
HFRS	hemorrhagic fever with renal syndrome
HPS	hantavirus pulmonary syndrome
IFRC	International Federation of Red Cross and Red Crescent Societies
IHR	International Health Regulations
IPAA	International Partnership Against AIDS in Africa
IUATLD	International Union Against TB and Lung Diseases
KEMRI	Kenya Medical Research Institute
LIFE	Leadership and Investment for Fighting an Epidemic initiative
LITS	Laboratory Information Tracking System

MERTU/G	Medical Entomology Research and Training Unit/Guatemala
NAMRU-2	Naval Medical Research Unit No. 2, Jakarta, Indonesia
NAMRU-3	Naval Medical Research Unit No. 3, Cairo, Egypt
NASA	National Aeronautics and Space Agency
NGO	nongovernmental organization
NIH	National Institutes of Health
NMRCD	Naval Medical Research Center Detachment, Lima, Peru
NOAA	National Oceanic and Atmospheric Administration
PacNET	Pacific Public Health Surveillance Network
PAHO	Pan American Health Organization
PEP	WHO/AFRO Programme d'Epidemiologie Pratique
PHLIS	Public Health Laboratory Information System
PHSWOW	Public Health Schools Without Walls
RBM	Roll Back Malaria initiative
SIGN	Safe Injection Global Network
STD	sexually transmitted diseases
STI	sexually transmitted infections
TB	tuberculosis
TEPHINET	Training in Epidemiology and Public Health Interventions Network
UNAIDS	Joint United Nations Programme on AIDS
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USAMRU-K	United States Army Medical Research Unit, Nairobi, Kenya
USDA	United States Department of Agriculture
WHO	World Health Organization
WHO/AFRO	World Health Organization Regional Office for Africa
WHO/EMRO	World Health Organization Regional Office for the Eastern Mediterranean

APPENDIX A
GLOBAL HEALTH WEBSITES

Organization	Publication	Web Address
Carter Center	Guinea Worm Eradication Program	http://www.cartercenter.org/guineaworm.html
Center for Strategic and International Studies	Contagion and Conflict: Health as a Global Security Challenge	http://www.csis.org
Centers for Disease Control and Prevention	The HIV/AIDS Collaboration, CDC and The Ministry of Public Health Thailand	http://www.hac.or.th/
Centers for Disease Control and Prevention	Global Polio Eradication Initiative	http://www.cdc.gov/nip/global
Centers for Disease Control and Prevention	Guinea Worm Disease Fact Sheet	http://www.cdc.gov/ncidod/dpd/parasites/guineaworm
Centers for Disease Control and Prevention	Global AIDS Program	http://www.cdc.gov/nchstp/od/gap
Centers for Disease Control and Prevention	Working with Partners to Improve Global Health: A Strategy for CDC and ATSDR	http://www.cdc.gov/ogh/pub/strategy.htm
Centers for Disease Control and Prevention	International Health Data Reference Guide, 1999	http://www.cdc.gov/nchs/data/ihdrg99.pdf
Centers for Disease Control and Prevention	U.S.-Mexico Border Infectious Diseases Surveillance	http://www.r10.tdh.state.tx.us/obh/bids.htm
Centers for Disease Control and Prevention	Preventing Emerging Infectious Diseases: A Strategy for the 21st Century	http://www.cdc.gov/ncidod/emergplan
Centers for Disease Control and Prevention	Biological and ChemicalTerrorism: Strategic Plan for Preparedness and Response	http://bt.cdc.gov/documents/btstratplan.pdf
Centers for Disease Control and Prevention	Protecting the Nation's Health in an Era of Globalization: CDC's Global Infectious Disease Strategy	http://cdc.gov/globalidplan.htm
Council on Foreign Relations and Milbank Memorial Fund	Why Health Is Important to U.S. Foreign Policy	http://www.cfr.org//public/pubs/Kassalow_Health_Paper.htm
Department of Defense	Global Emerging Infections System	http://www.geis.ha.osd.mil
Department of Health and Human Services	DHHS Global Health Website	http://www.globalhealth.gov
Bill and Melinda Gates Foundation		www.gatesfoundation.org
Global Alliance for Vaccines and Immunization		http://www.vaccinealliance.org/
Institute of Medicine	Emerging Infections from the Global to Local Perspective	http://www4.nationalacademies.org/iom/iomhome.nsf
Institute of Medicine	America's Vital Interest in Global Health	http://www.nap.edu/books/0309058341/html
Joint United Nations Programme for AIDS (UNAIDS)		http://www.unaids.org
National Institute of Allergy and Infectious Diseases, National Institutes of Health	Global Research Plan for HIV/AIDS, Malaria, and Tuberculosis	http://www.niaid.nih.gov/publications/globalhealth / global.pdf
National Intelligence Council	The Global Infectious Disease Threat and Its Implications for the United States	http://www.cia.gov/cia/publications/nie/report/ nie99-17d.html

Organization	Publication	Web Address
National Science and Technology Council, Committee on International Science, Engineering, and Technology, Working Group on Emerging and Reemerging Diseases	Infectious Disease—A Global Health Threat	http://www.ostp.gov/CISET/html/toc.html
Rockefeller Foundation	Program on Health Equity	http://www.rockfound.org/display.asp?context=3&SectionTypeID=13
Roll Back Malaria		http://www.rbm.who.int
Safe injection Global Network		http://www.injectionsafety.org
Stop TB Initiative		http://www.stoptb.org
United Nations Foundation		http://www.unfoundation.org
United States Agency for International Development	Infectious Disease Strategy	http://www.usaid.gov/pop.health/ID/index/html
World Bank, Pan- American Health Organization, and Inter- American Development Bank	Shared Agenda for Health in the Americas	http://wbln0018.worldbank.org/external/lac/lac.nsf
World Bank	World Development Report 2000/2001	http://www.worldbank.org/poverty/wdrpoverty/report
World Health Organization	Removing Obstacles to Healthy Development	http://www.who.int/infectious-disease- report/index-rpt99.html
World Health Organization	WHO Antimicrobia. Resistance Infobank	http://oms2.b3e.jussieu.fr/arinfobank
World Health Organization	WHO Report on Global Surveillance of Epidemic-prone Infectious Diseases	http://www.who.int/emc- documents/surveillance/docs/whocdscsrisr2001.ht ml/Tableofcontents/about.htm
World Health Organization	Overcoming Antimicrobial Resistance	http://www.who.int/infectious-disease-report/2000/index.html
World Health Organization	Global Strategy for the Containment of Antimicrobial Resistance	http://www.who.int/emc/globalstrategy/strategy.html
World Health Organization	The World Health Report 2000	http://www.who.int/whr/2000/en/report.htm
World Health Organization, Rotary International, Centers for Disease Control and Prevention, United Nations Children Fund (UNICEF)	Global Polio Eradication Initiative	http://www.polioeradication.org
World Health Organization, UNICEF, UNAIDS, World Bank, United Nations Educational, Scientific, and Cultural Organization (UNESCO), United Nations Population Fund	Health a Key to Prosperity	http://www.who.int/inf-new/

APPENDIX B DIPLOMATIC FORUMS THAT ADDRESS EMERGING INFECTIOUS DISEASE ISSUES

Emerging infectious diseases are a topic of discussion at many high-level international meetings, including

Group of Eight Industrialized Nations (G8)[a]
http://usinfo.state.gov/topical/econ/group8

Asia-Pacific Economic Cooperation (APEC)[b]
http://www.apecsec.org.sg

Common Agenda with Japan
http://www.mofa.go.jp/region/n-america/us/agenda

Transatlantic Agenda with the European Union
http://www.eurunion.org/partner/agenda.htm

U.S.-Mexico Binational Commission
http://www.r10.tdh.state.tx.us/obh/bids.htm

The Arctic Council[c]
http://www.arctic-council.org

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a. The Group of Eight Industrialized Nations includes: Canada, France, Germany, Italy, Japan, the Russian Federation, the United States, and the United Kingdom.

b. The economies of the Asia-Pacific Economic Cooperation include Australia, Brunei, Canada, Chile, China, Hong Kong China, Indonesia, Japan, Republic of Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, the Philippines, Russia, Singapore. Chinese Taipei, Thailand, the United States, and Vietnam.

c. The Arctic Council includes: Canada, Finland, Greenland/Denmark, Iceland, Norway, Russia, Sweden, and the United States.

