



T H E W O R L D B A N K

Public Health Surveillance Toolkit

A guide for busy task managers

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PUBLIC HEALTH SURVEILLANCE

TOOLKIT

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PREFACE

There is growing international awareness that efforts to reduce disease are facilitated by effective public health surveillance systems. This has led to countries being increasingly interested in the need for and benefits of public health surveillance, and to a greater demand for technical assistance and financing.

Public health surveillance is important for governments in fulfilling their stewardship responsibilities. Countries' health priorities include controlling, reducing, and preventing diseases; surveillance is a key strategy for them to be able to achieve those priorities. Public health surveillance has been identified as an essential public health function by the World Health Organization (WHO) Delphi study, the Pan American Health Organization (PAHO) for the region of the Americas, and by the U.S. Centers for Disease Control and Prevention (CDC) (Beltcher, Sapirie, and Goon 1998). Surveillance is noted as a public good and one of the core public health functions in the World Bank public health strategy note (Claeson and others 2002). Outputs from surveillance could be critical for monitoring and evaluation in the poverty reduction strategy paper process, for measuring progress toward Millennium Development Goals (MDGs), as well as for assessing the status of individual Bank health projects.

The World Bank, the Inter-American Development Bank (IDB), and the PAHO have formulated a Shared Agenda for Health in the Americas as a way of institutionalizing coordinated and complementary efforts that benefit from the comparative advantages of each of the three institutions. One of the areas of common work in this Shared Agenda is public health surveillance.

The PAHO has a long history of technical cooperation in developing infrastructure for surveillance in general, and for selected communicable diseases in particular. Notably successful systems have been developed for vaccine-preventable diseases. Multiple projects financed through bilateral and multilateral agencies have been implemented with the PAHO's technical and management support. The World Bank has financed two projects to date that are entirely focused on surveillance, and another has been funded by the IDB. There are also several other loans with surveillance components. As interest in such loans increases, there is a need to share experiences and best practices. To collaborate in strengthening surveillance systems internationally, we need to better prepare Bank staff. The development of this toolkit contributes to that effort.

This toolkit draws on the expertise of public health practitioners who have experience with public health surveillance and who have recognized the core role of surveillance in public health. These practitioners have advocated for surveillance programs, supplied innovative ideas, and provided insightful critiques over many years. This toolkit also draws on the experience of Bank staff and

technical experts from the PAHO and the CDC who have contributed to Bank missions. The toolkit also makes use of WHO references, primarily those from the WHO's Web site (www.who.int/emc/surveill/index.html).



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ABBREVIATIONS AND ACRONYMS

AFP	Acute flaccid paralysis
AIDS	Acquired immune deficiency syndrome
ARI	Acute respiratory infection
BCG	Bacille Calmette-Guerin
BRF	Behavioral risk factor
BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
DALYs	Disability-adjusted life years
DHS	Demographic and Health Surveys
FETP	Field Epidemiology Training Program
GIS	Geographic information system
HIV	Human immunodeficiency virus
IBRD	International Bank for Reconstruction and Development
IDB	Inter-American Development Bank
IMR	Infant mortality rate
MDG	Millennium Development Goal
MMWR	<i>Morbidity and Mortality Weekly Report</i> (of the CDC)
MoH	Ministry of health
MMR	Maternal mortality rate
NCD	Noncommunicable disease
NGO	Nongovernmental organization
ORS	Oral rehydration solution
PAHO	Pan-American Health Organization
PHTN	Public Health Training Network
STEPS	STEPwise approach to risk factor surveillance
STI	Sexually transmitted infection
TB	Tuberculosis
TEPHINET	Training Programs in Epidemiology and Public Health Intervention Network, Inc.
VIGI-A	Public Health Surveillance and Disease Control project in Argentina
VIGISUS	Public Health Surveillance and Disease Control Project in Brazil
WHO	World Health Organization
WISQARS™	Web-based Injury Statistics Query and Reporting System
YPLL	Years of potential life lost

BACKGROUND

The audience for this toolkit is World Bank Task Managers and their counterparts in other organizations—those who, in response to requests, go to countries, assess the problems, design projects to address these problems, and implement or supervise these projects. Most World Bank staff are already overloaded with work and do not have the time to read material that is impractical or research-oriented. Many have little or no background in public health or surveillance, which further complicates the situation.

It is the goal of this toolkit to present fundamental concepts for surveillance in public health. After they have read this document project teams should be able to critically assess the public health surveillance system (or systems) currently operating in a given country, and have some idea of ways to improve these systems. The World Bank operates in countries with varying economic states of development.

This toolkit will focus on a range of potential surveillance activities, recognizing that there are cost and work force considerations in establishing a surveillance system in any given country.

Part A of this toolkit provides some theoretical concepts, and knowledge about surveillance that has been gained through applying these concepts and the practice of surveillance in developing countries. A moderate number of sources are cited so that the more curious reader might have a guide to primary sources (see appendix A.5). Additional information can be found in the other appendixes.

Part B provides information that will be useful to Task Managers as they prepare loans for strengthening public health surveillance systems. Several World Bank experiences are shared. The focus of part B is on practical aspects of surveillance and on lessons learned.

PART A

Public Health Surveillance: Questions and Answers

Good surveillance does not necessarily ensure the making of right decisions, but it reduces the chances of making the wrong ones.

Alexander D. Langmuir (Langmuir 1963).¹

What is public health surveillance?

Surveillance is defined as the “ongoing systematic collection, collation, analysis, and interpretation of data; and the dissemination of information to those who need to know in order that action be taken” (www.who.int/emc/surveill/index.html).

A more complete definition of surveillance is: The ongoing systematic collection, analysis, and interpretation of health data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those who need to know. The final link in the surveillance chain is the application of these data to prevention and control. A surveillance system includes a functional capacity for data collection, analysis, and dissemination linked to public health programs (CDC 1988).

There have been three developments in the conception and definition of surveillance. The original concept development was the watching and confinement of individual cases of highly communicable diseases responsible for devastating epidemics, in particular smallpox and yellow fever.

The object of watchfulness was moved from the individual to the surveillance of epidemic diseases in populations during the mid-20th century, largely due to the work of Alexander Langmuir (Langmuir 1976; Fowler 1993; Fowler 1994; Chorba and others 1989).

Finally, the concept of public health action was clearly attached to surveillance. *Action is what distinguishes surveillance from the task of simply monitoring events.* Donald Henderson, who was instrumental in the eradication of smallpox in the 1970s, once described surveillance as the “neurologic system of public health.” Surveillance, the eyes and ears of public health, provides information through which public health programs can act effectively and efficiently. Controlling and preventing diseases based on information collected through surveillance requires action. In some cases actions must be immediate—within hours—in order to prevent large-

¹ Dr. Langmuir (1910–1993) was a surveillance expert and chief epidemiologist at CDC for more than 20 years. He was also founder of the U.S. epidemic intelligence service.

Box 1.**SURVEILLANCE IS NOT RESEARCH**

Public health *surveillance* is essentially descriptive in nature. It describes the occurrence of injury or disease and its determinants in the population. It also leads to public health action.

Research, in contrast, is experimental in design, aimed at testing a hypothesis by comparing and contrasting groups. Surveillance data are usually limited in detail and price (that is, in the cost of obtaining the data), but may eventually be used to develop research hypotheses. Research data are often quite complex and detailed and are usually expensive to produce. If we confuse surveillance with research, we may be motivated to collect large amounts of detailed data on each case. The burden of this approach is too great for the resources available for surveillance systems and usually leads to failure.

scale epidemics and deaths (from, for instance, cholera, meningitis, Ebola, or food contamination). In others, control and prevention activities are long-term responses to information about diseases (such as tuberculosis [TB], acquired immune deficiency syndrome [AIDS], malaria, and noncommunicable diseases such as diabetes and hypertension), and action may be taken within days, weeks, or years.

What are the goals of public health surveillance?

The goals of surveillance often differ at the various administrative levels of the public health system (Table 1; WHO 1999a). Surveillance data are used to allocate resources and evaluate the impact of control and prevention strategies and programs at all levels. However, at the local level² the use of surveillance to trigger basic public health investigations and implement specific control activities predominates for infectious diseases and environmental hazards. In contrast, monitoring for trends, measuring the effectiveness of specific interventions, and conducting more complicated analysis to elucidate risk factors predominate at the national level. At the local level analytic capacity is usually much more limited than at the national level. At the state level³ public health agencies typically share both perspectives.

There are many types of surveillance systems, which vary from very simple to complex. In general, in developing countries the use of less complex, more easily established, and sustainable systems are pre-

Table 1.
Levels Where Surveillance Activities Are Performed

Activities	National level	State level	Local level
Detection and notification of cases	—	—	Yes
Collection and consolidation of case data	Yes	Yes	Yes
Analysis and interpretation	Yes	Yes	Yes
Investigation of cases and confirmation of diagnosis:			
• Epidemiologist	—	Yes	—
• Clinician	—	—	Yes
• Laboratory	Yes	Yes	—
Feedback	Yes	Yes	Yes
Dissemination	Yes	Yes	Yes
Action			

— = not usually

Source: Adapted from WHO 1999b.

² This toolkit will use the term “local level,” which is also referred to as the municipal, district, county, or jurisdictional level, among others.

³ This toolkit will use the term state level to refer to the intermediate level between national and local, which is also referred to as provincial, departmental, or regional, among others.

ferred. Examples of key elements of surveillance systems are provided in box 2.

Box 2.

KEY ELEMENTS OF SURVEILLANCE SYSTEMS

All surveillance systems involve six key elements:

1. Detection and notification of health event
2. Investigation and confirmation (epidemiological, clinical, laboratory)
3. Collection of data
4. Analysis and interpretation of data
5. Feedback and dissemination of results
6. Response—a link to public health programs, specifically *actions* for prevention and control.

Source: Adapted from WHO 1999a.

Central to the concept of surveillance is that any system implemented serves as a stimulus to some action. Collection of data without an accompanying plan for using these data to address health problems is a waste of resources. (Box 3)

Box 3.

USES FOR SURVEILLANCE

Surveillance may be used to:

- Recognize cases or clusters of cases to trigger interventions to prevent transmission or reduce morbidity and mortality (includes the special case in which surveillance at the national level is required to recognize multi-state clusters);
- Assess the public health impact of health events or determine and measure trends;
- Demonstrate the need for public health intervention programs and resources, and allocate resources during public health planning;
- Monitor effectiveness of prevention and control measures and intervention strategies;
- Identify high-risk population groups or geographic areas to target interventions and guide analytic studies; and
- Develop hypotheses that lead to analytic studies about risk factors for disease causation, propagation, or progression.

Different goals require different approaches to data collection. Tradeoffs are necessary between timeliness and detail, and between achieving representativeness and getting case reports for control of transmission or exposure or other individualized interventions (Meriwether 1996). For example, at the local level a case of measles in a day-care center requires an immediate public health response to prevent spread based on clinical findings prior to laboratory confirmation. In contrast, only laboratory-confirmed cases and those cases that are epidemiologically linked to confirmed cases are used at the state and national levels to monitor progress toward measles elimination.

In a similar way local public health authorities may review individual cases of infant mortality to assess gaps in the health-care delivery system and obstacles to the implementation of community-based prevention strategies. At the state level infant mortality may be mapped using sophisticated geographic information systems (GISs) not available locally to identify areas where further interventions should be targeted. At the national level cause-specific infant mortality rates (IMRs) may be used to judge the effectiveness of nationwide strategies that promote infant survival (such as oral rehydration solution (ORS), or Integrated Management of Childhood Illnesses (IMCI), vaccination, breast-feeding, and clean deliveries). Cause-specific mortality rates are also used to modify recommendations as efforts to reduce infant mortality succeed and the causes of infant mortality change.

Surveillance often results in more targeted and focused prevention activities. Such activities can be described as primary, secondary, or tertiary (see box 4).

Surveillance systems play an important role at each of the three prevention levels. An example at the primary protection level would be surveys of im-

Box 4.**PRIMARY, SECONDARY, AND TERTIARY PREVENTION IN PUBLIC HEALTH**

- Primary:** Prevention of the development of disease or injury in a susceptible or potentially susceptible population through specific measures, such as immunization
- Secondary:** Efforts to decrease the duration and severity of disease/injury through early diagnosis and prompt intervention
- Tertiary:** Efforts to limit mortality and the degree of disability and promote rehabilitation and restoration of function after disease/injury

munization coverage among school-age children that form the basis of a surveillance system of vaccination programs. Surveillance of reports from health-care providers on cases of measles to assess whether appropriate treatment has been rendered would be an example of surveillance at the secondary prevention level. Finally, routine assessment of hospital-based records for utilization of rehabilitative services for those cases with severe measles would be an example of surveillance at the tertiary prevention level.

Why invest in surveillance?

With relatively small investments, public health programs are very effective in reducing death, disease, and disability. By investing in public health surveillance the public health system is made more effective and efficient. For example, surveillance can lead to early detection of a local epidemic when its control is more effective and less costly in dollars expended and lives claimed. Apart from the health sector, epidemics can be costly because of their impact on productivity as well as on other aspects of the economy. For instance, the economic impact of the plague epidemic in India in 1994 was a loss of \$1.7

billion (which was especially due to losses in the tourism and exports industries). The 1991 cholera epidemic in Peru involved a total loss of \$770 million, which was primarily from losses in the tourism and seafood industries (Rodier 1998).

Intra-national and international borders are ineffective for containing diseases, so investment in surveillance and public health is a wise investment for the country in which the epidemic is or might be currently occurring, as well as the countries to which it might spread. The cholera epidemic in Peru mentioned above eventually spread throughout much of Latin America. Smallpox is another example of a disease that spreads quickly. The cost of the surveillance and public health programs to eradicate smallpox was relatively small in comparison to the increasing dividends to all countries for being able to eliminate mass immunization programs for this disease.⁴ The economic devastation from the AIDS epidemic can serve as a warning of the potential consequences of a more rapidly lethal epidemic of hemorrhagic fever (including, for instance, the Ebola virus), plague, or cholera should we fail to control epidemics of any of these entities at the local level and should they become national, regional, or international epidemics. Antibiotic resistance is an emerging cross-border issue that requires surveillance for effective control and prevention (http://www.who.int/emc/amr_interventions.htm). While it necessitates an investment in laboratory systems, in the long term such an investment may be minimal compared with the costs of treating antibiotic-resistance diseases on a large scale or from years of productive life lost (YPLL).

Beyond its role in controlling devastating epidemics surveillance is important for the control and prevention of endemic diseases that reduce produc-

⁴ This is also true of the cost in terms of disability-adjusted life years (DALYs).

tivity and can be costly to manage. Good surveillance systems permit early identification of diseases such as TB and syphilis that can easily be cured with low-cost treatments, combined with other public health actions. Early detection of these communicable diseases decreases the amount of time an infected person is able to transmit the disease to others thus preventing, and potentially eliminating, new cases. Treatment of chronic noncommunicable diseases (NCDs) such as heart disease and diabetes and their sequelae is expensive, so their prevention is far more cost-effective. Prevention and control of these diseases requires surveillance of the behavioral risk factors (BRFs—such as smoking, physical inactivity, and obesity) that lead to their development, as well as actions to promote the desired changes and risk reductions.

While there are human and fiscal costs of epidemic and endemic disease, there are also opportunity costs associated with investing in public health programs. It is essential that interventions be evaluated and resources targeted so that their contribution, compared with other possible interventions, is optimized. Surveillance can provide useful information to identify populations at greatest risk where intervention may make the most contribution and to gauge the effectiveness of intervention programs. For example, surveillance of behavioral risk factors for diseases such as human immunodeficiency virus/acquired immune deficiency (HIV/AIDS) may identify growing high-risk sexual behavior in targeted populations. It may also provide information on whether programs such as public education are leading to an increase in preventive behaviors over time. In the case of HIV/AIDS, this would include increased condom use or decreased needle sharing.

What is the spectrum of outcomes amenable to surveillance?

Most countries have promulgated by law or regulation a list of public health conditions for which there

is mandatory reporting by health providers or health-care facilities. The list of conditions is determined by each country and primarily includes communicable diseases. Communicable diseases commonly subject to mandatory reporting are: childhood vaccine-preventable diseases such as polio, measles, tetanus, and diphtheria; TB; hepatitis; meningitis; and leprosy. However, reporting of noncommunicable conditions—such as infant and maternal deaths, injuries—and occupational and environmental diseases—such as pesticide poisoning—are often required, as well. International regulations currently require reporting the occurrence of three diseases to the WHO: plague, yellow fever, and cholera (WHO 2001b).

Surveillance may be performed on any element of the chain of causation that leads to a communicable or NCD. For example, elements of measles surveillance could involve routinely assessing how many members of a community are vaccinated, how many cases of measles occur, how many cases occur among vaccinated individuals (called vaccine failure), and costs associated with vaccination programs and treatment of cases, among many others.

Behavioral risk factors are also a reasonable target for surveillance. Prevention of deaths due to heart disease, lung cancer, and stroke includes the promotion of abstinence from smoking, while sexually transmitted infections (STI) and AIDS prevention involves the promotion of condom use. The prevention and early detection of some cancers also involves changes in behavior (such as regular Pap smears and mammograms, use of sun block, or smoking cessation).

The expanding scope of conditions and determinants of conditions amenable to surveillance is, however, a cause for concern. *The number of conditions and determinants designated for surveillance must be restricted to the human and financial resources available*

to adequately sustain the surveillance system, and to conditions in which surveillance can effectively lead to prevention. There is no “magic number” of conditions that should be included. Rather, the resources available to manage the system effectively and to collect data of reasonable quality should determine the number of conditions and determinants that are included. Priorities must be established (discussed below under Setting Priorities). Notifiable diseases (such as botulism and anthrax) often occur at very low frequency, but because of their public health implications it is essential any cases be reported.

Although there is no “magic number,” table 2 presents a possible scheme for developing a surveillance system. The first column designates a minimal list of diseases for surveillance. (Note that all countries of the world now have at least some sort of rudimentary system of surveillance for at least polio and TB.) Diseases should be added as the system evolves and resources become available. A suggested second

line of diseases is presented in the second column of table 2. However, the expansion of the list of notifiable diseases will depend on a country’s public health priorities. In some countries (for example, countries in Eastern Europe and Central Asia) NCDs may be a greater priority, and therefore BRF surveillance may be more important to include in the second line. Once the system is developed other diseases may be added. High-income countries have dozens of conditions under surveillance. It is preferable to achieve a reasonable level of accuracy, connection to control programs, and sustainability before adding diseases.

Overambitious designation of conditions for surveillance stems from at least two sources. On the one hand the resources for doing surveillance well are underestimated. On the other hand even if a condition, however grievous, is not preventable, mounting a surveillance system is a way for governments to respond, albeit ineffectually, to societal pressures for action.

