Surveillance of infectious diseases

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Acknowledgments

This two-year curriculum was developed through a participatory and collaborative approach between the Academic faculty staff affiliated to Egyptian Universities as Alexandria University, Ain Shams University, Cairo University , Mansoura University, Al-Azhar University, Tanta University, Beni Souef University , Port Said University, Suez Canal University and MTI University and the Ministry of Health and Population(General Directorate of Technical Health Education (THE). The design of this course draws on rich discussions through workshops. The outcome of the workshop was course specification with Indented learning outcomes and the course contents, which served as a guide to the initial design.

We would like to thank **Prof.Sabah Al- Sharkawi** the General Coordinator of General Directorate of Technical Health Education, **Dr. Azza Dosoky** the Head of Central Administration of HR Development, **Dr. Seada Farghly** the General Director of THE and all share persons working at General Administration of the THE for their time and critical feedback during the development of this course.

Special thanks to the **Minister of Health and Population Dr. Hala Zayed and Former Minister of Health Prof. Ahmed Emad Edin Rady** for their decision to recognize and professionalize health education by issuing a decree to develop and strengthen the technical health education curriculum for pre-service training within the technical health institutes.

توصيف مقرر دراسى

1- بيانات المقرر		
الرمز الكودى :	اسم المقرر :ترَصُّد الأمراض المعدية Infectious Disease Surveillance (IDS)	الفرقة /المستوى :الثانية / شعبة تسجيل طبي
التخصص :	عدد الوحدات الدراسية : Hrs. 3 نظرى Hrs. 6 عملى (أسبوعياً)	
2- هدف المقرر:	This course is prepared for the undergraduate students at Health Technical Institute aiming at introducing the student to different techniques of infectious disease surveillance (IDS). It should also support the students who master this material to be able to work in the field of IDS by mastering the required skills and understanding, by examples, how IDS is implemented.	
3- المستهدف من تدريس المقرر :		
ا. المعلومات والمفاهيم :	On successful completion of this course, the student will be able to: • Define infectious disease surveillance (IDS). • Classify infectious disease surveillance (IDS). • Recognize the commonly used terms in IDS. • Select the appropriate method of IDS. • Describe the different methods of IDS including active surveillance as compared to passive surveillance. • Determine the aims and proper use of IDS.	
ب- المهارات الذهنية :	On successful completion of this course, the student will be able to : 1. Solve problems he/she might face in IDS implementation. 2. Apply the proper surveillance method to a given disease. 3. Collect required data for IDS. 4. Report data collected from IDS. 5. Analyze collected data. 6. Compare the different systems of IDS. 7. Hypothesize in a correct way what needs IDS and how IDS will be implemented.	
ج- المهارات المهنية الخاصة بالمقرر:	On successful completion of this course, the student will be able to : 1. Collect required data for IDS. 2. Examine the available data to decide about the proper IDS. 3. Label terminology of IDS. 4. Summarize IDS techniques. 5. Solve IDS problems. 6. Criticize different IDS techniques.	
د- المهارات العامة :	1. Able to search for a computer software or website to help perform IDS in a proper and professional way. 2. Work hardly to improve the skills required for IDS as a career. 3. Demonstrate caution and proficiency in applying IDS.	
	1. Preface.	

2. Introduction. 3. Chapter (1): Definitions and the scope of IDS. 4. Chapter (2): Core-disease reporting systems. 5. Chapter (3): Core-disease reporting systems alternatives. 6. Chapter (4): PHA / Non-traditional partners collaborations. 7. Chapter (5): Challenges and promises for the future of IDS. 8. Chapter (6): International health regulations (IHR). 9. Chapter (7): IDS in practice: An introduction. 10. Chapter (8): Measles Surveillance. 11. Chapter (9): Tuberculosis Surveillance. 12. Chapter (10): Viral hepatitis Surveillance 13. Chapter (11): National notifiable disease surveillance in Egypt	4- محتوى المقرر:

1- Lectures using power point presentations. 2- Positive interaction with the lecturer by asking questions or answering them. 3- Practical sessions to solve IDS exercises. 4- Hand-outs to simplify the scientific material. 5- External readings of specialized books. 6- Training to answer model question exercises.	5- أساليب التعليم والتعلم
NA	6- أساليب التعليم والتعلم للطلاب ذوى القدرات المحدودة
	7- تقويم الطلاب :
1- Practice Test. 2- Midterm Test 3- Final Written Test.	أ- الأساليب المستخدمة
Final theoretical written exam: 3-hours. And 6 Hours Practical per week. Midterm test at the 6th week.	ب- التوقيت
Case records and reports (5 marks) Quiz : 5 mark Midterm: 10 marks Attendance 5 marks Clinical: 20 marks Clinical exam:15 marks Final written exam 90 marks. Total percentage 150 mark	ج- توزيع الدرجات
	8- قائمة الكتب الدراسية والمراجع :
• Handouts for the lectures and practical sections	أ- مذكرات

• M'ikanatha et al. (2013): Infectious Disease Surveillance. Second Edition. Edited by Nkuchia M. M'ikanatha, Ruth Lynfield, Chris A. Van Beneden and Henriette de Valk. Wiley-Blackwell publishers (www.wiley.com/wiley-blackwell).	ب- كتب ملزمة
• M'ikanatha and Iskander (2015): Concepts and methods in infectious disease surveillance. Edited BY Nkuchia M. M'ikanatha and John K. Iskander. Wiley-Blackwell publishers (www.wiley.com/wiley-blackwell).	ج- كتب مقترحة
https://www.cdc.gov/globalhealth/healthprotection/ghs/ihr/index.html https://www.cdc.gov/globalhealth/healthprotection/gdd/egypt.htm	د- دوريات علمية أو نشرات ..... الخ

Contents

Course Description

This course is prepared for the undergraduate students at Health Technical Institute aiming at introducing the student to different techniques of infectious disease surveillance (IDS). It should also support the students who master this material to be able to work in the field of IDS by mastering the required skills and understanding, by examples, how IDS is implemented.

Core Knowledge

On successful completion of this course, the student will be able to:

- Define infectious disease surveillance (IDS).
- Classify infectious disease surveillance (IDS).
- Recognize the commonly used terms in IDS.
- Select the appropriate method of IDS.
- Describe the different methods of IDS including active surveillance as compared to passive surveillance.
- Determine the aims and proper use of IDS.

Core Skills

On successful completion of this course, the student will be able to:

- Solve problems he/she might face in IDS implementation.
- Apply the proper surveillance method to a given disease.
- Collect required data for IDS.
- Report data collected from IDS.
- Analyze collected data.
- Compare the different systems of IDS.
- Hypothesize in a correct way what needs IDS and how IDS will be implemented.

Teaching and Learning Method

- Lectures using power point presentations.
- Positive interaction with the lecturer by asking questions or answering them.
- Practical sessions to solve IDS exercises.
- Handouts to simplify the scientific material.
- External readings of specialized books.
- Training to answer model question exercises.

Teaching and Learning Method for students with limited abilities

- N A

The Methods used in student assessment

- Practice Test.
- Midterm Test
- Final Written Test.

Timing

- Final theoretical written exam: 3-hours. And 6 Hours Practical per week. Midterm test at the 6th week.

Distribution of grades

- Midterm test = 20 marks
- Written test= 90 marks
- Practical test = 40 marks

References

- Handouts for the lectures and practical sections.
- **M'ikanatha et al. (2013):** Infectious Disease Surveillance. Second Edition. Edited by Nkuchia M. M'ikanatha, Ruth Lynfield, Chris A. Van Beneden and Henriette de Valk. Wiley-Blackwell publishers (www.wiley.com/wiley-blackwell).
- **M'ikanatha and Iskander (2015):** Concepts and methods in infectious disease surveillance. Edited BY Nkuchia M. M'ikanatha and John K. Iskander. Wiley-Blackwell publishers (www.wiley.com/wiley-blackwell).

Course Overview

Week	Theory	Practice
1st week	Introduction to Part I: IDS in theory: Human history of infectious disease surveillance (IDS) Definitions and scope of IDS	- Plot a flow chart for IDS - Browse the relevant websites such as Project Notify.
2nd week	Core-disease reporting systems	- Browse the relevant websites particularly MMWR.
3rd week	Alternatives to Core-disease reporting systems	- Browse the relevant websites particularly CMS and YRBSS.
4th week	Collaborations between human public health agencies (PHA) and non-traditional partners	- Browse the relevant websites particularly VAERS.
5th week	Challenges and promises for the future of IDS	- Browse the relevant websites particularly EIS and UK FETP.
6th week	International Health Regulations (IHR)	- Browse the relevant websites particularly National IHR Focal Points website
7th week	Revision for Part I: IDS in theory	Revision for Part I: IDS in theory
8th week	Introduction to Part II: IDS in practice: Case reporting Case notification Pandemic surveillance components	Recall the data flow of public health surveillance
9th week	Measles surveillance	Lessons from measles surveillance
10th week	Tuberculosis surveillance	Lessons from TB surveillance
11th week	Viral hepatitis surveillance	Lessons from VH surveillance
12th week	National Notifiable Disease Surveillance in Egypt	Training in National Egyptian Diseases Surveillance System (NEDSS)
13th week	Revision for Part I: IDS in practice	Revision for Part I: IDS in practice
TOTAL HOURS (117)		

Introduction

Throughout human history, infectious diseases have caused human suffering, disrupted trade, restricted travel, and limited human settlement.

Today the emergence of new pathogens and reemergence of new strains of old pathogens in different parts of the world illustrates the continuing threat of infectious diseases to the public's health.

A combination of globalization of the food supply and travel within countries and across international borders makes it easy for an outbreak in one location to spread rapidly within and beyond national borders.

Endemic infectious diseases, including sexually transmitted diseases like gonorrhea, foodborne illnesses like campylobacter infection, and blood-borne pathogens such as hepatitis B and C remain problems in many regions of the world.

As an example, the ten most commonly reported communicable diseases in the United States in 2013 included multiple types of STDs, infections transmitted by food and water, vaccine-preventable diseases, and a vector-borne disease transmitted by ticks (Lyme disease). The cumulative morbidity from these 10 diseases, in a single wealthy country, is nearly 2 million cases a year or approximately 32 cases of a communicable disease per 10,000 persons.

Given that underreporting occurs in many surveillance systems, the real figures of cases and attendant suffering and healthcare costs is undoubtedly higher.

Surveillance can provide timely information crucial to public health interventions in an evolving situation. For example, during the 2009–2010 H1N1 influenza pandemic, surveillance data were used to prioritize vaccination to specific high-risk groups such as pregnant women because the supply of vaccine was limited.

Surveillance data also form the bases for disease-specific treatment guidelines; in

the United States, for example, public health authorities now recommend use of injectable third generation cephalosporins for treatment of gonococcal infections because of increasing resistance to oral cephalosporins.

Information from carefully designed and implemented surveillance systems can also inform the allocation of resources to public health programs and reassure the public in face of public health crises resulting from natural disasters such as the Sichuan earthquake in China in 2008.

Epidemiologic data generated through disease surveillance serve as the bases for research and development of drugs, vaccines, and other therapeutic and prophylactic interventions.

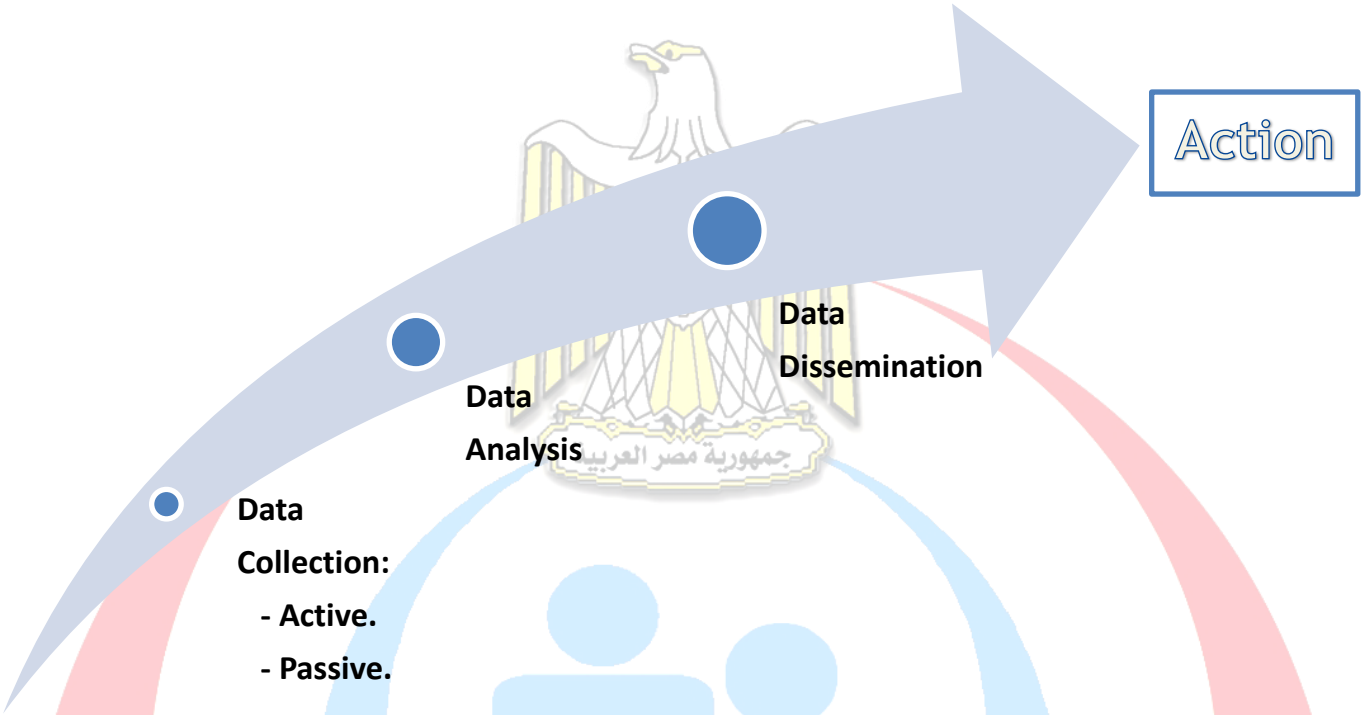
Although central to disease prevention programs, public health surveillance infrastructure is inadequate or weak in many parts of the world. The need to strengthen capacity to conduct *public health surveillance* for infectious diseases is a priority for practitioners and policy makers in North America and Europe.

The establishment of the European Centre for Disease Prevention and Control (ECDC) and the renewed focus on surveillance at the United States Centers for Disease Control and Prevention (CDC) demonstrate the growing interest in this field.

Furthermore, the current International Health Regulations obviously call for establishment of functioning surveillance units in the public health systems in all countries.

Contrary to the misconception that infectious diseases have been captured by advances in medicine and technology, established and newly emerging pathogens will continue to be threats to public health.

Flow chart of IDS:



Chapter 1
Definitions and the scope of IDS

1.1- Definitions:

Public health surveillance:

Surveillance has three basic component activities. These surveillance activities are data collection; analysis and timely dissemination. They represent a dynamic process, are interrelated and rely upon each other.

1. *Data collection*:
   This process can be:
   a. **Passive:** Data are reported in such a way that the *receiving agency* waits for data reports to be sent in. This is seen in *standard systems* that report notifiable diseases to a *public health department*.
   b. **Active:** Data are actively sought out.
2. *Analysis*:
   Analysis of data is a dynamic, expert and intellectual process of interpretation and results in the production of important information on which to base action.
   To carry out analysis adequately requires expertise in the subject area, skill in analytical techniques and knowledge of the relevant public health literature.
3. *Dissemination*:
   Proper dissemination of information to those who need to know must be timely and also requires communication skills and experience.

The three surveillance "legs" are contained both in the original 1969 International Health Regulations (IHR) and in the most recent definition of surveillance in the current IHR (2005).

The IHR 2005 defines surveillance as *"the systematic ongoing collection and analysis of data for public health purposes and the timely dissemination of public health information for assessment and public health response as necessary"*.

These components are considered central to public health surveillance system.

Intended audiences for surveillance data may include public health practitioners, physicians, and other healthcare providers; policymakers; traditional media; and the general public.

Depending on the primary target audience, the format and manner in which surveillance data are communicated may vary substantially. Contemporary communications channels for sharing surveillance information include various types of social media.

The final and most-important link in the surveillance chain is the application of these data to disease prevention and control.

A surveillance system includes a functional capacity for data collection, analysis, and dissemination linked to public health programs.

Bio-surveillance:

Bio-surveillance has been defined as *"the science and practice of managing health-related data and information so that effective action can be taken to mitigate adverse health effects from urgent threats"*.

Syndromic surveillance:

The CC defines syndromic surveillance as *"surveillance that uses health-related data that precede diagnosis and signal a sufficient probability of a case or an outbreak to warrant further public health response"*.

1.2- Scope (Value) of IDS:

Because collection of data is a major undertaking, there is a risk that the data collection process itself may consume surveillance programs.

However, merely collecting disease data has little impact. Instead, successful surveillance programs analyze and disseminate data to inform prevention and control activities.

Therefore, the values of well-designed IDS include:

1. **Guide seasonal vaccine formulation:**

The WHO Global Influenza Surveillance Network, including five WHO Collaborating Centers for Reference and Research on Influenza and 136 laboratories in 106 countries, conducts annual surveillance for new strains of influenza.

The results form the basis for WHO recommendations on the composition of influenza vaccine for the northern and southern hemispheres each year, enabling the vaccine to be antigenically similar to recently circulating influenza viruses.

2. **Guide vaccination strategies:**

Characterization of risk factors for bacterial infections such as invasive pneumococcal and meningococcal disease and data on circulating serotypes guide the development of vaccination recommendations.

For example, the US Advisory Committee on Immunization Practices uses data from active laboratory and population-based surveillance to formulate guidelines for vaccination with a 7-valent pneumococcal conjugate vaccine that was licensed in 2000 for use among young children.

Continued surveillance then documented both the rapid decline in pneumococcal serotypes included in the 7-valent vaccine and the increase in disease due to non-vaccine serotypes.

This subsequently led to 2010 licensure of a 13-valent vaccine, which includes many of the serotypes that emerged.

3. **Assess vaccine safety:**

The success of vaccination recommendations depends on their acceptance by the public and by healthcare providers; an acceptable vaccine *risk-benefit ratio* is important in gaining this confidence.

Surveillance for adverse events following vaccination enables public health authorities to investigate concerns and detect problems about specific vaccines.

For example, data collected through Vaccine Adverse Event Reporting System (**VAERS**) enabled detection of intussusception related to rotavirus vaccine in 1999. When evidence exists, this type of surveillance is also important for promotion of vaccines with good safety records.

4. **Monitor adverse events of transfusion and transplantation**

Advances in healthcare technology have enabled lifesaving procedures including blood transfusion, solid organ transplantation, and musculoskeletal allografts.

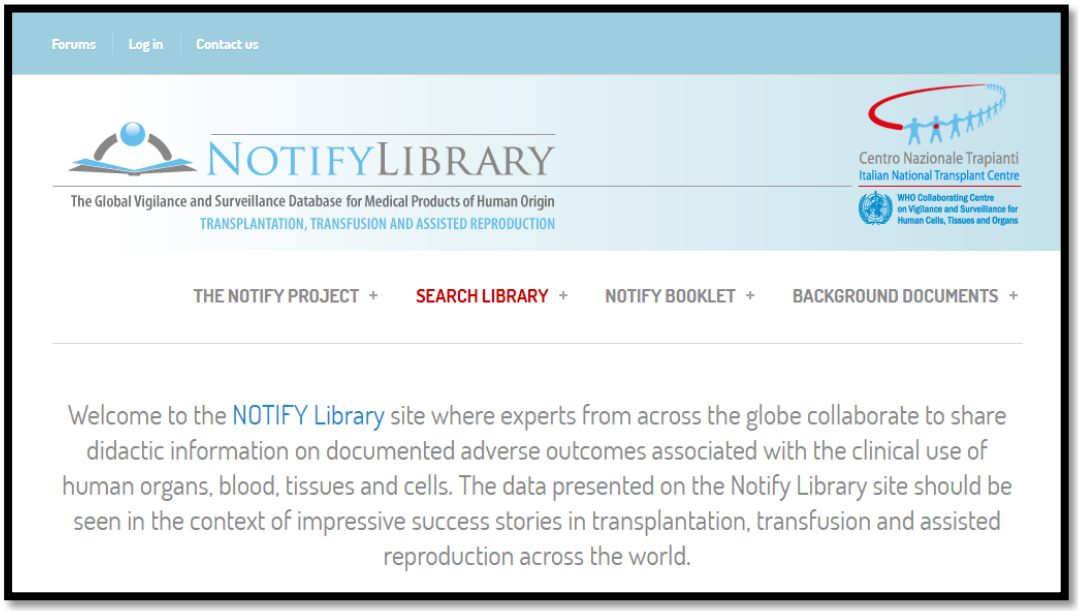
These procedures, however, have an inherent risk of transmission of pathogens from donors to recipients.