APPENDIX C EXAMPLES OF INTERNATIONAL OUTBREAK ASSISTANCE

During the 1990s, CDC participated in numerous outbreak investigations in other countries, sometimes as part of an international WHO team and sometimes in direct response to a request from an affected nation. These investigations included

1990	Japanese encephalitis in Saipan
1990	Epidemic dysentery in Burundi
1991	Hepatitis E in Kenya and Somalia
1991-92	Epidemic dysentery in Zambia
1991	Cholera in Bolivia, Ecuador, El Salvador, Guatemala, and Peru
1991	Cholera in Brazil
1991	Polio in Romania
1991	Polio in Bulgaria
1992	Polio in Jordan
1992-96	Diphtheria in Ukraine
1993-96	Diphtheria in Russia
1993	Polio in Namibia
1993	Polio in Uzbekistan
1994	Dengue in Nicaragua
1994	Plague in India
1994-95	Measles in Palau, Guam, and the Federated States of Micronesia
1995	Diphtheria in Georgia, Kyrgyzstan, Kazakhstan, Uzbekistan, and Turkmenistan
1995	Leptosporosis in Nicaragua
1995	Ebola fever in the Democratic Republic of the Congo (then Zaire)
1996	Epidemic dysentery in South Africa
1996	West Nile encephalitis in Romania
1996	Typhoid fever in Tadjikistan
1996	*E. coli* O157:H7 infection in Japan
1996	Polio in Albania
1997	Polio in Turkey
1997	Botulism in Argentina
1997	Cholera in Kenya
1997	Avian influenza in Hong Kong
1997	Rift Valley fever in Kenya
1997	O'nyong-nyong fever in Uganda

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1997	Nosocomial HIV-associated multidrug-resistant TB in Argentina
1997	Multidrug-resistant TB in Colombia
1998	Measles in Romania
1998	Bolivian hemorrhagic fever in Bolivia
1999	Louseborne relapsing fever in southern Sudan
1998	Plague in Ecuador
1998	Dengue in Palau
1998	Dengue in Yap
1998	Amebiasis in the Republic of Georgia
1998-99	Influenza outbreaks on cruise ships (U.S.-Canada)
1999	Dengue fever on U.S.-Mexico border
1999	Epidemic poststreptococcal glomerulonephritis in Brazil
1999	Typhoid fever in Nauru
1999	Nipah virus encephalitis in Malaysia
1999	Marburg fever in the Democratic Republic of the Congo
1999	Polio in Angola
1999	Measles in Costa Rica
1999-2000	Hantavirus pulmonary syndrome in Panama
2000	Polio in the Democratic Republic of the Congo
2000	Tularemia in Kosovo
2000	Cholera in Pohnpei State, Federated States of Micronesia
2000	Rift Valley fever in Saudi Arabia and Yemen
2000	Ebola hemorrhagic fever in Uganda
2000	Measles in Haiti, Dominican Republic, Bolivia
2000	Polio in Haiti and the Dominican Republic
2000	Measles in Zambia
2000	Diphtheria in Latvia
2000	Dengue hemorrhagic fever in El Salvador

APPENDIX D WHO COLLABORATING CENTRES (WHOCCS) BASED AT CDC

WHOCC for Antimicrobial Resistance
WHOCC for Arthropod-Borne Viruses in the Western Hemisphere
WHOCC for *Clostridium botulinum*
WHOCC for Dengue and Dengue Hemorrhagic Fever
WHOCC for Research, Training, and Eradication of Dracunculiasis
WHOCC for HIV/AIDs
WHOCC for Reference and Reagents for Human Immunoglobulin Subclasses
WHOCC for Foodborne Disease Surveillance
WHOCC for Surveillance, Epidemiology, and Control of Influenza
WHOCC for Evaluating and Testing New Insecticides
WHOCC for Leptospirosis
WHOCC for Control and Elimination of Lymphatic Filariasis
WHOCC for Malaria Control in Africa
WHOCC for Production and Distribution of Malaria Sporozoite ELISAs
WHOCC for Mycoses in North America
WHOCC for Reference and Research on Plague Control
WHOCC for Poliovirus and Enterovirus Surveillance
WHOCC for Reference and Research on Rabies
WHOCC for Respiratory Viruses Other Than Influenza
WHOCC for Rickettsial Diseases
WHOCC for *Shigella*
WHOCC for Smallpox and Other Poxvirus Infections
WHOCC for Reference and Research in Syphilis Serology
WHOCC for Viral Hemorrhagic Fevers
WHOCC for Reference and Research on Viral Hepatitis

Tentative WHO Approval:

WHOCC for Lyme Borreliosis
WHO/PAHO Collaborating Center for Rotavirus and the Agents of Viral Gastroenteritis
WHOCC for Public Health Systems and Practice

Proposed New Centers:

WHOCC for Cysticercosis
WHOCC for Molecular Identification and Typing of Insect Disease Vectors
WHOCC for Measles Virus Diagnostics (also serves as the PAHO Regional Measles Reference Laboratory)
WHOCC for Prevention and Control of Epidemic Meningitis
WHOCC for Prevention and Control of *Mycobacterium ulcerans* (Buruli ulcer)
WHOCC for Insecticide Resistance
WHOCC for Infectious Disease Pathology
WHOCC for Salmonella Surveillance
WHOCC for Streptococcus
WHOCC for *Vibrio cholerae* O1 and O139

APPENDIX E REGIONAL AND DISEASE-SPECIFIC SURVEILLANCE NETWORKS

A. Regional Networks for Disease Surveillance & Outbreak Response

Africa

- Integrated Disease Surveillance and Epidemic Preparedness and Response Project, led by WHO/AFRO
- International Disease Survey for diseases of epidemic potential (e.g., meningitis, yellow fever, cholera, measles, and polio), supported by USAID

Other disease surveillance activities in Africa:
The disease surveillance component of UNAIDS' International Partnership Against HIV/AIDS in Africa (IPAA) monitors progress in reducing infection rates and deaths from HIV/AIDS, TB, and opportunistic infections.

As part of USAID's African Integrated Malaria Initiative (AIMI), CDC helps ministries of health in Benin, Kenya, Malawi, and Zambia monitor progress in reducing illness and deaths from malaria. During 2001, AIMI surveillance activities will also be conducted in collaboration with the ministries of health of the Democratic Republic of the Congo, Nigeria, Senegal, and Uganda.

