Public Health Surveillance

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Core Epidemiologic Functions

- Public Health Surveillance
- Field investigation
- Analytic studies
- Evaluation
- Linkages
- Policy Development

Epidemiologic Tools and Public Health Solving Cycles

Magnitude

Evaluation

- Program effectiveness
- Impact

Management

- Advocacy
- Mediate
- Enable for
  - Policy
  - Supportive env
  - Community action
  - Healty service orientation

Distribution

(time-place-person)

Cause & Determinants

•Host- Agent-Enviroment

Preventive measures

By staging
Demand and supply
Efficacy

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Overview of Field Epidemiology.
Kumnuan Ungchusak MD, MPH

Outline

- Definition & History of surveillance
- Characteristics of a surveillance system
- Components of a surveillance system
- Types of a surveillance system
- Setting up a surveillance system
- Major Public Health surveillance systems in Thailand

Definition of a surveillance system

Surveillance

(super)

(over)

+

(vigilatia)

(to watch)

(Merriam-Webster, 1976)

The very French history of the word 'surveillance'
https://www.bbc.com/news/blogs-magazine-monitor-33464368

Major milestones in the historical development of PH surveillance

Year	Place	Event
3180 B.C.	Egypt	First recorded epidemic "A great pestilence"
460 B.C.	Greece	Hippocrates wrote about the endemic state and epidemic state of disease
1348	Venice	First public health action that can be attributed to surveillance "The Black Death": prohibited ships with infected passengers from docking at the port
1532-1662	London	First systematic ongoing collection of surveillance data "the London Bills of Mortality" First comprehensive analysis and interpretation of mortality data
1741	USA	First legislation for surveillance Tavern-keepers reporting contagious disease among the patrons
1766	Germany	First link of surveillance to policy School health, public water & sewage treatment
1874	USA	First systematic reporting of infectious disease

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Start Recording

Analyzing& interpreting

Information for action

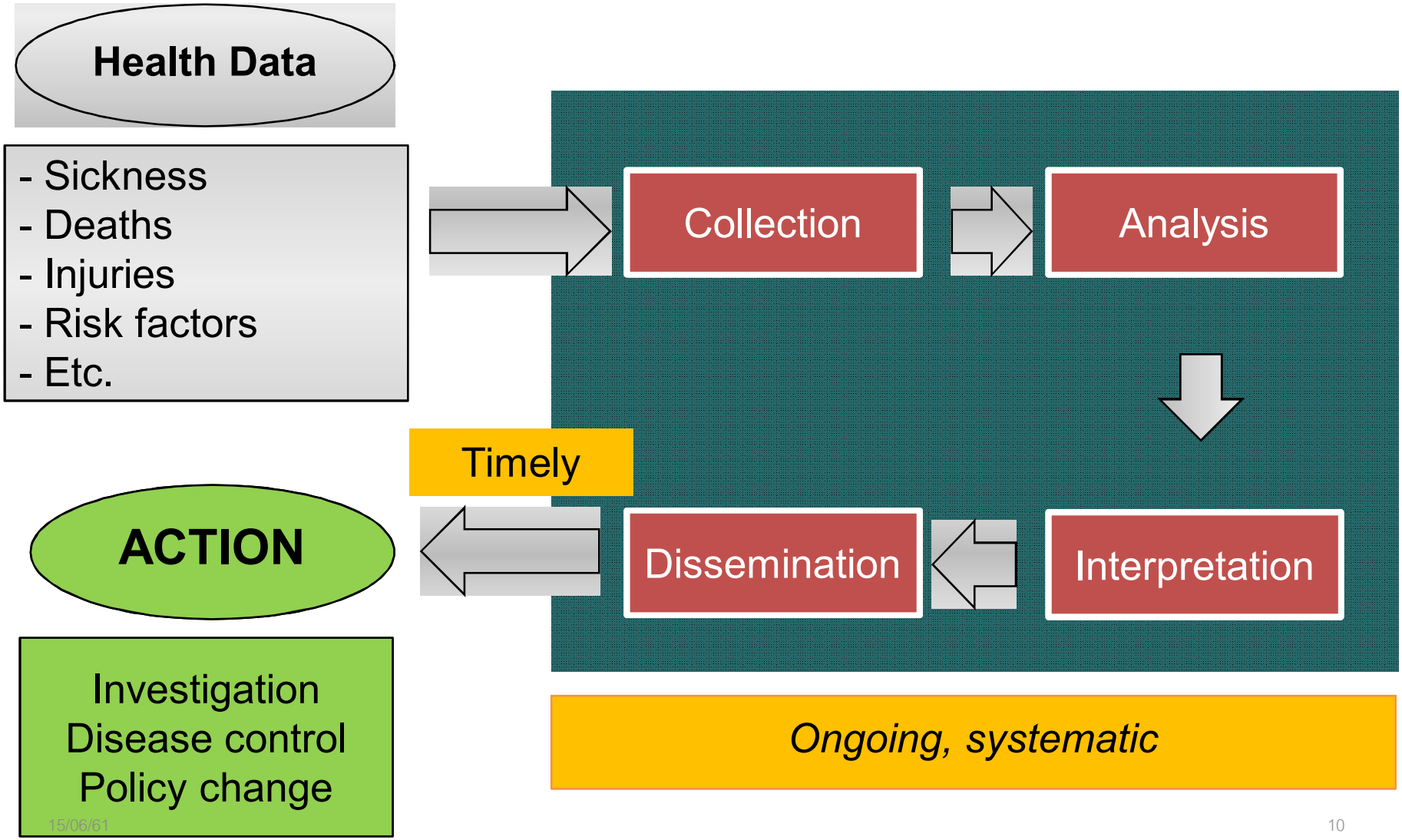
Choi, BCK. The Past, Present and Future of Public Health surveillance.2012.