In 2011 public health authorities in New York City documented HIV transmission through organ transplantation from a living donor.

Surveillance for adverse events associated with the use of human tissues and development of strategies to reduce risk requires collaboration among **stakeholders** including regulators, the private sector, medical societies, and public health authorities.

Project Notify (Figure 1.1), an initiative led by the WHO and expert societies in Europe, recently created an online database for exchange of information on adverse events associated with the use of substances derived from humans (e.g., solid organs and tissues) in medical procedures (http://www.notifylibrary.org/).

Figure 1.1: Project Notify website.



5. **Inform antimicrobial stewardship programs:**

The emergence of resistance to antimicrobial agents is an unresolved threat to public health worldwide. Thus, the European Parliament, the WHO, and other organizations call for deployment of surveillance systems to guide interventions.

As an example of this effort, data on antimicrobial consumption (e.g., antibiotics and antivirals) are collected in 32 countries through surveillance networks supported by the European Center for Disease Prevention and Control (ECDC).

These data are used to guide facility-based antimicrobial stewardship programs and in campaigns to increase awareness about antimicrobial resistance in Europe.

6. **Control emergence of antimicrobial-resistant organisms in animals**

Widespread use of antimicrobial agents in animal husbandry is associated with increased resistance to antibiotics in bacteria isolated from domesticated animals and humans.

The European Food Safety Authority (EFSA) in collaboration with ECDC and other partners monitors antimicrobial resistance in organisms recovered from animals and food across Europe.

In 2006, EFSA standardized antimicrobial resistance surveillance for two important foodborne pathogens of animal origin: Salmonella and Campylobacter.

In 2012, EFSA and the ECDC released a joint report on antimicrobial resistance, which documented high prevalence of fluoro-quinolone resistance in Campylobacter jejuni isolated from humans (51.6% among 9728 isolates from 13 Member States and Iceland) and food (50% among 670 isolates from seven Member States).

The EFSA–ECDC report contributed to the European Union President's initiative to combat antimicrobial resistance.

7. Guide resource allocation for disease prevention/treatment programs

Surveillance data are used to guide allocation of resources to control infectious diseases at various levels.

In the USA over $2.2 billion from the Ryan White federal program are allocated to HIV-related services based in part on the number of cases reported by public health jurisdictions.

Annual estimates of the burden of HIV/AIDS in different countries had stimulated creation of organizations like The Global Fund to Fight AIDS, Tuberculosis and Malaria (https://www.theglobalfund.org/en) (Figure 1.2) and the Bill and Melinda Gates Foundation (Figure 1.3) (https://www.gatesfoundation.org). These organizations focused on securing resources to expand public health programs in the countries that are most affected by HIV/AIDS.

Figure 1.2: The Global Fund to Fight AIDS, Tuberculosis and Malaria website.

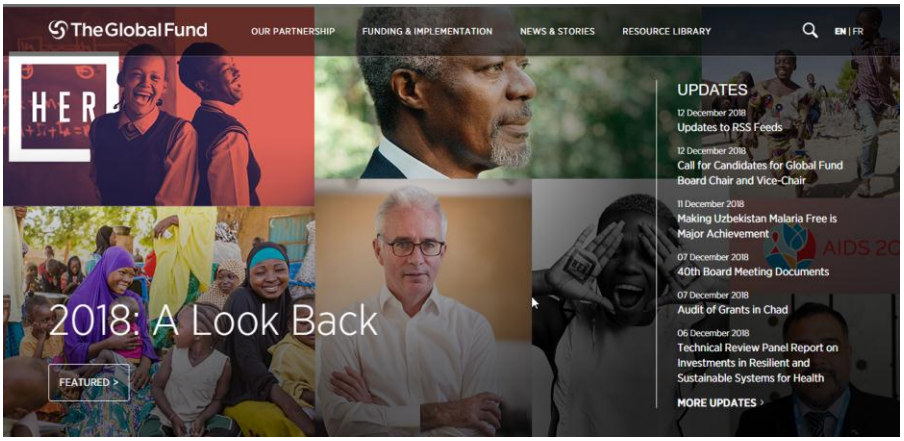
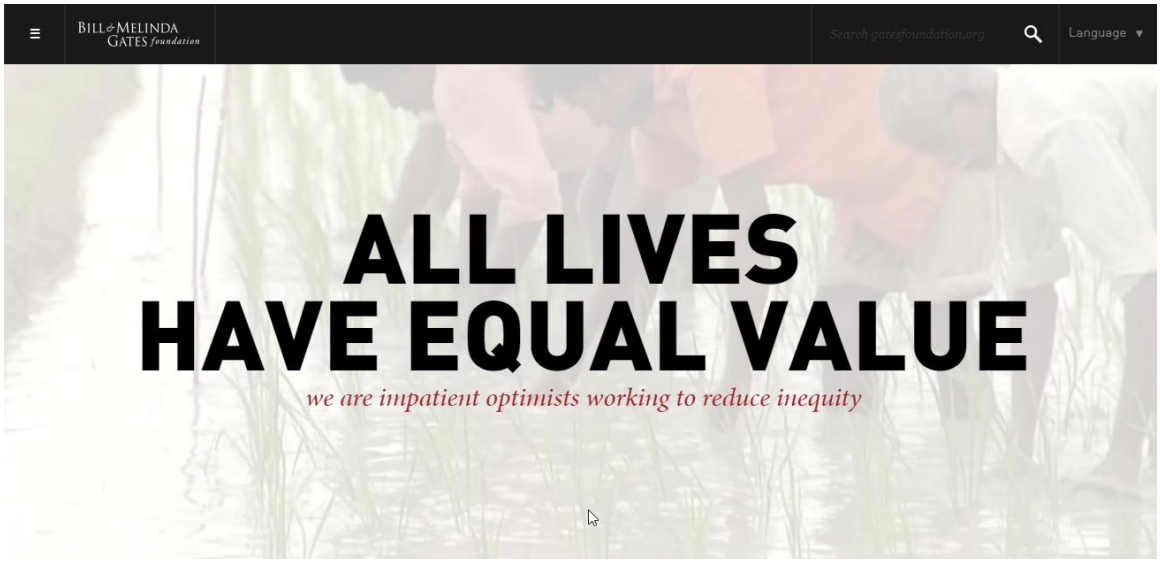


Figure 1.3: Bill and Melinda Gates Foundation website



8. Identify outbreaks and guide disease control interventions

Advancement in laboratory methods has enhanced the usefulness of surveillance in outbreak detection by linking bacterial isolates obtained from geographically dispersed cases.

For example, **PulseNet** (Figure 1.4), a national network of public health and food regulatory agency laboratories in the USA, performs standardized molecular subtyping (or "fingerprinting") of disease-causing foodborne bacteria by pulsed-field gel electrophoresis (PFGE).

PFGE patterns of isolates are compared with other patterns in the database to identify possible outbreaks.

In a large multistate Escherichia coli O157:H7 outbreak in 1993, PFGE was first used to link cases with consumption of hamburgers from a restaurant chain.

Public health action in Washington State prevented consumption of over 250 000 potentially contaminated hamburgers, preventing an estimated 800 cases.

Surveillance data can provide the historical baseline necessary to detect an outbreak, especially when PFGE patterns are common, as was the case with the 2011 multistate Salmonella Heidelberg outbreak in the USA.

Combined with integrated surveillance data, PFGE enabled investigators to implicate consumption of ground turkey from a specific establishment, resulting in recalls of approximately 36 million pounds of ground turkey products that may have been contaminated with a multidrug-resistant strain of Salmonella Heidelberg.

Public health laboratories are increasingly adapting new technologies to enhance detection of outbreaks.

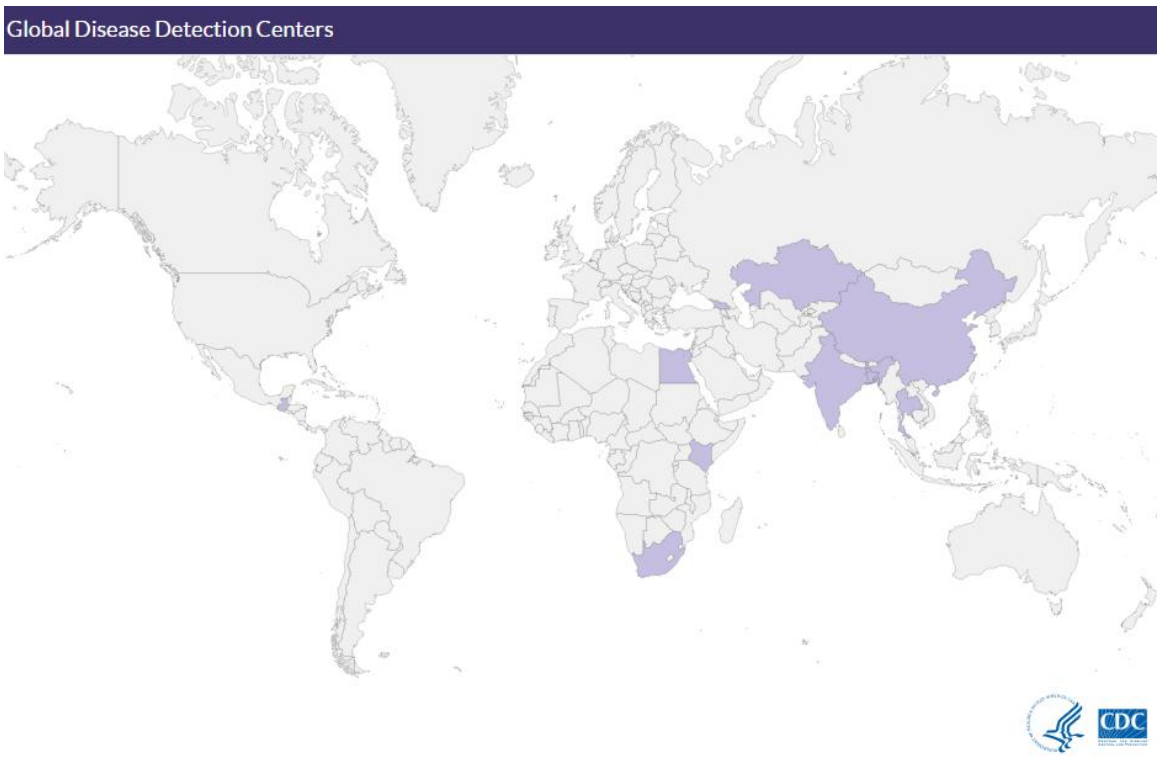
For example, whole-genome sequence typing was used to investigate a suspected cluster of transplantation related Coccidioides immitis infections in three patients.

Figure 1.4: PulseNet website: https://www.cdc.gov/pulsenet/index.html

1.3- Egyptian Global Disease Detection (GDD) Center:

Early warning for international outbreaks is critical.

The Centers for Disease Control & Prevention (CDC) build capacity to detect, identify and contain emerging infectious diseases through ten state-of-the-art Global Disease Detection Centers in different regions of the world (Figure 1).



CDC respond to high-profile public health events such as Ebola, polio eradication, MERS-CoV, cholera, and Nipah virus, while increasing engagement in the agency's global health security activities.

For over 20 years, the Centers for Disease Control & Prevention (CDC) worked with public health institutions in the Middle East and North Africa (MENA).

In 2006, this collaboration broadened through the establishment of a Global Disease Detection (GDD) Center in Cairo, Egypt.

GDD supports efforts to protect the public's health by developing and strengthening the ability of countries in the MENA region to rapidly detect and respond to disease outbreaks and emerging infectious diseases.

GDD brings together CDC-wide expertise to support capacity-building activities and training in epidemiology; surveillance; laboratory diagnostics; data management and reporting; infection control; and outbreak investigations.

The GDD Center in Egypt helps contain outbreaks close to the source by building up local resources, drawing on combined expertise in:

1) Emerging infectious disease detection and response.
2) Field epidemiology and laboratory training.
3) Pandemic influenza preparedness and response.
4) Zoonotic disease research and control.

CDC works in conjunction with regional country governments, World Health Organization (WHO), local partners, and other U.S. government agencies to:

1) Reduce the impact of emerging diseases.
2) Build capacity in areas such as laboratory systems and epidemiology.
3) Strengthen immunization services.
4) Respond to public health emergencies.
5) Conduct surveillance, surveys, and studies.

Together, partners provide vital technical assistance to detect and respond to major public health challenges, including H5N1, dengue, Rift Valley Fever, and hemorrhagic illness.

Making an impact:

From 2007-2016, the GDD Center in Egypt supported

1) Effective response to over 132 outbreaks at the invitation of affected countries.
2) Systematic surveillance for select conditions and diseases reportable within days, and sometimes hours, of the occurrence.
3) Detection and identification of 12 novel strains and pathogens new to the region or world.
4) Establishment of newly available in-country laboratory diagnostic testing capacity for 73 pathogens.
5) Graduation of over 88 future national health leaders through the two-year Field Epidemiology Training Program (FETP).
6) Training of over 9,300 Egyptian nationals and 5,500 Ministry of Health and Population staff in surveillance and laboratory diagnostics since 2009

Chapter (1) review questions:

1- Short essay:

1. Mention two causes that make it easy for an outbreak in one location to spread rapidly within and beyond national borders.
2. What are the three basic component activities of surveillance?
3. Define:
    a) Bio-surveillance.
    b) Syndromic surveillance.
4. Mention three values (scopes) of infectious disease surveillance.

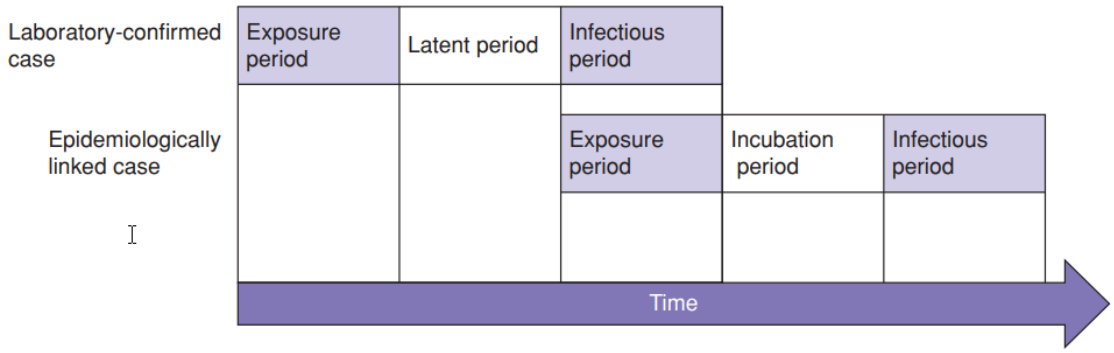
2- MCQs:

1. Values of infectious disease surveillance include:
    a. Guiding the development of vaccination recommendations.
    b. Detection of problems about specific vaccines.
    c. Both a. and b.
    d. Neither a. nor b.
2. An online database for exchange of information on adverse events associated with the use of substances derived from humans (e.g., solid organs and tissues) in medical procedures is called:
    a. Project Notify.
    b. The European Food Safety Authority (EFSA).
    c. Bill and Melinda Gates Foundation.
    d. The Global Fund to Fight AIDS, Tuberculosis and Malaria.

Chapter 2
Core disease-reporting systems

2.1- Epidemiologic link:

Figure 2.1: Guidance for defining an epidemiologically linked case prospectively (Based on Australian case definition)



An epidemiologic link is established when there is contact between two people involving a plausible mode of transmission at a time when:

- One of them is likely to be infectious and
- The other has an illness onset within the incubation period after this contact.

At least one case in the chain of epidemiologically linked cases (which may involve many cases) must be laboratory confirmed.

2.2- Core disease-reporting system:

1. Disease reporters:

In most countries, mandatory disease reporting relies upon physicians or other healthcare providers to diagnose and report specified diseases to public health authorities.

Many other authorities in the USA, Europe, Australia, and other parts of the world require notification of specific test results to public health authorities.

In addition, directors of schools, childcare centers, prisons, or other institutions are often required to notify public health officials of any clusters of disease, such as two or more cases of suspected food poisoning.

Despite being legally mandated, diseases are largely under-reported. While failure to comply with reporting requirements can lead to criminal penalties, enforcement is rare. Moreover, physicians are often unaware of which diseases to report. Physicians may also not believe in the utility of surveillance, and the logistics of reporting cases can become unmanageable for busy clinicians.

One key reason for sharing data with clinicians is to demonstrate the usefulness of disease reporting. Creative means to motivate and support disease reporters can also be helpful. Until recently, physicians in England were given a modest financial incentive to notify public health authorities of suspected cases of reportable diseases. To promote reporting of HIV, Michigan Department of Community Health (USA) maintains an active relationship with HIV care specialists through an email group that provides up-to-date information on HIV and other infectious disease news.

Surveillance, prevention, and control of healthcare-associated infections are new areas for many public health practitioners. Some authorities in the USA, UK, and France have mandated reporting of healthcare-associated infections; state and local health departments have subsequently become more involved. Audits can be a component of assessing healthcare facility compliance with reporting requirements.

2. Laboratory-based surveillance

Clinical microbiology and public health laboratories can be rich sources of information on pathogens causing disease within a population.

Compared with individual healthcare providers who are often spread across multiple clinics and acute and chronic care facilities, clinical laboratories are fewer and data are better consolidated. Adaption of electronic information systems by clinical laboratories has created opportunities for new methods of submitting reportable conditions to public health authorities.

Implementation of electronic laboratory reporting (ELR) has improved timeliness, completeness, and facilitated development of complementary laboratory-based surveillance systems for monitoring specific conditions. Nevertheless, deployment of ELR requires an understanding of its strengths, limitations, and strategies for analysis of increased data.

3. Diseases selected for surveillance

In most European countries, diseases considered to be of public health significance and warranting systematic surveillance are selected at a national level.

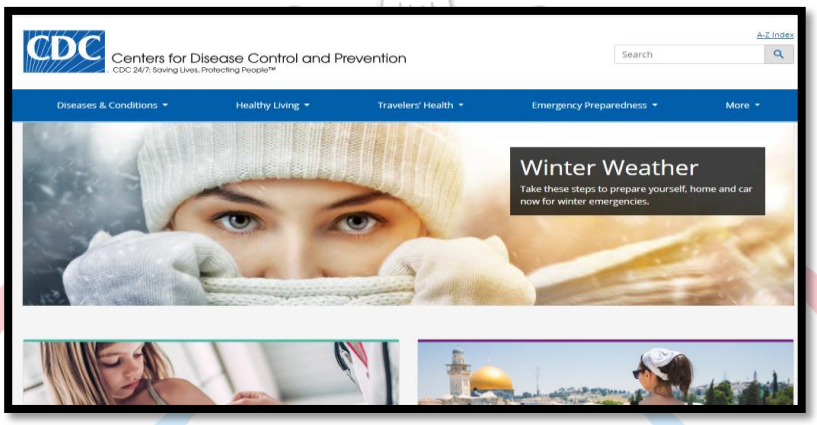
In the USA, the authority to require disease reporting is ***decentralized***. For example, coccidiomycosis is typically reportable only in areas in the southwestern USA where the fungus is endemic.

4. Case definitions

To standardize surveillance data within and across public health jurisdictions (authorities), case definitions are used with specific clinical and

laboratory criteria. In the USA, the Council of State and Territorial Epidemiologists, an organization representing public health epidemiologists, establishes and periodically updates case definitions used in surveillance for nationally notifiable infectious diseases; a current list is available on the US Centers for Disease Control and Prevention's (CDC) website (www.cdc.gov) (Figure 2.2).