The U.S. Army Medical Research Unit in Nairobi (USAMRU-Kenya) is coordinating an effort to enhance surveillance for HIV/AIDS, malaria, yellow fever, and enteric illnesses in east Africa. Partners include ministries of health in Kenya and Uganda. the Kenya Medical Research Institute (KEMRI), the African Medical and Research Foundation (AMREF), and CDC's Kenya Field Station.

The Americas and the Caribbean

- Amazon Basin Network
  Includes 7 laboratories from 5 nations
- Southern Cone Network
  Includes 8 laboratories from 6 nations
- Caribbean Epidemiology Center (CAREC) disease surveillance system
  Includes the 21 members of CAREC
- Middle America Network
- U.S.-Mexico Border Infectious Disease Surveillance System
- U.S./Canada International Circumpolar Surveillance project to enhance surveillance for invasive bacterial infections among indigenous peoples in subarctic regions of northern Canada and Alaska. This project is conducted in association with the International Circumpolar Surveillance project in Europe (see: Europe).

Other disease surveillance activities in the Americas and the Carribean:
The U.S. Naval Medical Research Center Detachment (NMRCD) in Lima is coordinating an effort to enhance surveillance for malaria, yellow fever, dengue, and other hemorrhagic fevers in South America. Planners include ministries of

health of Peru, Ecuador, and Bolivia, WHO/PAHO, and CDC. An epidemiologist from CDC is currently stationed at NMRCD.

Asia

- Mekong Delta Surveillance Network.
  Includes China (Yunan), Cambodia, Laos, Thailand, Myanmar, and Vietnam
- Pacific Public Health Surveillance Network (PacNet)
  Includes 20 Pacific Islands
- Early Warning Outbreak Recognition System (EWORS)
  A collaboration between the Indonesian Ministry of Health and U.S. Naval Medical Research Unit No. 2 (NAMRU-2). It currently involves hospitals throughout Indonesia and is expanding to include hospitals in Cambodia.

Other disease surveillance activities in Asia:
Disease Surveillance and Electronic Networking are two of six "pillars" in a strategy to fight HIV/AIDS and infectious diseases endorsed at the 2001 summit meeting of the Asia Pacific Economic Cooperation (APEC). (The other pillars are: Outbreak Response, Capacity Building, Partnering Across Sectors, and Political and Economic Leadership.) As part of this effort, work has begun toward the creation of an Asia-Pacific network of networks that will knit together existing electronic infectious disease networks and facilitate timely transmission of public health information across APEC economies. The cooperative system will build on existing APEC projects that enhance surveillance for influenza, *E. coli* O157 infection, dengue, and dengue hemorrhagic fever.

The first International Emerging Infectious Program (IEIP) was established in Bangkok in September 2001, as a collaboration between CDC and the Ministry of Health of Thailand. This IEIP site will serve as a resource for infectious disease surveillance networks in Asia.

The United States participates in binational projects to improve disease surveillance with Vietnam, Thailand, and Cambodia. These collaborations are coordinated by CDC, the Armed Forces Research Institute of Medical Science (AFRIMS-Thailand) in Bangkok, and NAMRU-2 in Jakarta. For example, an epidemiologist from CDC stationed at NAMRU-2 and a satellite laboratory in Phnom Pen is working with the Cambodian Ministry of Health to establish a school of public health. An epidemiologist from CDC has also been assigned to China to facilitate collaborative projects that address the prevention and control of viral hepatitis, which is a mjor public health concern in China.

Europe

- E.U.'s EnterNet system for surveillance of international foodborne outbreaks
- International Circumpolar Surveillance project to enhance monitoring of invasive bacterial infections in the circumpolar regions of Europe (Iceland,

Greenland [Denmark], Norway, Sweden, Finland and Russia). This project is conducted in association with the U.S./Canada International Circumpolar Surveillance project (see: The Americas and the Caribbean).

The Middle East

- WHO Middle East Initiative to enhance disease surveillance in Israel and the Palestinian territories

Other disease surveillance activities in the Middle East:
The U.S. Naval Medical Research Unit No. 3 (NAMRU-3) in Cairo is coordinating a collaborative effort to enhance surveillance for diseases of importance in the Middle East (e.g., meningitis, influenza, acute febrile illnesses, and antibiotic-resistant enteric organisms). Partners include the Egyptian Ministry of Health and Population, health authorities in Yemen, Pakistan, and the Palestinian Territories, WHO/EMRO, and CDC. An epidemiologist from CDC is currently stationed at NAMRU-3.

B. Selected Global Networks for Infectious Disease Surveillance & Outbreak Response

- WHO Influenza Surveillance Network
- WHO Global Network for Polio Eradication/Measles Elimination
- WHO Supranational Reference Laboratory Network for Antituberculosis Drug Resistance
- WHO Global Salmonella Surveillance (Global Salm-Surv)
- WHO Global Alert and Response Network (see Box 14)
- Surveillance in support of the worldwide eradication of guinea worm disease
- Surveillance for vaccine-preventable diseases under the Expanded Programme on Immunization (EPI)
- GeoSentinel, the global surveillance network of the International Society of Travel Medicine

  Includes 26 travel and tropical medicine clinics, 15 in the United States, 2 in the United Kingdom, 2 in Australia, and 1 each in Canada, Germany, Israel, Italy, Nepal, New Zealand, and Switzerland

As mentioned above, the first International Emerging Infectious Program (IEIP) was established in 2001 in Thailand. As new IEIP sites are founded (see page 53), they will provide technical assistance to local disease surveillance networks and become members of a global IEIP network.

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REFERENCES

1. Zhu T, Korber B, Nahmias AJ, Hooper E, Sharp PM, Ho DD. An African HIV-1 sequence from 1959 and implications for the origin of the epidemic. Nature 1998;391:594-7.
2. Lanciotti RS, Roehrig JT, Duebel V, et al. Origin of the West Nile virus responsible for an outbreak of encephalitis in the northeastern United States. Science 1999;286:2333-7.
3. Working Group on Emerging and Re-emerging Infectious Diseases. Committee on Science, Engineering, and Technlogy (CISET), National Science and Technology Council. *Infectious Disease—A Global Health Threat.* Washington, DC: U.S. Government Printing Office, 1995. http://www.ostp.gov/CISET/html/toc.html
4. Institute of Medicine. *America's Vital Interest in Global Health.* Washington, DC: National Academy Press, 1997. http://www.usaid.gov/pop_health/id/index.html
5. Garrett L. *Betrayal of Trust: The Collapse of Global Public Health.* New York: Hyperion, 2000.
6. The global infectious disease threat and its implications for the United States. National Intelligence Estimate (NIE 99-17D). January 2000. http://www.cia.gov/cia/publications/nie/report/nie99-17d.html
7. Gallup JL, Sachs, JD. The economic burden of malaria. Harvard Center for International Development Working Paper No. 52, July 2000. http://www.cid.harvard.edu/cidwp/052.htm/
8. World Health Organization Press Release WHO/28, 25 April 2000. Economic costs of malaria are many times higher than previously estimated. Joint report issued by the World Health Organization, Harvard University, and the London School of Hygiene and Tropical Medicine at the African Summit on Roll Back Malaria in Abuja, Nigeria, April, 2000. http://www.who.int/inf-pr-2000/en/pr2000-28.html
9. World Bank. *Confronting AIDS: Public Priorities in a Global Epidemic.* New York: Oxford University Press. 1997.
10. Centers for Disease Control and Prevention. *Preventing Emerging Infectious Diseases: A Strategy for the 21st Century.* Atlanta, GA: U.S. Department of Health and Human Services, 1998. http://www.cdc.gov/nci-dod/emergplan
11. Centers for Disease Control and Prevention. *Working with Partners To Improve Global Health: A Strategy for CDC and ATSDR,* Atlanta, GA: U.S. Department of Health and Human Services, 2000. http://www.cdc.gov/ogh/pub/strategy.pdf
12. Quinn TC, Mann JM, Curran JW, Piot P. AIDS in Africa: an epidemiologic paradigm. Science 1986;234:956-63.
13. Lengeler C. Insecticide-treated bednets and curtains for preventing malaria (Cochrane Review). In: The Cochrane Library, Issue 3, 2001. Oxford: Update Software.
14. Quick RE, Venczel LV, Mintz ED, et al. Diarrhea prevention in Bolivia through point-of-use disinfection and safe storage: a promising new strategy. Epidemiology and Infection: 1999;122:83-90.
15. U.S. Agency for International Development and UNAIDS. *Children on the Brink—2000.* Http://www.usaid.gov/pubs/hiv_aids/childrenreport.pdf
16. *Shared Agenda for Health in the Americas,* Pan American Health Organization, Inter-American Development Bank, and the World Bank. Http://wbln0018.worldbank.org/external/lac/lac.nsf
17. *Global Measles Mortality Reduction and Regional Elimination: Strategic Plan, 2001–2005.* WHO/UNICEF, November 2000. Http://www.unicef.org/newsline/01pr26.htm