Table 2.
Scheme For Developing And Expanding A List For Mandatory Disease Reporting

Minimal list	Second line	Third line
<i>Vaccine preventable:</i> Polio ^a Measles Tetanus	<i>Vaccine preventable:</i> Diphtheria Pertussis	<i>Vaccine preventable:</i> Rubella Chickenpox Mumps
<i>Communicable:</i> TB	<i>Communicable:</i> Meningitis Syphilis HIV/AIDS	<i>Communicable:</i> Hepatitis Nosocomial infections Gonorrhea/Urethritis Foodborne pathogens
<i>Internationally required:</i> Cholera Yellow fever Plague	<i>Non-communicable:</i> Infant death	<i>Non-communicable:</i> Behavioral risk factors Maternal death Pesticide poisoning
<i>In endemic areas:</i> Malaria Leprosy Onchocerciasis ^a (river blindness) Dracunculiasis ^a (guinea worm)	<i>In endemic areas:</i> Dengue-especially hemorrhagic Ebola/hemorrhagic fevers Rabies	<i>In endemic areas:</i> Encephalitis

^aTargeted for eradication

Table 3.
Major surveillance methods

Surveillance methods	Comments
Mandatory disease notification ^a by health-care providers or facilities	<ul style="list-style-type: none"> • Require immediate public health response; or • Recognizable solely by providers
Reports by laboratories (reporting source)	<ul style="list-style-type: none"> • Immediate public health response may or may not be needed • Laboratory test needed for recognition or to meet case definition • Laboratory test adds relevant information (such as Salmonella serotypes, antibiotic susceptibilities for TB and pneumococcus, cell type for cancer) • Back-up to clinician's reporting
Sentinel surveillance	<ul style="list-style-type: none"> • Useful for collecting detailed information on a subset of cases • Designed so findings can be generalized to a specified population • Collect limited information to recognize the onset, termination and characteristics of a particular public health problem of limited duration (such as influenza) • Used when incidence of a condition is high (such as diarrheal diseases, acute respiratory infection [ARI])
Periodic or ongoing prevalence surveys	<ul style="list-style-type: none"> • To assess prevalence trends over time (such as HIV seroprevalence surveys, BRF surveys) • Optimal if designed to be useful to state and local public health agencies • Generate hypotheses regarding risk factors • Evaluate the effectiveness of a public health or clinical intervention
Vital records	<ul style="list-style-type: none"> • Surveillance of births and deaths; trends in causes of death • Key for infant and maternal mortality surveillance • May be used alone for some analyses
Secondary analysis of datasets collected for other purposes	<ul style="list-style-type: none"> • Places no additional burden on public health surveillance systems • Care must be taken in analysis and interpretation • Immediate public health response are not needed • Assess the public health impact or monitor trends • Measure morbidity costs due to chronic or recurrent health events • Potential data sources include hospital discharges, billing, insurance, emergency room, school/work attendance, immunization registries, work-site injury and law enforcement records

^aThese diseases vary from country to country, and even from state to state.
Source: Adapted from WHO 1999^a.

What are the major surveillance methods?

Mandatory reports of certain diseases by clinicians or health-care providers or facilities

This is the traditional source of surveillance data. Compliance with reporting requirements varies greatly and is dependent on the health-care provider's perception of whether the public health agency is

really using the information for action rather than merely collecting and mothballing data. Generally, the more severe the illness (such as meningitis) the more likely it is to be reported. Reports from providers are routinely based on clinical diagnoses, which are not usually based on the most sophisticated diagnostic testing. Hence, cases are more likely to be reported as hemorrhagic fevers (rather than a

specific type of virus), or as suspected diagnoses, such as suspected rabies in the case of fatal encephalitis following an animal bite. Nevertheless, such reporting alerts the public health authorities to potential problems.

Reports by laboratories

Laboratories are usually more compliant in reporting disease than are health-care providers. Surveillance systems based on laboratory reporting must balance the greater accuracy of the diagnosis with the sensitivity of the system for detecting a meaningful proportion of cases in the community. In more developed countries and those with stronger systems clear lines of communication between regional referral and reference laboratories and those responsible for surveillance should be nurtured, since the number of samples submitted (such as for suspected encephalitis) to the laboratory, as well as the number of confirmed cases are a dependable source of information. Due to high costs, the volume of laboratory testing in low-income countries is low and therefore the usefulness of lab-based systems is limited. Diagnostic accuracy in developing-country laboratories is also a frequent problem.

Sentinel surveillance

In sentinel surveillance a sample of reporters (such as clinicians, hospitals, and local laboratories) are designated as the reporting sources. Sentinel surveillance is effective where the goal is to estimate the magnitude and trends of a disease, rather than to detect the earliest or all cases, which may not be within the domain of the sentinel reporter. By focusing on a specific sample of reporters the surveillance system has a better chance of obtaining accurate and high quality information. Sentinel reporting is sufficiently sensitive to detect common diseases such as influenza or diarrheal diseases, but is generally ineffective for epidemics that are localized and that must be identified as early as possible, such as any of the hemorrhagic fevers, cholera, or vaccine-preventable diseases.

Periodic or ongoing prevalence surveys

A periodic survey of a representative sample of the population can provide useful information on prevalence of behavioral risk factors, utilization of preventive measures, occurrence of exposures, injuries, self-reported disease, and so on. The benefit of sampling is that information from a relatively small group of respondents provides accurate estimates of the general population. A repeated survey can qualify as surveillance, as in the case of phone surveys of seatbelt use, or school-based surveys of tobacco use or other behaviors among students. Continuous surveys require greater resources, but provide time-linked information that is very useful in assessing the impact of events or particular interventions.

Vital records

Vital records of births and deaths are generally underutilized as a surveillance source. These records can be used to estimate the magnitude of certain diseases and injuries, describe distribution (such as by age or geography), track trends, set priorities, and fulfill many other useful public health needs. However, collection of information without analysis and dissemination for use in prevention does not qualify as public health surveillance. The reduction of IMR and MMR are two millennium development goals (MDGs)—whose surveillance is carried out using vital records, primarily. Effective surveillance of IMR and MMR at the local level can lead to more appropriate interventions for preventing such deaths. Electronic systems for reporting vital records data are making this type of surveillance more timely and effective. (See box 13, in appendix B.4, for more information.)

Secondary analysis of datasets collected for other purposes

Data are collected by nonpublic health agencies for a myriad of reasons. For example, local industries will collect data on absenteeism and even on the causes for absenteeism. Departments of transporta-

tion may collect information on motor vehicle accidents and injuries. This information may then contribute to the overall surveillance system.

What is the difference between surveillance and health information systems?

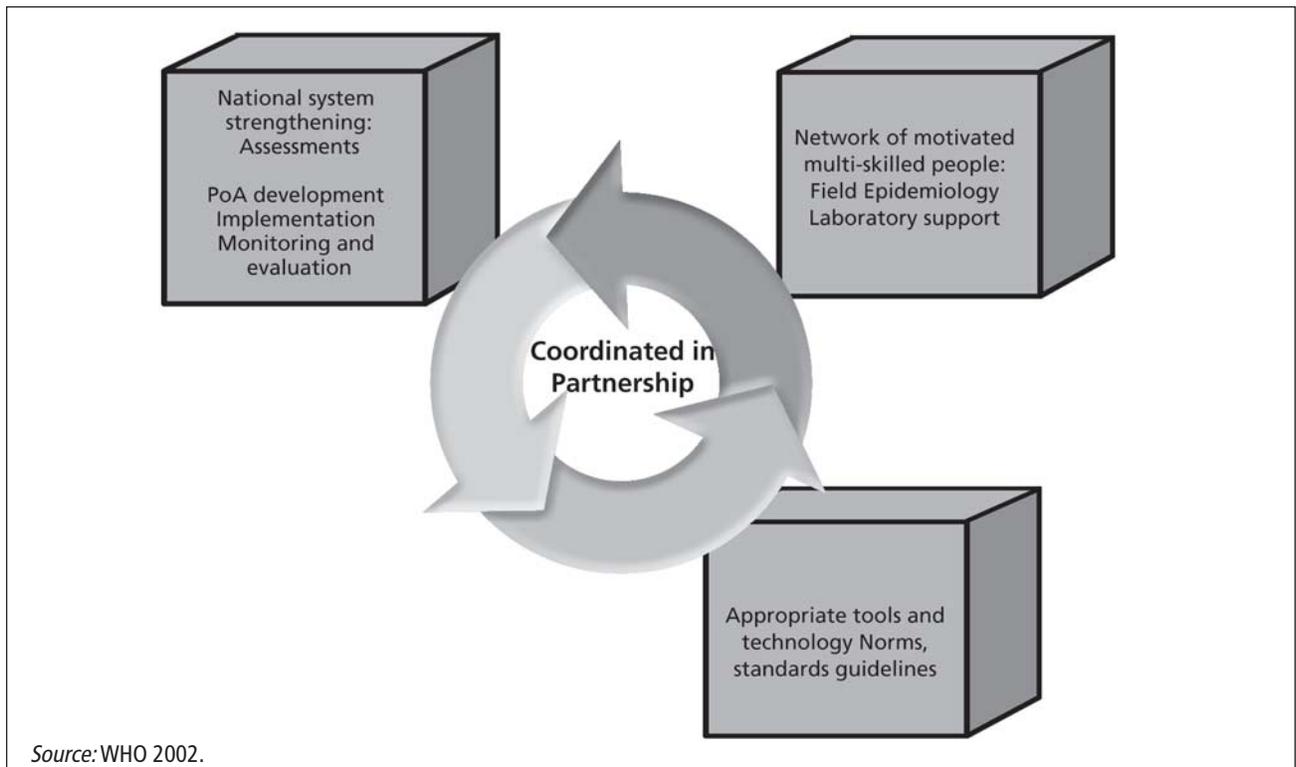
Health information systems encompass all the different data collection systems available to a ministry of health (MoH), including information from hospitals, clinics, and providers (such as the numbers of patients, diagnoses, procedures, and outcomes; personnel, and pharmaceutical and other procurement systems; program-specific data such as vaccinations, prenatal care, disease treatment outcomes; and so on). Public health surveillance is one component of the health information system. Health information systems everywhere, but particularly in low-income countries, should avoid collecting too much infor-

mation that is never used, often because the goals are not clearly articulated or are focused on more specific needs.

What is the difference between vertical and integrated surveillance systems?

Vertical surveillance systems focus on one disease or injury. Information is then fed back into the specific disease control program. The information collected may be drawn from one or more elements in the chain of causation and prevention of that disease or injury. For example, because of the current global effort to eradicate polio, information from surveillance systems is fed directly back to the Expanded Program on Immunization (EPI) polio program, which mounts a rapid response when a case of acute flaccid paralysis (AFP) is detected. Such surveillance systems tend to be costly but very effective. In the

FIGURE 1
INTEGRATED APPROACH TO COMMUNICABLE DISEASE SURVEILLANCE



case of polio the costs are often borne by international donors who are supporting the global campaign to eradicate the disease.

In contrast, *an integrated approach envisages a common system for multiple diseases using similar structure, processes, and personnel.* (Figure 1) This requires coordination but is more efficient and less costly, because it allows building on existing resources and capacity. It also promotes the most effective use of health resources. The WHO is currently recommending the creation of units at the national level to coordinate various surveillance activities in communicable diseases. Coordination implies providing individual programs (such as programs for TB, vaccines, and injury prevention) with the needed information. An integrated surveillance system collects information on behaviors related to both NCDs and communicable diseases (condom use for HIV, hand-washing practices for diarrheal diseases, and hepatitis, for instance) and—ideally—requires an integrated approach (WHO 2000). At the local level, integrated systems are often the norm and make particular sense since the numbers of cases for any particular disease may be small and would not warrant separate vertical systems. At the local level, the same personnel usually report and investigate all notifiable diseases.

What is active versus passive surveillance?

Passive surveillance depends on voluntary data reports from health-care providers, laboratories, and others. This is fundamental to any surveillance system. *Active surveillance* takes surveillance another step and involves searching for cases by a surveillance authority. House-to-house searches in outbreaks, such as an outbreak of Ebola, is an example of active surveillance. STI surveillance (gonorrhea or syphilis, among others) is often active surveillance, with follow-up of cases confirmed by the laboratory to ensure all cases have been adequately treated. STI surveillance usually involves

an active search for persons who have had sexual contact with infected persons to ensure their treatment. Little surveillance takes place in low- and middle-income countries because it is resource-intensive; exceptions may include case finding in outbreaks and contact investigation for STIs or TB.

What are important issues when considering sources for surveillance data?

There are three major issues in considering alternative sources of surveillance data. One issue is *cost*. Surveillance systems that are based on, or that piggyback on, existing systems are less costly. Such systems are also more likely to survive through the worst of times, since the rationale for maintaining the program on which surveillance is based may be more compelling to decisionmakers than supporting a surveillance system that stands alone. For example, reporting of communicable diseases by health-care workers is a low cost surveillance system.

A second issue in selection of source of surveillance data is *sustainability*. Whether a surveillance system can be sustained and maintain its effectiveness over time depends on many factors, including the complexity of the system, its burden on reporters, the reporters' perception of the system's value to them, the cost of the system, and program funders' assessments of the system's contributions to prevention.

The third major factor is *whether the system meets its goals*. There are numerous goals for surveillance, including the detection of epidemics, responding to health problems with appropriate public health actions, and estimating the magnitude of a health problem over time. The goals of each surveillance system should be well specified. While not every surveillance system meets all the goals of surveillance, a surveillance system that does not meet its specified goals should be corrected or abandoned.

What are the considerations in planning public health surveillance?

Setting priorities

Priorities must be set among the long list of diseases and injuries that affect humankind. A common problem is an over-ambitious approach in establishing the list of notifiable diseases and injuries. The list of associated risk and preventive factors is also long. Priorities should be based on public health importance, including the measure of the disease's seriousness for the individual, its current burden on society, the potential burden on society (which involves the issue of communicability and the potential for epidemic spread), and preventability. Priorities are also determined by the country's capacity to respond with the necessary public health actions for disease prevention and control. Middle-income countries will be able to address an expanded list of health priorities compared with low-income countries.

Parameters for measuring the importance of a health event—and therefore the need for a surveillance system with which to monitor it—include:

- Total number of cases, incidence, and prevalence
- Indices of severity, such as the case-fatality ratio
- Mortality rate
- An index of lost productivity: such as bed-disability days
- An index of premature mortality: such as YPLL
- Cost-effectiveness of interventions
- Preventability
- Epidemic potential

Setting goals and objectives

There are many goals for surveillance programs. These goals include estimating incidence, measuring trends, identifying cases for intervention,

developing effective prevention and control programs, and evaluating interventions. Not every surveillance project can meet each goal, but a given system must meet the goals for which it was designed. Data must be collected for a purpose, not just routinely, or the system will ossify, and participants—especially reporters—will lose interest.

Case definition

The definition of what constitutes a “case” in terms of surveillance can depend on clinical diagnosis, laboratory results, demographic information, or any other agreed on attribute. Cases can be defined with different degrees of certainty. For example, measles may be defined by clinical presentation, or by sophisticated laboratory procedures. Case definitions for surveillance must be standardized. They may be more or less restrictive than criteria used for clinical diagnosis (CDC 2001). Case definitions vary from country to country depending on what resources (particularly laboratory resources) are available (CDC 1997). (See appendix A.8 for examples of WHO case definitions.)

Suspected versus confirmed cases

It is important to maintain a high degree of suspicion and cast a wide net initially, in order not to miss cases. Thus a definition for a suspected case is established and the case is then confirmed through laboratory testing or clinical follow-up. Most suspected cases are reported with minimal information; this is followed up with a more thorough investigation to confirm the disease, and assess potential sources and possible contacts so that they, too, may receive treatment, as needed.

What conditions lend themselves to successful surveillance programs?

As stated earlier, an important component of a national surveillance plan is a list of priority diseases for surveillance. This list, as short as possible, should be established with the close participation of national

health authorities. These questions should be addressed not only from the national perspective but also from a regional, and possibly international, viewpoint because diseases may spread rapidly, without regard for national boundaries. The questions in box 5 can be used to guide disease selection.

In addition to specific diseases, specific syndromes (including hemorrhagic fever syndrome) as well as some specific public health issues (such as antibiotic susceptibility of some infectious agents) should be considered for surveillance. Following, or possibly preceding, the list of priority diseases, an inventory of existing surveillance activities should be carried out. This should be based on thorough on-site visits and a review of all key components of the health system, including public and private sectors where appropriate, as well as a review of any nongovernmental organizations (NGOs) involved in long-term health activities in the country.

Box 5.

CRITERIA FOR DISEASE SELECTION

- Does the disease have a high disease impact (morbidity, disability, or mortality)?
- Does it have a significant epidemic potential (including cholera, meningitis, or measles)?
- Is it a specific target of a national, regional, or international control program (by, for example, the WHO, or other international or regional control programs)?
- Will the information collected lead to significant public health action (such as an immunization campaign, other specific control measures, or international reporting)?

Source: WHO 1999a.

What data should be collected?

Data sources and surveillance methods must be carefully selected to match the specified goals of surveillance and to maximize the attributes (such as timeliness, sensitivity, positive predictive value, simplicity, or flexibility⁵—see also appendix A.6) of greatest importance at each level of the public health system for each health event or determinant (Romaguera, German, and Klaucke 2001; CDC 2001). Data that are not needed should not be collected, unless it is more efficient to collect a standard set of easily available data for a group of health events. For example, it may be more convenient to collect a copy of a hospital admission sheet and abstract the desired information later, rather than collect only the information needed for surveillance while at the hospital.

Surveillance systems vary in their need for personally identified information. Where there is a need to refer to the individual case or to identify the community of the case, or perhaps the eating establishment frequented by the case, there is a need for personal identifiers. At the national level, where attention is more focused on magnitude and trends of conditions, personal identifiers are rarely needed.

For some illnesses (such as meningitis, rabies, or gonorrhoea) it is necessary to collect the name of the patient, and the time and place of infection. In each instance direct individual actions are taken in response to the case—whether the action is antibiotic prophylaxis, vaccination, or treatment of recent sexual contacts. However, for conditions such as dengue fever there are no such direct, individual interventions, but rather community level interventions. Therefore simply counting case numbers is generally sufficient and does not overburden the system.

⁵ *Timeliness*: delay between steps in the surveillance process. *Sensitivity*: identification of all cases of a disease or condition in question. *Predictive value positive*: the probability that a person with a positive test result actually has the disease. *Simplicity*: system structure and ease of operation. *Flexibility*: the ability of the system to adapt to changing needs, such as the addition of new conditions or data-collection elements.

Data should be collected in the least labor-intensive manner possible consistent with the quality, scope, and detail needed. An efficient surveillance system is one in which the minimum necessary local or state public health resources (personnel and fiscal) are expended to collect information.

Are there stages of development in a public health surveillance system?

Public health surveillance systems range in complexity from the very basic (using pins in maps to track cases) to the very complex (using digital GISs to link data and geography). Some involve very simple laboratory techniques (blood smears for malaria), while others are exceedingly sophisticated (HIV sequencing, which requires DNA testing). Data management can range from a box of index cards to enormous datasets maintained on computers.

For all systems, however, there is a need to first identify the goal or goals of the surveillance system—what

data are being sought and to what end—and to select the simplest system that allows for collection of these data. As the complexity of the surveillance system increases, so does the cost of the system, as well as the infrastructure required (much more overhead is involved in HIV sequencing in the laboratory than is involved in doing blood smears for malaria in the field).

Nearly all countries now have some type of surveillance for polio and TB, albeit with varying degrees of success. Many countries have also developed surveillance systems for measles, malaria, and cholera. These systems may then form the basis for functioning public health surveillance systems.

Table 4 offers considerations for implementing or strengthening surveillance systems in countries with weak institutional capacity and financial resources (which would include many African countries), and for countries with moderate institutional capacity

TABLE 4
FEASIBLE SURVEILLANCE SYSTEM CHARACTERISTICS RELATIVE TO DIFFERENT RESOURCE LEVELS

Consideration	Low resources	Moderate resources
Goals of surveillance	Information for action but limited to highest priority diseases and outbreaks of most serious communicable diseases. Strive to use surveillance data for planning.	Same but extended scope of conditions and routine use for health planning and evaluation.
Scope of surveillance	Vital registration; core communicable diseases; detection of outbreaks and preventive interventions (seat belt use).	Same plus expanded list of communicable and NCDs; surveillance for BRFs (smoking)
Training needs	Basic concepts of surveillance applied to routine disease control and outbreak investigation.	Application of more complex methodology for surveillance of NCDs, injuries, and so on.
Information transfer	Reliance on routine means of communication: mail, phone, or fax.	Use of e-mail, Internet sites, and so on if available in-country (usually a mix of old and new).
Laboratory	Emphasis on accurate basic capability; reliance on reference laboratories for sample analysis.	More capability in-country with reference laboratories used more for quality control than for sample analysis.
Communication	Focus on direct communication with disease reporters to insure transmittal of information to those who must know and on whom the surveillance system relies for routine information.	Expanded range of communication of information to broader audience with goal of raising societal public health competency.
Major problems	Ineffective surveillance (too many conditions, too much useless information, too little connection to action) leading to decreased interest in surveillance and public health.	Enthusiasm based on series of successes leading to increasing expectations that are not matched by new resources; greater emphasis on chronic diseases where success of public health intervention is less demonstrable in the short term.

and financial resources (including most Latin American or Eastern European countries).