Definition of public health surveillance

- "the *ongoing systematic collection*, *analysis*, and *interpretation* of data, closely integrated with the *timely dissemination* of these data to those responsible for preventing and controlling disease and injury" – Field Epidemiology

Thacker S. B., Berkelman R. L. Public Health Surveillance in the United States. Epidemiologic Reviews. 1988;10:164–90

Public Health Surveillance



Purposes, Characteristics and Uses of surveillance

Purposes and Characteristics

- Facilitate the prevention and control of disease
- Clear objectives determine
  - Timeliness
  - Representation
  - Sensitivity
  - Specificity

Uses of PH surveillance

- The World Bank described 6 categories of uses of public health surveillance

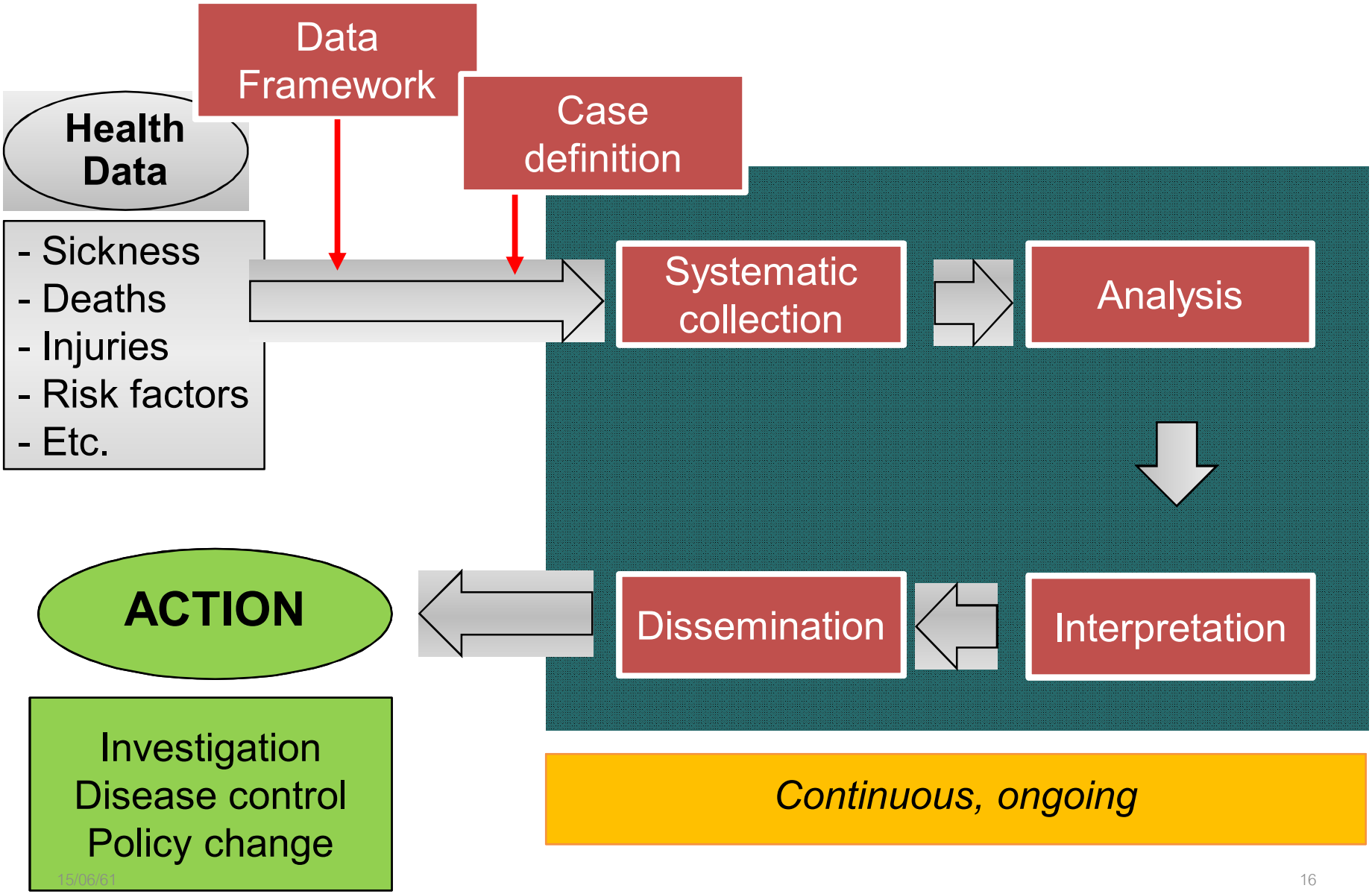
1. Recognizing cases/clusters of cases to trigger intervention to prevent transmission or reduce morbidity and mortality
2. Assess the public health impact & measure trends
3. Demonstrate the need for public health intervention programs and resources and resource allocation
4. Monitor effectiveness of prevention and control measure and intervention strategies
5. Identify high-risk population groups or geographic areas to target interventions and guide analytic studies
6. Develop hypothesis that lead to analytic studies about risk factors for disease causation, propagation, or progression

Components of a surveillance system

Components of a surveillance system

1. Data Framework
2. Setting a case definition
3. Data collection
4. Data analysis
   - Time, Place, Person
5. Data interpretation
6. Data dissemination
   - Report to stakeholders & people

Public Health Surveillance



1. Data Framework

Identifying health problems under surveillance

- Public health importance
  - Incidence, prevalence
  - Severity
  - Socioeconomic
  - Communicability
  - Public perception
- Ability to prevent, control, or treat the problem
- Capacity of health system to implement control measure for the health problem

Disease prioritization for surveillance

Class	High severity	High Transmissibility	Effective preventive measures	Reporting
I. Highly important diseases	+	+	+/-	Urgent report with detailed information (within 24 hr)
II. Notifiable diseases	-	+	+	Routine, case-based
III. Diseases for statistics	-	-	+/-	None

http://www.boe.moph.go.th/files/meeting/506.pdf

Table 1. Prioritisation criteria and definitions of the corresponding scores.