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Atlanta, GA 30333
Fax: 404-371-5490

or visit the website: www.cdc.gov/globalidplan.htm

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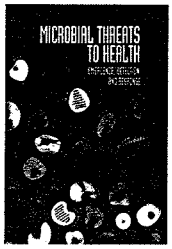
Shaping the Future for Health

MICROBIAL THREATS TO HEALTH:
EMERGENCE, DETECTION, AND RESPONSE



Infectious diseases continue to be a serious burden around the world, in developing and industrialized countries alike. Whether naturally occurring or intentionally inflicted, infections can cause illness, disability, and death in individuals while disrupting whole populations, economies, and governments. And because national borders offer trivial impediment to such threats, especially in the highly interconnected and readily traversed "global village" of our time, one nation's problem soon becomes every nation's problem. The United States has shown leadership in the past by strengthening its own and others' capacities to deal with infectious diseases, but the present reality nevertheless is that public health and medical communities are inadequately prepared. We must do more to improve our ability to prevent, detect, and control emerging—as well as resurging—microbial threats to health.

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In 1992, the Institute of Medicine (IOM) published a landmark report, *Emerging Infections: Microbial Threats to Health in the United States*, offering the consensus of a wide-ranging group of specialists that America needed a wake-up call. The report maintained that infectious diseases were a tangible threat to our security and that we might soon regret the comfort and complacency that had overtaken us with the advent of wonder drugs and vaccines. That study was a stimulus for numerous other studies and policy actions, many of them in response to the harsh realities of the spread of HIV/AIDS, the emergence of new or previously unrecognized diseases, the resurgence of old diseases, and the looming failure of scientific research and technological innovation in antimicrobial drugs to keep up with the constant evolution of microbial resistance.

The present report is the successor to the 1992 IOM document, and it observes that a decade later the impact of infectious diseases on the United States has only increased. Illnesses unknown in this country only a few years ago, such as West Nile encephalitis and hantavirus pulmonary syndrome, have emerged to kill hundreds of Americans—and the long-term consequences for survivors of

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Permanent Subcommittee on Investigations
EXHIBIT #3

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these illnesses are as yet unknown. Meanwhile, *known* diseases that were thought to be virtually eradicated in the United States, such as measles, pertussis, and malaria, still reappear, occasionally in epidemic proportions. Moreover, gains made against sexually transmitted diseases have recently slowed or reversed in certain population groups.

Compounding the danger posed by these infectious diseases are other important trends: the continuing increase in antimicrobial resistance, which has become pervasive not only in the United States but worldwide; the country's diminished capacity to recognize and respond to microbial threats—particularly those originating elsewhere; and the intentional use of biological agents to do harm.

Thus conclude the report's authors, the Committee on Emerging Microbial Threats to Health in the 21st Century, who were charged by IOM in 2001 to: review the current state of knowledge on the emergence of infectious diseases; assess the capacity of the United States to detect and respond to microbial threats to health; and identify potential challenges and opportunities for public health actions, both global and domestic, to strengthen capabilities in prevention, detection, and response.

In other words, the committee's assignment was to set forth the principal factors involved in the threats' emergence, take stock of existing measures for dealing with them, and specify what further investments of fiscal and political capital are needed. The committee's subsequent conclusions and recommendations are summarized below.

FACTORS IN EMERGENCE

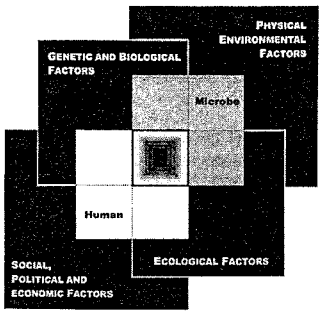
It's conceivable, in fact, that in certain places microbial "perfect storms" could occur—convergences of *all* the factors—and unlike meteorological perfect storms, the events would not be on the order of once-in-a-century, but frequent.

Thirteen individual factors—some reflecting the ways of nature, most of them reflecting our ways of life—account for new or enhanced microbial threats. Any of these factors alone can trigger problems, but their convergence creates especially high-risk environments where infectious diseases may readily emerge, or re-emerge, afflicting individuals and societies alike while posing particular challenges for the medical and public health communities that must face these situations at the front lines. It's conceivable, in fact, that in certain places microbial "perfect storms" could occur—convergences of several factors—and unlike meteorological perfect storms, the events would not be on the order of once-in-a-century, but frequent.

The individual factors in emergence examined in this report are these:

Microbial Adaptation and Change. The tremendous evolutionary potential of microbes makes them adept at developing resistance to even the most potent drug therapies and complicates attempts at creating effective vaccines.

Human Vulnerability. Susceptibility to infection can result when normal defense mechanisms are impaired by causes such as genetically inherited traits and



The Convergence Model.
At the center of the model is a box representing the convergence of factors leading to the emergence of an infectious disease. The interior of the box is a gradient flowing from white to black; the white outer edges represent what is known about the factors in emergence, and the black center represents the unknown (similar to the theoretical construct of the "black box" with its unknown constituents and means of operation). Interlocking with the center box are the two focal players in a microbial threat to health—the human and the microbe. The microbe–host interaction is influenced by the interlocking domains of the determinants of the emergence of infection: genetic and biological factors; physical environmental factors; ecological factors; and social, political, and economic factors.

malnutrition. Susceptibility can also result from antimicrobial resistance induced by the promiscuous use of antibiotics.

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Climate and Weather. Climate can directly affect disease transmission through its impacts on the replication, movement, and evolution of microbes and vectors; climate can also operate indirectly through its effects on ecology and human behavior.

Changing Ecosystems. Altered environments have immense influence on the transmission of microbial agents, whether waterborne, airborne, foodborne, or vector-borne.