Figure 2.2: CDC website:



Case classifications range from "**suspected**" to "**confirmed**", depending on the availability of supporting data. Case definitions for over 80% of nationally notifiable diseases in the USA require a positive laboratory test for confirmation. An epidemiologic link to a laboratory confirmed case is typically required for designating a case as "**probable**".

For some diseases, such as tetanus, surveillance is primarily based on clinical criteria (e.g., an acute onset of hypertonia or painful muscular contractions, usually of the muscles of the jaw and neck, and generalized muscle spasms without other apparent medical cause). The sensitivity and specificity of a case definition are influenced by the availability of reliable laboratory diagnostic assays to support clinical criteria, and by epidemiologic factors.

In an outbreak or in other settings where confirmatory laboratory assays do not exist or are not practical, sensitive but less specific case definitions may be selected. For example, a gastrointestinal illness can be counted as a case of salmonellosis if epidemiologically linked to a laboratory-confirmed case of Salmonella.

By contrast, when a single case has major public health implications, the case definition may be quite rigorous with strict laboratory criteria, e.g., vancomycinresistant Staphylococcus aureus or human infection with influenza A (H5N1) virus.

Case definitions are subject to evolution in response to diagnostic and therapeutic advances—for example, the case definition for HIV/AIDS has been refined several times.

Caution is necessary when interpreting data following a change in case definitions because any observed changes might be surveillance artifacts (i.e., due to the change in case definition rather than a change in the true incidence of disease).

5. Data flow

Reporters telephone, fax, mail, or electronically transmit case reports to local health jurisdictions that investigate cases. Public health officials then ensure that case definitions are met, and initiate appropriate interventions.

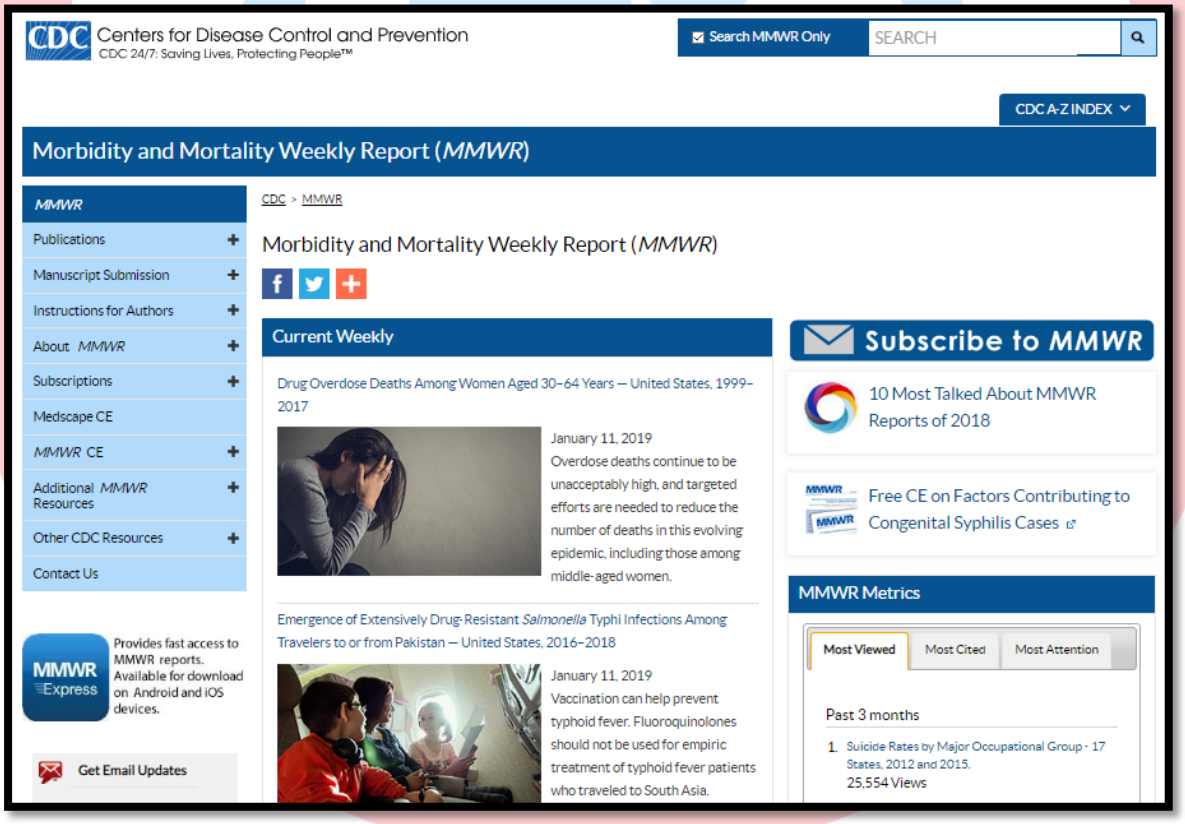
In the USA, case reports for diseases that are deemed "nationally notifiable" are forwarded to the National Notifiable Disease Surveillance System (NNDSS) at the CDC. Submission of data to the national system in the USA is voluntary; nevertheless, all jurisdictions participate.

In countries where the disease-reporting authority is ***centralized*** at the national level, all cases confirmed at the local jurisdiction are forwarded to the national surveillance system.

6. Dissemination of data

Surveillance data are compiled, analyzed, and presented at many levels. A prominent outlet in the USA is the Morbidity and Mortality Weekly Report (MMWR) where surveillance summaries on notifiable diseases are published both on a freely accessible website (Figure 2.3) (http://www.cdc.gov/mmwr/) and in printed copies that are mailed to subscribers.

Figure 2.3: Morbidity and Mortality Weekly Report (MMWR) website:



In the UK, surveillance data are published regularly in the Health Protection Report, available on the Health Protection Agency website (http://www.hpa.org.uk/hpr/) (Figure 2.4), and by email subscription.

Figure 2.4: Health Protection Report website:

States, territories, and local health departments in the USA have a variety of methods to share surveillance data. Because sharing surveillance data with healthcare providers and the public is crucial, public health jurisdictions are increasingly taking advantage of Facebook, YouTube, Twitter, and other social media tools to achieve this objective.

2.3- Internationally-notifiable diseases: International Health Regulations:

In most countries, public health agencies operate independently. Because infectious pathogens do not respect national borders, concerns about some events extend beyond the "index" country; the international public health response may therefore be essential to controlling an outbreak.

The international health regulations (IHR), as originally articulated by the World Health Assembly in 1969, required countries to report cases of yellow fever, plague, and cholera to the WHO.

By 2007, virtually all members of the United Nations (194 countries) had implemented IHR and progress has been made in key areas including establishment of national IHR focal points.

Limitations:

Limitations encountered by the core disease-reporting systems include:

1. Delays in notification.
2. Underreporting.
3. Lack of representativeness, and
4. Exclusive focus on human diseases.

Chapter (2) review questions:

1- Short essay:

1. Explain when an epidemiologic link is established.
2. Enumerate three infectious disease reporters.
3. Mention three values of Implementation of electronic laboratory reporting (ELR).

2- MCQs:

- A periodically updated case definitions used in surveillance for nationally notifiable infectious diseases is available on website for:

  a) The US Centers for Disease Control and Prevention's (CDC).

  b) Electronic laboratory reporting (ELR).

  c) pulseNet.

  d) The European Food Safety Authority (EFSA)

3- True or False:

- In USA, the disease-reporting authority is decentralized.
- Because sharing surveillance data with healthcare providers and the public is crucial, public health jurisdictions are increasingly taking advantage of Facebook, YouTube, Twitter, and other social media tools to achieve this objective.

Chapter 3

Alternatives to core disease-reporting systems

Some of the deficiencies of core disease-reporting systems can be addressed by surveillance conducted by alternative modalities:

3.1- Active surveillance:

Describing surveillance systems as "passive" is a misnomer because it suggests minimal effort on anyone's part. Usually, labeling some surveillance systems as "passive" and others as "active" is *to distinguish the intensity of public health agency effort in finding and investigating cases*.

Systems based on mandatory disease reporting, while obviously relying on healthcare-provider energies, generally involve minimal public health effort to encourage case reports, and thus are described as "passive".

Under-reporting is a major limitation of this type of surveillance system.

In practice, however, no surveillance system should be entirely "passive," even from the point of view of the public health agency, as regular communication and feedback to healthcare providers are necessary to ensure a successful system.

By contrast, "active" surveillance signifies *intensive public health efforts to identify cases needed to determine incidences and epidemiologic characteristics of specific conditions within defined regions*.

Population-based surveillance aims to capture every case diagnosed within a population living in a defined geographic catchment area and thus can best describe the epidemiology and measure rates of a disease under surveillance.

To be sufficiently comprehensive, active and population based surveillance sometimes involves retesting of isolates submitted by clinical laboratories and collection of additional epidemiologic and clinical information.

The benefits of population-based surveillance to public health are clear; however, the *additional resources* required for conducting this type of surveillance limits widespread implementation of this approach.

In the USA, the Emerging Infections Program (EIP) supports active, population-based surveillance for selected pathogens conducted in a representative population of approximately 44 million or 14% of the total population in 2012.

This approach involves 10 EIP sites distributed throughout the USA that conduct surveillance activities in collaboration with state and local health departments, academic institutions, clinical laboratories, and healthcare providers.

The Active Bacterial Core surveillance (ABCs), which tracks *selected invasive disease*, is an example of population-based surveillance activities conducted by EIP sites, e.g., Streptococcus pneumoniae, groups A and B Streptococcus, Haemophilus influenzae, and Neisseria meningitides.

The EIP sites also monitor the incidence of *selected foodborne pathogens*, e.g., Salmonella, Campylobacter, and Shiga toxin-producing E. coli.

3.2- Sentinel surveillance:

The intensive public health resources required to conduct population-based surveillance are often not readily available; as an alternative strategy, sentinel surveillance involves collection of data from a "sentinel" or subset of a larger population.

The strategy of focusing on a small population subset can be conceived as a type of "sampling".

To generalize these data to larger populations, it is necessary to ensure that:

1. The sentinel population is representative and
2. The sentinel data are linked to denominator information on a pre-defined population under surveillance

The Gonococcal Isolate Surveillance Project systematically monitors antimicrobial resistance among Neisseria gonorrhoeae isolates collected from 25-30 sentinel US cities.

Antimicrobial susceptibility testing is performed on the first 25 isolates per month from male patients with gonococcal urethritis (approximately 5900 isolates annually).

Rising resistance documented by this surveillance system has contributed to recommendations that fluoro-quinolones should no longer be used to treat gonococcal infections in the USA.

Recent concerns about N. gonorrhoeae resistant to cephalosporins warrant vigilance in monitoring patients for treatment failures and prompt reporting of isolates with decreased cefixime or ceftriaxone susceptibility (≥0.5 µg/mL) to public health authorities.

In France, a network of sentinel primary care physicians report information at weekly intervals on a selected group of health events that are relatively common in general practice such as influenza like illness, acute gastroenteritis, mumps, chickenpox, herpes zoster, male urethritis, and Lyme disease.

Data are extrapolated to regional and national levels. The system, known as Sentinelles, describes the occurrence and progression of regional and national outbreaks.

Multiple "sentinel" surveillance methods have been used to estimate the prevalence of HIV in India, South Africa, and other countries. Testing for HIV in women presenting for antenatal care is common. Targeted

sentinel surveillance for HIV is also conducted in high risk groups, e.g., female sex workers and single male migrants.

3.3- Animal reservoir and vector surveillance:

Because of the central role of wildlife, domestic animals, and vectors, e.g., ticks and mosquitoes, zoonotic diseases cannot be adequately understood and controlled by only monitoring the disease in human populations.

With increasing recognition of the importance of zoonotic diseases, surveillance systems have been designed to monitor pathogens as they circulate in various human and non-human hosts.

Brucellosis control in the USA has been successful because of the focus on animal health as a way to protect human health: comprehensive animal testing, vaccination of breeding animals, and depopulation of affected herds.

Surveillance for vector-borne diseases (e.g., West Nile virus, Lyme disease, and dengue) involves different complementary modalities.

Surveillance for West Nile Virus in the USA has evolved with a recent decline in utility of dead bird monitoring and an increase in entomologic capacity. Still, recognition of transplantation as a new mode of West Nile virus transmission demonstrates the need for robust monitoring of risk factors.

3.4- Detection of pathogens in the environment:

The identification of the fungus Cryptococcus gattii in British Columbia, Canada, illustrates the use of surveillance to define an emerging pathogen intrinsically linked to the environment.

Previously only known in tropical and subtropical climates, the fungus emerged in approximately 1999 in Vancouver Island as a pathogen in humans and domestic and wild animals.

Environmental sampling identified the fungus on trees, in soil, in air samples, and in water, and helped to define the evolving kingdom of this new pathogen.

C. gattii expanded to the Pacific Northwest region of the USA. Studies of isolates from patients revealed that genetically similar strains of C. gattii caused outbreaks in the US Pacific Northwest while other strains caused disease in a wider geographical area.

3.5- Surveillance across borders and mobile populations:

Conventional surveillance systems may not fully capture infectious diseases among border or mobile populations.

The Early Warning Infectious Disease Surveillance (EWIDS) **is a *cross-border surveillance system* that involves 20 public health jurisdictions in the USA, Canada, and Mexico. It is an example of a regional effort to improve timeliness of public health response through early detection of pathogens.**

An example of surveillance activities carried out by EWIDS collaborators is sharing of molecular laboratory test results through PulseNet and sharing data on biologic agents that are of concern in bioterrorism.

The Border Infectious Disease Surveillance, **along the USA- Mexico border, is another example of a system coordinated by public health jurisdictions in two countries.**

Surveillance for infectious disease associated with *mass gathering* presents challenges to traditional surveillance systems. *Mass gatherings* involve potentially thousands of persons in an inherently transient population.

In the case of the Hajj, the Muslim annual pilgrimage to Mecca, the gathering is estimated at 2.5 million people.

Experiences from systems deployed during winter and summer Olympic Games and the 2009 Hajj, which took place during the influenza H1N1 pandemic, provide lessons for enhancing surveillance during mass gatherings. These lessons include integration of new sources of data from Internet-based systems.

3.6- Use of health services & administrative data for disease surveillance:

Infectious disease surveillance systems have sometimes incorporated administrative and vital statistics data that are being collected for other purposes:

1. International Classification of Diseases (ICD):

To bill for services, healthcare facilities in the USA assign diagnosis codes to clinical care encounters; International Classification of Diseases, 10th revision (ICD10). This is a potential source for surveillance activities for a range of diseases.

2. Hospital admission data:

Hospital admission data can also complement routine surveillance data.

In Germany, national surveillance systems extract records on diagnoses and treatment of specific diseases under surveillance from healthcare reimbursement databases.

In England, hospital admission data have been used to monitor end-stage liver disease where the underlying cause is chronic viral hepatitis.

3. Monitoring of drug utilization and drug sales:

Monitoring of drug utilization and drug sales may be an indirect measure of disease activity. At the US CDC, where a supply of "orphan" drugs are housed for treatment of rare diseases, increased requests for pentamidine in the 1980s led to an investigation of a cluster of pneumocystis pneumonia which, in turn, led to the first detection of AIDS in the world.

4. Syndromic surveillance:

To complement core surveillance systems that are based on reporting of specific diagnoses, public health authorities use syndromic surveillance data to monitor selected indicators.

Syndromic surveillance systems typically use automated data extraction and analytic methods to detect aberrations from expected levels of various syndromes.

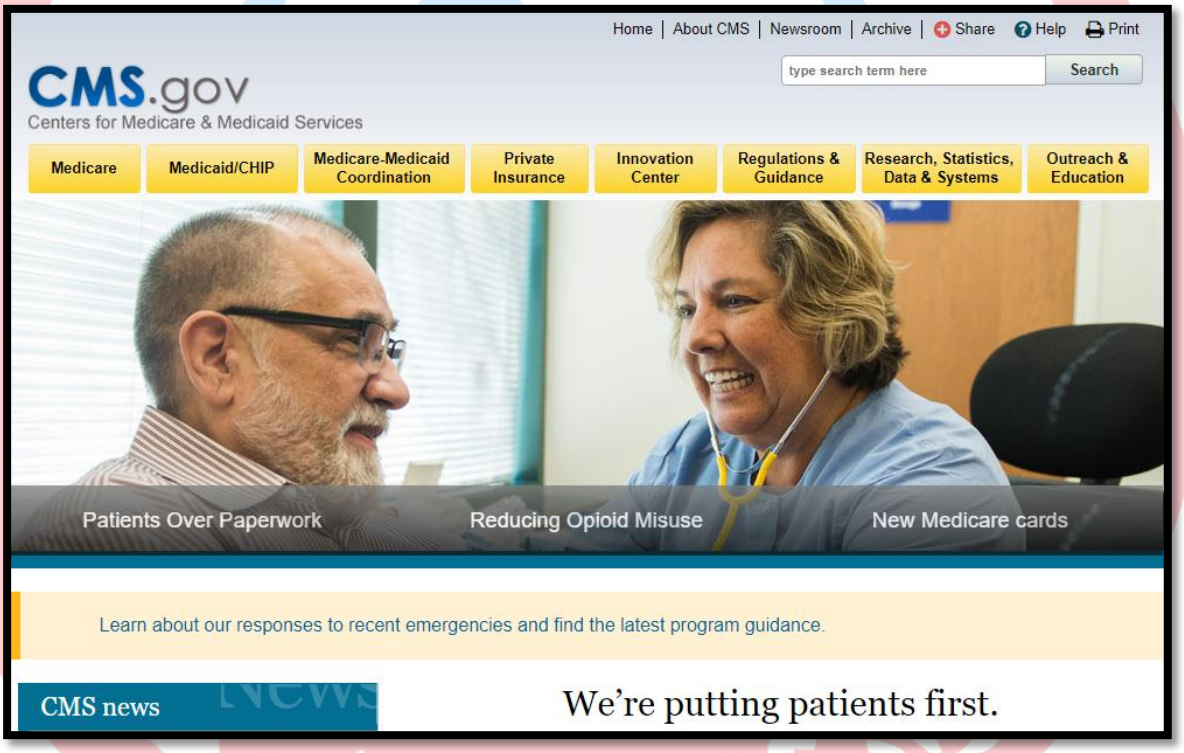
For example, in Virginia the chief complaints recorded at emergency department visits are used to track influenza-like illness during the flu season.

Pharmaceutical databases have been explored for a variety of syndromic surveillance systems.

In the USA, initiatives under the 2009 Health Information Technology for Economic and Clinical Health (HITECH) **Act will likely accelerate use of health records for surveillance purposes.**

This law provides incentives to promote "meaningful use" of electronic health records to improve clinical outcomes for patients and public health (www.cms.gov) (Figure 3.1).

Figure 3.1: Centers for Medicare & Medicaid Services website



For example, HITECH offers healthcare facilities and providers incentives for submitting specified electronic immunization data to registries.

The law also provides incentives for developing statewide Health Information Exchange (HIE) **to enable healthcare organizations to seamlessly share and receive electronic immunization and other forms of data. The use**

of data from HIE in public health settings was in the early stages development as of the end of 2012.

3.7- Risk factor surveillance:

Although most surveillance systems focus on disease occurrences or circulation of pathogens causing disease, several surveillance systems have focused on behaviors that pose risk for specific diseases.

Two examples relate to HIV/AIDS surveillance in the USA:

1. The National HIV Behavioral Surveillance system:

   This system includes interviews of a sample of persons to assess the prevalence of sexual behaviors, drug use, and testing history for other sexually transmitted infections. Data from this system examine the front end of the HIV/AIDS epidemic and may guide and assess prevention programs.