Criteria
Incidence
Work and school absenteeism
Healthcare utilization
Chronicity/sequalae
CFR
PH action required
Trend
Public attention
Prevention possibilities
Treatment possibilities

No.	Criteria	Scoring values		
		−1	0	+1
1	Incidence (including illness and symptomatic infection)	<1/100 000	1–20/100 000	>20/100 000
2	Work and school absenteeism*	This pathogen causes a negligible proportion of absenteeism due to an infectious illness	This pathogen causes a small to moderate proportion of absenteeism due to an infectious illness	This pathogen causes a large proportion of absenteeism due to an infectious illness
3	Health care utilization (primary care and hospitalisation)*	This pathogen causes a negligible proportion of health care utilization due to an infectious illness	This pathogen causes a small to moderate proportion of health care utilization due to an infectious illness	This pathogen causes a large proportion of health care utilization due to an infectious illness
4	Chronicity of illness or sequelae*	This pathogen causes a negligible amount of chronicity or persistent sequelae (estimate prevalence of those being <0.1/100 000 population)	This pathogen causes a small to moderate amount of chronicity or persistent sequelae (estimated prevalence of those being 0.1–1.0/100 000 population)	This pathogen causes a large amount of chronicity or persistent sequelae (estimated prevalence of those being >1.0/100 000 population)
5	Case fatality rate**	<0.01%	0.01–1%	>1%
6	Proportion of events requiring public health actions (see Note 2 for explanation)**	A small proportion of the estimated total number of events or exceptional events require public health actions (<25%)	A moderate to large proportion of the estimated total number of events require public health actions (25–75%)	Almost all of the estimated total number of events require public health actions (>75%)
7	Trend**	Diminishing incidence rates	Stable incidence rates	Increasing incidence rates
8	Public attention (including political agenda and public perception)*	Risk perception of this pathogen by general public is low and it is not high on political agenda	Risk perception of this pathogen by general public is moderate and informal political expectations/agenda is present	This pathogen implies international duties or its risk perception by general public is high or it is explicitly high on political agenda
9	Prevention possibilities and needs (including vaccines)**	Preventive potential seems low or the disease does not require prevention or effective prevention strategies are well-established; no need for significant strategy modification	Measures for prevention are established but there is need to improve their effectiveness	Need for prevention is established but currently no effective preventive measures are available
10	Treatment possibilities and needs (including AMR)**	Medical treatment is rarely necessary or effective regimens are well-established; no need for significant modifications	Medical treatment regimens are established but there is need to improve their effectiveness	Need for medical treatment is established but currently no effective treatment is available or AMR limits treatment options

Balabanova Y, Gilsdorf A, Buda S, Burger R, Eckmanns T, et al. (2011) Communicable Diseases Prioritized for Surveillance and Epidemiological Research: Results of a Standardized Prioritization Procedure in Germany, 2011. PLOS ONE 6(10): e25691. https://doi.org/10.1371/journal.pone.0025691
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0025691

PLOS | ONE

Before collecting cases….

- Who will be counted as a case?
- To ensure comparability, use a case definition!

A case definition

A set of standard criteria for classifying whether a person has a particular disease, syndrome, or other health condition.

2. Setting a case definition

- The surveillance case definition can differ from the clinical or diagnostic case definition

What are your differential diagnosis?

A 14-year-old Thai boy living in Bangkok

Symptoms: He has had fever, headache, myalgia, mild cough, nausea, no vomiting for 2 days

Physical exam

BT 39 C, PR 86/min, RR 18/min, BP 100/60 mmHg
HEENT : not pale, no jaundice, pharynx not injected
Lung: Clear
Heart: Normal S1,S2, no murmur
Abdomen: no distension, RUQ-not tender
Extremities : no rash
Tourniquet test - negative

Reporting Criteria for dengue in R506

- The system requires health officers to report all suspected dengue fever or dengue hemorrhagic case.

Definition for a suspected case

A suspected dengue fever case

Acute fever with 2 of following symptoms: headache, retroorbital pain, myalgia, bone or joint pain, rash, bleeding, tourniquet test positive

A suspected dengue hemorrhagic fever case

Acute fever with tourniquet test positive with 1 of following symptoms:, headache, retroorbital pain, myalgia, bone or joint pain, rash, bleeding, enlarged liver, shock

Should this case be reported?

A 14-year-old Thai boy living in Bangkok

Symptoms: He has had fever, headache, myalgia, mild cough, nausea, no vomiting for 2 days

Physical exam

BT 39 C, PR 86/min, RR 18/min, BP 100/60 mmHg
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Abdomen: no distension, RUQ-not tender
Extremities : no rash
Tourniquet test - negative

Should this case be reported? – Yes

A 14-year-old Thai boy living in Bangkok

Symptoms: He has had fever, headache, myalgia, mild cough, nausea, no vomiting for 2 days

Physical exam

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Extremities : no rash
Tourniquet test - negative

This case should be reported as a suspected dengue fever case

3. Data collection

- Purpose: health-related, administrative, legal, politic, economic
- Sources: individual person, environment, healthcare providers and facilities
- Methods
  - Environmental monitoring
  - Survey
  - Notification
  - Registries