Economic Development and Land Use. Commercial activities can have intended or unintended impacts on the environment. For example, new or previously unknown infectious diseases have emerged from the increased human contact with animal reservoirs that resulted from changing land-use patterns.

Human Demographics And Behavior. Infectious diseases can result from individuals' activities that involve exposure to microbial pathogens or simply from the increased probability of infectious disease as populations grow and people come into closer contact.

Technology and Industry. Advances in medical technologies, such as blood transfusions and organ transplants, have created new pathways for the spread of certain infections. Meanwhile, the use of antibiotics in food-product animals has heightened antimicrobial resistance.

International Travel and Commerce. The rapid and virtually unrestricted transport of humans, animals, foods, and other goods can lead to the broad dissemination of pathogens and their vectors throughout the world.

Breakdown of Public Health Measures. In many places, the lack of basics such as potable water or sanitation contributes to infectious diseases. But similar effects can also occur elsewhere from inadequate vaccine supplies, low immunization rates, or a paucity of expertise—say, in vector control.

Poverty and Social Inequality. Mortality from infectious diseases is closely correlated with global inequities in income. Economic trends affect not only the individuals at risk but also the structure and availability of public health institutions necessary to reduce risks.

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War and Famine. Displacement caused by war and the fairly consistent sequelae of malnutrition from famine can contribute significantly to the emergence and spread of infectious diseases.

Lack of Political Will. It is not only the governments in the regions of highest disease prevalence that must commit themselves, but also the leaders of affluent regions that ultimately share the same global microbial landscape.

Intent To Harm. The world today is vulnerable to the threat of deliberate biological attacks that can cause large numbers of deaths and widespread social disruption. The likelihood of such events, in fact, is high, and public health systems and health care providers must be prepared to address them.

DETECTION AND RESPONSE: ADDRESSING THE THREATS

Who should do what, and why, to reduce the rising infectious disease rates prompted by the above emergence factors both singly and in combination? The committee responded with an array of conclusions and recommendations for specific actions, actors, and coordinators to fortify or replace current policies and infrastructural elements that the committee deemed inadequate.

Among the committee's most prominent recommendations are the following two, based on the inevitability that an effective national response to infectious diseases, given their highly transportable nature, must be a global response:

The United States should seek to enhance the global capacity for response to infectious disease threats, focusing in particular on threats in the developing world.

The United States should seek to enhance the global capacity for response to infectious disease threats, focusing in particular on threats in the developing world. Efforts should be coordinated by key international agencies such as the World Health Organization (WHO); based in appropriate U.S. federal agencies (the Centers for Disease Control and Prevention [CDC], the Department of Defense [DOD], the National Institutes of Health [NIH], the Agency for International Development [USAID], and the Department of Agriculture [USDA], for example); and include collaboration with private-sector organizations and foundations. Investments should take the form of financial and technical assistance, operational research, en-

hanced surveillance, and efforts to share both knowledge and best public health practices across national boundaries.

The United States should take a leadership role in promoting the implementation of a comprehensive system of surveillance for global infectious diseases that builds on the current global capacity of infectious disease monitoring. To this end, CDC should enhance its regional infectious disease surveillance; DOD should expand and increase in number its Global Emerging Infections Surveillance overseas program sites; and NIH should increase its global surveillance research. In addition, CDC, DOD, and NIH should intensify their efforts to develop and arrange for distribution of laboratory diagnostic reagents needed for global surveillance, transferring technology to other nations where feasible to ensure self-sufficiency and sustainable surveillance capacity. Overseas activities should be coordinated by a single federal agency such as CDC. Sustainable progress and ultimate success in these efforts will require health agencies to broaden partnerships to include nonhealth agencies and institutions such as the World Bank.

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Another of the committee's main recommendations stresses the need to bolster the U.S. public health infrastructure, which has suffered from years of neglect:

U.S. federal, state, and local governments should direct the appropriate resources to rebuild and sustain the public health capacity necessary to respond to microbial threats to health, both naturally occurring and intentional. Expanded prevention and control measures must be executed by an adequately trained and competent workforce. Examples of such measures include surveillance; laboratory capacity; epidemiological, statistical, and communication skills; and systems to ensure the rapid utility and sharing of information.

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The committee directly aims a recommendation—involving the critical need for vaccine development, production, and deployment—to the highest levels in government, which at present are " neither addressing all of these challenges at a sufficiently high level nor providing adequate resources":

The U.S. Secretary of Health and Human Services should ensure the formulation and implementation of a national vaccine strategy for protecting the U.S. population from endemic and emerging microbial threats. Only by focusing leadership, authority, and accountability at the cabinet level can the federal government meet its national responsibility for ensuring an innovative and adequately funded research base for existing and emerging diseases as well as an ample supply of vaccines. In that spirit , the Secretary of HHS should work closely with other relevant federal agencies, Congress, industry, academia, and the public health community.

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To avert an imminent crisis resulting from microbial agents' increasing resistance to available antimicrobial drugs, the committee recommmends procedures to alert infectious disease control stakeholders to the problem and more finely target the use of antimicrobials. It also advises action on one major source of the problem:

FDA should ban the use of antimicrobials for growth promotion in animals if those classes of antimicrobials are also used in humans.

> CDC, FDA, professional health organizations, academia, health care delivery systems, and industry should expand efforts to decrease the inappropriate use of antimicrobials in human medicine through (1) expanded outreach and better education of health care providers, drug dispensers, and the general public on the inherent dangers associated with the inappropriate use of antimicrobials; and (2) the increased use of diagnostic tests, as well as the development and use of rapid diagnostic tests, to determine the etiology of infection and thereby ensure the more appropriate use of antimicrobials.
>
> FDA should ban the use of antimicrobials for growth promotion in animals if those classes of antimicrobials are also used in humans.

Another important pair of recommendations reflect the present realities that "the reporting of infectious diseases by health care providers and laboratories remains inadequate" and that open lines of communication are essential to robust systems of surveillance, investigation, and response:

The agency should develop innovative strategies to improve communication between health care providers and public health authorities...

> CDC should take the necessary actions to enhance infectious disease reporting by medical health care and veterinary health care providers. The agency should develop innovative strategies to improve communication between health care providers and public health authorities, and it should do so by working with other public health agencies federal, state, and local; health sciences educators; and professional medical organizations. *(The committee specifically identifies what it believes are some of the obligatory actors in these categories.)*
>
> CDC should expeditiously implement automated electronic laboratory reporting of notifiable infectious diseases from all relevant major clinical laboratories (e.g., microbiology, pathology) to their respective state health departments as part of a national electronic infectious disease reporting system. This set of actions would not only improve surveillance but assist in the control of antimicrobial resistance.

Other recommendations in the report involve the development and use of diagnostics, the education and training of the microbial threat workforce, the need for new antimicrobial drugs, vector-borne and zoonotic (animal to human) disease control, a comprehensive infectious disease research agenda for the United States, and the establishment of interdisciplinary infectious disease centers.

TRUMPETING THE MESSAGE

No responsible assessment of microbial threats to health in the 21st century can end without a call to action on what the committee has called a potentially "catastrophic storm of microbial threats."

Dramatic advances in science, technology, and medicine have enabled us to make great strides forward in our struggle to prevent and control infectious diseases, yet we cannot fall prey to an illusory complacency. We must understand that pathogens—old and new—are endlessly resourceful in adapting to and breaching our defenses. We must also understand that factors relating to society, the environment, and our increasing global interconnectedness actually enhance the likelihood of disease emergence and spread. Moreover, it is a sad reality that today we must also grapple with the intentional use of biological agents to do harm, human against human.