Development of surveillance builds on success. Demonstration of the effectiveness of an initial surveillance system builds support among reporters and those who must provide resources. It can create public awareness of the importance of information for managing epidemics, tracking diseases, and better health in general. Once the potential benefits of surveillance is better understood it may be difficult to initiate a surveillance system for a small, limited array of conditions. However, being too ambitious initially may lead to loss of enthusiasm for any continued effort and be more destructive than starting slowly.

While advances in computer and information technology present many opportunities for improved surveillance, they also present new threats to the development of effective surveillance. It is easier to buy equipment (provided funding is available) than to train and develop adequate staff and to build partnerships with disease reporters and others, without whom surveillance would not function. Effective surveillance can be accomplished with rudimentary technology; *technology will not replace conceptual understanding, management skills, and development of essential partnerships.*

What systems are used for data transmittal?

The data transmission system should be the result of design choices that are practical and feasible for the situation. There is an array of potential reporters to be considered, including providers, clinics, hospitals, and community health workers. In addition, many potential communications media may be employed, including postcards, telegraph, telephones, faxes, e-mail, and the Internet. Similarly, databases may be based on paper files, may be computerized, or may be Internet-based. The methods of data transmittal must be technologically appro-

priate for the country. Historically, effective surveillance systems have used very basic means of communications, such as postcards.

In designing the surveillance system consideration should first be given to development of the analysis plan. What data should be analyzed for the intended audience? Analysis can have different levels of complexity, depending on technical capacity and needs for decisionmaking. Decisions must be made concerning the frequency of tabulation and the level of analysis (for instance local as opposed to state, or state as opposed to national). Very basic tabulation of data is often quite useful for disease-prevention activities. More complex analyses sometimes reveal opportunities for prevention that are lost in the simplest data analyses. The degree of effectiveness of data analysis is more dependent on an analysis that is logical in thinking and committed to prevention, and less based on an automated or regimented approach.

What are the common issues in communication of surveillance results?

Communication to whom?

The communication style and format will depend on the intended audience. It may be directed to the governmental hierarchy, including local, state, and national authorities, or communication may flow across parallel levels of government, such as village-to-village or state-to-state. There may be a need to communicate internationally among governments. Obviously, information to individuals who must make personal decisions (concerning condom use, for instance) must be clearly articulated. Another frequently used avenue of communication is to nonhealth organizations or NGOs that may play a role in prevention (this category includes schools, industry, and the media).

Means of communication?

Among the many potential vehicles for communicating to the parties identified above are:

- Yearly bulletins (yearly reports of vital statistics)
- Periodic reports of notifiable diseases (such as weekly reports of numbers of notifiable cases, reports of epidemics, and other events)
- Periodic reports of epidemics of local, regional, national, or international importance
- Newsletters and mailings to professional groups
- Press and media releases
- Interviews with the press
- Posting to Web sites

Problems in communication?

Public health practitioners often run into attitudinal problems among potential data users and collectors. Among the more important problems are:

- Incredulity that communication can lead to change
- Potential inconsistency of public health and political messages
- Overly hierarchical, top-down communication
- Secretive attitudes

Problems in preparation?

Potential pitfalls in successfully preparing information include the following:

- Communication of data rather than communication of a public health message
- Undisciplined or impromptu policy developed ad hoc during communication itself
- Lack of timeliness
- Poor framing of message
- Inconsistent messages that are not integrated into overall public health strategy
- Over-dependence on only one of many effective communication strategies

What is the relationship between laboratories and surveillance?

Laboratories play many critical roles in prevention and are essential partners in surveillance. Clinical diagnosis often requires laboratory confirmation, such as in the diagnosis of malaria or TB. Laboratory work also determines, through drug susceptibility testing, how best to treat a patient for TB or dysentery. Beyond clinical diagnosis for the individual, specialized laboratory testing may demonstrate that a common organism is the cause of multiple outbreaks that are separated in space and time. Research laboratories may identify the cause for a heretofore-unknown condition, such as was the case with Legionnaire's disease and mad cow disease soon after their clinical recognition.

A complete health-care system will have a continuum of laboratories at the local, state, national, and international levels that work together in a cohesive network. The laboratory continuum is characterized by its diagnostic and research capability, and by its capability for containment of infection. A system of grading laboratories for biosafety has been developed: gradations range from P1 to P4, with P1 requiring the least and P4 requiring the most biosafety measures (CDC/NIH 1999). The P4 laboratories, however, are exceedingly costly to build and maintain and, to date, exist only in a small number of countries.

It is important for each system to consist of a continuum of laboratories providing the most basic to the most sophisticated services, but it is implausible that resources are sufficient everywhere to provide the entire continuum. Some smaller, low-income countries may need to consider cross-border collaboration and regional reference laboratories to resolve some of their laboratory needs. However, such collaboration still requires an organized system of transporting specimens and communicating results in order to be successful. While sophisticated equip-

ment must be reserved for the most sophisticated referral laboratories, good laboratory practices—such as the use of gloves and avoidance of procedures that aerosolize specimens—should be practiced universally. Good laboratory practices are the first line of defense against inadvertent infection of laboratory workers and the community.

How do you evaluate the surveillance system?

Evaluation of an existing surveillance system can be broken down into the following essential steps. Complete details of the process may be found in appendixes A.6 and B.1.

- What are the goals and objectives of the surveillance system, and is it meeting them?
- What is the public health importance of the diseases or health events under surveillance?
- How does the system operate?
- What resources are required?
- What are the system's attributes (see appendix A.6)? Is the system communicating with data sources?
- Is there communication and feedback between the different administrative levels?
- Does the system provide useful information? Is it leading to public health action?
- Are the findings provided to, and used by, policymakers?

There must be support from all those on whom the surveillance system depends. These groups who initiate and sustain the system includes government officials, health-care providers, community health workers, NGOs, and advocacy groups. Starting surveillance for a disease or BRF that is not sustainable due to a lack of resources is counter-productive in the long run.

What are the components of an effective surveillance program?

Surveillance systems can either show their public health merit (and become more effective), or they can spiral downward. Malison has described this downward spiral and presents a model for understanding how ineffective surveillance systems evolve (Malison 1992). Poor quality data is not useful, so it is not in demand by those who would effectively improve the public health. Other demands for data continue from "archivists," who are interested more in process and completeness of data than in their utility (see table 5). Lack of demand reduces incentives to improve quality, so the system deteriorates. The cycle continues until the supply of data—which continue to worsen in quality—equals demand that comes less from public health decisionmakers interested in improving outcomes and more from "archivists" interested in bean counting.

What are the issues of data privacy and accessibility for use?

Surveillance systems and the information systems that support them should be designed in such a manner that personal identifying information is accessible only to public health professionals who need to collect additional information of importance required to intervene to prevent adverse public health outcomes (such as transmission of communicable diseases, preventable workplace injuries, or progression from mild to advanced chronic disease), or for bona fide research. Indiscriminant data access can be minimized by providing training on confidentiality and privacy to surveillance staff, providing privacy on work phones, locking cabinets for hard copy data storage, secure computer storage for electronic data, and limiting transmission of data over public communication lines. It should be emphasized that confidentiality is both a matter of hardening data storage from intrusion, as well as limiting gossip and inadvertent disclosure of personal information.

**TABLE 5
FACTORS LEADING TO USEFULNESS OR INEFFECTIVENESS OF SURVEILLANCE SYSTEMS**

Factor or element	Effective system	Ineffective system
Number of conditions	Fewer	Too many
Amount of information per case	Lean	Too much
Burden on reporter (reporting forms)	Lean	Too complex and burdensome
Decisionmakers' interest in surveillance data	High	Low
Goals for surveillance	Clear and supported	May never have been clear
Reporting strategy for serious but common conditions	Enough information to meet goals and make decisions	Complete reporting
Usefulness of data to local collectors	High	Low
Limited to analysis of data and archiving	Low	High
Usefulness to decisionmakers for prevention action	High	Low

Inadvertent disclosure of personal information may occur for various technical reasons, such as occur when mapping cases with geographic information systems (GIS) to the point where an individual is identifiable.

In many cases personal identifiers (such as names, addresses, and social security numbers) are not needed to conduct effective surveillance. For example, there is generally no need for personally identifiable data at the national level, where public health issues mainly involve magnitude and trends.

Is a legal basis for public health surveillance necessary?

Medical information obtained by physicians and other health-care providers is usually considered confidential. However, mandatory reporting of some diseases includes personal identifiers such as name and address of the person affected. This permits the case investigation needed to control communicable diseases or the identification of interventions to prevent further cases from occurring as in infant and maternal mortality surveillance. In part due to this conflict between individual rights and societal needs, a legal basis is required in most countries for effective

mandatory notification to be implemented. Surveillance and disease-control activities are authorized in state statutes as part of the "police powers" of states. These laws usually include restrictions on the use and accessibility of the information thus trying to balance the needs of society to protect the public's health, with protection of the individual's right to privacy (Matthews, Neslun, and Churchill 2000).

How are outbreaks recognized?

Epidemics come in various sizes, from smaller, localized outbreaks (such as plague, food-poisoning, typhoid, diphtheria, Ebola), to widespread pandemics (cholera in South America in 1992–94, influenza worldwide in 1918, and the current almost-worldwide pandemic of HIV). Recognition of outbreaks occurs in various ways.

Localized outbreaks are usually identified and reported by an astute observer: by a victim, health department, or health practitioner. This is an informal system that works well when public health officials are flexible, curious, receptive to phone calls, and responsive. It is likely that some reports will be false positives. Nonetheless, officials should remain responsive to each of these reports.

In contrast, formal systems for detection of epidemics, such as those in place for pneumonia and influenza surveillance, depend on systematic collection and analysis of data and comparison with the expected number of cases. Many local and state health departments in the Americas maintain "endemic channels" for diseases (such as malaria and dengue fever) that are based on observations from the previous five years. A range for the maximum number of cases expected over the period of a year is developed. When the number of cases exceeds the maximum expected—the epidemic threshold—an epidemic is considered to be occurring, and public health actions beyond the routine should be initiated.

Recent advances in laboratory techniques have improved public health practitioners' abilities to recognize and track epidemics. Among these techniques is genetic fingerprinting of disease organisms,

which allows linkage of otherwise independent outbreaks. A recent example of the utility of this technique was the recognition of transmission of multidrug-resistant TB among the inmates of New York state prison facilities (CDC 1991).

How do I complete the surveillance process?

The surveillance process is completed when action is taken. Possible actions range from disease control measures to policy and planning or resource allocation activities.

THE #1 TAKE-HOME MESSAGE

There is no value to a surveillance system unless the information is used for actions that prevent or control diseases.

APPENDIX A.1

What Software Is Available for Surveillance?

There are numerous software packages available for use in public health surveillance. Many of them are complex and are aimed primarily at statistical analyses of datasets. Several easy-to-use software packages are widely accepted in the surveillance community.

Epi-Info

Epi-Info and Epi-Map (Centers for Disease Control and Prevention) are public domain software packages designed for the global community of public health practitioners and researchers. Both provide easy form and database construction, data entry, and analysis with epidemiologic statistics, maps, and graphs. A Web site devoted to the dissemination of these softwares, including tutorials

for their use, may be found at <http://www.cdc.gov/epiinfo>.

Prophet

Prophet offers advanced, easy-to-use software tools for data management, visualization, and statistical analysis. Information concerning this package may be found at www.prophet.bbn.com.

GIDEON

GIDEON, created by C.Y. Informatics, is an interactive computer program for diagnosis and reference in the fields of tropical and infectious diseases, epidemiology, microbiology, and antimicrobial chemotherapy. Information concerning this package may be found at <http://www.cyinfo.com>.

APPENDIX A.2

What Are International Sources of Surveillance Information?

Increasingly, information on surveillance may be accessed electronically. Several of the more important resources are listed below.

World Health Organization

The WHO maintains a wealth of information about international public health concerns. Useful items for a Task Manager include a series of basic documents outlining WHO policy, disease outbreak news, and the WHO Statistical Information System, which contains the data from the WHO's mortality database on causes of death, causes of infant death, life expectancy, and age-standardized death rates; statistical information on basic health indicators, burden of disease, health personnel, international classifications, HIV/AIDS, United Nations population data, links to national health-related Web sites, member states of the WHO, and links to other sources of health information. This information may be accessed at: www.who.int.

Centers for Disease Control and Prevention

CDC maintains a number of electronic databases that are easily accessible. CDC databases may be accessed at www.cdc.gov/scientific.html

1. CDC WONDER

CDC WONDER is an easy-to-use system that provides a single point of access to a wide variety of CDC reports, guidelines, and U.S. public health data. CDC WONDER (<http://wonder.cdc.gov/>) allows the user to:

- Search for and retrieve MMWR articles and prevention guidelines published by CDC.
- Query dozens of CDC datasets via “fill-in-the blank” request screens. Public-use datasets about mortality, cancer incidence, hospital discharges, AIDS, BRFs, diabetes, and many other topics are available for query, and the requested data can be readily summarized and analyzed.
- Locate the name and e-mail addresses of CDC staff and registered CDC WONDER users.
- Post notices, general announcements, data files, or software programs of interest to public health professionals in an electronic forum, for perusal by CDC staff and other CDC WONDER users.

2. WISQARS™

WISQARS™ (Web-based Injury Statistics Query and Reporting System), pronounced “whiskers,” is an interactive system that provides injury-related mortality data useful for research and for making informed public health decisions. The user can use “injury mortality reports” to determine injury deaths and death rates for specific external causes of injuries. The user can also use “leading causes of death reports” to determine the number of injury-related deaths relative to the number of other leading causes of death in the United States or in individual states.

3. Behavioral Risk Factor Surveillance System

In 1984 CDC established the Behavioral Risk Factor Surveillance System (BRFSS) to develop and conduct surveys to monitor state-level prevalence of the major behavioral risks among adults associated with premature morbidity and mortality (such BRFs include smoking, exercise, and seat-belt usage). The premise was to collect data on actual behaviors, rather than on attitudes or knowledge, that would be especially useful for planning, initiating, supporting, and evaluating health promotion and disease prevention programs. The BRFSS, administered and supported by the Division of Adult and Community Health, National Center for Chronic Disease Prevention and Health Promotion (a division of the CDC) is an ongoing data collection program. State-specific data on various BRFs are retrievable.

ProMED-mail

The ProMED-mail electronic outbreak reporting system, sponsored by the International Society for Infectious Diseases, was inaugurated on the Internet in August 1994 to monitor emerging infectious diseases on a global basis. It is the only rapid reporting system of outbreaks open to all sources and free of political restraints. Expert moderators screen all reports before posting.

A central goal of ProMED-mail is to establish a direct partnership among scientists and doctors in all parts of the world by making it possible for all to share information and discuss emerging disease concerns on a timely basis. ProMED-mail welcomes the participation of all interested colleagues, students, and interested people outside the health and biomedical professions. There is no charge for subscribing. Additional information may be found at www.promedmail.org/pls/promed/promed.home.

APPENDIX A.3

What Global and Regional Alert Systems Exist?

The WHO publishes notices of outbreaks on their Web site: www.who.int/disease-outbreak-news/index.html.

Pro-MED is the most timely source for reports of epidemics (www.promedmail.org/pls/promed/promed.home).

In addition, CDC publishes the *Morbidity and Mortality Weekly Report* (MMWR), which features topical reports of epidemics, surveillance data, and other public health concerns (www.cdc.gov/mmwr).

APPENDIX A.4

What Training Is Available?

Training needs will vary according to the particular circumstance. For instance, World Bank Task Managers have different needs from, say, sanitation specialists. In general, anyone involved in public health surveillance should have some insight into the basics of epidemiology and the purposes of surveillance. The CDC, universities, and—increasingly—the Internet are among the venues that provide opportunities for training. Several of these venues are discussed below.

Field Epidemiology Training Programs

For nearly 20 years CDC's international health specialists have collaborated with ministries of health around the world to establish and conduct 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. The two-year training and service programs are designed for health professionals in entry- or mid-level positions, and are intended to assist in building capacity in applied epidemiology and enhanced public health practice.

Countries with FETPs include: Australia, Brazil, Canada, the countries in Central America, Colombia, the Arab Republic of Egypt, Germany, Indonesia, Italy, Japan, Jordan, Mexico, Peru, the Philippines, Saudi Arabia, Spain, Taiwan (China), Thailand, and the United States. For further information consult www.cdc.gov/epo/dih/fetp.html.

Training Programs in Epidemiology and Public Health Intervention Network, Inc.

In June 1997, the Training Programs in Epidemiology and Public Health Intervention Network, Inc. (TEPHINET) was founded in a meeting in Annécý, France, attended by directors of 17 national and regional training programs, in response to an invitation of the WHO's Division of Communicable Disease Surveillance and Response; CDC; the Foundation Mérieux; and the national programs that have provided continued support to TEPHINET.

TEPHINET programs share a practical field-based or "learning-by-doing" approach to public health training. They are affiliated with governmental institutions, such as ministries of health, national disease prevention and control programs, and academic institutions. Emphasis is placed on developing competencies in the epidemiologic process, communication in public health, professional skills, and other core public health sciences. For further information, consult <http://asclepius.ic.gc.ca/tephinet>.

Public Health Training Network

The Public Health Training Network (PHTN) of CDC is a distance learning system that takes training to the learner. PHTN uses a variety of instructional media ranging from print to videotape and multimedia in order to meet the training needs of the public health work force nationwide. Since 1993 PHTN has delivered nearly 1 million training oppor-

tunities to professionals in public health settings and, increasingly, in health care and related settings. For further information consult www.cdc.gov/phtn/whatis.htm.

“Surveillance in a Suitcase”

“Surveillance in a Suitcase” is a training manual developed by CDC that follows the book *Principles and Practice of Public Health Surveillance*, edited by Steven M. Teutsch and R. Elliott Churchill (Teutsch and Churchill 1994). Staff at the CDC wrote each of the 13 chapters in “Surveillance in a Suitcase.” The text provides a practical and up-to-date reference on the topic of public health surveillance and is the basis of this training manual.

There are 14 lessons in the training package. Each lesson consists of a lecture outline and appropriate overheads that follow the narrative. Two work exercises dealing with public health surveillance and other practical exercises are included. This manual is to be used for teaching public health surveillance to public health and other health professionals. It

was developed for use in the United States, but is in the public domain and can be adapted for use in other countries. “Surveillance in a Suitcase” is available free of charge at: <http://www.cdc.gov/epo/surveillancein/>.

Academic Opportunities

Numerous universities offer courses in public health surveillance. These include, but are not limited to:

- Washington University (<http://depts.washington.edu/hsic/subject/subjects.html>)
- Emory School of Public Health (www.sph.emory.edu/home.html)
- Johns Hopkins School of Public Health (www.jhsph.edu)
- Harvard School of Public Health (www.hsph.harvard.edu)
- London School of Hygiene and Tropical Medicine (<http://www.lshtm.ac.uk/>)

APPENDIX A.5

Where Can I Find Useful Textbooks and Articles on Surveillance?

Recommended texts include Teutsch and Churchill 2000b; and Halperin, Baker, and Monson 1992 (See references).

The Internet has become an enormous repository of valuable information on public health surveillance. Useful information and articles include the following:

www.ph.ucla.edu/epi/snow/broadstreetpump.html—A fascinating historical look at Dr. John Snow (1813–58), a legendary figure in the history of public health, epidemiology, and anesthesiology.

www.cdc.gov/mmwr/preview/mmwrhtml/00042730.htm—A historical overview of CDC; national morbidity data from June 8, 1946, and June 22, 1996; reprints of articles published in CDC’s “earlier years” reports about an outbreak of smallpox and an outbreak of pentachlorophenol poisoning in newborn infants; and information resources about CDC.

www.who.int/aboutwho/en/history.htm—A brief history of the WHO.

www.who.int/emc-documents/surveillance/whocdscsr992c.html—Protocol for the Assessment of National Communicable Disease Surveillance and Response Systems: Guidelines for Assessment Teams.

www.who.int/emc-documents/surveillance/whoemcd972c.html—Protocol for the Evaluation of Epidemiological Surveillance Systems.

www.who.int/emc/surveill/index.html—Integrated Disease Surveillance.