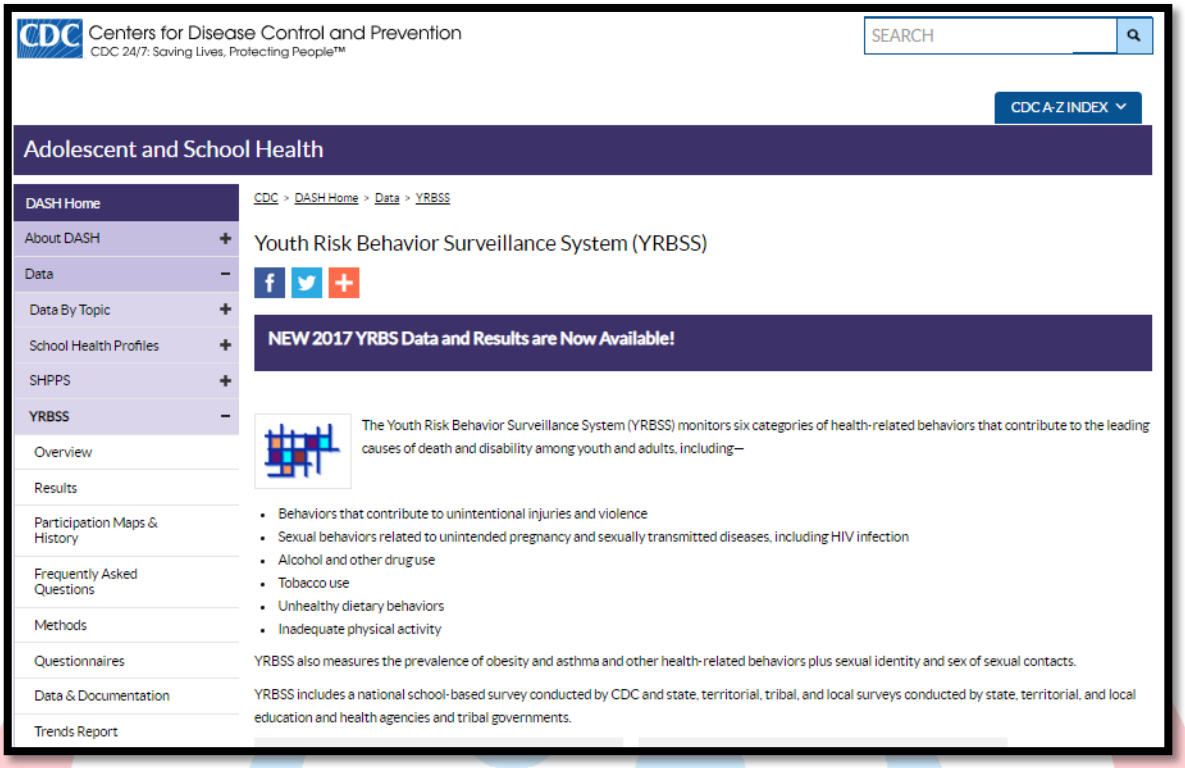
2. The Medical Monitoring Project:

   This is designed to produce national estimates about people living with HIV/AIDS in the USA. It involves collection of self-reported behavioral and selected clinical data through in-person interviews.

Similarly, the Youth Risk Behavior Survey System (YRBSS) measures the prevalence of health risk behaviors among adolescents through self-administered, school-based surveys.

Reports of sex without condoms and sex associated with drug and alcohol use are among the data collected (www.cdc.gov/yrbs) (Figure 3.2).

Figure 3.2: Youth Risk Behavior Survey System (YRBSS) website:



3.8- Emerging mobile technologies:

The convergence of mobile technology and the Internet coupled with declining costs of portable wireless devices present new approaches for tracking emerging and endemic pathogens.

By 2011, over 85% of the world's population (5.9 billion people) subscribed to mobile telephones and 1.2 billion were using these devices to access the Internet.

3.9- Surveillance based on media reports and computer algorithms:

The availability and speed of information transmission over the Internet has also allowed development of innovative electronic media based surveillance systems.

For example, the Global Public Health Intelligence Network (GPHIN) uses automated algorithms to filter electronic media reports, in seven languages, of occurrence of diseases on a real-time, 24-hour basis.

Although the electronically gathered information requires further verification by trained personnel, GPHIN (Figure 3.3) is used extensively as an early source of outbreak information by Health Canada, the WHO, the US CDC, and others.

https://gphin.canada.ca/cepr/articles.jsp?language=en_CA

Figure 3.3: GPHIN website:

Chapter (3) review questions:

1- Short essay:

1. Define active population-based surveillance.
2. What is the role of The Active Bacterial Core surveillance (ABCs)?
3. Define sentinel surveillance.
4. What is the value of The Early Warning Infectious Disease Surveillance (EWIDS)?
5. Mention an example for Risk factor surveillance.

2- MCQs:

- Infectious disease surveillance systems have sometimes incorporated administrative and vital statistics data that are being collected for other purposes. These include:
  a) International Classification of Diseases (ICD).
  b) Hospital admission data.
  c) Monitoring of drug utilization and drug sales.
  d) All of the above.

3- True or False:

- The Youth Risk Behavior Survey System (YRBSS) measures the prevalence of health risk behaviors among adolescents through self-administered, school-based surveys.
- The Global Public Health Intelligence Network (GPHIN) uses automated algorithms to filter electronic media reports, in seven languages, of occurrence of diseases on a real-time, 24-hour basis.

Chapter 4

Human PHA / non-traditional partners Collaborations

As illustrated by the broad variety of IDS systems, diverse sources of information can be utilized. The development of these systems relies upon *new collaborations* between human public health agencies (PHA) and non-traditional partners.

For example, *human health agencies* have traditionally acted as separate entities from *domesticated and wildlife animal health agencies*.

When West Nile virus emerged in the USA, public health officials who customarily focused only on human diseases began building collaborations with entomologists (insect scientist), veterinarians, and wildlife oversight agencies.

Human health agencies often do not have these diversely skilled personnel, but instead depend upon common goals and national agendas to facilitate collaborations.

Medical examiners have the authority to investigate sudden, unattended, and unexplained deaths. Although the focus of these investigations has traditionally been on intentional or accidental deaths, public health agencies have collaborated with medical examiners to systematize specimen collection and diagnostic testing relevant for detection of reportable, emerging, or bioterrorism-related infectious diseases.

Today's increasingly complex surveillance methods require strong information systems and data management support.

Optimal use of Internet-based systems and mobile technologies also requires close collaboration with IT specialists and computer scientists.

Because of the heightened need for *privacy* of surveillance data that use certain types of mobile technologies (e.g., smart phones), input from cyber wireless system engineers may be necessary.

To meet surveillance objectives, however, involvement of end-users in all phases of system design and testing is critical to ensure the viability of these potentially multimillion dollar systems.

Data analyses require statistical software and may necessitate input from individuals with a strong background in biostatistics.

Review of public health surveillance practices from an ethicist's perspective is needed. What constitutes research and unlinked anonymous testing for HIV are examples of persistent ethical dilemmas in infectious disease surveillance.

In the USA and elsewhere, surveillance is not exclusively a government function and involves working with multiple private entities.

For example, *private hospital laboratories* transmit large amounts of reportable disease information to health departments at their own cost.

Another example of public-private partnership is the US Vaccine Adverse Events Reporting System (https://vaers.hhs.gov) (Figure 4.1).

Figure 4.1: US Vaccine Adverse Events Reporting System (VAERS3) website

While federal public health agencies set programmatic objectives and provide technical oversight, the for-profit Constella Group (http://www.constellagroup.com) **(Figure 4.2) is contracted to support this surveillance system's data collection processes.**

These types of "mixed model**" partnerships may be able to bind private sector energy and efficiency while remaining faithful to public health objectives.**

Figure 4.2: Constella Group website:

Chapter (4) review questions:

1- Short essay:

1. Explain why the development of infectious disease surveillance systems relies upon new collaborations between human public health agencies (PHA) and non-traditional partners?
2. Mention an example for public–private partnership required in infectious disease surveillance systems.

2- MCQs:

- Non-traditional partners for collaboration with human public health agencies in infectious disease surveillance systems include:
    a) Entomologists.
    b) Veterinarians.
    c) Wildlife oversight agencies.
    d) All of the above.

3- True or False:

- Medical examiners have the authority to investigate sudden, unattended, and unexplained deaths.
- Optimal use of Internet-based systems and mobile technologies requires close collaboration of human public health agencies with IT specialists and computer scientists.

Chapter 5
Challenges and promises for the future of IDS

5.1- Introduction:

Progress in development of surveillance systems supports disease prevention and control, a primary obligation of governments to their citizens.

Moreover, to meet their obligation to the global community, all countries were required by IHR to have core capacity for surveillance by June 2012. While there are improvements, persistent challenges in surveillance and disease control remain around the globe.

Countries with limited resources struggle with a balance between providing basic medical services and efforts to control infectious diseases. It may appear more logical to address the needs of those suffering from diseases than divert resources to monitoring activities.

Infectious disease surveillance (IDS) in all countries requires political will to allocate adequate resources to sustain ongoing activities.

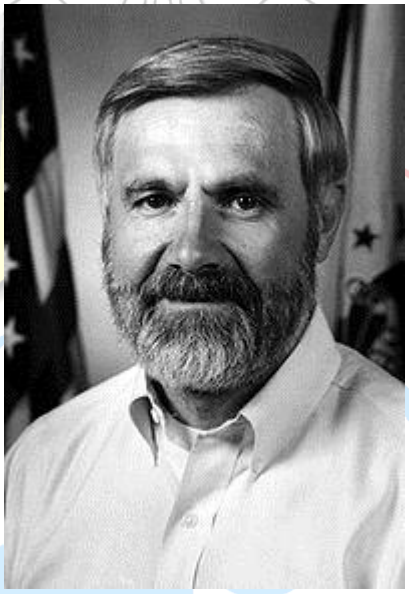
The gap between data collection and effective use of data for disease control and prevention is among the most difficult challenges faced by surveillance programs.

An unfortunate reality of public health surveillance is that substantial efforts are exerted for collection of data while sufficient resources are often not expended on timely dissemination and constructive use of the information.

If these data are not appropriately analyzed, disseminated, and applied, surveillance will be perceived as categorically ineffective.

As William Foege**, former director of the CDC, once remarked, *"The reason for collecting, analyzing, and disseminating information on a disease is to control that disease. Collection and analysis should not be allowed to consume resources if action does not follow".***

Figure 5.1: William Foege.



Strengthening core surveillance systems requires public health officials with sufficient training in principles and practical aspects of monitoring diseases.

Grasp of applied epidemiology and skills in data analysis and communication are among the basic prerequisites for those engaged in surveillance activities.

The modern concepts and public health surveillance, however, is relatively young. While much of the practice of surveillance may be learned on the job as newly hired personnel begin careers in public health, formal training offers tremendous advantages.

5.2- Training in public health surveillance and epidemiology:

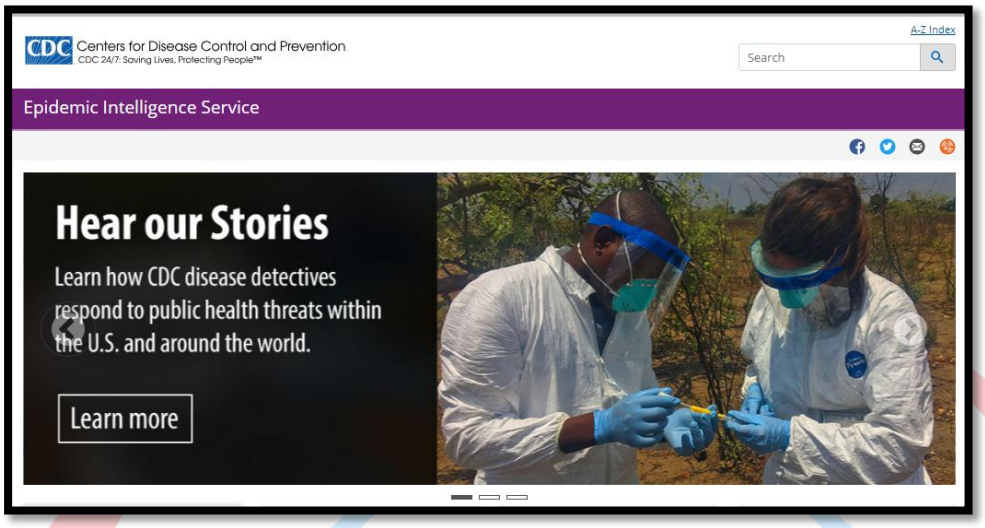
Two epidemiology training programs that combine didactic training with hands-on experience are:

a. Epidemic Intelligence Service (EIS):

This is a 2-year training and service program by the US Centers for

Disease Control and Prevention's (CDC) with a focus on applied epidemiology (https://www.cdc.gov/eis/index.html) (Figure 5.2).

Figure 5.2: EIS website



The EIS program emphasizes the public health practice of epidemiology and plays a critical role in developing practitioners experienced in the most current methods of public health surveillance, an area not often covered in academic training.

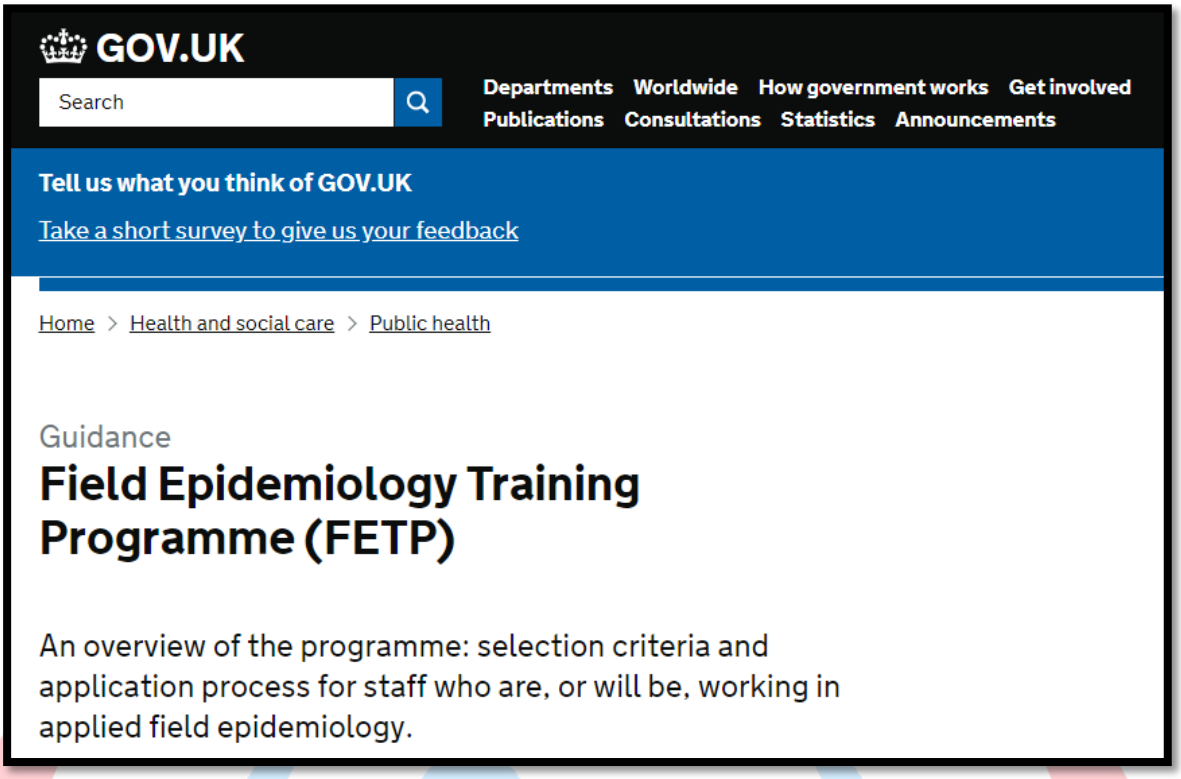
Epidemic Intelligence Service Officers (EISOs) receive didactic training and obtain practical experience in evaluation of surveillance systems. The service and learning process allows them to improve upon existing systems and at times to deploy new methods to monitor emerging or endemic diseases.

Owing to its success, the EIS program serves as a model for training public health practitioners of epidemiology, with more than 40 similar programs around the world.

b. European field epidemiology training programs (FETP):

https://www.gov.uk/guidance/field-epidemiology-training-programme-fetp

Figure 5.3: UK FETP website



The European Programme for Intervention Epidemiology Training **also includes joint training with the** European Public Health Microbiology Training Programme**.**

Another example of a formal training fellowship is the surveillance training for Fogarty international fellows from Eastern Europe and Central Asia.

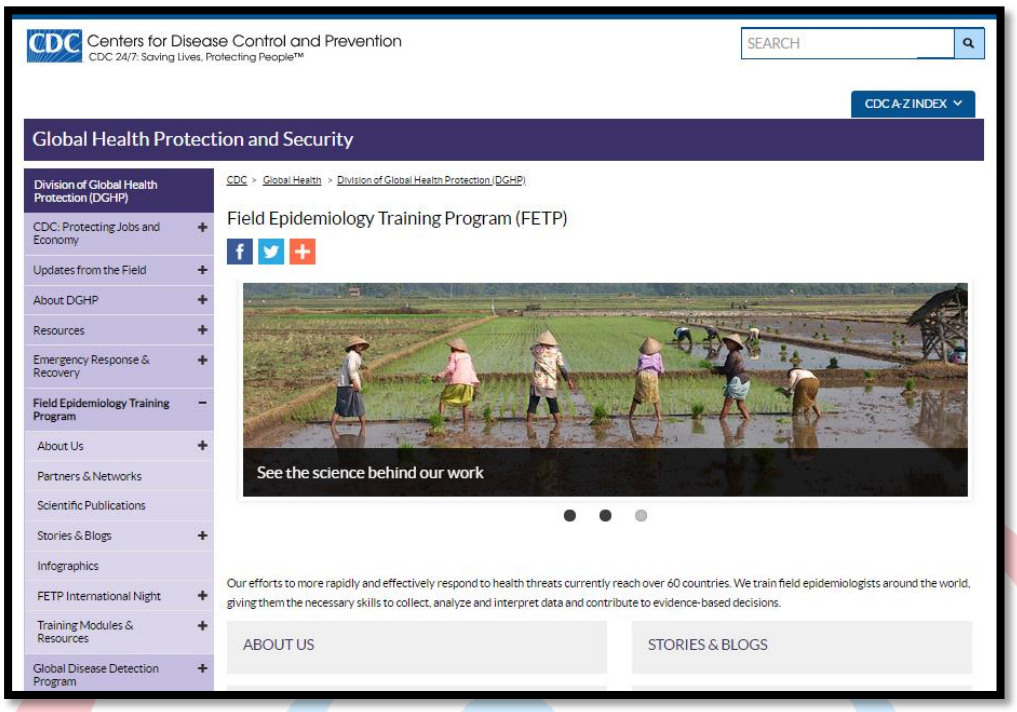
This program provides didactic training on surveillance courses at Albany, NY, in combination with a home country experience in assessing surveillance systems.

In collaboration with Ministries of Health in several countries, the US CDC offers two applied epidemiology programs that have a surveillance component:

c. **The Field Epidemiology Training Program.**
d. **The Field Epidemiology and Laboratory Training Program (FELTP)**

These are available on the CDC website at: http://www.cdc.gov/globalhealth/fetp

Figure 5.4: FELTP website



Practical training on actionable surveillance should also be an emphasis in schools of public health and other educational arenas.

5.3- FETP Egypt:

FETP Egypt was the second field epidemiology training program to develop within the Eastern Mediterranean region.

The advanced level (two-year) program began in 1993 in collaboration with the U.S. Centers for Disease Control and Prevention (CDC).

This program starts with an introductory or screening course that provides basic instruction in applied epidemiology and public health followed by seven modules covering the areas of interest.

The program has hosted 20 cohorts in which residents and graduates provide essential epidemiologic services to the country.

Most of the FETP graduates have continued their public health careers after graduation working as epidemiologists to serve the preventive sector of the Egyptian ministry of health and have filled leadership positions at central and governorate levels. A number of FETP graduates are working for the World Health Organization, African CDC, UNICEF and other international non-governmental organizations.

The Egyptian Ministry of Health and Population launched the basic level FETP (the Public Health Empowerment Program in Basic Field Epidemiology, or PHEP-BFE) in July 2017. This program is a three-month in-service training which targets sanitarians, as they are the backbone of preventive medicine in Egypt.

Mentoring is successfully implemented to drive rich learning and improvement for both residents and mentors. Twenty mentors have been assigned to guide FETP/PHEP-BFE residents to implement the needed field investigations and studies.