We must also understand that factors relating to society, the environment, and our increasing global interconnectedness actually enhance the likelihood of disease emergence and spread.

Thus the prevention and control of infectious diseases are fundamental to individual, national, and global security. Failure to recognize—and act on—this essential truth will surely lead to disaster. We must therefore continue to trumpet a message of urgency and concern.

That message is basically this: the magnitude of the problem requires renewed commitment. Despite our past achievements, we have still not done enough in our defense, or in the defense of others. But as we look at our prospects, it is clear that the best defense against any disease outbreak will be a robust public health system, both in its science and practice, and that sustained attention, dedication, and support will be essential.

Despite our past achievements, we have still not done enough in our defense, or in the defense of others.

Only in this way will we be able to ensure the health and safety of our nation—and the world. We certainly know that in our complex global village, numerous forces converge to make us more vulnerable; but we also know that a great many opportunities stand before us to make a real and enduring difference.

For More Information...
Copies of *Microbial Threats To Health: Emergence, Detection, and Response* are available for sale from the National Academies Press; call (800) 624-6242 or (202) 334-3313 (in the Washington metropolitan area), or visit the NAP home page at **www.nap.edu.** The full text of this report is available at **http://www.nap.edu**

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COMMITTEE ON EMERGING MICROBIAL THREATS TO HEALTH IN THE 21ST CENTURY

MARGARET A. HAMBURG (Co-chair), Vice President for Biological Programs, Nuclear Threat Initiative
JOSHUA LEDERBERG (Co-chair), Professor Emeritus and Sackler Foundation Scholar, The Rockefeller University
BARRY BEATY, Professor of Microbiology, Colorado State University
RUTH BERKELMAN, Professor, Department of Epidemiology, Rollins School of Public Health, Emory University
DONALD BURKE, Professor, Departments of International Health and Epidemiology, Bloomberg School of Public Health, Johns Hopkins University
GAIL CASSELL, Vice President of Scientific Affairs and Distinguished Research Scholar in Infectious Diseases, Eli Lilly and Company
JIM YONG KIM, Co-director of program in Infectious Disease and Social Change, Department of Medicine, Harvard University
KEITH KLUGMAN, Professor of International Health, Department of International Health, Rollins School of Public Health; Professor of Medicine, Division of Infectious Diseases, School of Medicine, Emory University
ADEL MAHMOUD, President, Merck Vaccines, Merck and Co, Inc.
LINDA MEARNS, Scientist and Deputy Director, Environmental and Societal Impacts Group, National Center for Atmospheric Research
FREDERICK MURPHY, Professor, Schools of Veterinary Medicine and Medicine, University of California, Davis
MICHAEL OSTERHOLM, Director, Center for Infectious Disease Research and Public Policy, Professor, School of Public Health, University of Minnesota
CLARENCE PETERS, Professor, Departments of Microbiology and Immunology and Pathology, University of Texas Medical Branch
PATRICIA QUINLISK, Iowa State Epidemiologist, Iowa Department of Public Health
FREDERICK SPARLING, Professor of Medicine and Microbiology and Immunology, University of North Carolina, Chapel Hill
ROBERT WEBSTER, Professor, Virology Division, Department of Infectious Diseases, Rose Marie Thomas Chair, St. Jude Children's Research Hospital, Memphis, TN
MARK WILSON, Associate Professor of Epidemiology, Associate Chair, Ecology and Evolutionary Biology, University of Michigan
MARY WILSON, Associate Professor of Medicine, Harvard Medical School, Associate Professor of Population and International Health, Harvard School of Public Health

STUDY STAFF

MARK S. SMOLINSKI, Study Director
PATRICIA A. CUFF, Research Associate
KATHERINE A. OBERHOLTZER, Project Assistant
RICHARD MILLER, Director, Medical Follow-up Agency

SUPPLEMENTAL QUESTIONS AND ANSWERS FOR THE RECORD
Submitted by Senator Frank Lautenberg
to
DR. MAJORIE E. KANOF
General Accounting Office

1. What are your thoughts about why the disease spread in Toronto but was relatively contained here in the United States?

   Health experts that we interviewed believe that the reason the disease was relatively contained in the United States was due to "luck" and timing based on the epidemiology of the disease. Toronto experienced a larger spread of the disease due to travel by an infected individual before much was known about Severe Acute Respiratory Syndrome (SARS) and before corresponding protective measures were put in place.

   Because of international travel and transmission to health care workers before the institution of protective measures, the first cases of this disease lead to subsequent clusters of SARS around the globe. The initial global spread of SARS occurred because a physician, who had treated patients with an unknown atypical pneumonia, traveled from the Guangdong Province in China to Hong Kong. He infected health care workers as well as guests in the hotel where he was staying. These guests then traveled home to their respective locations, which included Toronto. The traveler who first brought SARS into Toronto returned home on February 23, 2003 and died on March 5, 2003. This traveler infected five family members, the first of whom was hospitalized on March 7, 2003. Less than one week later, on March 12, 2003, the World Health Organization (WHO) issued its first global health alert describing an outbreak of atypical pneumonia. On March 15, 2003, WHO first referred to the disease as SARS. Toronto's experience with the SARS outbreak gave the United States a "heads up" and demonstrated the need for infectious disease control measures during a time when little information was known about the disease. The United States was fortunate that it did not get the first wave of infected travelers and that public health officials were able to begin large-scale communication efforts to notify health care professionals and the general public.

2. What factors should guide our reaction when we see new symptoms of an unknown disease that we do not know the characteristics, transmission rate, or transmission mode of the disease?

   The SARS experience reinforces the importance of global surveillance, both through international and national surveillance and communication systems, for identifying new disease outbreaks.[1] These systems track and report information about diseases so that public health officials, researchers, and clinicians can begin to identify and implement appropriate infectious disease control measures based on established effective practices for similar diseases.

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[1]Surveillance systems facilitate the performance of ongoing collection, analysis, and interpretation of disease-related data. Communications systems facilitate the secure and timely delivery of information to the relevant responders and decision makers.

Permanent Subcommittee on Investigations
EXHIBIT #4

Internationally, WHO monitors disease outbreaks through its Global Outbreak Alert and Response Network. The network electronically connects WHO member countries, disease experts, institutions, agencies, and laboratories to keep them constantly informed of outbreak events. In the United States, the Centers for Disease Control and Prevention (CDC) supports various surveillance and communication efforts, such as the National Electronic Disease Surveillance System (NEDSS) and the Epidemic Information Exchange (Epi-X). NEDSS is designed to facilitate the development of an integrated, coherent national system for public health surveillance. Ultimately, it is meant to support the automated collection, transmission, and monitoring of disease data from multiple sources (for example, clinician's offices and laboratories) from local to state health departments to CDC. Epi-X connects state and local public health officials so that they can share information about outbreaks and other acute health events, including those possibly related to bioterrorism. It is intended to provide epidemiologists and others with a secure, Web-based platform that can be used for instant emergency notification of outbreaks and requests for CDC assistance.