4. Analyzing data

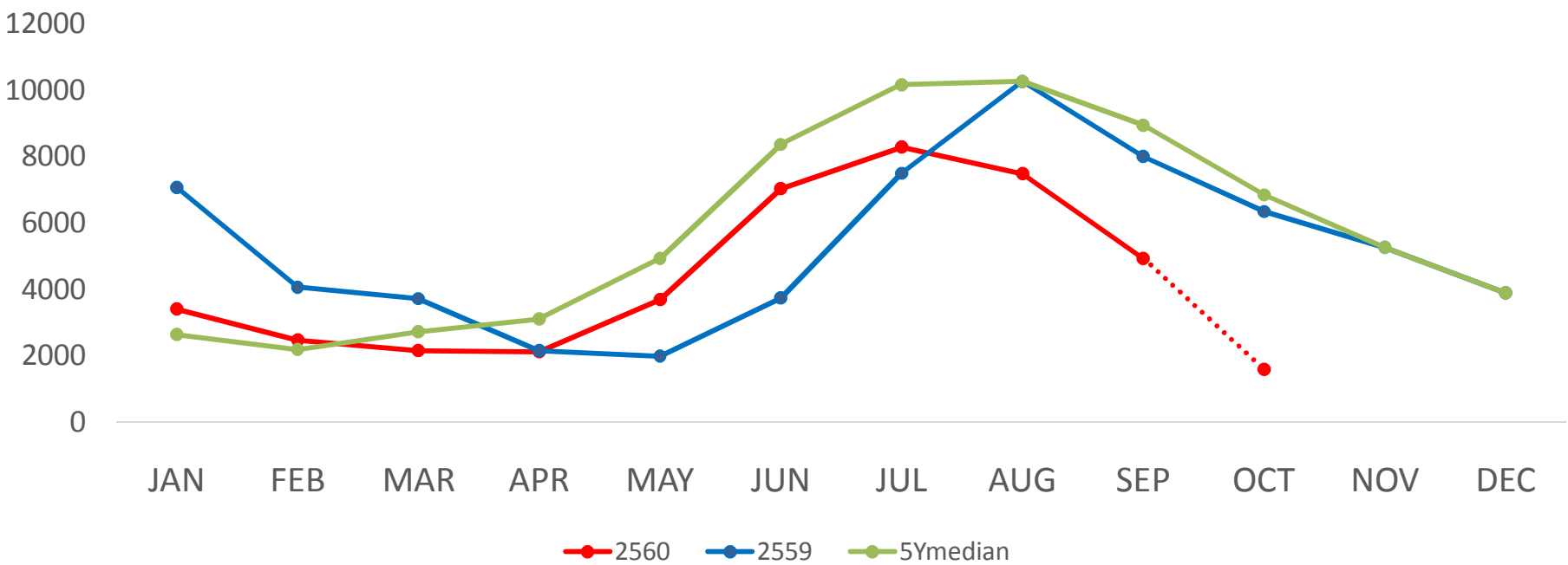
- Descriptive methods
  - Measure of frequency (count/rate)
  - Using tables and graphs
  - Does the incidence/prevalence increase??
    - Compare over time
    - Compare across areas
    - Know the baseline/ pattern

Analyzing by Time

- Characterize **trends**
- Detect changes in disease incidence
- Methods
  - Compare number of cases
    - To the previous week
    - To the same period for the last 2-10 years
  - Analysis of long-term trends (secular trends)
    - Trends
    - Events having an impact on the trend

Compare number of cases

จำนวนผู้ ป่ วยไข้ เลือดออกรายเดือน ประเทศไทย .ศ.
2560 เทียบกับ พ.ศ. 2559 และ ค่ามัธยฐาน 5 ปี
ย้ อนหลัง



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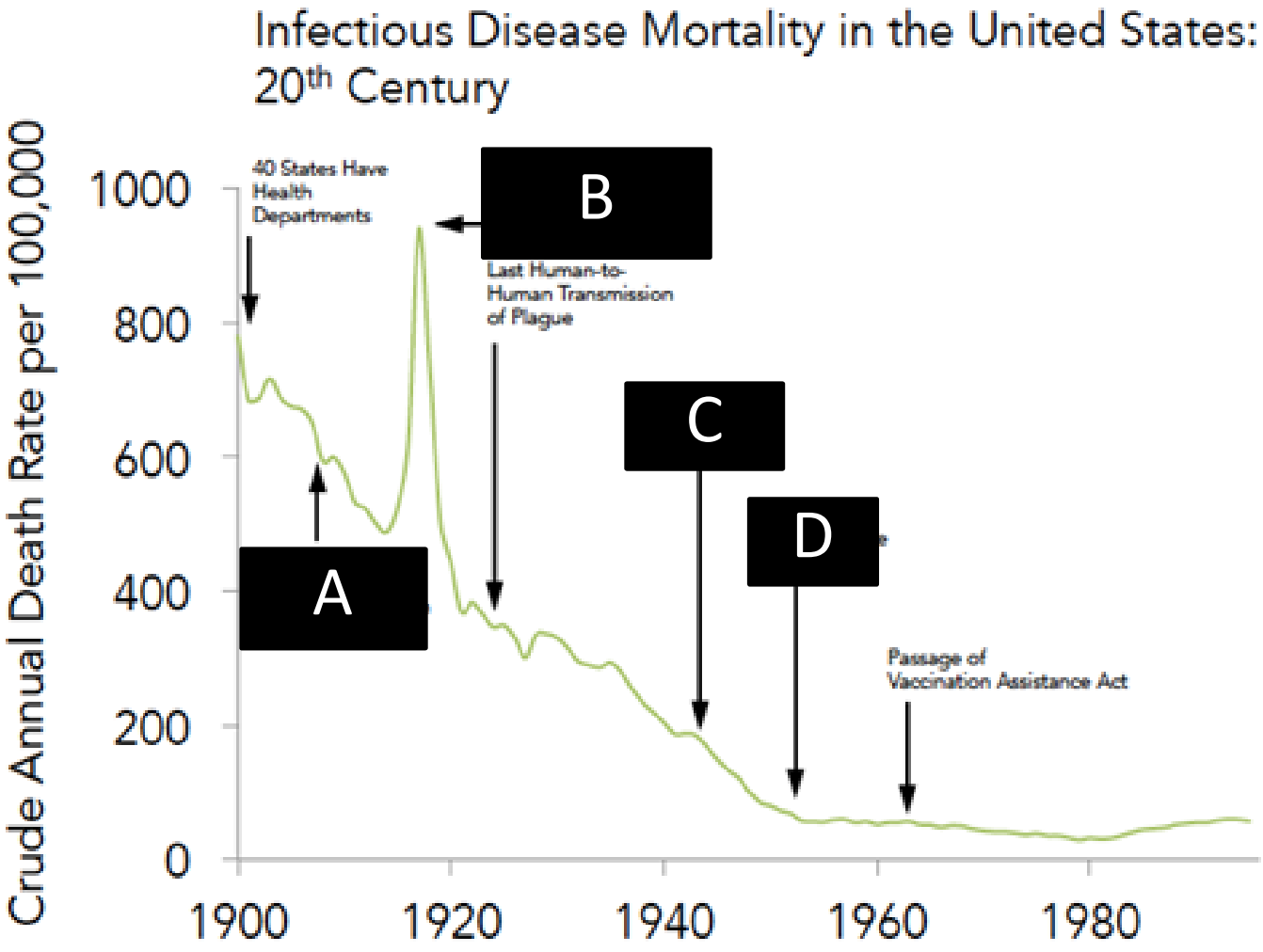
Events having an impact on a trend