The program recently developed a full web-based database of all FETP residents and mentors. This application will facilitate tracking the progress of residents during their training years.

https://www.tephinet.org/training-programs/egypt-field-epidemiology-training-program

Figure 5.5: Egypt FETP website

5.4- Evaluating and improving surveillance systems:

Ongoing evaluations are a core component of living surveillance systems.

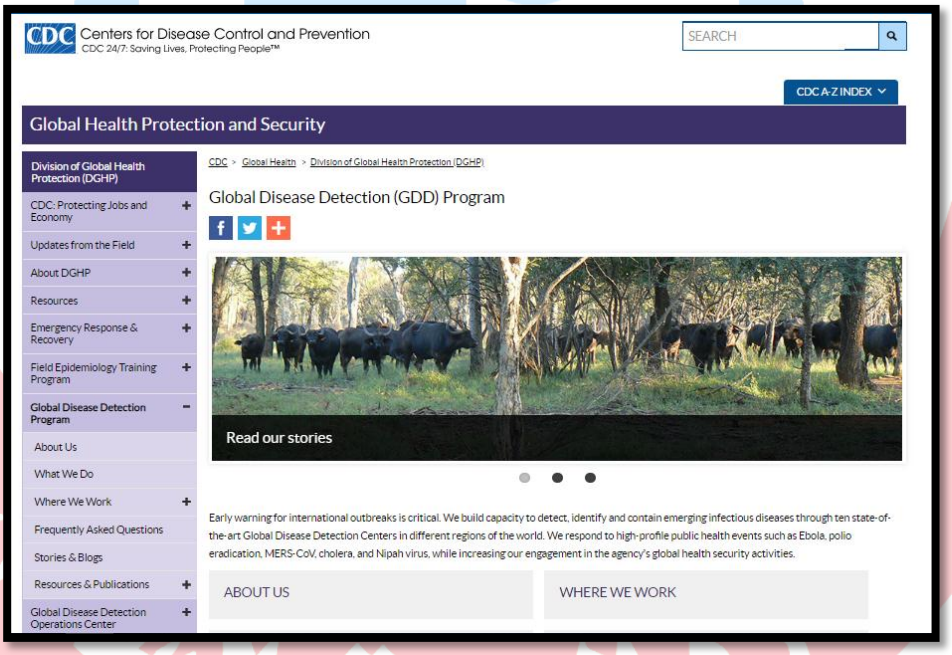
Systematic evaluations should assess whether surveillance systems are operating as effectively as possible, and, if not, determine what changes can be made.

Evaluations can also highlight achievements and in this way demonstrate their value to stakeholders.

For example, the US CDC Global Disease Detection Program recently described an evaluation by FELTP-Kenya of Eritrea's pediatric bacterial meningitis surveillance system.

https://www.cdc.gov/globalhealth/healthprotection/gdd/index.html

Figure 5.6: US CDC Global Disease Detection Program website



This effort eventually led to creation of a laboratory-based surveillance system for rotavirus and bacterial meningitis.

Surveillance systems face the challenges of chasing moving targets—as more is learned about the epidemiology of a disease, surveillance strategies must be adapted.

Emerging pathogens add further complexities.

Surveillance systems need to be regularly reviewed, refined, and re-energized.

On the frontiers of public health, technical advancements facilitate efforts to improve surveillance systems.

In addition to sophisticated IT instruments, molecular fingerprinting has improved the epidemiologic understanding of links between human cases, management of outbreaks, and links to animal reservoirs.

In the future, geographic information systems may be used to analyze multiple layers of geographical, ecologic, and climatic information, linking the epidemiology of zoonotic and other diseases to environmental conditions.

New tools to enhance infectious disease surveillance (IDS) continue to be developed.

How to optimize the use of both old and new surveillance tools to inform disease prevention and control remains both an ongoing challenge and an opportunity.

Chapter (5) review questions:

1- Short essay:

1. Mention two challenges faced by surveillance programs.
2. Mention two public health surveillance and epidemiology training programs.
3. What is the value of Field Epidemiology Training Program in Egypt (FETP Egypt)?

2- MCQs:

- In collaboration with Ministries of Health in several countries, the US CDC offers two applied epidemiology programs that have a surveillance component. These training programs include:
  a) The Field Epidemiology Training Program.
  b) The Field Epidemiology and Laboratory Training Program (FELTP).
  c) Both.
  d) Neither.

3- True or False:

- Collection and analysis of data on an infectious disease should not be allowed to consume resources if action does not follow.
- The Egyptian Ministry of Health and Population launched the basic level FETP in July 2017. This program is a three-month in-service training which targets sanitarians, as they are the backbone of preventive medicine in Egypt.

Chapter 6

International Health Regulations (IHR)

6.1- Protecting People Every Day:

With the signing of the revised International Health Regulations (IHR) in 2005, the international community agreed to improve the detection and reporting of potential public health emergencies worldwide. The revised IHR better address today's global health security concerns and are a critical part of protecting global health. The regulations require that all countries have the ability to detect, assess, report and respond to public health events.

CDC is currently working with countries around the globe to help meet the goals of the IHR. CDC's global programs address over 400 diseases, health threats, and conditions that are major causes of death, disease, and disability. Our global programs are run by world leaders in epidemiology, surveillance, informatics, laboratory systems, and other essential disciplines. Through partnerships with other countries' ministries of health, CDC is improving the quantity and quality of critical public health services.

6.2- IHR basics:

The IHR are a framework that will help countries minimize the impact and spread of public health threats. As an international treaty, the IHR are legally binding; all countries must report events of international public health importance. Countries are using the IHR framework to prevent and control global health threats while keeping international travel and trade as open as possible. The IHR, which are coordinated by the World Health Organization (WHO), aims to keep the world informed about public health risks and events.

The IHR require that all countries have the ability to do the following:

1. Detect: Make sure surveillance systems and laboratories can detect potential threats.
2. Assess: Work together with other countries to make decisions in public health emergencies.
3. Report: Report specific diseases, plus any potential international public health emergencies, through participation in a network of National Focal Points.
4. Respond: Respond to public health events

The IHR also include specific measures countries can take at ports, airports and ground crossings to limit the spread of health risks to neighboring countries, and to prevent unwarranted travel and trade restrictions.1

6.3- IHR: Made for today's health threats:

In today's interconnected society, it's more important than ever to make sure all countries are able to respond to and contain public health threats.

In 2003, severe acute respiratory syndrome (SARS) threatened global health, showing us how easily an outbreak can spread. Recently, the Ebola epidemic in West Africa and outbreaks of MERS-CoV have shown that we are only as safe as the most fragile state. All countries have a responsibility to one another to build healthcare systems that are strong and that work to identify and contain public health events before they spread.

While previous regulations required countries to report incidents of cholera, plague, and yellow fever, the revised IHR are more flexible and future-oriented, requiring countries to consider the possible impact of all hazards, whether they occur naturally, accidentally, or intentionally.

The IHR cover all events that might potentially become a public health emergency of international concern (PHEIC).

And global health security is not just a health issue; a crisis such as HIV or Ebola can devastate economies and keep countries from developing. The World Bank Group estimates that Guinea, Liberia, and Sierra Leone together will lose at least $1.6 billion in forgone economic growth in 2015 as a result of the Ebola epidemic.3 The impact of this kind of economic devastation reaches farther and wider than ever.4

The IHR also serve as a foundation for the CDC and the Global Health Security Agenda. The GHS Agenda is "an effort by nations, international organizations, and civil society to accelerate progress toward a world safe and secure from infectious disease threats; to promote global health security as an international priority; and to spur progress toward full implementation of the IHR."5

The GHS Agenda provides 11 clear targets which will serve as a road map to help countries create systems that are able to prevent, detect and respond to health threats. The GHS Agenda recognizes the challenges countries are facing, laying out practical and concrete steps countries can take toward strengthening their health systems, as well as ways in which countries can support each other.

6.4- Protecting people:

One of the most important aspects of IHR is the requirement that countries will detect and report events that may constitute a potential public health emergency of international concern (PHEIC).

Under IHR, a PHEIC is declared by the World Health Organization if the situation meets 2 of 4 criteria:

1. Is the public health impact of the event serious?
2. Is the event unusual or unexpected?
3. Is there a significant risk of international spread?
4. Is there a significant risk of international travel or trade restrictions?

Once a WHO member country identifies an event of concern, the country must assess the public health risks of the event within 48 hours.

If the event is determined to be notifiable under the IHR, the country must report the information to WHO within 24 hours.

Some diseases always require reporting under the IHR, no matter when or where they occur, while others become notifiable when they represent an unusual risk or situation.

Always Notifiable:

1. Smallpox
2. Poliomyelitis due to wild-type poliovirus
3. Human influenza caused by a new subtype
4. Severe acute respiratory syndrome (SARS)

Other Potentially Notifiable Events:

These may include:

1. Cholera, pneumonic plague, yellow fever, viral hemorrhagic fever, and West Nile fever, as well as any others that meet the criteria laid out by the IHR.
2. Other biological, radiological, or chemical events that meet IHR criteria.

6.5- Declared PHEICs:

Since the revised IHR were put into place, four PHEICs have been declared by WHO:

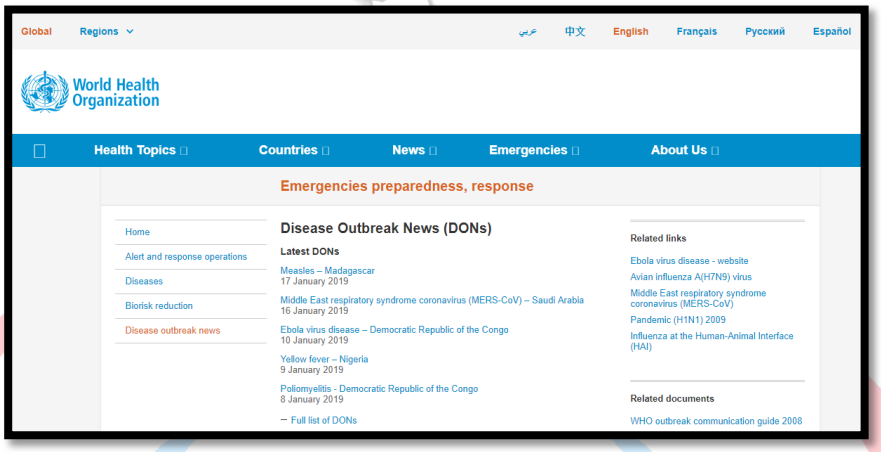
1. H1N1 influenza (2009)
2. Polio (2014)
3. Ebola (2014)
4. Zika virus (2016)

2014 and 2015 have been exceptional years for potential PHEICs. In the months from January 2014 to February 2015, 321 possible PHEICs were reported to WHO. WHO posted more than 400 updates and announcements

on their event information site (Figure 6.1) for National IHR Focal Points, relating to 79 public health events and regional updates.

Figure 6.1: National IHR Focal Points website:

https://www.who.int/csr/don/en/



Most postings concerned the Middle East respiratory syndrome coronavirus (MERS-CoV) event, the influenza A (H7N9) virus event in China, and the outbreak of Ebola in West Africa.

When a PHEIC is declared, WHO helps coordinate an immediate response with the affected country and with other countries around the world.

6.6- IHR timeline:

The idea that a health threat in one part of the world can impact other parts of the world is not new. Over time, there have been a series of agreements between countries to address the potential spread of disease, beginning with the International Sanitary Convention in 1892 and continuing until today with the International Health Regulations.

The IHR were originally written in 1969, and were revised in 2005, following the 2003 epidemic of severe acute respiratory syndrome (SARS). After the SARS epidemic, it became clear that stronger systems were needed to detect, assess, report, and respond to public health events.

The revised IHR entered into force for the United States on July 18, 2007.

Countries had been given an extension until 2016 to finish meeting IHR goals. The original timeline for IHR implementation is as follows:

- **May 2005: World Health Assembly approved revised IHR**
- **December 2006: United States accepted the revised IHR**
- **June 15, 2007: Initial start date for revised IHR**
- **June 2009: Within 2 years after IHR enters into force, Membe**
- **Countries complete assessment of the ability of their national structures and resources to meet minimum core capacities**
- **2012: Within 5 years after IHR enters into force, Member Countries achieve the required minimum level of core capacities, unless WHO grants an extension**
- **2014: End of 2-year extensions on achieving core capacity, unless an exceptional circumstance exists and a further extension is granted by WHO**
- **2016: End of final 2-year extensions (for exceptional circumstances) on achieving core capacities**

When countries committed to the IHR in 2005, the first target date for achieving its goals was set for 2012. By that date, however, fewer than 20% of countries had met IHR goals. After a 2 year extension, in 2014, 64 countries reported fully achieving the IHR core capacities. Only about 1/3 of the countries in the world currently have the ability to assess, detect and respond to public health emergencies.

6.7- Global participation in the IHR:

The IHR represent an agreement between 196 countries, including all WHO Member States, to work together for global health security.

In the U.S., CDC works with state and local reporting and response networks to receive information at the federal level and then respond to

events of concern at the local and federal levels. The Department of Health and Human Services (DHHS) has assumed the lead role in carrying out the reporting requirements for IHR (2005). The Health and Human Services' Secretary's Operations Center (SOC) is the National Focal Point responsible for reporting events to WHO.

Other federal agencies supporting IHR implementation include the Department of Agriculture, Department of Commerce, Department of Defense, Department of Energy, Department of Homeland Security, Department of Justice, Department of State, Department of the Treasury, Department of Transportation, Department of Veterans Affairs, Environmental Protection Agency, Joint Chiefs of Staff, Nuclear Regulatory Commission, Office of Management and Budget, Office of Science and Technology Policy, U.S. Agency for International Development, U.S. Central Intelligence Agency, U.S. Trade Representative, and the United States Postal Service.

Chapter (6) review questions:

1- Short essay:

1. What are the 4 International Health Regulations (IHR) basic requirements?
2. Explain by an example how International Health Regulations (IHR) are made for today's health threats?
3. Mention the criteria required for public health emergency of international concern (PHEIC) to be declared by WHO.

2- MCQs:

- Always notifiable infectious diseases include:
  a) Smallpox.
  b) Poliomyelitis due to ant poliovirus type.
  c) Human influenza caused by any subtype.
  d) All of the above.

3- True or False:

- 2014 and 2015 have been exceptional years for potential PHEICs.
- All countries in the world have the ability to assess, detect and respond to public health emergencies.

Chapter 7
IDS in practice: An introduction

In this part, we'll discuss surveillance of three major diseases but first we'll discuss:

- The differences between case reporting and notification (figure and table 7.1) and
- The components of pandemic surveillance (table 7.2).

7.1- Case reporting and case notification:

7.1.1- Case reporting:

The term case reporting refers to healthcare entities (i.e., healthcare providers, laboratories, and hospitals) identifying reportable conditions and submitting information about these conditions to a local, county, state, or territorial public health agency.

Individual case reporting requires patient information such as name, address, and phone number. Healthcare entities report suspected or confirmed diagnoses, laboratory tests and results, or information about outbreaks to public health using case morbidity report forms.

These report forms can usually be either mailed, faxed, phoned, or submitted electronically.

Following submission of the report, public health staff conducts follow-up investigations to confirm the cases based upon the criteria in the surveillance case definition for the reported disease and identify information needed for prevention and control.

7.1.2- Case notification:

Public health surveillance data are primarily collected at the local public health level where prevention and control activities occur.

Then, data are reported in a hierarchical fashion to the regional, state, or territorial health departments.

If a condition is considered important at the national level, it is defined as *nationally notifiable* and the reporting hierarchy continues from the state or territorial department to the federal Centers for Disease Control and Prevention (CDC).

Under this system, CDC is not the primary party responsible for public health surveillance; instead, this is the responsibility of local, state, and territorial public health authorities.

CDC provides assistance or consultative services to local, state, and territorial health departments in performing and evaluating surveillance as well as in planning and implementing disease control and prevention.

For example, CDC plays an important role in developing guidelines (e.g., surveillance system evaluation guidelines) to help assess the adequacy of existing systems.

Figure 7.1: Public health surveillance data flow

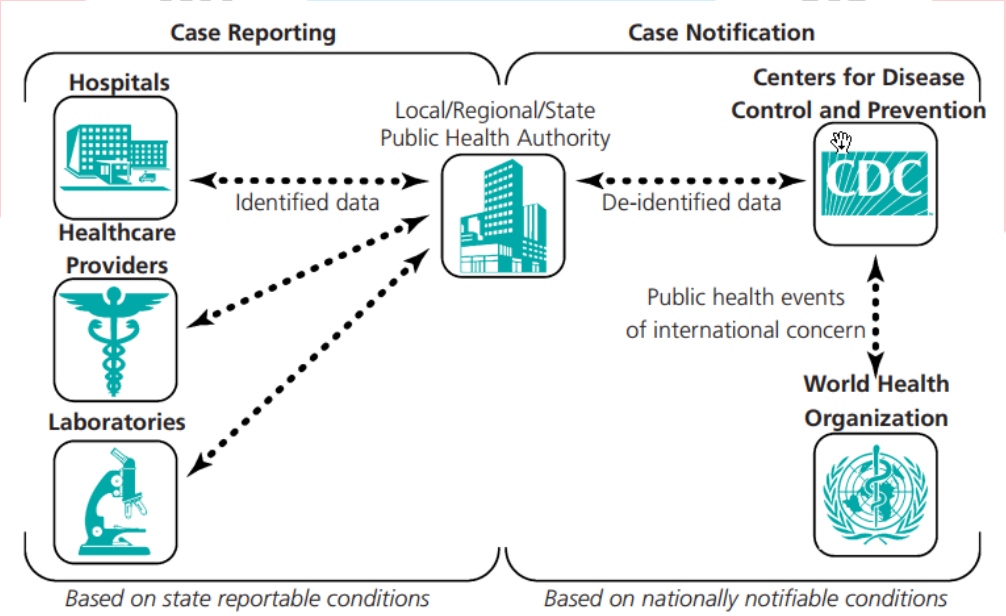


Table 7.1: Comparison between case reporting and case notification

Difference	Case reporting	Case notification
Data sender	Healthcare providers, laboratories, and other entities required to report	*Local, state, & territorial PHA*
Data receiver	*Local, state, and territorial public health authorities (PHA)*	CDC
Required	Yes	No (Voluntary)
Personal identifiers	Contained	Not contained

7.2- The three components of pandemic surveillance:

For the purposes of guiding surveillance efforts at the national level during a pandemic, WHO advises countries to plan for enhanced surveillance comprised of three components:

1. Early detection and investigation.
2. Comprehensive assessment of the first 100 or so cases, and
3. Pandemic monitoring.

Table 7.2: The three components of pandemic surveillance

	Component 1	***Component 2***	***Component 3***
	Early detection and investigation	**Comprehensive assessment**	**Monitoring**
Objective	Detect sustained human-to-human transmission of influenza virus with pandemic potential	Characterize the features of the new disease • Virological • Epidemiological • Clinical	Monitor the disease • Geographical spread • Trend • Intensity • Impact
Time frame	Early	Early	Throughout pandemic
Using existing system	Yes: Event-based system	Probably no: Will require preparation	Yes: Seasonal influenza system with modifications
Action at the national level	• Rapid containment for the first affected country • Alert phase for all other countries	• Review and revise pandemic plan • Define high-risk groups to prioritize interventions	• Monitor the situation
Action at the global level	• Change the pandemic phase • Deploy support to affected countries	• Change the vaccine composition • Provide early assessment of severity and subsequent updates	• Monitor the pandemic • Change the pandemic phase (e.g., end of first wave, end of pandemic)

Chapter (7) review questions:

1- Short essay:

1. Tabulate 4 differences between case reporting and case notification.
2. Tabulate the differences between the three components of pandemic surveillance.

2- MCQs:

- The time frame for monitoring pandemic surveillance (component 3) is:
  a) Early.
  b) Late.
  c) After the pandemic.
  d) Throughout pandemic.

3- True or False:

- The objective of comprehensive assessment of the first 100 or so cases in a pandemic is to characterize the features of the new disease.
- Local, state, and territorial public health authorities (PHA) are data receiver for case reporting and data sender for case notification.

Chapter 8

Measles surveillance

8.1- Introduction:

A key feature of measles eradication is that success is defined solely as a surveillance endpoint—zero measles cases.

Proving this negative is a form of proof by cases—if every potential locus of measles transmission is examined in sufficient detail for a sufficient period of time and no measles cases are found, then we may conclude that the disease has been eradicated.