For SARS, CDC officials we interviewed said that recommendations for infectious disease control measures were based on the early identification of SARS as a respiratory disease, and the recognition that much of the spread of the disease occurred in hospital settings. With this knowledge and in consultation with local, state, and international health officials, CDC recommended a combination of well-founded measures used to contain the spread of respiratory diseases. As we noted in our testimony, the combination of measures that were used depended on either the prevalence of the disease in the community or the number of SARS patients served in a health care facility. Additionally, no new infectious disease control measures were introduced. Instead, strict compliance with and additional vigilance to enforce the use of current infectious disease control measures was sufficient.

3. Is there a single place or national clearinghouse for local responders to report cases of SARS in their jurisdiction and get information about cases of SARS from other jurisdictions?

Local responders report cases of SARS to their local health department, which in turn report to state health departments. States then provide this information to CDC. CDC distributed a great deal of information on SARS through a variety of means such as publications and the agency's website. As stated in our testimony, California and New York City health departments provided information to health care workers via e-mail and training sessions.

During the SARS outbreak, CDC collected national data on reported SARS cases from health departments in each state. In our interviews with CDC, officials said that in order to receive quick reports of SARS cases, CDC developed a Web-based Internet tool that provided a Web page for states to log into and provide SARS information that was immediately available for use by epidemiologists in CDC's

Emergency Operations Center. CDC officials said they were pleased with the responsiveness of the states. CDC also posted and regularly updated all information about SARS, including guidelines, recommendations, and definitions, on their Website. Furthermore, CDC published numerous Morbidity and Mortality Weekly Reports that contained information on SARS, either specific to the United States or worldwide.

In addition, as stated in our testimony, the California health department utilized the California Health Alert Network to send E-mails with SARS information (often based on CDC information) to all local health departments and many hospitals and physicians. The New York City health department hosted a symposium specifically for health care workers, to share the latest available SARS information. Hospital officials we spoke with also offered training seminars for their health care personnel on the signs and symptoms of SARS, recommended screening questions, and appropriate infectious disease control measures. Furthermore, hospitals kept their patients informed about SARS via posters and flyers throughout their facilities, especially in emergency room waiting areas.

4. How can you determine the independent contribution of any one control measure for SARS? When do you make the decision to quarantine?

As noted in our testimony, health officials stated that a combination of infectious disease control measures was effective in containing the spread of SARS. They also noted that it is currently impossible to identify the relative contributions of a single component of SARS infectious disease control measures because all of the measures were intricately linked.

However, health officials added that further research would be helpful in identifying the best protective measures for SARS. For example, in one study of health care workers who had extensive contact with SARS patients in five Hong Kong hospitals, researchers found that no health care worker who consistently used either facemasks or N-95 respirators became infected. During the SARS outbreak, experts recommended the use of facemasks or N-95 respirators as an effective means of transmission control for SARS in inpatient settings. WHO health officials also have plans to review retrospective studies on the specific types of personal protective equipment that worked particularly well in containing the spread of SARS, which may facilitate preparations in the event of a resurgence.

Also as noted in our testimony, CDC officials stated that a graded response is appropriate in deciding when to implement quarantine. Considerations would include factors such as the prevalence of the disease (e.g. the number of SARS cases in a community) and the transmission mode of the disease (how the disease is spread).

5. In 2000 the nursing shortage in the U.S. was 6 percent and it is expected to reach 29 percent by 2020. Is the nursing shortage a consideration in developing protocols for

SARS? If a personnel crisis situation were to develop in a region, what are your suggestions for hospitals and state and local governments?

In our testimony we described various federal, state, and local efforts to prepare for a possible SARS resurgence; while these efforts include healthcare and public health system response, they do not focus on any particular health profession. Specifically, CDC has begun contingency planning for a SARS outbreak, having convened a task force of infection control experts who are responsible for developing SARS-specific guidelines and recommendations. As Dr. James Hughes, director of CDC's National Center for Infectious Diseases, noted in his statement before the subcommittee, the task force has various specialist teams, including one addressing response and preparedness for community, public health, and healthcare systems.

At the state and local levels, health departments are also in the process of developing contingency response plans for SARS. To facilitate this, the Association of State and Territorial Health Officials and the National Association of County and City Health Officials, in collaboration with CDC, published a checklist for state and local health officials to use in the event of a SARS resurgence. Several items on the checklist address workforce surge capacity.[2] For example, checklist items highlight that the jurisdiction has identified ways to augment medical, nursing, and other health care staffing to maintain appropriate standards of care and augmented public health laboratory, epidemiology, and disease control staffing to meet emergency needs and in the event public health workers are affected by an epidemic. Another checklist item indicates that a jurisdiction has a process to recruit and train medical volunteers for provision of care and vaccine administration during a public health emergency.

In our testimony we noted that several health department officials discussed methods that could be used to augment staffing. For example, California health department officials said they were developing a plan for surge capacity by considering staff rotations or details of health department specialists to maintain a high level of response during a potential SARS outbreak. Similarly, officials with the New York City health department said they had created a formal procedure manual, which outlines the roles of reallocated staff from various teams in the department, to help contain a large-scale SARS outbreak.

We recently reported that hospitals might be limited in their capacity to respond to large-scale infectious disease outbreaks.[3] Among other resources, few hospitals have adequate staff needed to care for the potentially large numbers of patients that may seek treatment. However, hospitals appear to be making efforts to

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[2]Surge capacity is the ability of the health care system to handle a large number of patients.

[3]U.S. General Accounting Office, *SARS Outbreak: Improvements to Public Health Capacity Are Needed for Responding to Bioterrorism and Emerging Infectious Diseases,* GAO-03-769T (Washington, D.C.: May 7, 2003).

address staffing issues. In our testimony, hospital officials we spoke with stated that they are taking steps to ensure that they have the necessary preparations to address a large-scale SARS outbreak. In further work, we also found that among urban hospitals whose emergency response plans addressed bioterrorism, 95.9 percent of these hospitals' plans included a description of how to obtain additional staff for surge capacity.[4] Additionally, hospitals reported on their participation in agreements to share or provide resources in the event of a bioterrorist or other mass casualty incident. About 70 percent of hospitals reported that they had agreements, such as memoranda of understanding or mutual aid agreements, with other hospitals to provide or share personnel, equipment, or other resources.

[4]U.S. General Accounting Office, *Hospital Preparedness: Most Urban Hospitals Have Emergency Plans but Lack Certain Capacities for Bioterrorism Response,* GAO-03-924 (Washington, D.C.: Aug. 6, 2003).

SUPPLEMENTAL QUESTIONS AND ANSWERS FOR THE RECORD
Submitted by Senator Frank Lautenberg
to
DR. JAMES HUGHES
Director, National Center for Infectious Disease
Centers for Disease Control and Prevention
Department of Health and Human Services

1. **Who should hold the primary power to make decisions to isolate or quarantine individuals?**

   Pursuant to the 10th Amendment to the U.S. Constitution, states and local jurisdictions have primary responsibility for isolation and quarantine within their borders. Under Section 361 of the Public Health Service Act (42 U.S.C. § 264), the Department of Health & Human Services has primary responsibility for preventing the introduction of communicable diseases from foreign countries into the United States and to prevent the interstate spread of disease. In addition, under 42 CFR § 70.2, CDC may intervene intrastate when the actions taken by any state or local health authority are inadequate to prevent the interstate spread of disease. It is possible for federal, state, and local health authorities simultaneously to have separate but concurrent legal quarantine power in a particular situation (e.g., an arriving aircraft at a large city airport). Therefore, coordination between all levels of government (federal, state, and local) is essential for an effective public health response.