https://www.bu.edu/sph/2016/01/03/a-world-without-public-health/

Analyzing by Place

- Tables or maps
- Adjusted for different size of population
  - Age-adjusted

- แผนที่แสดงอัตราป่ วยโรคไข้ เลือดออกประเทศไทย
- 1 ม.ค. – 17 พ.ย. 2560

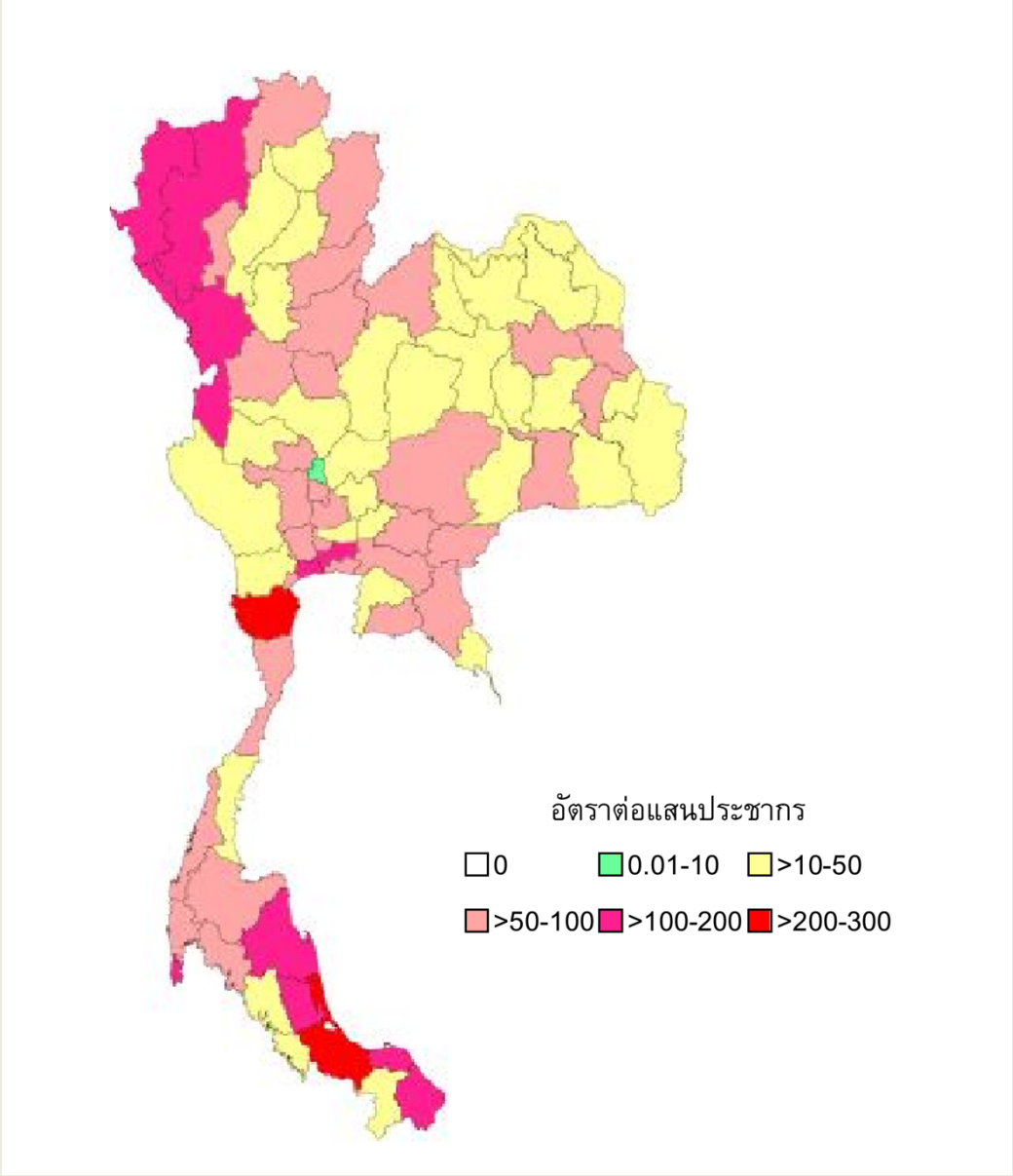


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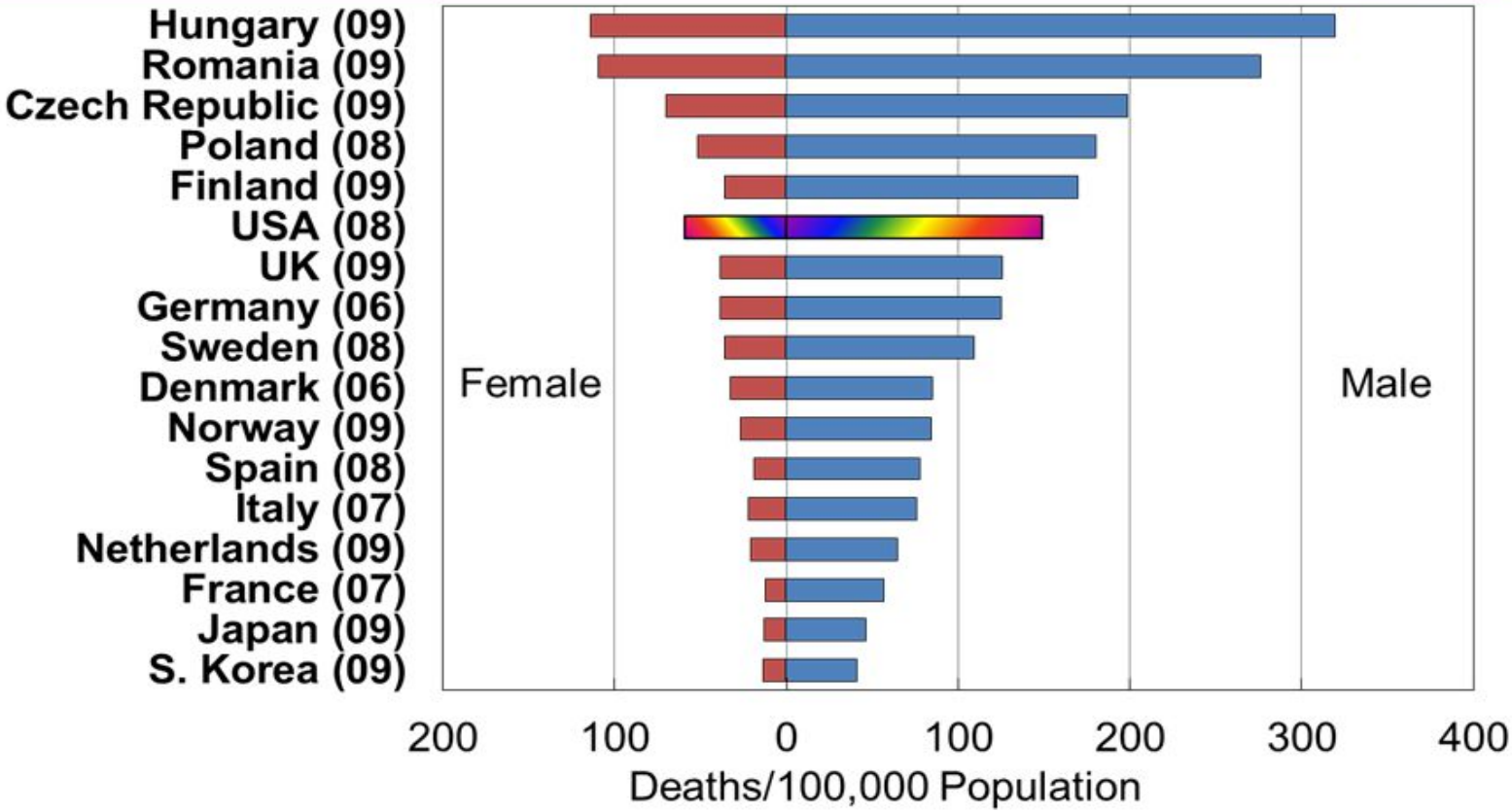