In theory, a proof by cases approach requires perfect surveillance.

In practice, given certain assumptions of the characteristics of measles transmission, imperfect surveillance can still achieve a high degree of certainty of disease elimination.

The centrality of surveillance is included in the definition of global measles eradication: "worldwide interruption of measles transmission in the presence of a surveillance system that has been verified to be performing well".

It is important to recognize that measles eradication is progressing in an era of ongoing poliomyelitis eradication programs.

The relationship between the two efforts has proven advantageous to measles surveillance in countries with limited resources.

Much of the measles surveillance infrastructure and methods were built on those of poliomyelitis surveillance.

Thus, there is substantial overlap in definitions, laboratory tools, and management methods.

In addition, the World Health Organization (WHO) manages both the poliomyelitis and measles laboratory networks with similar approaches with

regard to standards, training, and quality assurance.

8.2- Evolution of measles surveillance:

Measles surveillance has coevolved with increasingly ambitious measles control targets.

Until 1989, measles control targets in countries with limited resources focused exclusively on vaccination coverage while disease surveillance had a limited role.

During this period, measles surveillance data in countries with limited resources were typically extracted from clinical records and reported as aggregated data.

While many developed countries used case-based laboratory confirmation, few countries with limited resources did.

The global poliomyelitis eradication program changed the surveillance paradigm in countries with limited resources by bringing systematic and integrated case-based surveillance to them for the first time, including every country in Africa.

Moving from aggregate data to case-based reporting for measles was relatively easy because clinicians and public health workers were familiar with the case-based method from its use during poliomyelitis programs.

The quality of surveillance, in terms of sensitivity, specificity, and completeness, was not typically measured or managed prior to starting case-based surveillance, and the degree of under-reporting was high.

The World Health Assembly established the first global measles control targets in 1989, calling for a 90% reduction in cases and a 95% reduction in mortality from pre-vaccine era levels.

The introduction in 2000 of the “second opportunity” for measles vaccination—in effect, periodic mass campaigns in countries with limited resources—led to dramatic declines in incidence and, subsequently, the need for specific case definitions.

This approach was operationally refined by the Pan American Health Organization (PAHO) as “catch-up, keep-up, and follow-up”:

Initial wide age-range campaigns were followed by improved routine first dose and periodic follow-up campaigns for all children under the age of 5.

The establishment of both a disease control target and a means for reaching the target necessitated accurate measurements of progress.

This need was largely advanced by the publication of measles surveillance standards by the WHO in 2001.

These standards proved to be robust and applicable to a wide range of measles goals, from control to eradication, and have been continuously refined since then.

8.3- Case-based reporting and case definitions:

The foundation of measles surveillance is case-based reporting. The essential information that should be collected for measles cases reporting is relatively small and easily collected on a standardized case investigation form.

Collecting information on age and vaccination status and observing location and size of “outbreaks” (including single laboratory-confirmed cases) proved to be a powerful management tool.

For example, collecting age profile of cases is integral to describing the immune profile in the population.

Likewise, determining travel history can help distinguish imported and indigenous cases.

This information allows program managers to identify areas of low vaccination coverage.

As it is infectious, measles virus is an excellent “surveyor” of vaccination coverage—identifying districts, provinces, and countries with low coverage by producing detectable outbreaks of cases.

Vaccine failure is rare; therefore, cases highlight areas with inadequate vaccination coverage.

Experience in Africa and the Americas shows that there is a close

relationship between the rate of confirmed cases per million population and vaccination coverage.

The size of the “outbreak” is also very informative for program managers.

De Serres and colleagues have mathematically formalized calculations on size of outbreaks correlating with field observations in the past decade in Africa and the Americas.

When isolated single cases occur (assuming they are not false positives), local population immunity is adequate to maintain local elimination.

When there are clusters of three confirmed cases, population immunity is still adequate, but not as strong as if only single isolated cases were occurring.

Outbreaks of more than three cases start to indicate weakness in vaccination coverage and population immunity, since outbreaks this large indicate a moderate level of secondary transmission from the index “imported” case.

The percentage of suspected measles cases that were tested and were laboratory confirmed is also a useful management tool.

When the percentage is near 1%, then measles control is excellent and indicates high population immunity owing to vaccination. At 3–5%, measles control is still good but indicates a lower level of population immunity.

At near 10%, measles transmission has been eliminated in most areas but the level of population immunity may be low enough to allow local transmission.

At 20%, periods of measles virus circulation with small- or medium-sized outbreaks become more common and indicate that vaccination coverage needs to be raised to prevent an imminent large outbreak.

This systematic use of laboratory findings to inform program management illustrates the power of measles case-based surveillance.

Case definitions:

Case-based reporting uses a tier of case definitions as the need for specificity and sensitivity change according to the stage of the control program (Table 8.1):

Table 8.1: World Health Organization standard measles case definitions

Term	Definition
Clinical case	Any person in whom a clinician suspects measles infection, or any person with fever and maculopapular rash (i.e., non-vesicular) and cough, coryza (i.e., runny nose), or conjunctivitis (i.e., red eyes)
Laboratory confirmed	A case that meets the clinical case definition and is laboratory confirmed
Epidemiologically confirmed	A case that meets the clinical case definition and is linked to a laboratory-confirmed case
Clinically confirmed	A case that meets the clinical case definition and for which no adequate blood specimen was taken
Discarded	A suspect case that does not meet the laboratory definition (laboratory-test negative)

8.4- Quality control of measles surveillance:

As measles incidence falls, the greatest surveillance challenge is maintaining high reporting quality.

There are two key quality indicators for measles surveillance:

1. **Sensitivity indicator:**

Although an expected baseline for the incidence of acute flaccid paralysis in the absence of poliomyelitis is widely utilized, no such baseline is available for suspected cases of measles or rubella.

The experience of managing measles surveillance in the Americas forms the basis for the sensitivity indicator.

In the Americas, suspected measles cases in the absence of measles can vary between <1 and 40 per 100 000.

Nonetheless, the proportion of suspected cases that are not clinically or laboratory confirmed is useful for comparing the surveillance sensitivity between municipalities with similar demographic and geographic characteristics.

It also permits the assessment of sensitivity of the surveillance system over time in the same geographic area.

Reporting a minimum number of suspected cases assures that the system

is at least fully functional, even if the absolute rate reported may be difficult to interpret.

WHO has proposed that, in a well-functioning system, a minimum of two cases of non-measles febrile rash illness fitting the clinical case definition should be identified out of every 100000 population under surveillance in each country per year.

The numerator for this indicator is the number of suspected measles cases that serologically tested negative for measles IgM.

For administrative units with smaller populations, a rate of >1/100000 per year is indicative of a well-functioning surveillance system.

While this indicator has been developed from reviewing presumed well-functioning systems in Africa, it has not been well validated and may evolve with additional field experience.

2. **Geographical indicator:**

This is operationalized as "percentage of districts reporting at least one case with a blood sample," targeted as ≥80% of districts.

The geographical indicator is important because the surveillance system's geographic spread is substantially more important than the "level" of surveillance in an area.

If there are large geographical gaps in the surveillance system, even small outbreaks can escape detection.

If the level of surveillance is present but low, the first few cases might be missed, but small and moderate outbreaks are likely to be detected.

These indicators may need to be adapted for districts with relatively smaller populations (<100 000).

The WHO African Region publishes monthly reports on measles surveillance quality indicators on the Internet.

8.5- Challenges to surveillance for measles eradication:

1. To maintain vigilant surveillance:

One of the main challenges of global measles eradication is for measles-free countries to maintain vigilant surveillance until remaining countries also become free of measles cases.

In the USA, which has maintained measles elimination since 2001, challenges to maintaining elimination include large outbreaks of measles in highly traveled developed countries, frequent international travel, and clusters of US residents who remain unvaccinated because of personal belief exemptions.

Countries in PAHO, which have been free of measles since 2002, must continue high levels of surveillance until eradication is achieved worldwide.

While substantial progress is being made globally, particularly in Africa, elimination efforts are just beginning in India.

The principal challenge is maintaining sensitive reporting.

Once eradication is achieved, attention to post-eradication surveillance planning is necessary.

Diagnostic test availability and resources for virus destruction must be accounted for while balancing a realistic approach with a decreasing need.

Attention and consideration ahead of time will ensure that surveillance can be carried out quickly and correctly in the event of a suspected re-emergence.

It is predicted that as coverage increases, but remains below the elimination threshold, there will be increasingly erratic disease epidemiology, with potentially explosive outbreaks.

These outbreaks may be mitigated with early interventions, highlighting the importance both of reducing population susceptibility through vaccination and of vigilant surveillance.

2. Lack of universal coverage of case-based surveillance:

Another challenge is the lack of universal coverage of case based surveillance or reporting.

Gaps in global surveillance and reporting are blind spots and potential sources of future importations.

While some of the gaps are in small or island countries non-critical to global eradication, high-quality surveillance must be implemented in India, conflict areas (e.g., Pakistan and Afghanistan), and similarly crucial areas for global eradication to proceed.

Utilizing technologies that can improve communication and integration of complete country reporting, surveillance data, and laboratory data may help close these gaps.

Rapid reporting, detection, and response allow for more aggressive disease control; mobile technologies with integrated global positioning systems have demonstrated effectiveness with poliomyelitis surveillance efforts.

As with molecular epidemiology, poliomyelitis is opening other doors of innovation and technologic integration that can benefit measles surveillance.

As technologic innovations arise, measles surveillance efforts will take advantage of them.

In the post-eradication era, the epidemiology of measles suggests that, if population immunity is low, measles outbreaks may become explosive and large, making the diagnostic challenge easier.

However, utilization of new technologies and the current high quality of global surveillance are subject to limited resource appropriation.

Because of a considerable dependence on laboratories for case confirmation, current resources for laboratory based surveillance are stretched to the limit.

As poliomyelitis is eradicated, the task of locating sources of funding will fall entirely to the measles program.

The cost of measles surveillance during an eradication program is estimated to be over $680 million over a 10-year period between 2011 and 2020 in the African Region of the WHO alone.

The added task of securing funding can be ameliorated in part by integrating measles surveillance data—which is generally underused into advocacy efforts.

Demonstrating the quality of surveillance is an assurance to donors who place particular value on outcome indicators rather than process indicators.

8.6- Future steps:

It has been argued that global eradication should not proceed until control strategies have proven successful in large geographic areas.

It might be similarly argued that surveillance for measles must also be successfully implemented in these areas.

For measles, an effective eradication strategy has become practical and successful in the Americas and similar strategies have begun in most countries with limited resources, including most countries in Africa.

Additional innovation will be needed as eradication evolves.

The challenge for measles control and eradication will be either to avoid a sustained end-game where the last few geographic areas require a prolonged effort or to create systems to manage it.

Financing efforts, sustaining health worker and government interest, and deciding how to approach the end-game of eradication are the looming challenges.

Whether measles eradication is achievable is yet to be demonstrated, but, if it is ever achieved, it will only be possible to prove using surveillance.

This makes it imperative that we devote sufficient resources and planning to maximize measles surveillance quality and readiness.

Chapter (8) review questions:

1- Short essay:

1. Mention World Health Organization standard measles case definitions.
2. What are the two key quality indicators for measles surveillance?
3. Mention two Challenges to surveillance for measles eradication.

2- MCQs:

1. A case that meets the clinical case definition of measles and for which no adequate blood specimen was taken is termed:
    a. Discarded case.
    b. Laboratory confirmed case.
    c. Epidemiologically confirmed case.
    d. Clinically confirmed case.

3- True or False:

- When the percentage of suspected measles cases that were tested and were laboratory confirmed is near 1%, measles control is excellent and indicates high population immunity owing to vaccination.

Chapter 9
Surveillance for tuberculosis

9.1- Introduction:

Tuberculosis (TB) remains one of the top 10 leading causes of mortality globally.

According to the World Health Organization (WHO), one-third of the world's population is infected with TB.

In 2010, approximately 1.5 million patients died of this infection while TB accounted for an estimated 8.8 million incident cases (128 per 100 000 population), of which 40% occurred in South-East Asia, 26% in Africa, and 19% in the Western Pacific Region.

TB disproportionately affects socioeconomically vulnerable persons and those with human immunodeficiency virus (HIV) infection. This is reflected in the range of estimated TB rates from less than 20 per 100 000 in countries of Western Europe, North America, and Australia to approximately 100 per 100 000 in some East European countries and over 300 per 100 000 in some sub-Saharan countries.

Historically, TB was a major cause of morbidity and mortality in Europe. Over the last century, TB rates steadily declined in most Western European countries, with a temporary resurgence during the two World Wars.

Similarly, in Europe the mortality rate from TB decreased from over 200 per 100 000 inhabitants in 1885 to less than 15 per 100 000 in the late 1980s.

A comparable decline in TB rates was observed in North America, largely because of improved living conditions.

This decline was accelerated in the 1950s following the increased use of combination anti-TB treatment and the increased control of bovine TB owing to the widespread pasteurization of dairy products and to improved testing and control in slaughterhouses.

The late 1980s and early 1990s were marked by stabilization or increase of notification rates in several European countries and the USA.

The main factors contributing to this reversal include the impact of the acquired immunodeficiency syndrome epidemic, the deterioration of living conditions of certain population groups, and the impact of international migration from countries with high endemicity.

In addition, control efforts were reduced in some Western European and North American countries over the 1970s and 1980s because of the perception that TB was close to being eradicated.

These episodes have demonstrated the importance of reinforcing TB control and prevention efforts and the need for a robust surveillance system to accurately monitor these efforts.

9.2- Rationale and objectives of tuberculosis surveillance:

9.2.1- Aims:

The principal aim of TB surveillance is to reduce disease and death by guiding disease prevention and control efforts.

Surveillance may also be used to monitor the effectiveness of prevention efforts.

More specifically, the information provided by TB surveillance may be used locally, nationally, and internationally to:

1. Monitor disease trends and frequency of anti-TB drug resistance.
2. Identify population characteristics that predispose people to a higher risk of infection and disease.

3. Identify disease outbreaks and guide timely public health action to ensure appropriate management of active TB cases and contacts.
4. Inform policy and monitor the effectiveness of TB control programs.

9.2.2- Indicators:

Although TB surveillance includes the collection of both mortality and morbidity information, for the majority of low-incidence countries the most useful indicators are based on morbidity owing to the significant decline in case fatality rates in recent decades.

In the absence of widespread drug resistance, the WHO estimates that the incidence of disease will decline if at least 70% of cases of infectious TB are detected for a given population, and if 85% of these patients complete treatment.

To monitor progress towards such targets, it is essential to have a reliable surveillance system that monitors both case detection and treatment outcome.

9.3- What are the special considerations for tuberculosis surveillance?

Some specificities of the natural history of TB have to be taken into account in designing and implementing TB surveillance. TB may develop several years (sometimes decades) after the initial infection.

Also, individuals may have more than one episode of disease owing to a relapse or a new infection.

The epidemiology of TB may therefore reflect both a new infection and recent transmission or reactivation of infection acquired in the past.

In low TB incidence countries, TB in the elderly is most often due to reactivation of infection acquired in the past when the disease was more prevalent.

On the other hand, disease in children, who are more likely to develop TB shortly after infection, reflects recent transmission.

Individuals with latent infection serve as a pool for future cases.

An understanding of the burden of latent M. tuberculosis infections provides information on transmission of TB in the community but requires surveys of the general population.

It is usually recommended to carry out these surveys among children to get better estimates of the extent of recent transmission.

Such surveys provide information on prevalence of infection from which an annual risk of TB infection can be derived.

However, implementation of these surveys and interpretation of the results is challenging.

The tuberculin skin test, recommended to be used for such surveys, is difficult to interpret in countries with a universal BCG vaccination program, because of the confounding effect of BCG on the test results.

In low-incidence countries, such surveys would require a very large sample size.

In addition, significant migration from populations who may have been infected in their country of origin limit the value of latent TB screening because it is difficult to ascertain whether they were infected abroad or locally.

Surveillance of TB, therefore, is mainly based on morbidity and mortality data associated with active TB.

9.4- Methods for tuberculosis surveillance:

Data collection methods should be based on internationally agreed common principles while taking into account not only the country specific TB epidemiology but also the prevalence of health conditions such as HIV infection and the strengths of the existing health infrastructure.

TB surveillance methodology also depends on the disease incidence, availability of resources to support the collection and analysis of data, and general infectious disease surveillance methods used.

Because TB is typically a mandatory notifiable disease, in most countries TB surveillance is linked to national legislation for infectious disease

surveillance. However, international surveillance definitions have been agreed globally.

In some regions further work on standardization has been undertaken.

For example, a European program (EuroTB) implemented in 1996 aims to improve the standardization and quality of TB surveillance in Europe using common definitions and methods.

In 2008, the EuroTB program was transferred to the European Centre for Disease Prevention and Control (ECDC), which, jointly with WHO Europe, coordinates TB surveillance in Europe.

Each year, data on TB are collected from all European countries, compiled, analyzed, and published in an annual report and through scientific publications.

These European initiatives have pushed a lot of European countries to reinforce and renew their TB surveillance systems.

Case definitions:

According to international recommendations published by the WHO, cases to be reported are "definite cases" or "any person in which a health worker (clinician or other medical practitioner) has diagnosed TB and has decided to treat the patient with a full course of TB treatment."

Definite cases are patients in whom M. tuberculosis complex is identified from a clinical specimen, either by culture or by a newer method such as molecular line probe assay.

In countries that lack the laboratory capacity to routinely identify M. tuberculosis, a pulmonary case with one or more initial sputum smear examination positive for acid-fast bacilli is also considered to be a "definite" case, provided that there is a functional external quality assurance system with blind rechecking.

Cases to be notified to public health authorities should include:

1. New cases (those with no previous episode of TB).
2. Those with a previous episode of TB (recurrent infection), and
3. Those with a postmortem diagnosis of TB.

Among recurrent cases, a distinction is usually made between those who have relapsed and other recurrent cases. **Relapsed cases** are patients who have been considered cured following a full course of anti-TB treatment and negative bacteriologic results, who subsequently become positive again. In contrast, **other recurrent cases** may arise from reinfection or may be the result of treatment failure owing to drug resistance or treatment interruption.

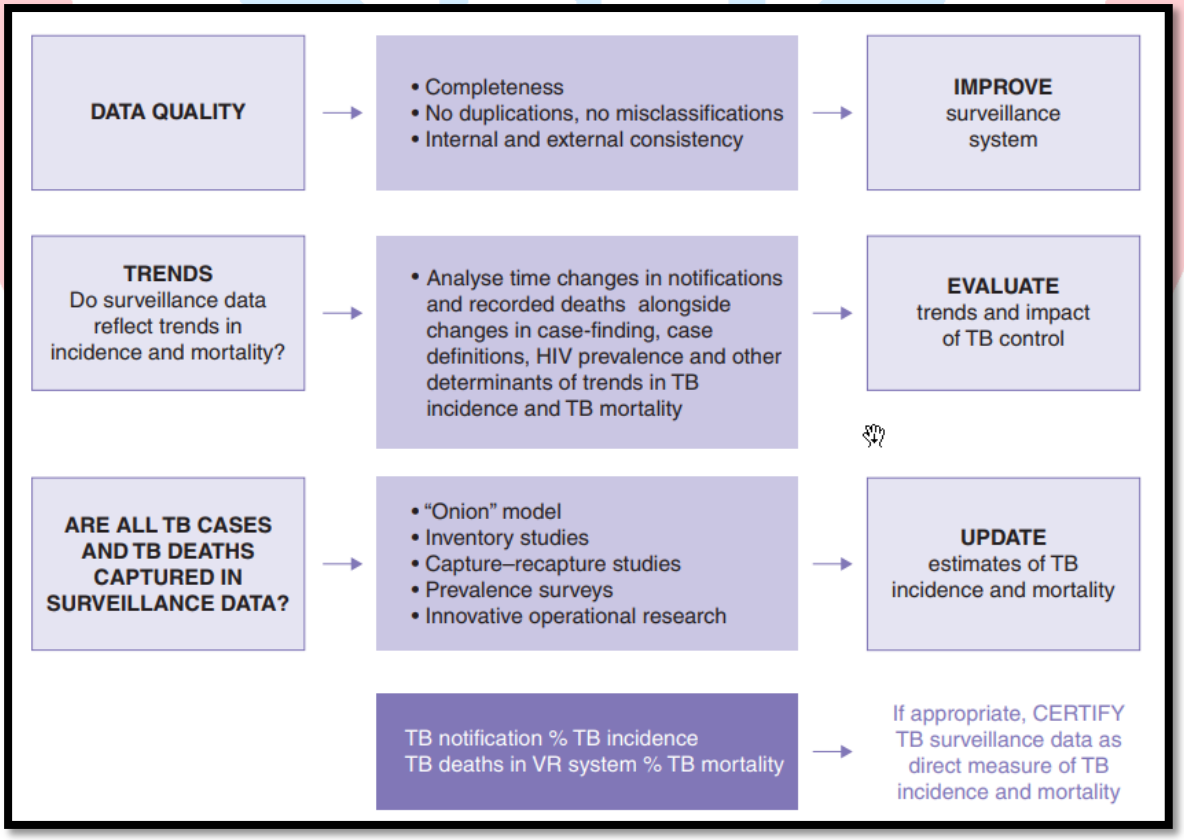
9.5- Monitoring and evaluation of tuberculosis surveillance:

In order to inform TB policy, it is essential to have a good understanding of possible limitations of the surveillance system.