Other sources

www.who.int/emc/surveill/index.html

www.cdc.gov/preview/mmwrhtml/rr5013a1.htm

www.who.int/emc-documents/surveillance/whocdscsr992c.html

http://www.who.int/emc/amr_interventions.htm

Additional readings

Aylward, R. B., H. F. Hull, S. L. Cochi, R. W. Sutter, J. M. Olive, and B. Melgaard. 2000. “Disease Eradication as a Public Health Strategy: A Case Study of Poliomyelitis Eradication.” *Bull WHO* 78: 285–97.

CDC (Centers for Disease Control and Prevention). 1991. “Transmission of Multidrug-Resistant Tuberculosis among Immunocompromised Persons in a Correctional System.” *MMWR* 41 (28): 507–09.

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Dowdle, W. R., and D. R. Hopkins, eds. “The Eradication of Infectious Diseases.” Dahlem workshop report. John Wiley & Sons Ltd, Chichester, England, 1998.

Hennekens CH and Buring JE. *Epidemiology in Medicine*. Little, Brown and Company. Boston. 1987.

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- White, M. E., and S. M. McDonnel. 2000. "Public Health Surveillance in Low- and Middle-Income Countries." In Teutsch, S. M., and R. E. Churchill, eds., *Principles and Practice of Public Health Surveillance*. Second edition. Oxford University Press.
- Wilcox, L. S., and J. D. Marks, eds. 1994. "From Data to Action: CDC's Public Health Surveillance for Women, Infants, and Children." USDHHS.

ALSO SEE REFERENCES AFTER PART B.

APPENDIX A.6

How Are Surveillance Systems Evaluated?

The evaluation of surveillance systems should promote the best use of public health resources by ensuring that only important problems are under surveillance and that surveillance systems operate efficiently. Insofar as possible the evaluation of surveillance systems should include recommendations for improving quality and efficiency—by eliminating unnecessary duplication, for instance. Most important, an evaluation should assess whether a system is serving a useful public health function and is meeting the system’s objectives.

Because surveillance systems vary widely in methodology, scope, and objectives, characteristics that are important to one system may be less important to another. Efforts to improve certain attributes—such as the ability of a system to detect a health event (sensitivity)—may detract from other attributes, such as simplicity or timeliness. Thus, the success of an individual surveillance system depends on the proper balance of characteristics, and the strength of an evaluation depends on the ability of the evaluator to assess these characteristics with respect to the system’s requirements. Any approach to evaluation must be flexible, in order to accommodate these objectives. With this in mind, the guidelines that follow describe measures that can be applied to surveillance systems, with the understanding that all measures will not be appropriate for all systems and taking into account the time constraints and complexity of the process.

Outline of tasks for evaluating a surveillance system

1. Describe the public health importance of each health event under surveillance. The following are the three most important categories to consider:
 - Total number of cases, incidence and prevalence
 - Indices of severity such as the mortality rate and the case-fatality ratio
 - Preventability
2. Describe the system to be evaluated
 - List the objectives of the system
 - Describe the health event or events under surveillance. State the case definition for each health event.
 - Draw a flowchart of the system
 - Describe the components and operation of the system
 - What is the population under surveillance?
 - What is the timeframe and time period of data collection?
 - What information is collected?
 - Who provides surveillance information?
 - How is information transferred?

- How is information stored?
 - Who analyzes the data?
 - How are the data analyzed and how often?
 - How often are reports disseminated?
 - To whom are reports distributed?
 - How are reports distributed?
3. Indicate the level of usefulness by describing actions taken because of data from the surveillance system. Characterize the entities that have used the data to make decisions and take actions. List other anticipated uses of the data.
 4. Evaluate the system for each of the following attributes:
 - Simplicity
 - Flexibility
 - Data quality
 - Acceptability
 - Sensitivity
 - Predictive value positive
 - Representativeness
 - Timeliness
 - Stability
 5. Describe the resources needed to operate the system (that is, the direct costs).
 6. List conclusions and recommendations. State whether the system is meeting its objectives, and address the need to continue or modify the surveillance system, or both.

The public health importance of a health event and the need to have that health event under surveillance

can be described in several ways. Health events that affect many people or require large expenditures of resources clearly have public health importance. However, health events that affect relatively few persons may also be important, especially if the events cluster in time and place—a limited outbreak of a severe disease. At other times, public concerns may focus attention on a particular health event, creating or heightening the sense of importance. Diseases that are now rare because of successful control measures may be perceived as “unimportant,” but their level of importance should be assessed in light of their potential to re-emerge. Finally, the public health importance of a health event is influenced by its preventability.

Parameters for measuring the importance of a health event—and therefore the need for a surveillance system with which to monitor it—include:

1. Total number of cases, incidence, and prevalence
2. Indices of severity, such as the case-fatality ratio
3. Mortality rate
4. An index of lost productivity: such as bed-disability days
5. An index of premature mortality: such as YPLL
6. Cost-effectiveness of interventions
7. Preventability
8. Epidemic potential

These measures of importance do not take into account the effect of existing control measures. For example, the number of cases of vaccine-preventable illness has declined following the implementation of school immunization laws in the United States and elsewhere, and the public health importance of these diseases would be underestimated by case

counts alone. In such instances it may be possible to estimate the number of cases that would be expected in the absence of control programs.

Assessing the usefulness of a surveillance system: An assessment of the usefulness of a surveillance system should begin with a review of the objectives of the system and should consider the dependence of policy decisions and control measures on surveillance. Depending on the objectives of a particular surveillance system, the system may be considered useful if it satisfactorily addresses at least one of the following questions.

Does the system:

- Detect trends signaling changes in the occurrence of disease?
- Detect epidemics?
- Provide estimates of the magnitude of morbidity and mortality related to the health problem under surveillance?
- Stimulate epidemiological research likely to lead to control or prevention?

- Identify risk factors associated with disease occurrence?
- Permit assessment of the effects of control measures?
- Lead to improved clinical practice by the health-care providers who are the constituents of the surveillance system?

A surveillance system is useful if it contributes to the prevention and control of adverse health events, including an improved understanding of the public health implications of such events. A surveillance system can also be useful if it helps to determine that an adverse health event previously thought to be unimportant is actually important.

Not every surveillance system will meet all the goals of surveillance. Inevitably tradeoffs have to be made that involve resources; work force; infrastructure; and social or political constraints, or both.

Source: CDC 2001; WHO 2001a.

APPENDIX A.7

What Are the Key Statistical Concepts for Surveillance?

Statistics and epidemiology form the cornerstone of public health surveillance. An understanding of statistical principles is necessary to comprehend the published literature and practice in a rational manner. The purpose of this section is to review some of the basic statistical principles and formulas. More in-depth discussion can be obtained in texts of epidemiology and biostatistics.

Measurements of disease frequency

Prevalence is the most frequently used measure of disease frequency and is defined as:

$$\text{Prevalence} = \frac{\text{Number of existing cases of a disease}}{\text{Total population at a given point in time}}$$

Incidence quantifies the number of new cases that develop in a population at risk during a specific time interval:

$$\text{Cumulative incidence} = \frac{\text{Number of new cases of a disease during a given time period}}{\text{Total population at risk}}$$

Cumulative incidence reflects the probability that an individual will develop a disease during a given time period.

Mortality rate is an incidence measure:

$$\text{Mortality} = \frac{\text{Number of deaths}}{\text{Total population}}$$

Case-fatality rate is another incidence measure:

$$\text{Case-fatality rate} = \frac{\text{Number of deaths from the disease}}{\text{Total number of cases of the disease}}$$

Attack rate is also an incidence measure:

$$\text{Attack rate} = \frac{\text{Number of cases of the disease during a given time period}}{\text{Total population at risk due to having been exposed}}$$

Test result characteristics

It is important to understand predictive value, which helps in interpreting test results for an individual. The *predictive value positive* expresses the probability that a person with a positive test result is actually infected; the *predictive value negative* is the probability that a person with a negative test result is not infected. The predictive value depends not only on the accuracy of the test itself but also on the prevalence (the percentage of persons who are infected in the population tested). The predictive value of a positive test result decreases as the prevalence declines in the population tested.

Table 6 demonstrates how these values are generated.

From this table four important statistics can be derived:

- *Sensitivity*—A sensitive test detects a high proportion of the true cases, and this quality is measured by $a / a + c$.

Table 6
Comparison of a survey test with a reference test

Survey test result	Reference test result Positive	Negative	Totals
Positive	True positives, correctly identified = (a)	False positives = (b)	Total test positives = (a + b)
Negative	False negatives = (c)	True negatives correctly identified = (d)	Total test negatives = (c + d)
Totals	Total true positives = (a + c)	Total true negatives = (b + d)	Grand total = (a + b + c + d)

- *Specificity*—A specific test has few false positives, and this quality is measured by $d/b + d$.
- *Systematic error*—For epidemiological rates it is particularly important for the test to give the right total count of cases. This is measured by the ratio of the total numbers positive to the survey and the reference tests, or $(a + b) / (a + c)$.
- *Predictive value*—The proportion of positive test results that are truly positive; it is important in screening. It should be noted that both systematic error and predictive value depend on the relative frequency of true positives and true negatives in the study sample (that is, on the prevalence of the disease or exposure that is being measured). Predictive value is measured by $a/a+b$.

APPENDIX A.8

How Does Surveillance Case Definition Relate to Sensitivity and Specificity?

As noted in part A above (discussion of surveillance methods) public health officials rely on health-care providers, laboratory personnel, and other public health personnel to report the occurrence of notifiable diseases, conditions, injuries, and so on to health departments. To facilitate this reporting case definitions are developed to provide uniform criteria for identifying these diseases and conditions.

Case definitions always involve a balancing act of sensitivity as opposed to specificity. A definition is *sensitive* if it identifies all the cases of a disease or condition in question. A definition is *specific* if it excludes individuals without the disease or condition in question. Sensitivity and specificity thus describe the accuracy of the test. Sensitivity determines the percentage of false-negative results, and specificity determines the percentage of false-positive results, when a large number of positive and negative samples are tested.

An insensitive case definition may suffice when cases are plentiful and it does not matter if some cases are missed. On the other hand, in the end-game of control (when a disease nears elimination), it is important to have a sensitive definition to ensure

that all possible cases are captured, even if many are false positive.

The WHO has a catalog of case definitions for infectious diseases (WHO 1999a).

Examples of case definitions from the WHO include:

CHOLERA

Clinical case definition

- In an area where the disease is not known to be present: severe dehydration or death from acute watery diarrhea in a patient aged 5 years or more or
- In an area where there is a cholera epidemic: acute watery diarrhea, with or without vomiting in a patient aged 5 years or more.⁶

Laboratory criteria for diagnosis

- Isolation of *Vibrio cholerae* O1 or O139 from stools in any patient with diarrhea.

Case classification

- *Suspected*: A case that meets the clinical case definition.
- *Probable*: Not applicable.
- *Confirmed*: A suspected case that is laboratory-confirmed.

Note: In a cholera-threatened area, when the number of "confirmed" cases rises, shift should be made to using primarily the "suspected" case classification.

⁶Cholera does appear in children under 5-years old; however, the inclusion of all cases of acute watery diarrhea in the 2- to 4-year-old age group in the reporting of cholera greatly reduces the specificity of reporting. For management of cases of acute watery diarrhea in an area where there is a cholera epidemic, Cholera should be suspected in all patients.

MEASLES

Clinical case definition

- Any person with fever, and maculopapular (nonvesicular) rash, and cough, coryza (runny nose) or conjunctivitis (red eyes), *or*
- Any person in whom a clinician suspects measles infection.

Laboratory criteria for diagnosis

- At least a fourfold increase in antibody titre *or*
- Isolation of measles virus *or*
- Presence of measles-specific IgM antibodies

Case classification

- *Clinically confirmed*: A case that meets the clinical case definition.
- *Probable*: Not applicable.
- *Laboratory-confirmed*: *only for outbreak confirmation and during elimination phase*. A case that meets the clinical case definition and that is laboratory-confirmed or linked epidemiologically to a laboratory-confirmed case.

MENINGOCOCCAL DISEASE

Clinical case definition

- An illness with sudden onset of fever ($>38.5^{\circ}\text{C}$ rectal or $>38.0^{\circ}\text{C}$ axillary) *and one or more* of the following:
 - Neck stiffness
 - Altered consciousness
 - Other meningeal sign or petechial or purpurial rash
- In patients younger than <1 year, suspect meningitis when fever accompanied by bulging fontanelle.

Laboratory criteria for diagnosis

- Positive CSF antigen detection *or*
- Positive culture

Case classification

- *Suspected*: A case that meets the clinical case definition.
- *Probable*: A suspected case as defined above and: Turbid CSF (with or without positive Gram stain) or ongoing epidemic and epidemiological link to a confirmed case
- *Confirmed*: A suspected or probable case with laboratory confirmation.

PART B

How to Prepare a Surveillance Project: Operational Aspects

Part A addressed the concepts of surveillance and the “ideal” way of implementing a surveillance project. In Bank operations there are multiple constraints, related not only to the Bank style of doing business but also to clients’ demands and the pressures of prompt and timely delivery. These circumstances influence project preparation: Technical aspects, information needs, and loan preparation processes must be balanced against each other.

Part B offers a rapid surveillance system assessment within the usual time and cost constraints of project preparation. The most common surveillance issues that may be encountered are discussed, as are the main decisions necessary in project implementation. This chapter outlines the professional expertise needed for missions, where to find such professionals, as well as the corresponding terms of reference. The most common training and staffing needs are indicated. Projects might consider funding such training and staffing to assure a successful project and good system performance. Part B also touches on assessment of project progress and impact, and itemizes the most common budget lines that should facilitate the project costing process. Finally, all these elements will combine to outline the main conditions for successful project implementation.

Where do I begin?

When preparing a project to strengthen a national surveillance system several main steps are necessary

to determine (a) the state of the current system, (b) the desired characteristics of the “ideal” system, and (c) strategies for attaining a better system.

Do I need to know all health data systems that exist in the country?

It is important to know the current data systems because they can be used to feed the epidemiological surveillance system. An information system can be built to link those that already exist; in doing so there will be more information available for policy and decisionmaking purposes.

The most common data systems are:

1. Mandatory disease notification systems
2. Vital statistics
3. National laboratory systems
4. Vertical programs
5. Periodic surveys
6. Hospital discharge information systems

Current system needs assessment. What should I look for?

The seven elements of surveillance are:

1. Detection and notification of a health condition or event
2. Epidemiological, clinical, and laboratory investigation and confirmation

3. Data collection and consolidation
4. Data analysis
5. Reporting
6. Data transmission, communication, and feedback
7. Resources
8. Connection to action

Based on the above seven elements of surveillance there are four main areas to assess:

1. Communicable disease and NCD risk factor surveillance
2. Laboratory network
3. Information and telecommunications system
4. Economic analysis

In this paper these four areas will be referred to as the “epidemiological surveillance system.” Due to time constraints in Bank operations, it is not generally possible to fully assess the system as recommended in appendix A.6 and as described in various documents cited in this toolkit. However, there is a set of core information needed to establish the objectives of the project and to identify areas for improvement (WHO 2001a). The relevant questions are presented below.

Communicable Disease Surveillance Systems

The assessment should strive to answer the following questions (based on Koo and Ostroff’s report No: 19154—for World Bank 1999).

Policies and conditions under surveillance

- How many health conditions are notifiable at the national level?
- Are the notifiable health conditions well defined, and are definitions properly applied by reporting personnel?

- What were the selection criteria? Who was part of the selection committee?
- Are there also syndromes under surveillance?
- Are these diseases and syndromes reported nationally?
- Besides this set of health conditions reported nationally, are there more reported only at the state and local level, or both?
- Do specific surveillance guidelines exist?
- Are there systems for surveillance of communicable diseases besides the mandatory notification system (such as vertical programs)?

Organization of the system

- How is the system organized?
- Is there a clear definition of the tasks and responsibilities of the three levels of the system?
- Is there clear assignment and awareness of responsibilities? Do providers know their responsibilities?
- Are those functions adequate for the surveillance process?
- Does the national level recognize and understand the need for a good relationship between the national and state levels?
- Are the personnel at all levels of the system committed to data collection and disease surveillance?

Reporting procedures and quality of data

- Are there standardized reporting forms? Are they nationally adopted, maintained, and used?
- Is the information that is collected adequate for action to be taken?

- Is there too much or too little information?
- What is the periodicity of reporting?
- Are there substantial lag times in the reporting system?
- Is there zero reporting? (See definition in glossary, appendix B.7.)
- What are the main sources of reporting data? Does the private sector also report?
- Are data reported in a way that is easy to interpret? How are data reported—electronically or on paper?
- Are reporting procedures consistent and standardized?
- Are reported cases in concordance with the epidemiological profile of the states and states?

Disease investigation: data use

- Is the investigative capacity adequate?
- Is the investigative response timely?
- How much of the information collected is actually used for reports, public health action, or research.
- Do investigations lead to public health actions?
- Who is responsible for case investigation? Are jurisdictions clearly drawn?
- Are there regular interactions between the public sector and other groups (for instance academic centers and medical organizations)?
- Is there a core team with investigative capacity at the national level?

Information dissemination

- What kind of reports does the national epidemiology unit produce? Are they simple

numerical summaries, or do they include more sophisticated analysis and interpretation?

- What is the periodicity of the dissemination?
- To whom is information distributed?

Capacity issues

- How are data transmitted (fax, telephone, mail, vehicle, Internet)?
- Does the system have adequate personnel in terms of quantity and quality to perform surveillance tasks?
- How many staff are at the national level, and what are their profiles? How many staff are in each state or local epidemiology department, and what are their profiles?
- Do they have computers?
- Do they have standardized software, no software at all, or various levels of software?
- Provide case studies of recent events that stressed the system—where it failed or performed well.

Noncommunicable diseases and behavioral and other risk factor surveillance

There are countries with epidemiological profiles that justify surveillance for NCDs and their risk factors. Countries in Eastern Europe, Latin America, the Middle East; and China have all undergone the transition from a disease burden largely attributable to communicable diseases to one primarily due to NCDs (such as heart disease, diabetes, cancer, and injuries). A public health surveillance project can help countries start or strengthen NCD surveillance and BRFSSs.

Most of the questions raised above for communicable disease surveillance—for instance organization, reporting, dissemination, capacity—also apply to NCD surveillance. However, NCDs differ

from communicable diseases in that most cannot be cured. Disease investigation is not usually a component of NCD surveillance, and public health actions focus on primary prevention. NCDs can be entirely prevented through lifestyle and behavior change. Early diagnosis and adequate management are important for secondary prevention—for preventing the complications they cause (heart attacks, strokes, blindness and amputations, among others). Specific issues that should be addressed include:

Behavioral and other risk factor surveillance

- Have any surveys—national, state, or local—been conducted that address behaviors? How many? Are there plans to continue the surveys?
- Will these surveys be periodic, or are there plans to make data collection continuous and systematic?
- What risk factors are included in the survey or surveys? Is the information collected just about behaviors, or are physical measurements (such as weight or blood pressure) included?
- Have any clinical samples (such as cholesterol or glucose) been collected?
- Are BRFs limited to NCDs, or is there interaction with communicable disease programs and collection of key communicable disease behavior data (such as sexual behaviors and hand-washing)?

(See appendixes A.3, A.5, B.4, and B.5 for more information on behavioral and other risk factor surveillance.)

NCD mortality

- Is there a periodic assessment of mortality from NCDs?
- How complete is death registration? How accurate is classification of cause of death?

NCD morbidity

- Is there any information about the prevalence of NCDs in the population?
- Is there any information about the prevalence of undiagnosed disease?
- What sources of information are used? Is the source self-reported information or health facility information? Hospital discharge surveys, or ambulatory surveys?