2. **Please describe what ultimately had to be done in Toronto to deal with such a large outbreak of SARS. Can this model be copied in American cities?**

   CDC is currently reviewing best practices and lessons learned from the Toronto experience as well as from other countries. CDC will use this information to guide planning and preparedness for a possible resurgence of SARS this fall.

   Preparedness planning will take into account the variation in experiences with the introduction of SARS into a community, for example, the difference between that seen in U.S. and Toronto, by matching the response and control measures to the level of transmission in the community. If Toronto-like transmission were to occur in the U.S., we would likely use similar isolation, infection control, and quarantine strategies. We are having active interchange with health officials from the national, provincial, and city levels in Canada to learn from their experiences.

Permanent Subcommittee on Investigations
EXHIBIT #5

3. **State laws still vary widely in the power they give officials to isolate and quarantine individuals. Is there any case to be made for a federal law that would establish standard procedures for state officials in the event of an outbreak of an infectious disease?**

As part of a broad effort to strengthen the country's preparedness for bioterrorism and other public health emergencies, CDC requested that legal experts at Georgetown and Johns Hopkins Universities, through the Center for Law and the Public's Health, develop a draft model law (known as the Draft Model State Emergency Health Powers Act) that states could use as they review their existing laws. The draft covers reporting of disease cases, quarantine, vaccination, protection of civil liberties, property issues, infectious waste disposal, control of healthcare supplies, access to medical records, and effective coordination with other state, local and federal agencies. It is each state's decision to adopt, modify, or reject the provisions contained in the draft.

The extent to which the draft model law's provisions have been incorporated into each state's laws varies. According to information posted by the Center for Law and the Public's Health at **www.publichealthlaw.net**, as of August 11, 2003, the draft model law has been introduced in whole or part through bills or resolutions in forty-three **(43)** state legislatures, the District of Columbia, and the Northern Mariannas Islands. As of August 11, 2003, 20 state legislatures and the District of Columbia, have adopted in whole or in part the draft model law's provisions regarding quarantine and isolation.

4. **In an emergency situation, some widely used technologies might not be available. What kinds of reference material for SARS that are not reliant on the internet or cellular technology are under development?**

To date, most of CDC's informational materials on SARS have been web-based due to the evolving nature of information on the disease. Examples of "hard copy" materials used during the outbreak, however, include the more than 2.7 million Health Alerts ("yellow cards") in 6 languages distributed to travelers entering the United States. As more information on the disease has become available and in preparation for a possible recurrence of SARS, many other educational materials have been or are being developed to ensure that the public and health care workers are aware of appropriate precautions and responses needed to protect themselves and others. Recently, the Association for State and Territorial Health Officials (ASTHO) and the National Association of County and City Health Officials (NACCHO), in collaboration with CDC, developed a comprehensive SARS preparedness checklist for use by health officials at all levels. Within this checklist, a section on communication and education includes several procedural requirements, including the development of a "multi-component communications network" and distribution plan.

CDC currently is updating core information materials and creating new materials based on lessons learned during the SARS outbreak. These materials would be recommended for a state or local repository of information where they could be reproduced and distributed locally if Internet technology were not available. In addition to revised guidelines for the clinical, laboratory, and public health communities, educational materials, including fact sheets, brochures and posters for doctors' offices and hospitals, training videos, CD-ROMs, and TV and radio Public Service Announcements, are also being developed. Having materials and messages pre-positioned and the systems in place to transmit updates and breaking information will help to secure the nation's ability to respond to SARS, even in the midst of a technological failure.

5. **How can Congress and federal agencies help work toward better awareness and improved infrastructure to deliver SARS information that does not rely on internet or cellular technology?**

Providing a strong communications infrastructure can help to minimize the clinical, social, and economic effects of an infectious disease outbreak. Congress and federal agencies can work together to ensure that the healthcare community and the public receive accurate and complete information regarding what they should do to respond to and protect against illness.

HHS has a variety of communications channels and systems to help facilitate communications between state, local, and federal agencies. Such systems include the Public Health Information Network (PHIN), Epi-X, and the Health Alert Network (HAN). These systems are good examples of Congressional and federal agency support for state and local communications infrastructure. HAN is funded in all 50 states, 8 territories, and 4 large cities (including the District of Columbia) to establish core information infrastructure at the local level. In addition to high-speed connectivity, goals of HAN include development of broadcast capacity for emergency communication via fax. To date, 89% of fully functional health departments have achieved these capacities; by FY '04, coverage is expected to reach 95%. An important part of the Health Alert Network is establishing multiple methods to deliver information—such as fax messages or short wave radio. Epi-X is an interactive communications tool that is run over a secure internet connection and has been built with a large degree of redundancy and security designed to operate even during power outages or other man-made or natural disasters. In addition to providing up to the minute information and the opportunity for real-time interactive communications to individuals actively on the site, Epi-X has the capability of alerting health officials of emergencies via phone, cell phone, or pager, on a 24/7 basis.

Although many steps have been taken to address the need for non-electronic information, continued efforts are needed to determine additional means of developing, distributing, and updating such information to ensure that effective communication channels are available at all times.

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United States General Accounting Office
Washington, DC 20548

CCAR-03-1045

September 16, 2003

The Honorable Norm Coleman
Chairman
Permanent Subcommittee on Investigations
Committee on Governmental Affairs
United States Senate

Dear Mr. Chairman:

Thank you for the opportunity to appear before the Permanent Subcommittee on Investigations on July 30, 2003, to testify on the infectious disease control measures practiced within health care and community settings that helped contain the spread of Severe Acute Respiratory Syndrome (SARS) and the initiatives and challenges in preparing for a possible SARS resurgence.

Enclosed is our response to a question posed during the July 30, 2003 hearing that we are submitting for the published record of the hearing. If we can further assist you or your staff, please call me at (202) 512-7101.

Sincerely yours,

Dr. Marjorie Kanof

Marjorie E. Kanof
Director, Health Care—Clinical
Health Care Issues

Enclosure

Permanent Subcommittee on Investigations
EXHIBIT #6

Enclosure Enclosure

Question from Senator Carl Levin, Permanent Subcommittee on Investigations, Committee on Governmental Affairs, July 30, 2003.

1. Could you compare the research dollars that we are devoting to SARS to research dollars on other kinds of respiratory infectious diseases?

   Research funding for SARS for Fiscal Year (FY) 2003 is estimated at $36.68 million by the Centers for Disease Control and Prevention (CDC) and the National Institutes of Health (NIH).

   CDC has projected that SARS research funding for FY 2003 will be $2.28 million. Funding for research on other respiratory infectious diseases by CDC divisions, centers, or programs in FY 2003 totals $46.3 million and includes:

   - Tuberculosis $31.9 million
   - Pneumonia $10.9 million
   - Influenza $1.5 million
   - Other $0.9 million
   - Streptococcus pneumoniae (Strep) $0.8 million
   - Haemophilus influenzae (Hib) $0.3 million

   NIH estimates it will spend $34.4 million for SARS research in 2003, primarily through its National Institute of Allergy and Infectious Diseases. Estimated FY 2003 NIH funding for research on other diseases includes nearly $1.1 billion for emerging infectious diseases (both respiratory and non-respiratory) and $105.3 million for tuberculosis research.