Chart 3–34 Age-Adjusted Death Rates* for CHD‡ by Country & Sex, Ages 35–74, 2006–2009



* Age-adjusted to European standard. Data for years indicated in parentheses.
‡ CHD: Coronary heart disease.

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National Heart Lung and Blood Institute

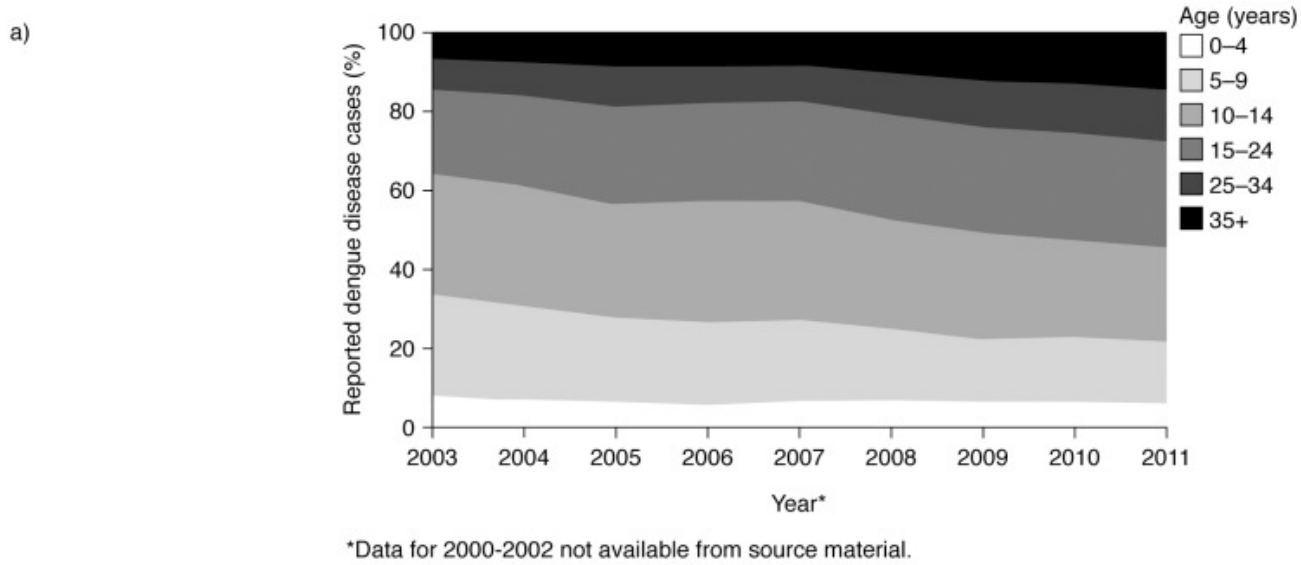
National Heart, Lung, and Blood Institute. February, 2012