NCD control

- Is there a survey or routine information collected on treatment and control of NCDs?

Organization and data utilization

- What is the link between those who do NCD and BRF surveillance, and those who develop and implement prevention and control activities? Is there good communication between these departments?
- Do those who work in prevention and control contribute to the development or modification of the data collection instruments? Does the information collected address their needs?
- Are the data utilized to improve prevention and control?
- Have priorities been set and criteria developed for measuring success against surveillance goals for NCD?

Prevention and control activities

- What types of health promotion activities does the health department carry out? Are there any school health activities, workplace activities, activities in health clinics, or public service announcements in the media?
- More specifically—what work is being done to reduce tobacco addiction? Are there any smoking regulations?

- Are there activities to encourage physical activity, promote injury reduction (such as seat belt campaigns), or better eating habits?
- What about treatment of NCDs such as diabetes and hypertension—is identification and treatment included in the primary health-care package?

Laboratory network

Usually the national laboratory system is comprised of different types of laboratories, such as national reference laboratories, public health laboratories, entomological units, zoonosis control centers, blood banks, and biosafety laboratories, among others. Due to limited project preparation time, it is advisable to assess a representative sample of laboratories at each corresponding level of the system, rather than the entire laboratory network. Concurrent with the Bank's assessment a situational analysis should be conducted by authorities in the national laboratory network. There should be consensus between the two assessments.

The assessment should review:

- Building facilities and working conditions
- Laboratory equipment and reagents
- Training of laboratory staff and whether there is a sufficient number of laboratory personnel
- Diagnostic capability (speed of diagnoses, number of diseases diagnosed, and major gaps)
- Reporting (links up and downstream, timeliness of reports, ability to communicate emergencies)
- Participation in national quality programs
- Laboratory management, quality control procedures, proficiency programs

While the client may be tempted to spend large amount of resources on renovating or building new

laboratories, this temptation should be counterbalanced by the critical need to invest in personnel and training to efficiently and effectively use existing laboratories.

Information and telecommunications system

There are many components of the information and telecommunications system. The most important is staff trained in the use of data and information technology. Other important aspects include the availability of desktop computer equipment and software, and the overall communications infrastructure (paper mail, fax machines, e-mail, Internet, and so on).

Depending on the resources available, countries have adopted a variety of different models for collecting and analyzing data. At one end is a highly centralized approach, such as where most of the work is done at the national level. At the other end is a decentralized model where states or local levels have staff and equipment that allow them to manage their own data. There are also hybrid models where larger states and local levels manage their own data, while smaller states rely on national staff, or smaller local levels rely on state staff.

The questions that should be answered with respect to the information and telecommunication systems fall into three categories:

- How are data collected and reported to local, state, and national health authorities?
- Who is responsible for managing, analyzing, and interpreting data?
- How, in what form, and to whom are results communicated?

Responses to these questions should be used to determine what infrastructure (staff, hardware, software, telecommunications links) are currently available and what will be needed in the future.

Data collection

Data collection can be paper-based, electronic, or some combination thereof. For example, notifiable disease surveillance may use an Internet-based electronic system, while NCD surveillance may use a field survey with information initially collected on paper and later entered into a computer.

- For each health data system identified, how does information flow—who reports the data, and how (and on what medium—paper, fax, e-mail, Internet-based data entry) is it reported?
- How do the data get to the state or local health department?
- How are these data then communicated to the national health authority?
- Where and when is paper, fax, e-mail, Internet used?
- Does the current system allow easy querying or correcting of data?

Data analysis and interpretation

- Once the data are collected, who does the analyses? Is it expected that staff at the national level will do all analyses, or should state and local health departments be able to produce their own analyses and reports?
- Are health program staff involved in analysis, interpretation and reporting, or is it all done by surveillance staff?

Data dissemination and communication

- Once the analyses are completed, how are results communicated to potential users? Are state and local staff, and individual data reporters given routine feedback based on the information they collect? How do they receive the information? Are reports printed on paper and mailed to them? Are they faxed or sent via e-mail? Are they accessible on the Internet?

- What about the general public? Are summary reports prepared and published? Are they made available on the Internet?
- Is there effective communication between the health department and the media? Is the media utilized for public health messages?
- Are health programs in the communication loop? NGOs? Communities?

Computer equipment

- What kind of computer and telecommunications infrastructure is available or needed to support and expand the data collection, analysis, and information dissemination efforts?
- Do states and local levels have the staff and equipment needed to collect and analyze their own data, or will this be done for them at the national level?
- How will sensitive and confidential data be secured? What safeguards are in place to assure that no breaches of confidentiality—accidental or intentional—occur?

In preparing for the future it is important to think creatively about the role the Internet may play. A number of national systems have been, or are being, developed that use the Internet to collect data directly from health care providers and local authorities to disseminate preformatted reports and analyses based on those data, and to allow users to request custom analyses of data. For such a system to work effectively, providers and users of data will need Internet access. Application development, database management, and security are best handled centrally because of the complexity and expense in setting up such systems. Because local and state governments do not need to create and manage their own separate infrastructure there can be substantial cost savings and increased managerial efficiency over the long term.

What are some general issues and needs of the surveillance system?

Coordination and standardization

- Does the system have leadership and coordination from the national level? Are data collected nationally, representatively, and in a uniform fashion?
- Do all states and local levels collect, investigate, record, and report in the same fashion?
- Are there standard definitions and guidelines easily accessible for notifiable diseases?
- Are there standardized disease investigation forms for each notifiable disease? Which kind of data do these forms include?
- Are disease reporting and laboratory data linked? How simple and successful is this linkage?

Integration

- Are the main components of the system (the surveillance system, the disease-specific programs, and the national laboratory network) working in an integrated manner and effectively sharing information?
- Is there a link to datasets in place?

Consolidation and assessment

This assessment should include a review of each disease, why it is being reported, what actions need to be taken at the local, state, and national levels and how data should be reported. Information needs may vary depending on the disease and on the level of the health system (see table 1, appendix B.6). Surveillance information generally gets consolidated and condensed as it moves up the pipeline from the local to state to national level. “High volume” conditions such as influenza, diarrheal diseases, and pneumonia, may overwhelm surveillance personnel if detailed information is collected about every single case. In order meet public health needs and provide

appropriate information for control programs, alternative methods of surveillance (such as sentinel site surveillance) that provide higher quality data more efficiently can be devised.

In addition to consolidating information on any particular disease, the system should be streamlined to avoid duplication—for instance multiple reporting systems for the same disease.

Training and capacity building

- Usually there is a great need to have well trained personnel at all levels of the system.
- Assess the number of persons involved in disease monitoring.
- Have cases been properly investigated?
- How skilled are personnel at the national level?
- Identify the critical staffing needs and type of training needed.

Analytic capability

Systems often generate numbers and disease rates, but lack data analysis and interpretation.

- Are data sufficient to develop meaningful information on risk factors and provide diagnostic confirmation in order to appropriately plan prevention and control activities?
- Is there a GIS or capacity for developing one?

Quality control

- Is there a quality control system in place?
- What proportion of cases meet case definitions for disease?

For instance, diarrhea is usually defined as “presence of illness for at least 24 hours with more than three loose bowels in that period,” so unless charts

are reviewed there is no way to tell what proportion of cases meet the case definition.

Investigation

- Does the system have outbreak response capacity at all levels, and conduct epidemiological studies to address priority diseases?
- Do personnel know their main tasks and degree of responsibility when an outbreak occurs?
- How many investigations have been performed at the national level?
- Are there written reports or publications of these investigations?

Data reporting and feedback

- Does the system produce periodic bulletins and provide feedback to disease reporters?
- Are data appropriately summarized and presented and easily available for decisionmakers to take appropriate control and prevention actions?

Alternative surveillance methods

As mentioned above (in discussion of consolidation and assessment), there is a need to determine the best methods for collecting data of sufficient quality for use in developing control programs.

- Are appropriate alternative methods of surveillance such as sentinel networks used appropriately for influenza or diarrheal diseases?
- Are these alternative systems linked to the national laboratory network?

Regulatory aspects

A system of mandatory disease notification means that notification is compulsory. Obliging health pro-

viders to report certain diseases and information that may otherwise be confidential requires a basis in law,

Box 6

LESSONS LEARNED FROM JEAN-JACQUES DE ST. ANTOINE, TASK MANAGER FOR PREPARATION OF THE BRAZIL'S DISEASE SURVEILLANCE PROJECT (VIGISUS)

In 1997, we received a request from Brazil basically saying: "Our disease surveillance system is 20-years-old. We need to modernize it; we would like to make it become the Brazilian CDC. Can the Bank help us with that?"

"Of course we will help you," I replied (not having even written a PCD for the project). The challenge was to agree on a vision of what the system should look like in 10 years, what would need to be done technically and financially, at what pace, and who would have the responsibility to do what at the federal or the local level. The technical work consisted of compiling the best package to strengthen skills at the center, as well as regional and municipal staff, to improve the collection, transmission and analysis of data and create mechanisms to ensure the link with decision-making required to address diseases (either prevent diseases, deal with outbreaks of communicable diseases, or reducing the risk factors for noncommunicable ones), and finally modernizing the laboratory network. The role of the various levels of the system (federal, state, and municipal) would be reviewed. The work with partners in CDC and PAHO gave me great professional satisfaction. The work with the client presented the challenge of addressing the needs of a sophisticated client in an immense country, making sure to keep project design fairly simple and flexible. It was a great learning experience for me. *Based on that experience, if I had a chance to do a second project, I would:*

- Fully evaluate the existing system as part of project preparation or sector work to make things easier later. *I would involve the client as much as possible in the exercise.*
- Build strong partnerships with CDC and the WHO and its regional offices, the key actors in this field.
- Get the *best* consultants (they need to have both the theoretical and practical knowledge and be able to sell their ideas to the client).
- Press the client to limit the number of disease and risk factors under surveillance, but pick them well.
- Design a project with a few key activities that are sure to have a strong and lasting impact in the country (training, improvement of data collection, and upgrading of laboratories).
- Pay close attention to what should be done at different levels of the system (national, state, and municipal)."

ideally. Most countries with this type of reporting have some type of statutory provision that enumerates exactly how, to whom, and within what period the reporting must occur. In the United States, for instance, this power resides in the states, and reporting requirements vary from state to state (Matthews, Neslund, Churchill 2000).

What are the main decisions and options for project implementation?

Responses should be consistent with the level of development of the health service infrastructure, personnel, available funding, and project duration, among other factors.

Flexible project design versus rigid structure

One alternative project design is a federal, fully detailed, and standardized national surveillance system. This approach might not properly fit the system needs, given the specific gaps and capacity of different states and local levels. In addition, despite the current climate of decentralization, local surveillance needs are often unrecognized at the national level. A top-down approach could weaken local ownership since the local level might not have the opportunity to articulate its needs. At the same time, a national surveillance system requires an overall conceptual framework and standardization of data collection, laboratory procedures, case definitions, and basic norms to be followed by all participants of the system. The most common approach is a project partly predetermined and partly flexible during implementation, based on state and local level development plans. This alternative balances the need for national consistency with the opportunity to respond to local needs and targeted interventions.

Comprehensive versus focused

The surveillance system should be developed rationally, based on national capacity and cost-effectiveness. It is not always appropriate to have

a large number of health conditions under surveillance since it may be difficult to properly address and respond to each one. Criteria should be applied to determine high-priority events for surveillance, and the system should rely on alternative surveillance methods, such as sentinel sites, when needed. These sentinel sites are often more successful when implemented gradually.

Phasing by region or diseases versus phasing by activity

There are several options to consider. First, the project may be implemented by geographic area. This is a difficult option, because most of the time states or local levels are not willing to wait for “their turn.” The second option is to implement the project for a few diseases at a time. This option could potentially be used, but probably not when financed by a loan, since phasing by disease could require costly duplication of training efforts, standardization of procedures, and many other activities related to implementation of the system. A third, and possibly best, option is to implement the project for high priority events, or to begin in sites where the maximum number of cases would be detected, using the least effort. Certain project activities could then be implemented gradually (for example, training programs, sentinel networks, telecommunications systems, and NCD surveillance, if applicable).

Communicable diseases versus noncommunicable diseases

Addressing NCDs and BRFs depends on the epidemiological profile and development of the country. Middle-income countries with longer life expectancies and increasingly urban populations have reached the point where chronic diseases and diseases related to lifestyle cause the majority of deaths and illnesses. Understanding current disease patterns and related behaviors in those countries and long-term monitoring of changes in these patterns and behaviors over time is critical to effective plan-

ning and execution of appropriate public health interventions. Most of these countries are not prepared in this field. Therefore, an incremental, strategic approach to chronic disease surveillance and associated risk factors is advised. The project could begin by setting priorities in chronic disease control and prevention, determining staffing needs, and then implementing an appropriate training program.

Private versus public intervention

Health surveillance and disease control are public goods and are core areas of responsibility of the national ministries of health, and their state and local counterparts. Nevertheless, there may be ways in which private health insurers could become partners in the system and contribute through cost-recovery. Clearly, health insurance providers have a vested interest in seeing that disease incidence is reduced through surveillance, control, and public health programs, and may be willing to pay for these services through contributions or levies on insurance premiums. Health insurance providers could be contracted to perform certain services.

What about the economic analysis?

One of the most common problems observed in surveillance systems is a high number of health conditions under surveillance that burden the system and prevent it from working efficiently. Often, strengthening surveillance is automatically associated with increasing the number of health conditions included in the system. This can become a difficult issue for negotiation; it is crucial to give evidence of the negative impact of choosing too many health conditions for monitoring.

To establish priorities and to address the cost-effectiveness of the proposed interventions on which the

economic justification of the surveillance system is based, a quantitative analysis can be carried out to help determine the optimal scope of surveillance and disease control. The establishment of priorities and the final decision of which diseases to include can be based on the following criteria: (a) disease impact on national DALYs; (b) approximate cost-effectiveness of control interventions; (c) outbreak potential of emergent diseases; (d) plan or potential for eradication; (e) vaccine preventability; (f) classification as an indicator or risk factor for an important disease; and (g) the probability that improved surveillance would lead to better control (that is, reduced mortality, morbidity, or disability) of the disease.

This analysis should take place early in the project preparation cycle in order to have an impact on the design of the system, both in scope and method, and should use a participatory process, involving the stakeholders in the analysis. This early involvement will ease the process of discussing the final list of health conditions to be included in the system as well as the corresponding surveillance methods.

This process was successfully carried out in the preparation of a World Bank surveillance project. The original list of 50 notifiable health conditions targeted for surveillance (too many for an efficient system) was reduced to 29 for notification, and 4 to be surveyed by alternative methods such as sentinel sites.

Sustainability analysis

Aside from quantitative analysis to prioritize the health conditions targeted for surveillance, a sustainability analysis should also be undertaken. In other words, will the changes initiated by the project be sustainable?⁷

⁷ This two-part economic analysis (carried out by G. Beeharry and D. Akhavan) can be found in the Project Appraisal Document (PAD) of the Argentina Public Health Surveillance and Disease Control Project, Report No: 19154.

What expertise do I need on missions?

The minimum core technical personnel necessary to prepare the project include:

- A *communicable diseases surveillance specialist* and, in some middle-income countries, a noncommunicable disease and BRF surveillance specialist.
- A *laboratory expert* with experience in laboratory surveillance.
- An *information technology expert* with experience in designing and establishing telecommunications systems. In less-developed countries this specialty may be replaced by an information specialist, since these countries may lack the capacity to implement and sustain a telecommunications system.
- A *health economist* to develop a cost-effectiveness and sustainability analysis. Understanding of surveillance and disease control is desirable.

Ideally, the consultants should not only have knowledge about the subjects but also practical experience, especially in developing countries.

Where can I look for this expertise?

There is no organized network or directory of surveillance experts. However, there is a very effective informal network. One can access the informal network by contacting the many national and international agencies that are in the forefront of public health activity, such as the CDC in the United States, parallel organizations in other countries, and the WHO and its regional offices, which provides a Web site directory of national surveillance centers (www.who.int/emc/surveill/mohglobal.html). Numerous for-profit and not-for-profit consulting firms can also provide or identify expertise. Schools of public health are a resource, as are specialists of national surveillance systems, especially from countries that have proven, high quality, surveillance systems.

Finally, there is a new effort by retirees from state and federal public health agencies in the United States to establish a nonprofit consortium in order to continue their contributions to public health. This organization, Public Health Emeritus, may be reached in the United States at (973) 972-4422. Terms of reference for some specialties can be found in appendix B.3.

National stakeholders need to be involved, right?

Right! The system assessment described in the beginning of this section will provide the minimal information needed to establish the project options available based on a needs assessment of each state in terms of resources (personnel, equipment, infrastructure, and financial) and perceived and actual disease priorities. In one state the critical need may be personnel, in another computers, while in another it may be improved laboratory capacity. One model will probably not suit the needs in all states, so active involvement of the national stakeholders may help determine the most appropriate and suitable model. This has two main benefits: better data are obtained for decisionmaking in key areas for improvement; and ownership and commitment of the key project implementers is established through making them part of the team-based decisionmaking process.

How do I involve the stakeholders in the process?

Rather than addressing all diseases, the evaluation should focus on certain diseases and can be conducted in specific high-, medium-, and low-capacity states, as well as at the national level. A stakeholder workshop should be planned to address questions regarding the main problems assessed by the Bank team (see an example of such a workshop in appendix B.2). Every assessment should include participation of national experts and personnel involved in the national surveillance system.

Box 7**LESSONS LEARNED FROM MARCELO BORTMAN, COORDINATOR FOR THE PUBLIC HEALTH SURVEILLANCE AND DISEASE CONTROL PROJECT IN ARGENTINA (VIGI-A)**

Argentina is a federal country in which provincial states have been responsible for health-related services since Argentina was made a republic. This “independence” results in significant differences among the health services provided by each state. Thus, the surveillance system suffered not only problems of quality and coverage, but it also struggled with structural differences among states with substantial differences in the performance of their surveillance systems. Although well-developed states had better coverage and greater capacity for analysis and response, many states lacked capacity.

Therefore, the following was key for a smooth implementation and involvement of the states:

- Consensus among *states* regarding surveillance norms. Support from the state level was key for project success and consistency.
- States were involved in the selection of trainers and development of training plans.
- The training program was designed to develop incrementally, with intermediate and final products identified. Jurisdictions, epidemiology instructors, and epidemiology personnel were involved in the design of this program.
- Ensuring participation of state authorities in the selection of trainers, requiring a screening for knowledge of epidemiology prior to hiring.
- Internet-based surveillance software was developed for three standard modules encompassing most of the system: mandatory notification, active surveillance, and sentinel surveillance.
- Integrate laboratories, clinical personnel, and epidemiologists to create independent strategies and protocols for each of the conditions to be under surveillance by the sentinel surveillance units.

Due to the complexity of surveillance systems and the relationship with other areas of the health system, project preparation should not be rushed; rushing could result in overlooking the above-mentioned issues. If necessary, the first year’s loan funds could be used to complete the needs assessment.

After these activities, the team should be able to identify the system’s capacity and its main problems, and start discussing areas in need of investment, as well as to create ownership and support from the main stakeholders for project implementation.

What are the staffing needs?

The most common specialties are:

- Epidemiology
- Infectious diseases
- Statistics
- Data entry
- Computer support
- Microbiology (relationship between epidemiologists and laboratory technicians)
- Editing (editing epidemiological bulletins)

Staffing needs at the national, state, and local levels should be identified by task and quantified in terms of personnel per unit population (such as one state-level epidemiologist per 500,000 population, one computer-support person per 1 million persons) and specific circumstances (for instance geographic barriers, rural as opposed to urban) should be recognized and addressed.

At the national level a core group with technical expertise is required to provide leadership and supervision. At the state level technical people are needed to support surveillance activities (to analyze, investigate, report, respond, and provide feedback and technical support to the local level). At the state level the project will need at least an epidemiologist responsible for project implementation and collaboration with the Project Coordination Unit. Depending on the size of the state, it may also require a as well as another epidemiologist to assist with training.