These limitations apply mainly to the completeness of surveillance reporting and the quality and validity of information collected.

The WHO Global Task Force on Tuberculosis Impact Measurement has developed a framework for the evaluation of the quality of surveillance systems (Figure 9.1):

Figure 9.1: Framework for assessment of TB surveillance data



9.6- Challenges in tuberculosis surveillance:

Two of the main challenges of TB surveillance systems are:

1. The length of time between infection and progression to disease.
2. The absence of confirmation for some cases.

Validation of reported cases, therefore, takes time and requires knowledge of TB.

All laboratories, but especially national reference laboratories, should be heavily involved in the development of strategies to improve the quality of laboratory information.

This is essential to monitor confirmation of cases and drug resistance by ensuring that surveillance processes that are newly developed or revised take into account the limitations of testing methods such as variable drug susceptibility results for some second-line agents.

Known risk factors for TB are not always routinely collected in surveillance systems.

For example, reporting of HIV infection among TB patients is limited in some countries because of concerns over patient confidentiality while TB notification includes patient identification to allow local contact investigation.

The impact of socioeconomic conditions on the risk of TB has been documented, but such information, including qualitative data on living conditions (e.g., homelessness or indoor crowding), is difficult to collect in the context of routine surveillance.

Specific ad hoc surveys can be used to provide information on these factors and help tailor public health measures to the needs of population groups most at risk for TB.

Information on treatment outcome is a key indicator for assessing the effectiveness of TB control.

Monitoring the outcome of TB treatment can be done using repeated surveys. However, these surveys are usually carried out among the notifying

health professionals who may not necessarily be in charge of patient follow-up, especially in countries where TB treatment is given not only through a structured national program but also by private physicians or in general hospital.

Therefore, using a Web-based register (which includes patient follow-up) accessible to all health professionals involved in diagnosis and follow-up may certainly improve the completeness and the quality of information collected.

In addition, acceptability of the system is better when all stakeholders (e.g., clinicians, laboratories, public health professionals) have been included in discussions before implementing or adapting a new data collection system.

The variations in both the local TB epidemiology and overall disease burden among different countries challenge surveillance efforts.

For example, in low-incidence countries, TB has become a rare disease, concentrated in specific areas such as large urban areas or among specific population groups.

Therefore, one of the main objectives of the surveillance systems in these countries is to identify population groups at increased risk of TB.

Also, in low-incidence countries TB is often not seen as a public health priority.

The challenge for surveillance is then to maintain good coverage of notification and data quality despite a loss of expertise and lower public health interest.

Chapter (9) review questions:

1- Short essay:

1. What are the principal aims of TB surveillance?
2. What are the special considerations for tuberculosis surveillance?
3. Mention TB case definition.
4. How can tuberculosis surveillance be monitored and evaluated?
5. What are the two main challenges of TB surveillance systems?

2- MCQs:

- TB Cases to be notified to public health authorities should include:
  a) New cases (those with no previous episode of TB).
  b) Those with a previous episode of TB (recurrent infection).
  c) Those with a postmortem diagnosis of TB.
  d) All of the above.

3- True or False:

- Relapsed TB cases are patients who have been considered cured following a full course of anti-TB treatment and negative bacteriologic results, who subsequently become positive again.

Chapter 10
Surveillance for viral hepatitis

Hepatitis may be caused by several viruses that differ in clinical presentation, risk of chronic infection, transmission, and means of prevention. The most common are hepatitis A, B, and C.

10.1- Aims of hepatitis surveillance:

The general objectives of the surveillance of viral hepatitis are to:

1. Determine incidence, prevalence, burden, and trends of disease
2. Select and monitor prevention and control strategies
3. Identify and control outbreaks
4. Assist in planning appropriate healthcare for those infected.

10.2- Case definition:

Case definitions used in European countries differ in the specific clinical or laboratory criteria included. Although surveillance may be based only on a clinical diagnosis, laboratory confirmation is required in many countries.

The case definition advised by the European Union is a person with a clinical illness compatible with acute hepatitis, combined with specific laboratory criteria (Table 10.1).

Table 10.1: Case definitions for reporting communicable diseases to the European Community network (2008):

Clinical criteria	
Hepatitis A, B, and C	Discrete onset of symptoms and at least one of the following: Jaundice Elevated serum aminotransferase levels
Laboratory criteria	
Hepatitis A[a]	One of the following three laboratory tests: Detection of hepatitis A IgM antibody in serum Detection of hepatitis A virus nucleic acid in serum or stool Detection of hepatitis A antigen in stool
Acute hepatitis B[a]	Detection of IgM antibody to the hepatitis B virus core antigen
Hepatitis C[a]	One of the following three laboratory tests: Detection of hepatitis C IgG antibody in serum Detection of hepatitis C virus nucleic acid in serum Detection of hepatitis C virus antigen in serum
Chronic hepatitis B	One of the following two sets of laboratory tests: Detection of HBsAg in serum on two occasions at least 6 months apart Detection of HBsAg in serum that is negative for IgM antibody to the hepatitis B virus core antigen

10.3- Towards hepatitis C virus elimination: Egyptian experience:

10.3.1- Introduction:

Hepatitis C virus (HCV) is a major health problem worldwide. In 2015, the global prevalence of HCV infection was 1.0%, with the highest prevalence in the Eastern Mediterranean Region (2.3%) followed by the European one (1.5%). The annual mortality due to HCV-related complications is estimated to be approximately 700000 deaths.

The highest prevalence of HCV infection is present in Egypt, with 92.5% of patients infected with genotype '4'.

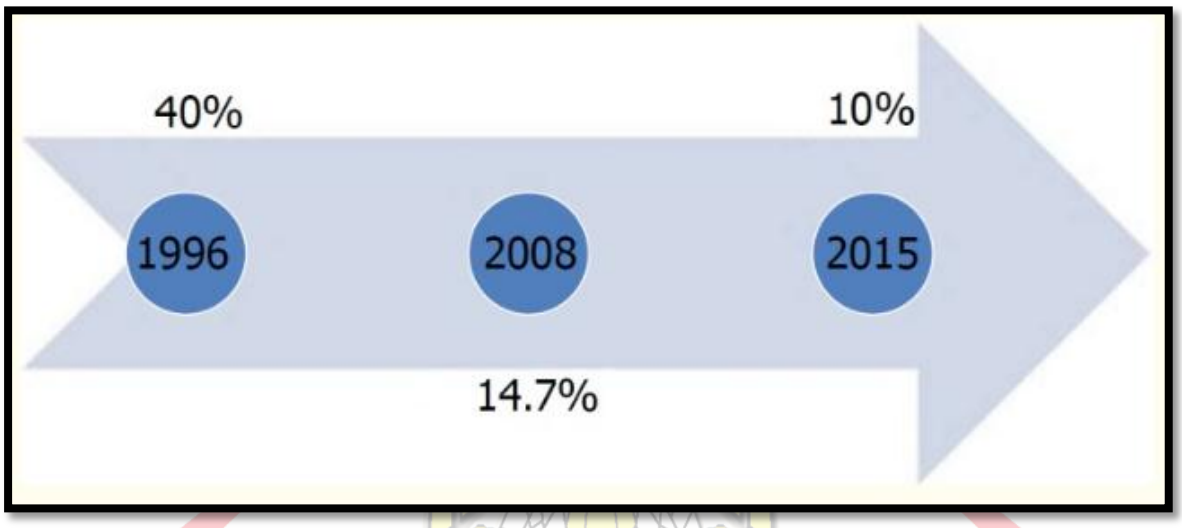
In Egypt, widespread HCV infection was caused by a mass-scale treatment campaign of intravenous anti-schistosomal injections executed between 1950 and 1980.

In 1996, the HCV seroprevalence was > 40% among adults, whereas in 2008, the Demographic Health Survey (DHS) showed a seroprevalence of 14.7% and viremic prevalence of 9.7% in 15-59-year-old patients.

The latest DHS in 2015 reported a seroprevalence of 10% and viremic prevalence of 7%.

As per the DHS, the HCV burden significantly decreased approximately 30% between 2008 and 2015 (Figure 10.1).

Figure 10.1: Timeline of hepatitis C virus prevalence in Egypt among adults.



However, in the 2008 DHS, this apparent decline in HCV seroprevalence was not attributed exclusively to the decrease in the newly acquired infections but to the aging of patients infected 50 years ago in the mass campaigns held for treatment of schistosomiasis.

10.3.2- Primary prevention:

Egypt is supporting a comprehensive approach for tackling hepatitis through "Plan of action for the prevention, care and treatment of viral hepatitis, Egypt 2014-2018".

Primary prevention of HCV:

Primary prevention of disease requires strict measures to prevent HCV transmission to vulnerable people.

This aim can be achieved by:

1. Strengthening surveillance to detect viral hepatitis transmission and disease: Guided by the MOH viral hepatitis centers, surveillance programs to detect viral hepatitis were expanded to many facilities other than hospitals, including, antenatal care units, prisons, dialysis units and patients requiring frequent medical intervention.
2. Promoting infection control practices to reduce viral hepatitis transmission: Viral hepatitis transmission in Egypt is largely related to improper infection control practice during various medical procedures as; dental, obstetric, injection administration and blood transfusion. In

2002, MOH, NAMRU-3, and WHO developed a plan to establish an organizational infection control (IC) program structure, develop IC guidelines, train health care workers (HCWs), promote occupational safety, and establish a system for monitoring and evaluating IC activities in Egypt. The plan implementation was assessed in 2011, denoting improved infection control practice, HCWs compliance and substantial reduction in iatrogenic HCV transmission.

3. Improving blood safety to reduce viral hepatitis transmission: Blood transfusion services providers should implement strict measures to ensure blood safety. Special precautions should be followed in hemodialysis centers; HCV patients should use certain hemodialysis instruments other than those used for non-infected individuals, healthcare providers should wear protective gloves while dealing with HCV patients and the hemodialysis instruments.
4. HCV vaccine: HCV vaccine is an important research issue. Two promising studies are in progress; one by GlaxoSmithKline and another that was launched in March 2011 as a clinical trial by National Liver Institute, Menofyia University, Egypt.

10.3.3- Secondary prevention:

Early detection and treatment of HCV patients is the goal of Egypt's treatment program starting in 2014, intending HCV prevalence reduction to < 2% in 10 years, in line with global targets.

In addition, Egypt has aimed to treat 250000 people annually up to 2020 in the first phase of their treatment program aiming at reducing the number of viremic patients, thus limiting the ongoing HCV transmission.

With the availability of DAAs, Egypt is struggling to eliminate HCV and HCV-related morbidity by 2030.

10.4- Screening programs:

Most HCV infected patients are unaware of being infected until they develop hepatic cirrhosis. Egypt has high HCV transmission rate with around 416000 new infections each year, related to self-sustained spread of infection; each HCV patient can transmit the infection to 3.54 subjects.

Screening programs helps to identify asymptomatic HCV patients to benefit from early treatment and counseling programs to maintain their health by avoiding high-risk behaviors and awareness about self-protection and prevention of further HCV spread in the community.

Due to the unavailability of HCV vaccine as well as the estimated large number of current and ongoing infections, the preventive measures, namely screening, should be prioritized at the same level as the treatment campaigns.

In 2008, the Egyptian Demographic Health Survey reported HCV antibody prevalence of 14.7%. The study sample included 11126 women and men aged 15-59 years. It was the first nationwide representative sample for anti-HCV testing performed in Egypt. The blood samples were tested by a third-generation enzyme-linked immunosorbent assay to detect the anti-HCV antibody. Sera positive for anti-HCV antibodies were tested for HCV RNA. This was followed by another screening in 2015.

Similar to other developing countries with a high HCV disease burden, Egypt has limited funds to support large-scale prevention programs. Therefore, prioritizing prevention activities, such as screening programs, through specific high-risk groups are essential.

In the past, blood transfusion or transfusion of other blood products was a major risk factor for HCV infection. In some historic cohorts, ≥ 10% of the patients who received blood transfusions were infected with hepatitis C. However, since the early 1990s, blood donor screening for HCV has nearly eliminated this transmission route.

Screening among hospitalized and special clinic populations revealed elevated HCV prevalence among individuals receiving even minor medical care

procedures in and outside established health care facilities.

Future prospective for HCV elimination:

Elimination of an ongoing nightmare like HCV is a national and global dream because of its burden on all aspects of life. Such a dream comes with its future perspectives. The plan is to build centers for controlling and treating HCV as nuclei for integrated multidisciplinary centers for liver disease management and screening of treated patients for HCC and centers of excellence for HCC treatment as well as liver transplantation.

To date, deceased donor liver transplantation has not been implemented in any treatment center program despite law approval by the Egyptian Parliament in 2010. The current practice of living donor liver transplantation (LDLT) is the only choice to save many lives and is implemented in nearly 13 centers, with an increase in the total number of LDLT cases to approximately 2400 with improving results.

HCC incidence is increasing worldwide. Globally, it is considered the second cause of cancer-related death. To date, in Egypt, HCC is known to be the second most common cancer in men and the sixth most common cancer in women, and unfortunately, no current program has yet been implemented for early detection and management of such cases.

However, it does not seem like a national dilemma as a Canadian study stated that most HCC cases referred to tertiary treatment centers are in palliative stages. Therefore, because of the obvious advantages of early intervention in HCC, surveillance measures with early detection seem to be the only plausible option.

In Egyptian experience, HCC developing after chronic hepatitis C treatment with DAAs showed a more infiltrative pattern of lesions. However, the possible role of DAAs in HCC development needs to be further studied to verify the assumption and to identify the possible associated factors. Currently, a surveillance program for patients who have completed DAA therapies in Egypt is being endorsed.

This surveillance program is based on the recall of all patients regardless

of their fibrosis stage. Such patients will be subjected to abdominal ultrasound and serum alpha fetoprotein measurement every 6 months.

In Egypt, the aim is to implement a long-term follow-up and screening program for our HCV patients so that such treatment centers also function as early detection centers for HCC. Such a program would encourage the government to implement therapeutic options for the early detected cases of HCC with higher success rates simultaneously with the running program for HCV eradication. Such an accomplishment will create centers of excellence targeting all HCV-related complications with radical therapeutic options.

Chapter (10) review questions:

1- Short essay:

1. What are the principal aims of hepatitis surveillance?
2. Tabulate viral hepatitis case definitions for reporting to the European Community network.
3. What is the prevalence of hepatitis C in Egypt?
4. Describe how to achieve primary prevention of hepatitis C?
5. Describe how to achieve secondary prevention of hepatitis C?
6. Discuss the surveillance program for patients who have completed DAA therapies in Egypt.

2- MCQs:

- Case definition for chronic hepatitis B for reporting to the European Community network include one of the following two sets of laboratory tests:
    a) Positive HBsAg on two occasions at least 6-months apart.
    b) Positive HBsAg with negative anti-HBc IgM.
    c) Positive HBsAg with negative anti-HBs.
    d) Positive HbeAg with negative HBsAg.

3- True or False:

- The highest prevalence of HCV infection is present in Egypt, with 92.5% of patients infected with genotype ‘4’.

Chapter 11
National Notifiable Disease Surveillance in Egypt

11.1- Introduction:

The development of surveillance systems that provide quality data to local and national health authorities on a timely basis is a high priority in public health.

Communicable disease surveillance in Egypt has shown reorganization and enhancement including the transition from paper-based to computerized reporting.

The early adoption of computers in the health sector has primarily been in the areas of personnel management, accounting, and monitoring the administration of clinical services, with limited emphasis on management of public health data.

In the early 1980s, the utilization of computers to support public health activities in Egypt became evident, particularly to assist in the analysis and management of statistics such as vital records and immunization coverage data.

By the mid to late 1980s, computers became more widely used to support research efforts in epidemiology and demography with rapid growth in utilization after establishment of the Field Epidemiology Training Program (FETP) in 1993.

The FETP program has been actively involved in the development of the National Egyptian Diseases Surveillance System (NEDSS) in Egypt.

NEDSS evolved out of activities supported by the Egyptian Ministry of Health and Population (MOHP), the World Health Organization (WHO), and United States government (USG) agencies in the late 1990s.

During that time, there was considerable interest in the area of communicable disease surveillance after publication by the Institute of Medicine on the Global Threat of Emerging Infectious Diseases.

Recognizing the mutual objectives of the MOHP, WHO, and USG technical partners, a working group was formed to coordinate assistance in the area of disease surveillance.

Chaired by the WHO country representative to Egypt, the group organized and supported an in-depth review of the communicable disease surveillance system in Egypt and subsequently developed a long-term plan and budget to strengthen surveillance.

This plan evolved over time and was extremely useful in managing diverse resources available to the MOHP, including support from the World Bank, the US Agency for International Development (USAID), and the US Department of Defense Global Emerging Infections Surveillance System (GEIS).

USAID played a key role in providing financial support; the main technical partner was the US Naval Medical Research Unit No. 3 with considerable input from the US Centers for Disease Control and Prevention (CDC).

Egypt is one of the most populous countries in the Middle East. The MOHP is organized into 255 administrative districts located in 27 governorates.

Surveillance for communicable diseases is a high priority because infectious diseases continue to be a leading cause of death and disability.

Traditionally, communicable disease surveillance has been restricted to the collection of data from public sector facilities and focused on monitoring hospital admissions to a network of 108 infectious disease hospitals throughout the republic.

These “fever hospitals” are designated as the primary referral centers for treatment of patients with priority infectious diseases.

Other reporting sources include public sector health units and MOHP general hospitals. Reporting from the general hospitals is ad hoc at best and there is considerable underreporting from public sector clinics.

University and private sector hospitals do not report communicable

diseases to the MOHP and there is no legislation requiring private providers to report.

Surveys on health-seeking behaviors suggest that the majority of patients with febrile illness seek care from private sector providers and population-based surveillance studies indicate that 50-60% of patients with diseases such as typhoid fever and brucellosis are managed in the primary care private sector.

Thus, there is considerable underreporting in the MOHP surveillance system.

11.2- In-depth review of communicable disease surveillance system in Egypt:

11.2.1- Limitations:

In the fall of 1999, WHO organized a mission to conduct an in-depth review of the communicable disease surveillance system in Egypt. Findings from this review included the following limitations:

1. Several different "official" lists of reportable diseases with >50 reportable conditions including many with limited public health importance.
2. No standardized case definitions of reportable diseases.
3. A paper-based reporting system of aggregate data to the national level.
4. Limited analysis and feedback of data at all levels.
5. Poor quality of data without laboratory confirmation of disease.
6. Multiple reporting systems that often included discrepant results.

11.2.2- Recommendations:

A plan to strengthen the surveillance system is outlined with the following key recommendations:

1. Development of an organizational structure for surveillance at the district, governorate, and national levels.
2. Implementation of a process to review and revise the list of reportable diseases.

3. Development of surveillance guidelines with standardized case definitions and case investigations.
4. Training to strengthen epidemiology and laboratory capacity at all levels.
5. Improved reporting from private sector providers.
6. Computerization of data at all levels to facilitate data analysis and feedback.