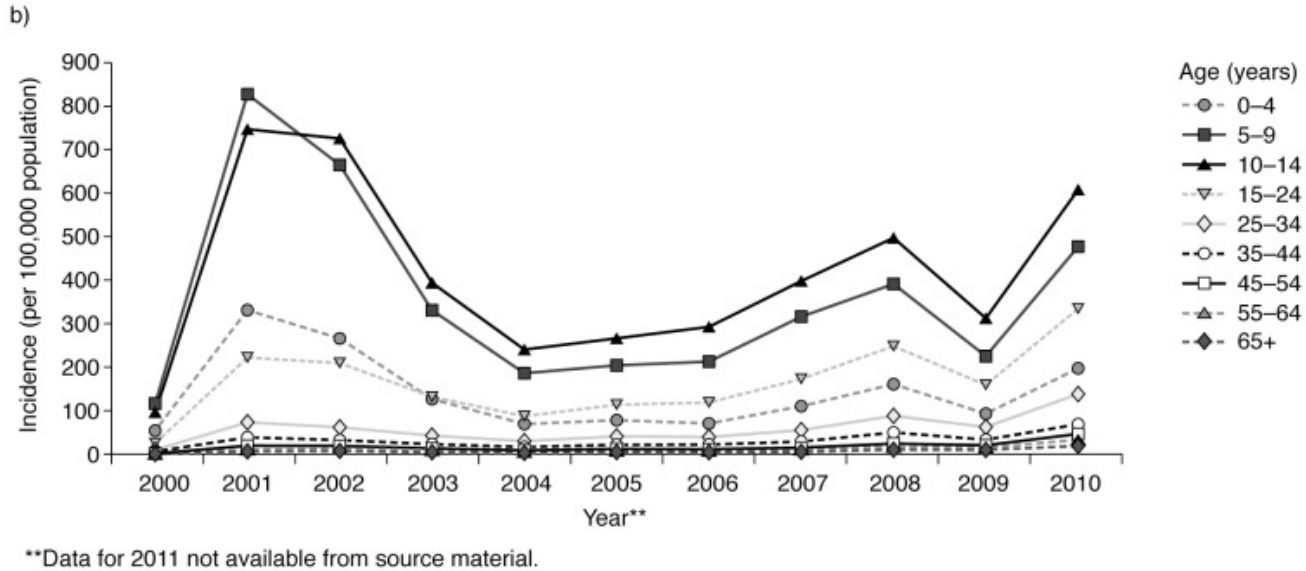
Analyzing by Person

- Age and sex
  - Standard age categories for childhood illnesses*
    - < 1 year, 1-4, 5-9, 10-14, 15-19, ≥ 20 years
- Race
- The presence of risk factors for specific diseases

Principles of Epidemiology in Public Health Practice 3rd Ed. CDC.

Dengue & Age group





Limkittikul K., Brett J., L'Azou M., Halstead SB. **Epidemiological Trends of Dengue Disease in Thailand (2000–2011): A Systematic Literature Review.** PLoS Negl Trop Dis. 2014 Nov; 8(11): e3241.

5. Interpreting the results

- Does the event need action/response?
  - If yes, what kind of the response needed and how fast should it be?
- Depends on
  - The priorities assigned to different diseases
  - Local department's capacities and resources
  - Public, political and media concern

Interpreting the results

- Artifactual changes
  - Reporting procedure/policies
  - Case definition
  - Health seeking behaviors
  - Physician’s awareness, increase in diagnosis
  - New laboratory test/ diagnostic procedure
  - Misdiagnosis/ Lab error
  - Batch reporting
  - Population size

6. Disseminating data

- Who should the surveillance data be sent to?
  - Healthcare providers
  - Laboratory director
  - Control program planner
  - Decision maker
- Forms of data dissemination
  - Surveillance summary report
- Regular, Timely