The number and profile of staff for surveillance or project implementation depends on many factors,

from the degree of decentralization of the country, to its size, population, and development. But there is always a common need—training. Regardless of the country characteristics, a national surveillance system needs to have a team of field-trained epidemiologists who are competent in the practical application of epidemiological methods as they relate to a wide range of contemporary public health problems.

What are the most common training needs?

Most countries lack epidemiology expertise, so projects should consider training actions in several areas. There is often a strong desire on the part of countries and Bank personnel to invest in renovating or building new facilities, particularly laboratories. This temptation should be resisted. Instead, it should be recognized that competent and qualified personnel, including laboratory personnel, are key to effective surveillance (see table 7). Training is fundamental to the success of any surveillance project.

What are the most common budget lines for public health surveillance?

(table 8 Common Budget Lines for Public Health Surveillance)

How can I assess project progress and impact?

Progress

There is a wide array of activities that can be implemented to increase efficiency, and strengthen and support surveillance systems—from training, to definition of surveillance norms and upgrading laboratory networks and communications systems. All these activities should be included in project implementation plans, and should be phased ac-

ording to priority for system development. Potential indicators for assessing progress in the system development include: (a) definitions and coding standards defined and approved; (b) key personnel trained in various areas of expertise and; (c) upgrading a certain number of laboratories to biosafety levels 3 and 2, and other laboratories to biosafety level 1;⁸ (d) number of case reports from each area reporting (e) number of cases from each area with completed disease investigation and appropriate response (f) epidemiological bulletin development and production of a certain number of bulletins;

Impact

Given the nature of the investments often required to develop or strengthen surveillance systems, it may not be possible to measure the impact of the project on surveillance during its short lifetime. Much of the project's lifetime is devoted to preparing the system; only when the project is close to an end will we start to see results. Therefore, it is advisable to be conservative in defining impact indicators, and to place greater emphasis on process indicators. The indicators used depend on the system and its resources. Impact measures should be quantifiable, including items such as:

- (a) Notifiable disease data appropriately utilized (for instance, X percent of cases of invasive meningococcal disease detected have been investigated and appropriate control measures instituted);
- (b) Surveillance system detects at least X percent of invasive meningococcal disease per 100,000 inhabitants. This level should be met or exceeded in Y percent of the provinces, B percent culture confirmed, and C percent of isolates sero-grouped;

⁸ Four biosafety levels exist depending on laboratory practices and techniques, safety equipment, and laboratory facilities (CDC/NIH 1999).

Table 7
Training and targeted personnel

Training	Targeted personnel
Basic epidemiology <ul style="list-style-type: none"> • Health indicators • Information systems 	Local (health center or hospital), state, and laboratory personnel, and the outbreak control team
State-level epidemiology training <ul style="list-style-type: none"> • Epidemiologic methods • Epidemiological studies and types of error • Epidemiology of communicable diseases and chronic illnesses 	Professionals at the national and state levels (working in epidemiology)
Basic principles of outbreak investigation (level I) <ul style="list-style-type: none"> • Case analysis • Description of outbreaks • Causes • Epidemic curves 	State-level doctors and nurses who would be future trainers
Principles of outbreak investigation (level II) To avoid long absences of professionals from the workplace, this training can be developed as 2 two-week courses, separated by a 6-month field project, and a one-week follow-up course	State personnel, health specialists, and outbreak control team who would be future trainers
Outbreak investigation (advanced level) <ul style="list-style-type: none"> • FETP • TEPHINET (usually two-year program). (See appendix A.4 for more information.) 	Epidemiologists, infectious disease specialists, laboratory experts, entomologists at national epidemiological unit—all of whom make up the national team to assist the country in the most difficult outbreaks
Laboratory biosafety One national and one international instructor (presence of the international instructor depends on national capacity in the subject) would provide training in instrument handling, and methods and equipment for biosafety	Laboratory personnel who would become biosafety specialists, providing training to other personnel.
Laboratory reporting systems Use of new computerized laboratory reporting system	Future trainers from 1 state laboratory and national laboratories
Training in information systems for state workers <ul style="list-style-type: none"> • E-mail and the Internet • Network security • New applications 	State computer experts who will then train and support other computer personnel at the state and local levels.
Software for surveillance systems <ul style="list-style-type: none"> • Basic operations and use of the computerized surveillance network • Transfers and protection of databases • Basic maintenance • Data input and output (one-week national training followed by a three-day evaluation six months later) 	Data entry clerks and computer software personnel to operate the disease notification software at the national, state and local level
Data for decisionmaking Collection, analysis, and use of data.	Heads of epidemiology, working with state programs and statistics, and public health specialists from national institutes and MoH
Management course <ul style="list-style-type: none"> • Improvement of management skills at the state level 	Directors of epidemiology programs, and state and national laboratories

Continued on next page...

Table 7 Training and targeted personnel (continued)

<p>Publication of bulletins or reporting system for surveillance data</p> <ul style="list-style-type: none"> • Design standards • Presentation of tables and graphics • Report writing 	At least one at the state level, and three at the national level
<p>Training to implement NCD and risk factor surveillance</p> <ul style="list-style-type: none"> • Establish data needs, priorities and management needs for NCD control • Training in data collection, follow-up, and so on • Instrument design (questionnaires, scales, reliability, validity, sampling methods, and so on) • Data format, record keeping, aggregation, and data analysis 	Public health professionals
<p>Training for health promotion</p> <ul style="list-style-type: none"> • Communication skills • Basic training in surveillance and disease control • Basic training in behavior change and priority BRFs. 	Epidemiology unit staff TV and radio journalists

**Table 8
Common budget lines for public health surveillance**

Budget line item	Sub-items
Personnel (salaries or per diem) ⁸	<ul style="list-style-type: none"> • Case or outbreak investigators • Surveillance officers • Data managers or statisticians • Laboratory staff • Trainers • Editors
Workshops or meetings for advocacy or coordination	<ul style="list-style-type: none"> • Planning workshops • Subnational training or planning workshops • Clinician advocacy • Coordination meetings • Newsletters (surveillance advocacy and project accomplishments)
Equipment (capital costs)	<ul style="list-style-type: none"> • Specimen carriers • Cold chain • Vehicles, motorbikes, boats, bicycles • Laboratory equipment • Computer equipment • Communications and data transfer equipment
Operations and supplies (recurrent costs)	<ul style="list-style-type: none"> • Specimen kits • Specimen collection and dispatch • Specimen shippers (for instance cross-border shipment) • Laboratory consumables • Computer maintenance • Communication equipment and maintenance • Creation of standard forms and feedback • Social mobilization and advocacy • Materials and activities • Ad hoc reimbursements for notifications

Continued on next page...

Table 8 Common budget lines for public health surveillance (continued)

	<ul style="list-style-type: none"> • Vehicle maintenance and spare parts • Petrol (gasoline) • Transportation of equipment • Publication and distribution of surveillance guidelines/norms • Epidemiological bulletins
Training	Personnel involved in surveillance at national, state, and local level, and laboratory staff

Source: Adapted from WHO 1999b.

- (c) Three cases of bacterial meningitis reported for every case of meningococcal disease recognized and X percent culture confirmed and;
- (d) An etiologic agent identified in at least X percent of stool cultures obtained from all persons identified with diarrheal diseases at sentinel sites.

What about project evaluation?

During project implementation the capacity of the system should be assessed again, not only to evaluate project impact but also to create a culture of evaluation. The MoH needs to understand the value of a surveillance assessment and lead the process. Evaluation should involve the main stakeholders, those who will benefit from the surveillance system. The assessment team should be multidisciplinary (such as epidemiologist, laboratory specialist, telecommunications specialist) and consist of national and international expertise. The WHO and CDC can be involved and provide coordinated support (see appendix A.6).

What are the most common problems in surveillance systems?

1. *Surveillance activities are usually centrally controlled by the MoH; other players have a limited role.* The national level makes decisions based on data collected by the local level, yet the local level usually receives no feedback on that

data. Communities are not involved in surveillance or disease control.

2. *The surveillance system is fragmented and uncoordinated* across all levels of the system and between epidemiological and laboratory surveillance. Thus duplication of activities, highly variable information, lack of standardization, and inefficient use of resources are common.
3. Surveillance systems are often *overly ambitious and unrealistic*, with too many health conditions under surveillance. They are often geared toward producing large numbers rather than useful information.
4. *Integration with the health-care delivery system* (public and private) is weak or nonexistent.
5. *Laboratory support for surveillance varies greatly between diseases.* Results are often delayed: timely, reliable confirmation of suspected cases to those who will make decisions and take action is rare. Poor conditions of biosecurity are common.
6. *Data management, transmission, and utilization are usually weak.* Much of the data collected are not analyzed or used for action. Minimal analysis and use is generally found at the national level, while at the state and local levels there is nothing but data collection. Usually the data transmission system is rudimentary and introduces inaccuracies, and

there is a lack of methods for easily querying or correcting data.

7. *Training and capacity building is usually a low priority.* This is more evident at the state and local levels. Often clients would rather use resources to upgrade facilities or even build new ones than invest in personnel and training.

Box 8

LESSONS LEARNED FROM JARBAS BARBOSA DA SILVA, JR., DIRECTOR OF THE NATIONAL EPIDEMIOLOGY DEPARTMENT OF BRAZIL

The decentralization process in epidemiology, surveillance, prevention, and disease control is very different from decentralization of health-care delivery. Faced with a decentralization process in these areas, in a country with the geographic dimension, socioeconomic and epidemiological diversity of Brazil, is a huge challenge.

The VIGISUS project^a has been an essential tool for enabling the “change of roles within the three levels of the system.” At the federal level, a higher response capacity for the most complex problems (for instance emergent diseases) was developed, and strong leadership was established for issues of standardization and coordination, to avoid fragmentation of the system and lack of effectiveness. At state and municipal levels, VIGISUS helped develop capacity to execute the intermediate and basic surveillance and disease control activities, with greater capacity for anticipating problems and increased efficiency in addressing them.

If I were beginning project preparation today, I would:

- Have a more detailed assessment of the surveillance system (preproject) at the state and municipal levels.
- Based on that assessment I would create a more detailed design of the investments for each level of the system.
- I would define, up-front, the content of the training program according to the needs of the state and municipal levels, since there were difficulties in negotiating the content with teaching institutions.
- Emphasize the importance of maintaining a minimum core team of Bank staff and consultants, from preparation to supervision, in order to have a good knowledge base of the country and the project.

^a Forty percent of the VIGISUS investment on surveillance is executed at state and municipal levels.

8. Worker *motivation* in many places *is low*.
9. Information obtained is *not linked to and utilized for public health action*.
10. The *private sector and the community* are not usually involved in disease surveillance. Most systems rely almost entirely on the public health system as the sole source of information.

What are the main conditions for successful project implementation?

1. *An evaluation of the system performed.* If there are resources and time, you ideally undertake all that is suggested in appendix A.6. If you do not have the time, and usually you do not, follow the assessment described in this part and also see appendix B.1. Get the client involved in the exercise (appendix B.2).
2. *A well defined and agreed-on list of health conditions* to be surveyed, standardization and acceptance of case definitions and surveillance methods.
3. *Sentinel surveillance.* A defined, *stepwise implementation* plan for sentinel sites, with health conditions and sites confirmed.
4. *Revised surveillance guidelines* which should include “what and how,” “when, who, and where.” Guidelines should be revised by national health surveillance officials, external review should take place and the final product approved by the main policy decisionmakers.
5. *Personnel and training.* Number and profile of staff at national and state levels, as well as a training plan for the corresponding target personnel, reporters, along with its cost.
6. *List of laboratories targeted for improvement* and, if possible, identification of the kind of rehabilitation required. Design upfront, if

possible, the bidding documents for laboratory rehabilitation.

7. *Telecommunication system defined or improvement of the existing one established.* Design upfront, if possible, the bidding documents for data transmission systems.
8. *Clear definition of the roles and responsibilities* of the three levels of the surveillance system. Often, these roles are not well defined and task overlap is common (see appendix B.6).
9. *Local ownership and commitment to the project.* This can be achieved through early involvement of the main stakeholders in project preparation and decisionmaking processes. It is important to actually visit and engage sites outside of the national capital. These activities should also include national professional

associations and social sectors other than health, which may also benefit from a good surveillance system (tourism, agriculture, treasury, and so on). Periodical dissemination of information to the press, and involving one or two health-related journalists, might also promote the project. As stated earlier, emphasis should be placed not only on technical aspects but also on the process as part of the strategy for maximizing ownership.

10. *Do as much project design as possible.* A detailed implementation plan that includes the identification of the task, and its objectives, the location, starting date and ended date, the responsible staff or entity for its implementation, the description of the main steps, unit cost and procurement procedures, and the outputs is an important management tool for the client, as well as for the Bank.

APPENDIX B.1

Evaluation of the system and capacity

In practice, for purposes of preparing lending projects, the evaluation process is modified here and differs from the more “ideal” method described in appendix A.6⁹ (CDC 2001; WHO 2001a). In order to evaluate the system and surveillance capacity at the state level, an evaluation of collection methods and use of information for six notifiable diseases or conditions should be conducted in six locations (that is, at the state or local level).

How?

1. Selection of states

One measure of performance is whether states are reporting anything to the national surveillance system. Select two states that are the most up-to-date in reporting (high capacity), two states that are average (reports are delayed by four to six weeks), and two states that have not reported for at least eight weeks (low capacity). During this evaluation the team should visit at least two of the local reporting areas in each selected state.

2. Selection of diseases

Diseases fall into three categories: (a) high numbers of cases, low specificity (diarrhea, influenza); (b) low number of cases, high specificity (measles, Chagas disease); (c) intermediate volume and specificity (hepatitis, meningitis).

3. Team composition

A team of two persons should visit each of the selected states to conduct the evaluation. These two persons should have experience in epidemiology and laboratory surveillance.

During this evaluation, the following questions should be answered:

1. How many persons are responsible for surveillance at the local and state level ...

These persons should be identified by task and quantified in terms of personnel per unit population (for instance, one state-level epidemiologist per 500,000 population, one computer support person per 1 million persons). This quantification should also take into account the proportion of time actually dedicated to surveillance activities.

2. ... and for each disease or condition...

- What are the sources of reports of this condition (for example, hospitals, clinics, laboratories)? Are they private or public?
- Do reporting sources know the definition? How well is it applied? (List the written case definitions for this condition.)
- Are cases defined by status (for instance “confirmed” as opposed to “suspected”)? What

⁹ Koo, D. and Ostroff, S. for VIGIA preparation mission. (See World Bank 1999—VIGIA PAD).

proportion of cases in this state are suspected, probable, or confirmed?

- Have local level reporters been trained in disease-recognition and reporting?
- Is there a standardized case report form specifically for this condition, and written instructions on how to fill out the form?
- What information is requested regarding cases of this condition?
- Who generally fills out the form?
- How often are data reported from the local level to the state and what mechanism is used for reporting (paper form by mail; telephone; fax)?
- How is information transferred?
- Are case report forms reviewed for completeness prior to their being sent to the state level?
- Are forms completely filled out? Review a sample.
- Are data sent as summary or individual cases, or both?
- Is laboratory diagnostic testing available for this condition in the state? If not, are laboratory specimens sent elsewhere (where)?
- What proportion of reported cases have had appropriate laboratory testing?
- Can case reports be linked to the corresponding laboratory data? If so, how?
- Are there written standards for case investigation and intervention?
- Have any outbreaks of this condition been identified through this system? How were these identified, and were investigations conducted? Who conducted the investigations (was it a local, state, or national team)?
- What is the time delay between the occurrence or detection of a case and its being reported to the state level?
- How is information about cases recorded or stored? (Is it computerized?)
- Who analyzes the data?
- How are data analyzed, and how often?
- How often are the reports disseminated, in what format, and to whom?
- Are the data provided to those who report them? (That is, is there feedback of data to the local level and to other groups, including physicians and laboratory personnel?)

The following resources may prove useful in evaluating surveillance systems:

www.cdc.gov/preview/mmrwhtml/rr5013a1.htm

www.who.int/emc-documents/surveillance/whocdscsr992c.html

APPENDIX B.2

Stakeholder Workshops

Goals of the workshop

1. Develop a more detailed, ideal vision for the revised surveillance system, its desired characteristics, and components;
2. Establish a system for prioritizing conditions for inclusion in the surveillance system; and
3. Develop strategies for stepwise implementation of the system.

Participants

Representatives from national, state, and local health departments. Preparation for this workshop should be coordinated with the National Epidemiological Council or equivalent body. Other participants in this workshop might include persons who represent private sources of health data (hospitals or private clinics) or academic medical societies or organizations, and health management organization. Given the activities involved in the second component of the workshop, it may be useful to invite MoH staff with expertise in the diseases, or at least to provide reports and information about these diseases.

Issues to be addressed during the workshop

Visions of the ideal surveillance system

- Sources of surveillance data (health centers, hospitals, laboratories, private insurance, and personal interviews)
- Surveillance methods (notifiable diseases, sentinel surveillance, surveys)

- Standards for reporting or linking surveillance data
- Integration with the health-care delivery system (through public and private health centers and assistance)
- Expected uses of surveillance data
- Desired timeliness of the system
- Level of computerization required
- Capacity needed within the MoH and at the state and local levels to ensure appropriate analysis, interpretation, dissemination, and use of surveillance data for public health action.

Prioritization of conditions for inclusion in the system

Criteria for selecting conditions that should be included in a surveillance system might include severity, incidence and prevalence, communicability, availability of a cost-effective control measure (a vaccine), societal concern, interest by the WHO or the PAHO, or ease of diagnosis. (See also appendix A.6 and p. 15—Setting priorities: What are the considerations in planning public health surveillance?). It is important to develop—with the participation of public health persons at local, state, and national levels—a method for prioritizing conditions that should be included in the national surveillance system.

Table 9 shows a sample agenda for a workshop for developing criteria for prioritizing conditions under surveillance.

Strategies for stepwise implementation

During this portion of the workshop participants would develop strategies for stepwise implementation of revisions to the system. Not all components of the system need to be implemented in all parts of the country. Some components may be pilot-tested

only in certain areas of the country (where there are regional problems with a specific disease or where human or other resources are already available or can be supplied).

Each strategy must be very specific and detailed, with the actions to be taken, by whom, and by what date. The strategy should also outline necessary resources and possible providers.

Table 9
Sample agenda for workshop

Day 1	<i>Morning</i>	Give the group a list of five diseases and explain that, hypothetically, the legislature has said they are cutting the MoH budget. In small groups, rank these five diseases in order of priority, so that when the MoH receives the budget there will already be an idea of how to spend the money. Each group then presents their rankings and the principles and rationale used to come to those conclusions.
	<i>Afternoon</i>	<ol style="list-style-type: none"> 1. (Individually.) Generate three criteria for selecting diseases. 2. (In groups of six.) Using criteria from individual activity above, establish a list of a maximum of 10 criteria. 3. A spokesperson from each group presents the criteria to the rest of the participants. There is no lengthy discussion, except to clarify concepts or meaning.
Day 2	<i>Morning</i>	<ol style="list-style-type: none"> 1. Meet in groups and try to find common categories among the lists presented by small groups the day before. 2. (Entire group.) List the overarching categories or criteria. 3. Determine whether all criteria are accounted for, and clarify the concepts or wording. Continue to collapse categories as needed. 4. Decide whether there should be a maximum number of criteria, or an appropriate system of weighting each criteria. 5. (Small groups.) Decide on the weight for each criterion (suggested: 0–5 points). 6. (Entire group.) Tally results and make decisions about weighting for each criterion. 7. Apply criteria to all conditions or diseases considered for surveillance, using the expertise of participants in the workshop or data from references or reports about these conditions and their prevalence in the country.
	<i>Afternoon</i>	<ol style="list-style-type: none"> 1. Tally results (including the respondent or source of the numbers—state or national, for instance). Present conditions in rank order by mean or median value (number of participants who responded, mean or median score, range of values, standard deviation of responses). 2. In small groups discuss how this list should be used. Should it be used to delete or add to the list of diseases or conditions under surveillance? Alternately, should it be used to determine the mode of surveillance and the resources allotted to surveillance for that condition (fewer resources or less frequent reporting for diseases lower on the list)? 3. Determine next steps.