11.3- Strategic approach for strengthening surveillance:

Following the in-depth review, WHO organized a surveillance working group with program heads from the disease control programs in the MOHP (e.g., immunizations, tuberculosis, vector-borne diseases, HIV, foodborne diseases) and key technical partners. This group implemented a strategy to strengthen surveillance over the next several months.

1. **Prioritization of diseases for reporting:**

The surveillance working group reviewed and revised the list of notifiable diseases based on a structured process to evaluate the public health importance of each disease (www.who.int/csr/resources/publications/surveillance/).

While the report from the WHO mission recommended restricting the list of reportable disease to no more than 16 priority conditions, the surveillance working group recommended a list of 28 priority diseases (Table 11.1).

Table 11.1: List of reportable diseases in Egypt by priority for reporting

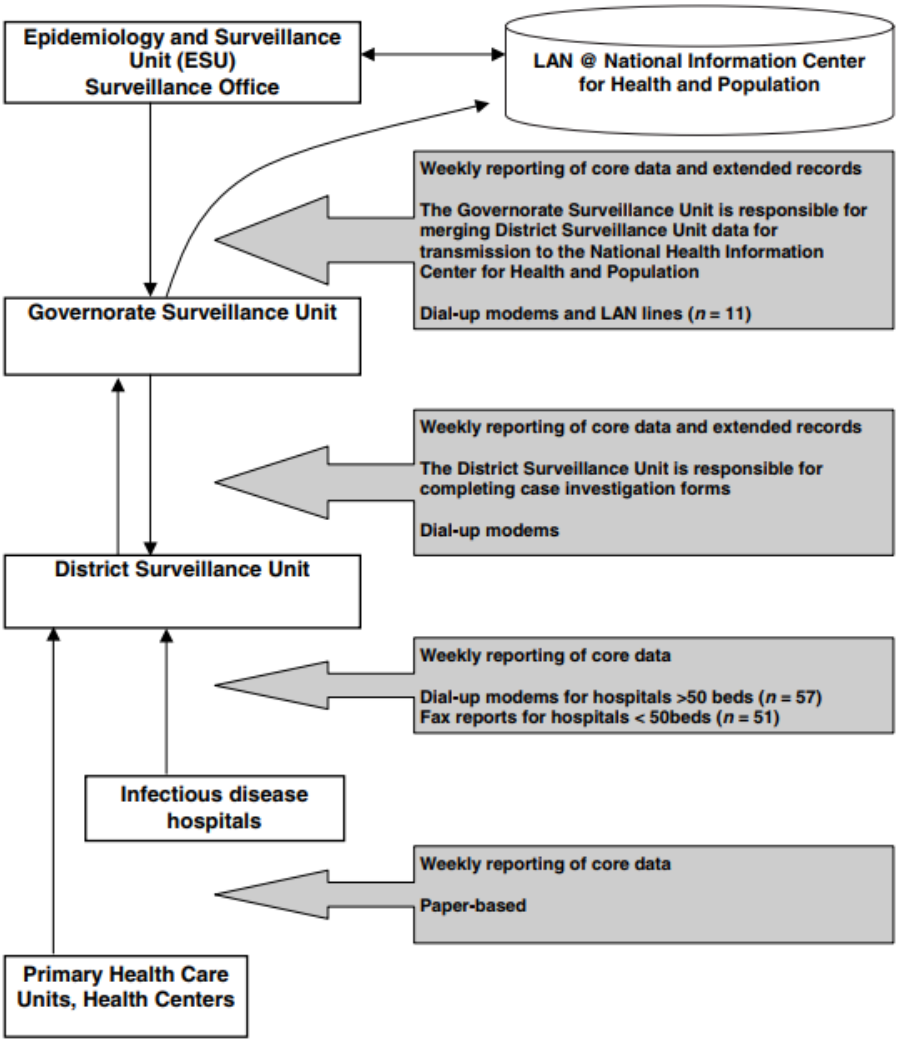
	ICD-10 classification
Group A: immediate reporting	
Meningitis	A39, G00, A87
Encephalitis	A80–A89
Acute flaccid paralysis/poliomyelitis	A80
HIV/AIDS	B20–B24
Rabies	A82
Diphtheria	A36
Malaria	B50–B54
Plague	A20
Tetanus (neonatal)	A33
Acute food poisoning	A02–A05
Unusual Health Events	
Botulism	A05.1
Viral hemorrhagic fever	A90, A91
Rift Valley fever	A92.4
Cholera	A00
Other	
Group B: weekly reporting	
Typhoid	A01
Brucellosis	A23
Tuberculosis	A15–A19
Measles	B05
Rubella	B06
Pertussis	A37
Bloody diarrhea (dysentry)	A03
Group C: monthly reporting	
Acute hepatitis	B15–B19
Mumps	B26
Leprosy	A30
Schistosomiasis	B65
Faschioliasis	B74
Filariasis	B74

2. Organizational structure for surveillance:

To facilitate human resource development, the Minister of Health called for the development of surveillance units at the district, provincial, and national levels.

At the national level, the **Epidemiology and Surveillance Unit (ESU)** defined roles and responsibilities for surveillance personnel at the provincial and district level and outlined a plan for the computerization and electronic flow of information for the new surveillance system (Figure 11.1).

Figure 11.1: Flow of Information in NEDSS



3. Assigning roles and responsibilities of surveillance staff:

Staff were identified and trained as surveillance focal points in each province and district during the phased approach for implementation and training.

The ESU assigned a leading role of the district surveillance unit as the core component of the reporting system with responsibilities for collecting and investigating case reports, entering data into computerized database, feedback of data to reporting sources, and feed forward of data to the provincial health office.

It was felt that the decentralization of the surveillance process to the district level would minimize duplication of efforts with data that is entered only once and transmitted to higher levels by disk or modem.

This process also allowed for the collection of case-based data with more detail on individual case records.

The previous reporting system lacked capacity for this level of detail.

4. **Assessment and development of Information Technology capacity:**

In the fall of 2000, the surveillance working group conducted an assessment of MOHP information technology capacity at all levels.

At district level:

a. There was no capacity to dedicate an existing computer for management of surveillance information.
b. There were a few software programs being used at the district level and most of these programs were either in a spreadsheet format or DOS-based related to specific projects.
c. There was no capacity to transmit information electronically and most district health offices had a single telephone line and fax machine.
d. None of the districts had access to e-mail.

At provincial level:

Computers were available but not used to manage surveillance information.

The health directorate had developed computerized networks in a few governorates with plans to install such systems throughout the country.

USAID supported the purchase of computers, servers, and other critical equipment and provided resources for training and logistic support.

To ensure sustainability of program support, USAID support was linked to efforts by the MOHP to establish a line item in the MOHP budget for operational activities of the ESU.

In addition, the MOHP supported recruitment of new staff, renovations of district health offices, and installation of phone lines and equipment.

5. **Guidelines development:**

Surveillance guidelines were developed and adapted to different practice settings and distributed to diverse reporting sources.

Case definitions were based on WHO criteria including recommended laboratory criteria for reporting suspect, probable, and confirmed disease (www.who.int/csr/resources/publications/surveillance/).

During the development of software, these definitions were used to develop automatic data validation routines on data entry and to provide feedback on errors on case investigation forms and reports.

6. Software development:

a. Development team:

To facilitate the computerization of data, a software development team was organized with primary responsibility for development assigned to the US CDC in collaboration with technical experts from the MOHP and NAMRU-3.

b. System requirements:

Because of limited experience with computer use at all levels, the design team envisioned a system that would be workable and acceptable to persons with minimal experience and would include an Arabic interface and menu-driven data entry screens.

System requirements were developed and agreed upon in writing as each version was developed.

c. Database architecture and design:

Based on core features, design requirements, existing information technology (IT) infrastructure, and data management capacity, the team elected to work in a provider-client model using a compiled application in Sequence Query Language (SQL).

The database was developed with a modular design modeled after National Electronic Telecommunications System for Surveillance (NETSS) in the US where modules can be added / linked without affecting the overall database structure. Each module was developed to be maintained independently. Thus, data specific modules or updated modules can be added or deleted to the system.

MS SQL was selected as a database engine based on several features:

1. It allowed for seamless integration with operating systems that were used in Egypt including MS Office Suite.
2. The application could be scalable from a simple workstation to a large application with anticipated evolution of the system over time.
3. MS SQL was being supported by Microsoft in Egypt with training and certification courses which had been attended by MOHP personnel.
4. It was anticipated that development costs would be low since Microsoft Desktop Engine (MSDE) was freely distributed with MS SQL server and only a limited number of licenses for MS SQL would be needed.
5. Other appealing features of MS SQL included the ability to export to several different programs using MS Excel messaging and performance features including processing speed and the capacity to handle large numbers of records.

7. <u>Strengthening laboratory-based surveillance:</u>

In parallel with efforts to strengthen epidemiology capacity, the MOHP upgraded laboratories to support reporting of laboratory confirmed disease.

Most of these efforts were directed to providing equipment and training in the provincial level public health laboratories and laboratories in the infectious disease hospitals with >50 beds.

Guidelines were developed with standardized procedures for processing of clinical samples using MOHP-approved diagnostic algorithms and reagents.

Multiple workshops were conducted to standardize practices and improve services with emphasis on laboratory management. The **Central Public Health Laboratory** developed logistic capacity to ensure adequate supplies of basic diagnostic reagents and supplies (e.g., blood culture media, serology reagents,

consumable supplies) and implemented a quality assurance program with supervision and monitoring visits.

Using input from MOHP laboratory personnel, "SLIME" (Software for Laboratory Information Management in Egypt) software was developed with features that supported reporting of notifiable diseases.

11.4- Piloting and implementation of NEDSS:

The beta version of the software was released in 2001 in three governorates.

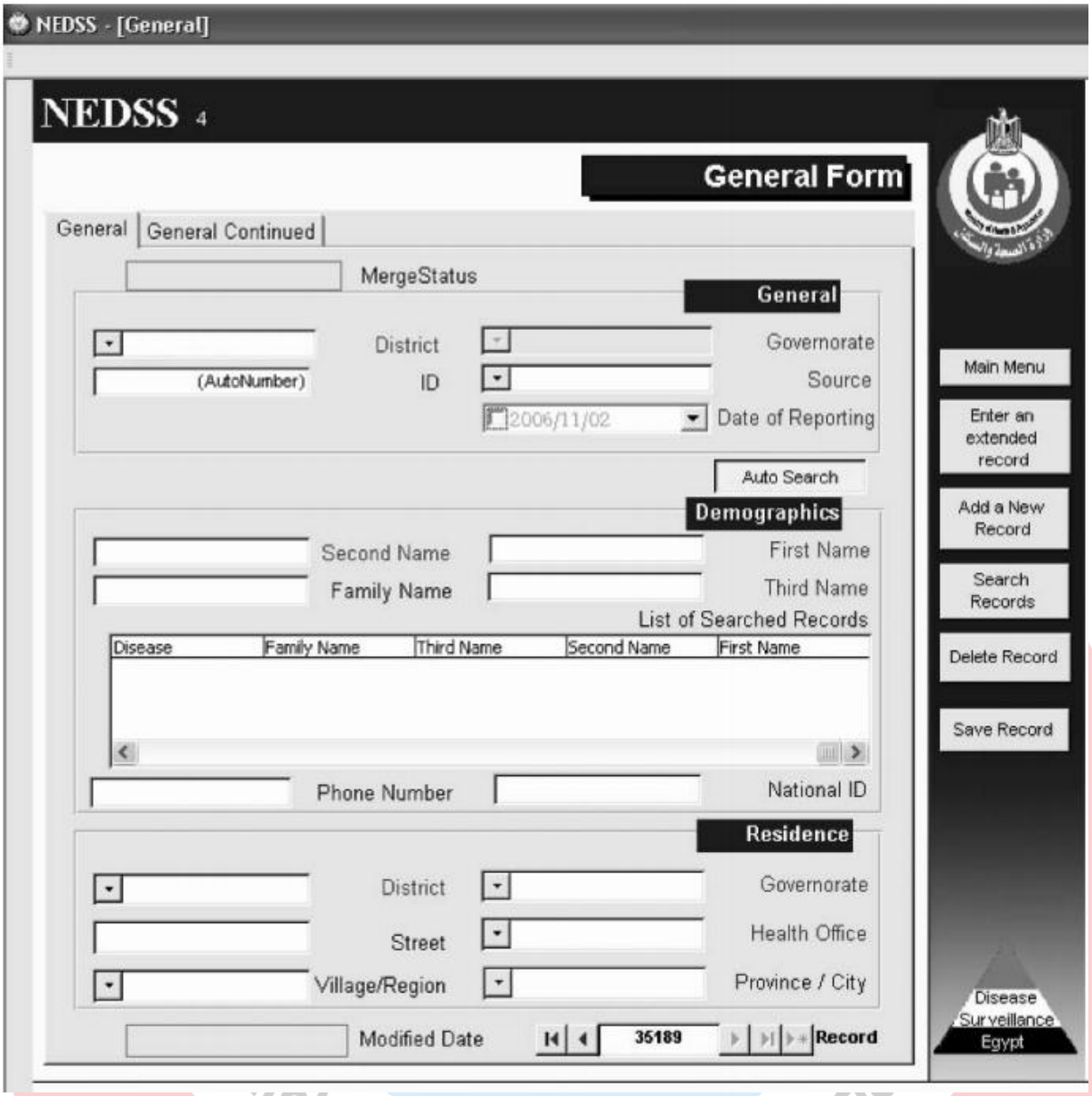
Based on feedback from the pilot utilization, the software was debugged and Version 1 was released in 2003.

Several lessons were learned in the release of the beta version including:

1. Problems with lack of dedicated staff.
2. Inadequate space for setup of computers and data entry, and
3. Limited access to phone lines.

A follow-up course focused on NEDSS data entry and data management at all levels. An example of the data screen is shown in Figure 11.2.

Figure 11.2: NEDSS - General electronic disease reporting form



Courses were initially conducted with provincial level staff who then assisted with training of district-level staff in their own province.

Since many of the district health personnel were novel users, NEDSS training included orientation to and use of computers and emphasized data entry, routine analysis and interpretation of data, backup of data, and file transfer procedures.

Chapter (11) review questions:

1- Short essay:

1. Mention three limitations to the communicable disease surveillance system in Egypt.
2. Outline three recommendations to strengthen the communicable disease surveillance system in Egypt.
3. Enumerate three strategic steps to strengthen the communicable disease surveillance system in Egypt.

2- MCQs:

- NEDSS evolved out of activities supported by:
  a) The Egyptian Ministry of Health and Population (MOHP)
  b) The World Health Organization (WHO)
  c) United States government (USG) agencies.
  d) All of the above.

3- True or False:

- Communicable disease surveillance in Egypt has shown reorganization and enhancement including the transition from paper-based to computerized reporting.
- Reportable diseases in Egypt by priority for immediate reporting (group A) include meningitis and encephalitis on the top list.

Appendix
2019 National Notifiable Infectious Diseases

The list of 2019 National Notifiable Infectious Diseases

- Anthrax
- Arboviral diseases, neuroinvasive and non-neuroinvasive
- California serogroup virus diseases
- Chikungunya virus disease
- Eastern equine encephalitis virus disease
- Powassan virus disease
- St. Louis encephalitis virus disease
- West Nile virus disease
- Western equine encephalitis virus disease
- Babesiosis
- Botulism
- Botulism, foodborne
- Botulism, infant
- Botulism, wound
- Botulism, other
- Brucellosis
- Campylobacteriosis
- *Candida auris*, clinical
- Carbapenemase Producing Carbapenem-Resistant Enterobacteriaceae (CP-CRE)
- CP-CRE, *Enterobacter* spp.
- CP-CRE, *Escherichia coli* (*E. coli*)
- CP-CRE, *Klebsiella* spp.
- Chancroid
- *Chlamydia trachomatis* infection

- Cholera
- Coccidioidomycosis
- Congenital syphilis
- Syphilitic stillbirth
- Cryptosporidiosis
- Cyclosporiasis
- Dengue virus infections
- Dengue
- Dengue-like illness
- Severe dengue
- Diphtheria
- Ehrlichiosis and anaplasmosis
- *Anaplasma phagocytophilum* infection
- *Ehrlichia chaffeensis* infection
- *Ehrlichia ewingii* infection
- Undetermined human ehrlichiosis/anaplasmosis
- Giardiasis
- Gonorrhea
- *Haemophilus influenzae*, invasive disease
- Hanse's disease
- Hantavirus infection, non-Hantavirus pulmonary syndrome
- Hantavirus pulmonary syndrome
- Hemolytic uremic syndrome, post-diarrheal
- Hepatitis A, acute
- Hepatitis B, acute
- Hepatitis B, chronic
- Hepatitis B, perinatal virus infection
- Hepatitis C, acute
- Hepatitis C, chronic
- Hepatitis C, perinatal infection
- HIV infection (AIDS has been reclassified as HIV Stage III)
- Influenza-associated pediatric mortality
- Invasive pneumococcal disease
- Latent TB Infection (TB Infection)
- Legionellosis
- Leptospirosis
- Listeriosis
- Lyme disease
- Malaria

- Measles
- Meningococcal disease
- Mumps
- Novel influenza A virus infections
- Pertussis
- Plague
- Poliomyelitis, paralytic
- Poliovirus infection, nonparalytic
- Psittacosis
- Q fever
- Q fever, acute
- Q fever, chronic
- Rabies, animal
- Rabies, human
- Rubella
- Rubella, congenital syndrome
- *Salmonella* Paratyphi infection (*Salmonella enterica* serotypes Paratyphi A, B [tartrate negative], and C [*S.* Paratyphi])
- *Salmonella* Typhi infection (*Salmonella enterica* serotype Typhi)
- Salmonellosis
- Severe acute respiratory syndrome-associated coronavirus disease
- Shiga toxin-producing *Escherichia coli*
- Shigellosis
- Smallpox
- Spotted fever rickettsiosis
- Streptococcal toxic shock syndrome
- Syphilis
- Syphilis, primary
- Syphilis, secondary
- Syphilis, early non-primary non-secondary
- Syphilis, unknown duration or late
- Tetanus
- Toxic shock syndrome (other than streptococcal)
- Trichinellosis
- Tuberculosis
- Tularemia
- Typhoid fever
- Vancomycin-intermediate *Staphylococcus aureus* and Vancomycin-resistant *Staphylococcus aureus*
- Varicella

- Varicella deaths
- Vibriosis
- Viral hemorrhagic fever
- Crimean-Congo hemorrhagic fever virus
- Ebola virus
- Lassa virus
- Lujo virus
- Marburg virus
- New World arenavirus – Guanarito virus
- New World arenavirus – Junin virus
- New World arenavirus – Machupo virus
- New World arenavirus – Sabia virus
- Yellow Fever
- Zika virus disease and Zika virus infection
- Zika virus disease, congenital
- Zika virus disease, non-congenital
- Zika virus infection, congenital
- Zika virus infection, non-congenital

Reference:

https://wwwn.cdc.gov/nndss/conditions/notifiable/2019/infectious-diseases/

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References

1. *M'ikanatha et al. (2013):* Infectious Disease Surveillance. Second Edition. Edited by Nkuchia M. M'ikanatha, Ruth Lynfield, Chris A. Van Beneden and Henriette de Valk. Wiley-Blackwell publishers (www.wiley.com/wiley-blackwell).
2. *M'ikanatha and Iskander (2015)*:Concepts and methods in infectious disease surveillance. Edited BY Nkuchia M. M'ikanatha and John K. Iskander. Wiley-Blackwell publishers (www.wiley.com/wiley-blackwell).
3. https://www.cdc.gov/globalhealth/healthprotection/ghs/ihr/index.html. Accessed 17-01-2019.
4. *Omran, D., Alboraie, M., Zayed, R. A., Wifi, M. N., Naguib, M., Eltabbakh, M., Abdellah, M., Sherief, A. F., Maklad, S., Eldemellawy, H. H., Saad, O. K., Khamiss, D. M., … El Kassas, M. (2018)*: Towards hepatitis C virus elimination: Egyptian experience, achievements and limitations. World journal of gastroenterology, 24(38), 4330-4340.
5. https://www.cdc.gov/globalhealth/healthprotection/gdd/egypt.htm. Accessed 16-01-2019.
6. **https://wwwn.cdc.gov/nndss/conditions/notifiable/2019/infectious-diseases/** Accessed 19-01-201

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