APPENDIX B.3

Sample Terms of Reference for Specialists Participating in Preparation Missions

- Evaluation of the surveillance system
 - Assessment of laboratory infrastructure
 - Computer-based information and telecommunications system
 - Noncommunicable diseases and risk factor surveillance
 - Economic analysis
- Timing: frequency of reports communicated between levels.

Statement of mission objectives: Evaluation of the surveillance system

(Name of consultant) will evaluate the surveillance system regarding:

1. Objectives
2. Detection of events
 - Notifiable diseases, syndromes, and case definitions
 - Recording forms; and
 - Outbreaks: detection and control.
3. Reporting procedures
 - Levels to which the information observed is reported;
 - Reporting forms;
 - Means of communication used for reporting the information to each level;
 - Utilization of data;
 - Collation and management of data; and
4. Decisionmaking and action
 - Decisionmakers with respect to surveillance;
 - Adequacy of information: identify information collected systematically but not used;
 - Communication and implementation of decisions; and
 - Monitoring system—mechanism in place for monitoring the implementation of decisions.
5. Feedback
 - Adequacy of feedback for supervision and improvement;
 - Timing: adequacy of the schedule for those receiving feedback; and
 - Indicators to define the quality of reporting.
6. Resources
 - Current staff and job descriptions for each main facility and administrative office;
 - Equipment: inventory of equipment, noting shortages;

- Budget: budget allocated to the surveillance system, including financing mechanism.
7. Assess the need for sentinel sites or periodic surveys and (with the MoH) develop a strategy for implementation.
 8. Review the MoH proposal for a national health surveillance system.
 9. Provide recommendations for redesigning or improving the current surveillance system, addressing all weaknesses identified.
 10. Provide cost estimates for the project.
 11. Propose agenda for implementation, including selection of states.
 12. Identify the main risks in implementing a national surveillance system.

Written output: Using existing MoH documents and findings during the mission, produce a short report summarizing the surveillance system to be improved (bullet points) for the aide memoire and a full report no later than (give delivery date).

Statement of mission objectives: Assessment of laboratory infrastructure

(Name of consultant) will assess the laboratory infrastructure covering the following topics.

1. In keeping with project objectives, assess and describe (number, location, type, human resources, technical capacity, communication capacity, and so on) the current laboratory infrastructure regarding:
 - (a) National reference laboratories
 - (b) Public health laboratories
 - (c) Entomological units
 - (d) Centers for zoonosis control
 - (e) Blood banks
 - (f) Biosafety laboratories

- (g) Others you may think are pertinent to the project
2. Undertake a biosafety evaluation of the laboratories, using criteria in the CDC-NIH publication *Biosafety in Microbiological and Biomedical Laboratories, 3rd Edition*.
3. Define specimen rejection criteria, if applicable.
4. Review diagnostic reagents production and suggest modifications, if necessary.
5. Review the plan for routine proficiency testing of subordinate laboratories.
6. Define the needs for strengthening National Reference Laboratories in outbreak investigation.
7. Review specimen log-in and tracking, as well as management results, and suggest a computer-based program, if necessary.
8. Define the scope of public health laboratories within the context of the national surveillance system.
9. Describe plans for rehabilitation and expansion of the laboratory network, assess necessity of new infrastructure, and propose modifications, if necessary.
10. Review the need for laboratory personnel training, in terms of present deficiencies and project objectives.
11. Define a standardized system for laboratory data to be used in national reference laboratories and in state laboratories.
12. Propose terms of reference for additional work in areas where data is not currently available or analysis needs to be completed.

Written output: A full report presenting your findings and recommendations, to be remitted to the Bank no later than (insert date).

Statement of mission objectives: Computer-based information and telecommunications system

(Name of consultant) will be responsible for:

1. Establishment of computer-based telecommunications system at national, state and local levels, and possibly in other areas to routinely collect, analyze, and disseminate surveillance data; to rapidly communicate messages; and to assist in the investigation of epidemics, including needs for software, hardware, data transmission, and data outputs.
2. Confidentiality issues should be addressed, as well as systems' management. (Should they be internal or contracted?)
3. Define a standardized system for laboratory data to be used in national reference laboratories and in state laboratories. This system should address needs for communicable and noncommunicable diseases.
4. Define training needs, develop implementation program, and estimate cost.

Written output: Produce a short report (bullet points) for the client, summarizing findings during mission and a full report no later than 8 days after the mission.

Statement of mission objectives: Noncommunicable diseases and risk factor surveillance

(Name of consultant) will:

1. In keeping with project objectives, review the project proposal regarding chronic diseases and risk factors surveillance.
2. In collaboration with the project team, select the health conditions for surveillance.
3. Recommend the most appropriate type of surveillance (sentinel, survey, or other) for the conditions or risk factors selected.
4. Review the recording and reporting forms.

5. Assess training needs (trainees, trainers, type of training, cost).
6. Assess the cost of a NCD and risk factor surveillance system.
7. Assess the need for sentinel sites or periodic surveys, and develop a strategy for implementation.
8. Propose terms of reference for additional work you may find necessary.

Written output: A short report summarizing your findings and recommendations, remitted to the Bank no later than (insert date).

Statement of mission objectives: Economic analysis

(Name of consultant) will collect the data necessary to undertake the economic analysis and write a first draft of the economic analysis that will consist of the following:

1. A cost-effectiveness analysis whose purpose would be to examine the potential impact of the surveillance system on the incidence or prevalence of each notifiable disease. This analysis would yield a map of the burden of diseases in the country and help determine where to orient surveillance efforts.
2. An equity analysis which would attempt to investigate the equity implications of the surveillance system—in other words, who would benefit most from the project?
3. A sustainability analysis that would address three questions: (a) Will there be sufficient counterpart funding for the project? (b) What are the additional recurrent costs that will be generated by the project and who (that is, what level of government) will pay for them? (c) Is there reason to believe that these entities will be able to afford this additional financial burden?

4. A risk analysis to test the robustness of the cost-effectiveness and sustainability analyses to reasonable changes in the key parameters. *Written output:* A short report (bullet points) regarding findings during the mission to appendix to the aide memoire, and a draft economic analysis no later than (insert date).

APPENDIX B.4

Specific Disease Surveillance “Tips”

Box 9

BEHAVIORAL RISK FACTOR SURVEILLANCE

Why are behaviors and noncommunicable diseases important?

Most countries of the world have undergone, or are undergoing, an epidemiologic transition with the burden of disease now primarily due to NCDs and injuries, not communicable diseases. In developing countries these changes place costly demands on the health sector because NCDs often require highly technical, expensive interventions and specialist care. The key to averting or controlling this global NCD epidemic is primary prevention.

How can NCDs be prevented?

The most common NCDs (diabetes, hypertension, coronary artery diseases, some cancers, and injuries) are largely preventable with changes in lifestyle and behaviors. Important BRFs for NCDs include: cigarette smoking, obesity, lack of physical activity, high dietary fat intake, and substance abuse. There is incontrovertible evidence that by modifying these risk factors NCDs can be prevented. Unintentional injuries due to traffic accidents are a leading cause of death, particularly among young adults. Many traffic injuries and deaths can be avoided by using seat belts in cars, and helmets while riding on motorcycles and bicycles. Other preventive behaviors are related to the utilization of health services; an example is Pap smears to screen for cervical cancer can lead to early diagnosis and cure. Information about the prevalence of these behaviors is vital to making health promotion and disease prevention programs more effective.

What is behavioral risk factor surveillance?

Surveillance of BRFs is essential to plan and evaluate programs that aim to prevent NCDs and injuries. BRF surveillance provides evidence about whether programs are having the desired impact of reducing risky behaviors and promoting healthy lifestyles. BRF surveillance in developing countries usually begins as a series of household surveys that include, at a minimum, questions regarding smoking, physical activity, alcohol use, and diet. Other topics include injury prevention, preventive health-seeking behaviors, mental health, sexual behaviors, and self-report questions on weight, height, and diabetes. In more developed surveillance systems BRF surveillance is continuous (such as ongoing phone surveys). This permits time-linked analyses that are more useful in assessing the impact of specific interventions and events on behaviors.

Are behaviors important only for noncommunicable diseases?

Behaviors and lifestyle contribute not only to the occurrence of NCDs, but to the occurrence of communicable diseases as well. Changing sexual behavior and condom use is essential to preventing STIs, including HIV/AIDS. Hand-washing is key to preventing transmission of diarrheal diseases, intestinal parasites, hepatitis, and skin infections. BRF surveillance often includes questions related to these behaviors.

What are youth surveys?

It is very important to focus prevention activities on youth, a time in life when risky behaviors often begin. Thus there are BRF surveys that focus specifically on young people. Youth surveys are usually carried out confidentially in schools.

Box 10**HIV/AIDS SURVEILLANCE***What conditions should be reported?*

- HIV infection, AIDS
- Deaths in persons with AIDS and HIV infection

Standard case definitions need to be addressed. Several public health organizations (the WHO, the PAHO, CDC) have established case definitions that can be used.

What information should be collected on these persons?

A standard set of data should be collected using a standardized report form for all cases that meet the reporting criteria, including: (a) personal identifier, (b) date of diagnosis, (c) basic demographic information, (d) place of residence, (e) risk behaviors, (f) opportunistic conditions, and (g) date of death. The data elements collected should be limited to those that will be routinely used for public health action. The simpler and shorter the case report form, the more likely it is that cases will be reported completely and quickly.

Who should report?

Hospitals, health-care workers who work in hospitals, private doctors, clinics, community health workers, and laboratories that perform HIV testing. Local laws can require these persons to report cases to health authorities. Health authorities may also actively contact health-care providers and institutions to ensure that all cases are reported.

How should they report?

There are many options for reporting, including mail, telephone, fax, e-mail, or through the Internet, if security can be maintained.

What are some of the key factors in a successful HIV/AIDS surveillance system?

- Strict confidentiality must be maintained in order for the system to remain acceptable to the community and providers.

- Underreporting may occur, especially in areas where HIV testing, health care, and resources are limited. Using active case findings may enhance surveillance in these areas.
- Dissemination of data to public health decisionmakers and back to the persons who reported the cases can help foster recognition of the importance and utility of HIV/AIDS surveillance.

What other sources of data may be useful in describing the HIV epidemic?

Data from HIV/AIDS surveillance should be interpreted with other available data for a more comprehensive picture of the HIV epidemic, such as (a) other surveillance systems (for instance, STI surveillance); (b) HIV serosurveys (in antenatal or STI clinics); and (c) vital statistics registries.

What is the role of HIV serosurveys (HIV sentinel surveillance) in describing the status of a country's HIV epidemic?

Population-based prevalence surveys are the most useful but may be difficult to undertake. Instead of those surveys, serosurveys of pregnant women in antenatal clinics most closely approximate the prevalence levels in the adult population (although the relationship between prevalence among clinic attendees and that of the general population remains uncertain).

High-quality sentinel surveillance systems have frequent and timely data collection, conduct surveillance in appropriate populations, are consistent in the sites and groups that are measured over time, and provide estimates that are representative of the population.

Box 11

SURVEILLANCE IN TUBERCULOSIS CONTROL

TB is a global public health threat. In the absence of treatment, the infectious disease can kill 50 percent of those who fall ill within two to five years. The epidemic is worsening where economic and social crises and the HIV/AIDS epidemic are raging. Persons with compromised immune systems are at high risk of infection and illness. The control of TB depends on the early detection and treatment of persons with infectious disease. This forms the core of the directly observed treatment (DOTS) strategy recommended by the WHO, the World Bank, and other partners. See <http://www.worldbank.org/TB> for further information and other links. Surveillance methods and several computerized reporting tools are available suitable for the capacity of different public health systems, and can form a part of an integrated surveillance system (see the WHO's EPI-TB and CDC's BOTUSA models).

Case detection

Sputum smear microscopy is the preferred cost-effective method of diagnosing infectious TB patients. In some countries registers of all respiratory symptomatics (those who have had a cough for two to three weeks) presenting at health services are kept, and are useful in determining whether all are referred for smear exams. Laboratory registers record all examined patients and results, which are then included in a TB treatment register. Assignment of proper case definitions are critical: new sputum-smear positive, sputum smear-negative, or extrapulmonary; relapse; or retreatment (which includes cases returning after default and previous treatment failures). Laboratory networks are formed to enable regular quality control of smear-microscopy and access to supplementary diagnostic tools. Quarterly reporting on new TB cases, by case category, and with age and sex disaggregation for smear-positive patients is recommended.

Treatment

The TB treatment register enables proper case management. TB treatment entails six to eight months of multi-drug therapy, with observation during at least the first two months, for new TB cases. Smear exams at two, five, and six to eight months are used to monitor treatment progress, and outcomes are recorded: cured (smear-negative); treatment completed (without final smear); lost for view; died; treatment failed; or transferred. Retreatment cases are monitored in a similar fashion, with drug susceptibility testing if available. Quarterly reports on treatment results are developed, usually at the local level. These reports enable examination of problems and progress in quality or access to services, and assist in tracking the epidemic and control efforts at state, national, and international levels. Global targets have been set for 2005 of: 70 percent detection of infectious patients and 85 percent cure rates of those treated.

Surveys to measure drug-resistant TB, HIV-TB, and trends in TB infection and prevalence

Additional surveillance tools are used in TB epidemiology and control. These include: (a) representative national surveys of drug-resistant TB; (b) surveillance of HIV-infection among registered TB patients and TB illness or infection among HIV-infected persons; (c) periodic population-based surveys (too costly for most low-income countries) to determine TB prevalence and incidence levels; (d) risk of TB infection surveys to estimate trends in incidence based on infection levels in schoolchildren or other subpopulations. Where routine death registration is operating, examinations of trends in reported TB mortality is useful. Investigations of TB outbreaks are more feasible in low-incidence countries or in subpopulations in higher-burden countries (prisons, hospitals, and so on).

See: <http://www.who.int> for the annual WHO reports on the global TB epidemic.

Box 12**MALARIA SURVEILLANCE**

1. The burden of malaria is heaviest in remote rural areas, which are often beyond the reach of health facilities. As many as 80 percent of malaria cases and deaths are managed without the patient ever accessing public health facilities. Of those who do seek care within the public health system, the vast majority will be managed at the periphery of the system. As a result, traditional public health facility–based surveillance systems will only detect a small fraction of malaria cases and deaths; these data are rarely used for planning or monitoring control programs. Therefore:
 - (a) Assess whether investments in routine surveillance systems are warranted, particularly in regions (Sub-Saharan Africa) where reporting infrastructure is not well developed. Support instead might be directed toward development or strengthening methods for collection of household level data, such as the Demographic and Health Surveys (DHSs) or Demographic Surveillance Systems, which provide better estimates of disease burden.
 - (b) Sentinel surveillance, using a small number of sites for monitoring malaria cases, has been used in some countries. One advantage of this approach is that one can better link changes in disease burden to specific interventions and investigations (such as entomologic studies).
 - (c) If investments in routine surveillance are warranted, all levels of the public health system must be involved in reporting malaria cases. Methods to include private sector providers (including pharmacies and drug sellers) in case reporting should also be explored.
2. In almost all countries where malaria is endemic cases will be diagnosed both by definitive methods (microscopy or rapid diagnostic tests) and by clinical findings. Definitive diagnostic methods are more widely available in Latin America and Asia than in Sub-Saharan Africa, but are rarely available in peripheral health facilities in any region. Therefore:
 - (a) Counting only definitively diagnosed cases greatly underestimates disease burden. Cases diagnosed on clinical grounds should also be included in case counts; reporting should not be limited to facilities with capability for definitive diagnosis.
 - (b) Because cases may be diagnosed by multiple methods, clear case definitions are required. These vary by the transmission intensity of the region. In Sub-Saharan Africa the definition of a clinical case often includes anyone with a recent fever history or measured temperature of more than 37.5° Centigrade. In other regions patients with fever may only be considered a malaria case if there is no other explanation for their illness. Care should be taken to not double-count cases diagnosed in both clinics and laboratories.
3. Regardless of the method chosen, surveillance data, in general, will greatly underestimate overall disease burden. In addition, malaria disease burden will vary with the seasons and from year to year based on changes in weather patterns. Interpretation of routine malaria surveillance data, therefore, should be based on trends, not absolute numbers, comparing case information with similar months over several years.
4. There are four species of *Plasmodium* that cause clinical malaria in humans. *Plasmodium vivax* is more common in Asia and the Americas and *P. falciparum* (the species responsible for almost all malaria associated deaths) causes more than 90 percent of cases in Sub-Saharan Africa. The other two species, *P. malariae* and *P. ovale*, are of little public health importance. Laboratory testing is the only method for determining species. The importance of differentiating these species for surveillance purposes must be weighed against the costs of laboratory testing and the additional burdens placed on data collectors. As a general rule, surveillance systems in Sub-Saharan Africa do not differentiate cases by species.

Box 13

VITAL STATISTICS AND SURVEILLANCE OF THE MILLENNIUM DEVELOPMENT GOALS: INFANT AND MATERNAL MORTALITY

What are vital statistics?

The measurement of vital events is “the single most important addition that developing countries can make to their existing surveillance system” (White and McDonnel 2000). Knowledge of levels, causes, and trends in mortality is fundamental to public health practice, and guides a country’s public health priorities. A vital registration system, using birth and death certificates, permits the reporting of key vital statistics such as the infant and maternal mortality rates (IMRs and MMRs).

What are Millennium Development Goals?

The MDGs were established by the international community as a roadmap for an expanded vision of development (<http://sima/mdg>). The MDGs are a focal point of the Bank Group’s strategic framework. Health-related MDGs include the reduction of under-five child mortality by two-thirds, and the reduction of maternal mortality by three-quarters between 1990 and 2015. The IMR and the MMR are indicators for these MDGs.

How is infant mortality measured and what is its importance at the local level?

The registration of births and deaths provides an accurate and timely measurement of IMR (number of infant deaths [under 1 year of age] per 1,000 live births). The international community has depended on household surveys (such as DHS) to estimate IMR. While these estimates may be accurate, they are not timely, representing a period five years prior to the survey, and quoted for years after. Furthermore, while surveys provide national, and sometimes regional estimates, they are rarely useful at an operational level (at the level of the state or municipality). Health systems are increasingly decentralized, requiring local assessments of IMRs. The need to focus scarce resources in areas with poorer health outcomes also argues for improved vital statistics at the local level.

How is maternal mortality measured?

The MMR is the number of maternal deaths (deaths during pregnancy, childbirth, or the puerperium that are due to the pregnancy or its management) per 100,000 live births. Measurement of maternal mortality has been an issue for many years and is not easily carried out even using household surveys. This highlights the need for identification of maternal deaths and their causes through improved death certification.

How is infant and maternal mortality surveillance carried out?

Reporting of IMR and MMR alone permits targeting areas with higher mortality rates. However, in order to focus resources more efficiently and reduce mortality rates more quickly, information about why women and infants are dying is needed. This is done through case investigations, or audits, that include information about events leading up to the death, whether proper care was obtained, whether there were economic, cultural, geographic, or other barriers to care, and so on.

What are obstacles and incentives to improving vital statistics?

Infant and maternal mortality surveillances are easier with a vital registration system. While coverage of death certification in low-income countries is often poor, it varies widely and is not necessarily related to gross domestic product. Obstacles to death and birth certification, such as fees, should be eliminated. Health facilities should provide birth and death certificates prior to discharge, rather than demand that people go to a special office to obtain those certifications. Local health-care providers can certify births and deaths in the community. Examples of incentives include the requirement of a death certificate for burial or to receive any inheritance. When building a system, vital registration can begin in small sentinel areas, and expand as it is evaluated and improved.

Proposed Intermediate indicators for health MDGs can be found at: <http://wbln0023/Networks/HD/HDdocs.nsf/Thematic+Group+Documents/All/By+Author/9FF92329E0A0EB5A85256B1300776723?OpenDocument>

Box 14

AVIAN AND HUMAN INFLUENZA SURVEILLANCE

What is influenza?

Influenza is caused by a virus that is spread from person to person primarily via respiratory droplets. Most people who are infected with influenza viruses will have mild respiratory and constitutional symptoms such as fever, cough, congestion, fatigue, and muscle aches. Nevertheless, influenza can cause severe disease requiring hospitalization and sometimes death. The influenza virus is constantly evolving, requiring the production of a new vaccine each year that will provide protection against the latest circulating virus strains.

What is avian influenza and why the concern about a pandemic?

Avian influenza refers to a variety of influenza viruses that primarily affect birds, but on rare occasions may infect other species including pigs and humans. Since 1997, more than 120 cases of human avian influenza infections have been documented caused by an influenza A(H5N1) subtype, with mortality rates of around 60%. The vast majority of cases have been among people who were in close contact with infected birds. A major concern is that the H5N1 virus may adapt into a strain that is easily transmitted from human to human. This could cause a global influenza pandemic. The possibility of such a mutation and new strain developing will persist as long as the virus continues to circulate in birds that have contact with humans - a situation which should endure for years to come. The world is considered to be in a pre-pandemic stage.

What surveillance activities are important in a pre-pandemic situation?

Surveillance during the pre-pandemic phase is more important than surveillance when a pandemic is underway. The greatest opportunity for preventing or delaying national and international spread occurs in the pre-pandemic phase when numbers are small and containment may still be possible. Resource-intensive activities, such as animal surveillance and the active detection, investigation and laboratory confirmation of human cases are vital pre-pandemic, but are neither sustainable nor a priority once a pandemic occurs.

Surveillance during a pre-pandemic is needed to detect the transition to efficient and sustained human to human transmission, carry out effective prevention and containment activities, and monitor circulating viral strains. Ideally, it is integrated within an existing public health surveillance system. Three types of surveillance are important:

1. An **early warning system that can detect human clusters of severe pneumonia** and lead to rapid containment of new cases should be developed in every country. Even in low resource settings, surveillance for clusters of deaths from pneumonia in health care settings can be implemented and such deaths quickly reported. At a bare minimum, clusters of deaths among hospital workers should be reported immediately. A rapid response team is needed to assist in investigating such clusters, and to swiftly begin containment interventions where appropriate. Ideally, communities should be involved in reporting unusual numbers of severe pneumonia or unexplained deaths (rumor registers). However, community reporting may be difficult to implement on a large scale.
2. Every country should also have a **system for identifying and investigating poultry die-offs**. In the pre-pandemic stage it is very important to work closely with animal control authorities and identify influenza outbreaks in bird and poultry in order to contain its spread and limit contact between infected birds and humans. This will reduce opportunities for human infection, thus decreasing the likelihood that the virus will adapt for human-to-human transmission. Any outbreak in birds should also lead to an active search for human cases.
3. Finally a **virologic surveillance system** should be implemented. Most countries, even those in low resource settings, have at least one laboratory with the potential for identifying viral types. Many countries have a network of laboratories. The system should monitor circulating influenza strains and reliably confirming whether the H5N1 sub-type is present, either in birds or humans. If a country has no laboratory, then arrangements should be made for confirming or discarding H5N1 by using laboratories in neighboring countries. The virus is highly pathogenic and laboratory bio-safety is an issue.

What are examples of prevention and containment activities carried out in the pre-pandemic phase?

A primary objective is to reduce opportunities for human infection. Multidisciplinary rapid response teams should be available to investigate poultry die-offs and human severe pneumonia clusters. Identification and culling of infected or exposed poultry limits their contact with humans. If human to human transmission is suspected, measures to limit contact among humans such as quarantines, closing schools and workplaces and limiting travel to and from affected areas may help delay spread. Protective gear should be provided to health workers. Vaccine development could

Much of this information comes from the WHO AI website (http://www.who.int/csr/disease/avian_influenza/en/), a very useful resource.

AVIAN AND HUMAN INFLUENZA SURVEILLANCE (CONTINUED)

be very effective in limiting the spread, however vaccine production usually takes several months after a new strain is identified. Anti-viral drugs may help decrease severe illness and death. Their mass use for prophylaxis is being discussed. Finally, it is necessary to communicate effectively with the public about risk and protection.

How is routine surveillance for seasonal influenza done?

In high income, and some middle income countries, routine influenza surveillance is carried out by monitoring people with flu-like illnesses, hospitalizations for flu, and via laboratory-based viral surveillance. Usually sentinel sites scattered throughout a country's health care system report the number of people with flu-like symptoms. Ideally, the sites also systematically test for influenza by collecting nasal or throat swabs and sending them to labs for viral typing. In addition, public health laboratories report trends in viral sub-types being isolated. This information is tracked by health departments and helps guide the care health workers provide. In addition to identifying the start of influenza outbreaks, these surveillance systems can detect unusual influenza strains. Implementing or enhancing seasonal influenza surveillance in as many countries as possible is important for pandemic preparation.

How is seasonal influenza controlled?

Vaccination is a key component of influenza control. Recommendations about who to vaccinate differ depending on a country's resources. Most high and some middle income countries target specific groups of people at high risk of severe influenza-associated disease. Health communication and education about individual protective strategies can also contribute to reduce the spread of influenza.

What is global influenza surveillance and why is it important?

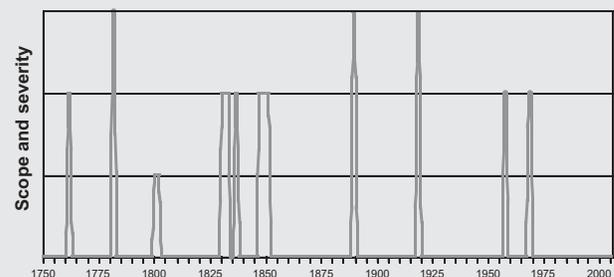
Continuous global surveillance of influenza is key for preparing annual vaccines and for identifying new or unusual strains that

may cause pandemics. WHO has a global network called Flu-Net. It consists of 112 National Influenza Centers (NICs) in 83 countries that monitor influenza activity and isolate influenza viruses. These NICs also report the emergence of "unusual" influenza viruses¹ that could be decisive for mounting a timely response to pandemics. The NICs send viral specimens to four WHO Collaborating Centers that carry out virus gene sequencing. Based on this system, every year WHO predicts the most likely strains to circulate. Influenza vaccines are updated semi-annually based on these predictions.

How are countries preparing for a pandemic?

Most countries have elaborated a pandemic preparedness plan that addresses the need for an adequate system for alert, response and disaster management. Depending on available resources, more specific preparations are made, such as stockpiling of antivirals, strengthening risk communications, investing in pandemic vaccine research and promoting domestic production of influenza vaccines. One component of such a plan should be to strengthen the capacity to respond to yearly epidemics of influenza. A surveillance network for human and animal influenza and a targeted influenza vaccination program are the cornerstones of a national influenza policy. The challenge now is to implement the plans.

Is a new flu due?
Major flu pandemics, 1750–2005



¹ According to the new International Health Regulations (IHR-2005) influenza A caused by a new viral subtype must be reported immediately to the WHO.

For further information, please visit:

http://www.who.int/csr/resources/publications/influenza/WHO_CDS_CSR_GIP_2005_8/en/index.html (Recommended strategic actions)

http://www.who.int/csr/disease/avian_influenza/consultation/en/index.html (Priority public health interventions)

APPENDIX B.5

The Who STEPwise Approach To Risk Factor Surveillance

The growing burden of NCD represents a major challenge to health development (Bonita and others 2001). The WHO has responded by giving higher priority to NCD prevention, control, and surveillance. The WHO STEPwise approach to risk factor surveillance (STEPS) is the WHO-recommended NCD surveillance tool. The WHO is building one common approach to defining core variables for surveys, surveillance, and monitoring instruments. The goal is to achieve data comparability over time and among countries. STEPS offers an entry point for low- and middle-income countries to get started in NCD activities. It is a simplified approach providing standardized materials and methods as part of technical collaboration with countries, especially those that lack resources.

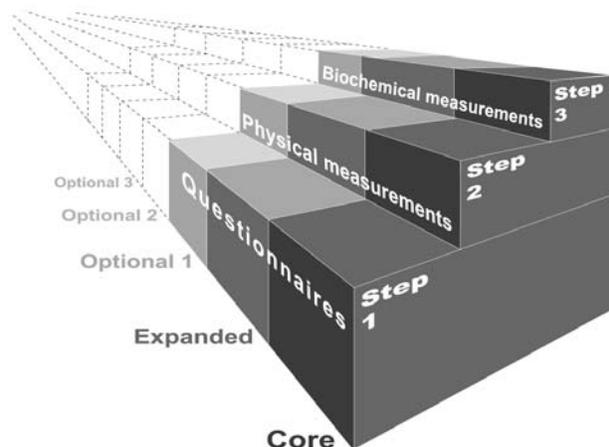
The STEPwise approach encourages the development of an increasingly comprehensive and complex surveillance system depending on local needs. The WHO emphasizes that, for surveillance to be sustainable, small amounts of good quality data are more valuable than large amounts of poor quality data.

Countries take the first step by adopting a core of standardized questions regarding behaviors including socioeconomic data, tobacco and alcohol use, physical inactivity, and nutrition. Questions that form the core data for each of these areas are simple and few—and ensure international comparability. Expansion of the basic questions is possible depending on local needs and resources. Optional modules on other behaviors can be incorporated.

Once step 1 is in place countries can build on it: more complex data can be added sequentially as resources allow. The core of step 2 includes physical measures of blood pressure, height, and weight. Step 3 involves blood sampling; the core includes blood glucose and cholesterol. Steps implementation at the country level is strategic and coordinated, builds capacity, and is sustainable.

The content of the WHO STEPS document is available on the Internet at: http://www.who.int/ncd/surveillance/surveillance_publications.htm.

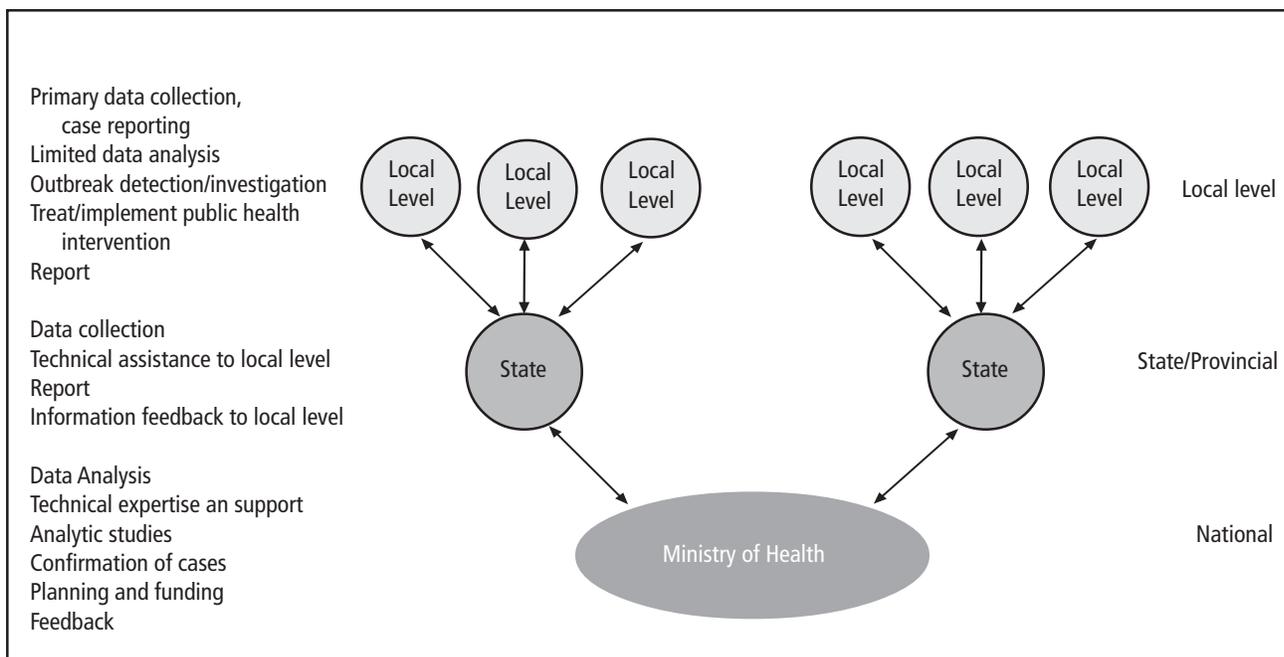
Figure 2
The WHO's STEPwise Approach



APPENDIX B.6

Surveillance Processes and Task by Level

Figure 3 Surveillance Processes and Task by Level



APPENDIX B.7

Surveillance Glossary

Active case finding	The dynamic identification of the occurrence of a disease or health event under surveillance (for example, house visits by community workers to identify cases of TB).
Active surveillance	The dynamic seeking of data from participants in the surveillance system on a regular basis.
Aggregate surveillance	The surveillance of a disease or health event by collecting summary data on groups of cases. In many general practice surveillance schemes clinicians are asked to report the number of cases of a specified diseases seen over a period of time.
Attack rate	The proportion of those exposed to an infectious agent who become (clinically) ill.
Carrier	A person who harbors a pathogen and can transmit it but has no clinical signs of infection. In epidemiological investigation we depend on the use of case definitions. Definition may be based on clinical or laboratory criteria. We may also allow for gradations in the likelihood of being a case (definite, probable, possible). This is particularly useful when the pathogen is unknown.
Case	A person who meets the case definition. The definition of a case will depend on what one is trying to describe. Infection can be clinical or subclinical. Both types of infection can lead to a carrier state.
Case-based surveillance	The surveillance of a disease by collecting specific data on each case (reporting of details on each case of AFP).
Case-fatality ratio	The proportion of people who die as a proportion of all cases. This will vary depending on the case definition used.
Cluster	The occurrence of an unusual number of cases in persons, places, or time.

Community surveillance	Surveillance where the starting point is a health event occurring in the community and reported by a community worker or actively sought by investigators. This may be particularly useful during an outbreak and where syndromic case definitions can be used. The active identification of community cases of Ebola virus infection in Kikwit, is an example of this type of surveillance.
Comprehensive surveillance	Surveillance of a specified disease or health event in the whole population at risk for that event (an example is AFP surveillance).
Contact	An individual who has had contact with a case in a way that is considered to cause significant exposure and therefore risk of infection.
Due dates	The dates by which reports from a specified period should be received by each level of the surveillance system (used to calculate timeliness).
Endemic	The constant presence of a disease within a given geographic area or population group.
Enhanced surveillance	The collection of additional data on cases reported under routine surveillance. Routine surveillance is a starting point for more specific data collection on a given health event.
Epidemic	The occurrence of cases of an illness clearly in excess of expectancy. This is often referred to as an outbreak (more neutral). Endemic diseases are those that exist at higher rates over a prolonged period.
Epidemiological case definition	The definition of a case used for reporting to the surveillance system. The definition may be clinical, laboratory, or both. It may relate to a specified disease (such as measles or yellow fever) or may identify a syndrome (for example, meningitis or AFP).
Exception flagging system	The existence of an automated system of data analysis that calculates thresholds for unusual events or exceptions.
Exposed	Someone who has met with an infectious agent in a way that may cause disease.
Feedback	The regular process of sending analyses and surveillance reports on the surveillance data back through all levels of the surveillance system so that all participants are informed of trends and performance.
Health event	Any event relating to the health of an individual (such as the occurrence of a specific disease or syndrome, the administration of a vaccine, or a hospital admission).
Hospital surveillance	Surveillance where the starting point for a report is the admission to a hospital of a patient with a particular disease or syndrome.
Incidence	The number of persons who fall ill with a certain disease during a defined time.

Infectious disease	An illness due to a specific infectious agent or its toxic products that arises through transmission of that agent or its products from an infected person, animal, or reservoir to a susceptible host, either directly or indirectly through an intermediate plant or animal host vector, or inanimate environment.
Integrated surveillance	Common approach that provides a universal surveillance service using similar structures and techniques.
Intensified surveillance	The upgrading from a passive to an active surveillance system for a specified reason and period (usually because of an outbreak). The system becomes more sensitive and secular trends need to be interpreted carefully.
Laboratory surveillance	Surveillance where the starting point is the identification or isolation of a particular organism in a laboratory (for example, surveillance of salmonellosis).
Mandatory surveillance	A surveillance where participants <i>must</i> report to the system. Notifiable diseases are one example of a mandatory system where reporting is mandated by law. In another example, health authorities may require that all public laboratories report specified diseases. This is usually not by law, but is linked to their contractual duties.
Notifiable disease	A disease that must be reported to the authorities by law or ministerial decree.
Outbreak	The occurrence of two or more linked cases of a communicable disease.
Passive surveillance	Surveillance where reports are awaited and no attempt made to actively seek reports from the participants in the system.
Performance indicators	Specific agreed-on measurements of how participants are functioning within the surveillance system. These indicators may measure both the process of reporting, action taken in response to surveillance information, and the impact of surveillance on the disease or syndrome in question.
Periodicity	The presence of a repeating pattern of excess cases. The repeater period can be in years, months, or weeks.
Prevalence	The number of persons who have a disease at a specific time
Primary care surveillance	Surveillance where the starting point for a report is a new consultation for a particular disease or syndrome with a primary care physician or health worker at a clinic.
Reporting completeness	Proportion of all expected reports that were actually received (usually stated as percent completeness as of a certain date).

Reporting system	The specific process by which diseases or health events are reported. This will depend on the importance of the disease and the type of surveillance.
Reporting timeliness	Proportion of all expected reports that were received by a certain due date.
Routine surveillance	The regular systematic collection of specified data in order to monitor a disease or health event.
Sentinel surveillance	The surveillance of a specified health event in a sample of the population at risk. The sample should be representative of the total population at risk.
Surveillance	The systematic collection, collation, and analysis of data and the dissemination of information to those who need to know so that action may be taken.
Surveillance predictive value	The likelihood that an “outbreak” detected by a surveillance system is truly an outbreak.
Surveillance report	A regular publication with specific information on the disease under surveillance. It should contain updates of standard tables and graphs as well as information on outbreaks, and so on. In addition it may contain information on the performance of participants using agreed-on performance indicators.
Surveillance sensitivity	The ability of a surveillance system to detect an outbreak (the proportion of all outbreaks that could be detected by the system).
Survey	An investigation in which information is collected systematically. It is usually carried out in a sample of a defined population group and in a defined time. Unlike surveillance, it is not ongoing, although it may be repeated. If repeated regularly, surveys can form the basis of a surveillance system.
Unusual event	The occurrence of a disease or health in excess of expectations. This expectation is either a static or dynamic threshold set by the system.
Voluntary surveillance	A surveillance system wherein participants take part and report voluntarily.
Zero reporting	The reporting of zero cases when the participant has detected no cases. This allows the next level of the system to be sure that the participant has not sent incomplete or lost data.
Zero surveillance	The surveillance of an infectious disease by measuring disease specific antibodies in a population or subpopulation.

Source: WHO 2001a.

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This toolkit draws on the expertise of public health practitioners who have experience with public health surveillance and who have recognized the core role of surveillance in public health. These practitioners have advocated for surveillance programs, supplied innovative ideas, and provided insightful critiques over many years. This toolkit also draws on the experience of Bank staff and technical experts from the PAHO and the CDC who have contributed to Bank missions. The toolkit also makes use of WHO references, primarily those from the WHO's Web site.

Part A of this toolkit provides some theoretical concepts, and knowledge about surveillance that has been gained through applying these concepts and the practice of surveillance in developing countries.

Part B provides information that will be useful to Task Managers as they prepare loans for strengthening public health surveillance systems. Several World Bank experiences are shared. The focus of part B is on practical aspects of surveillance and on lessons learned.