Disseminating data

Seven diseases under watch next year

in Editor's Choice, General | December 23, 2017 | (1,613 views) | By Thai PBS

Tweet G+

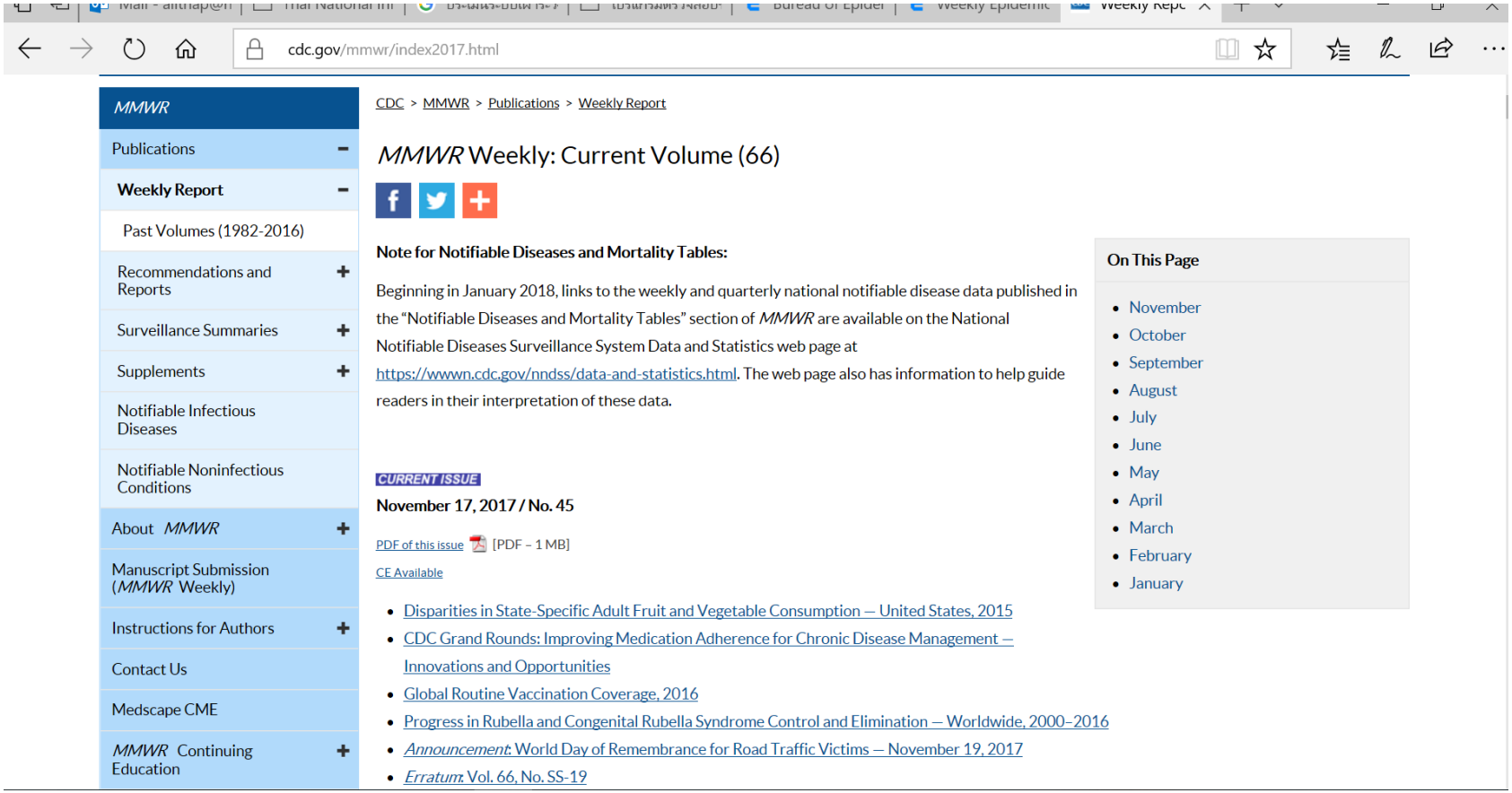
Disseminating data

- WESR (Thai)
  - http://www.wesr.moph.go.th/wesr_new/
- MMWR (USCDC)
  - https://www.cdc.gov/mmwr/index.html
- Promed (Global)
  - https://www.promedmail.org/index.php

WESR

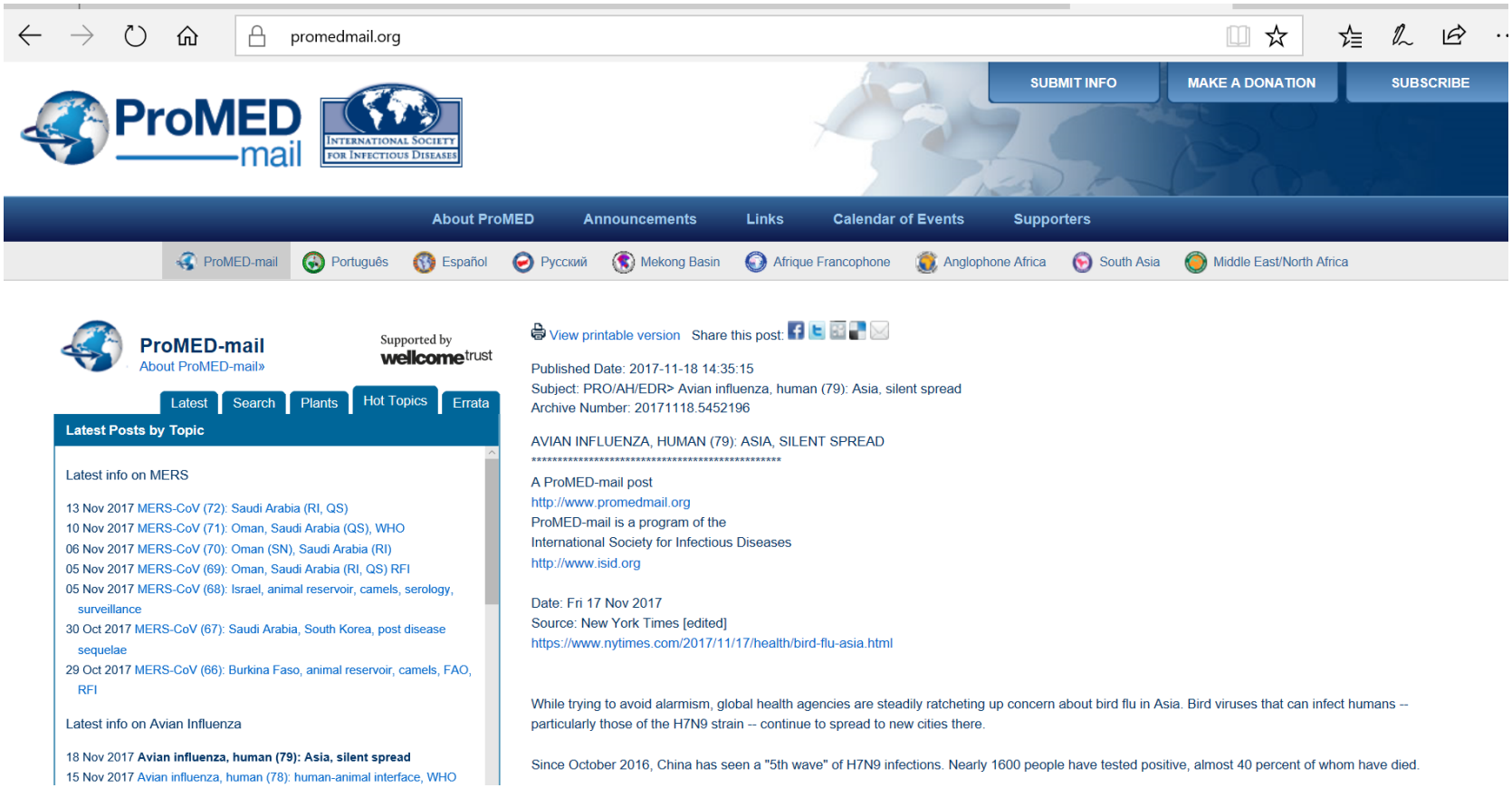
http://www.wesr.moph.go.th/wesr_new/

MMWR



https://www.cdc.gov/mmwr/index.html

Promed



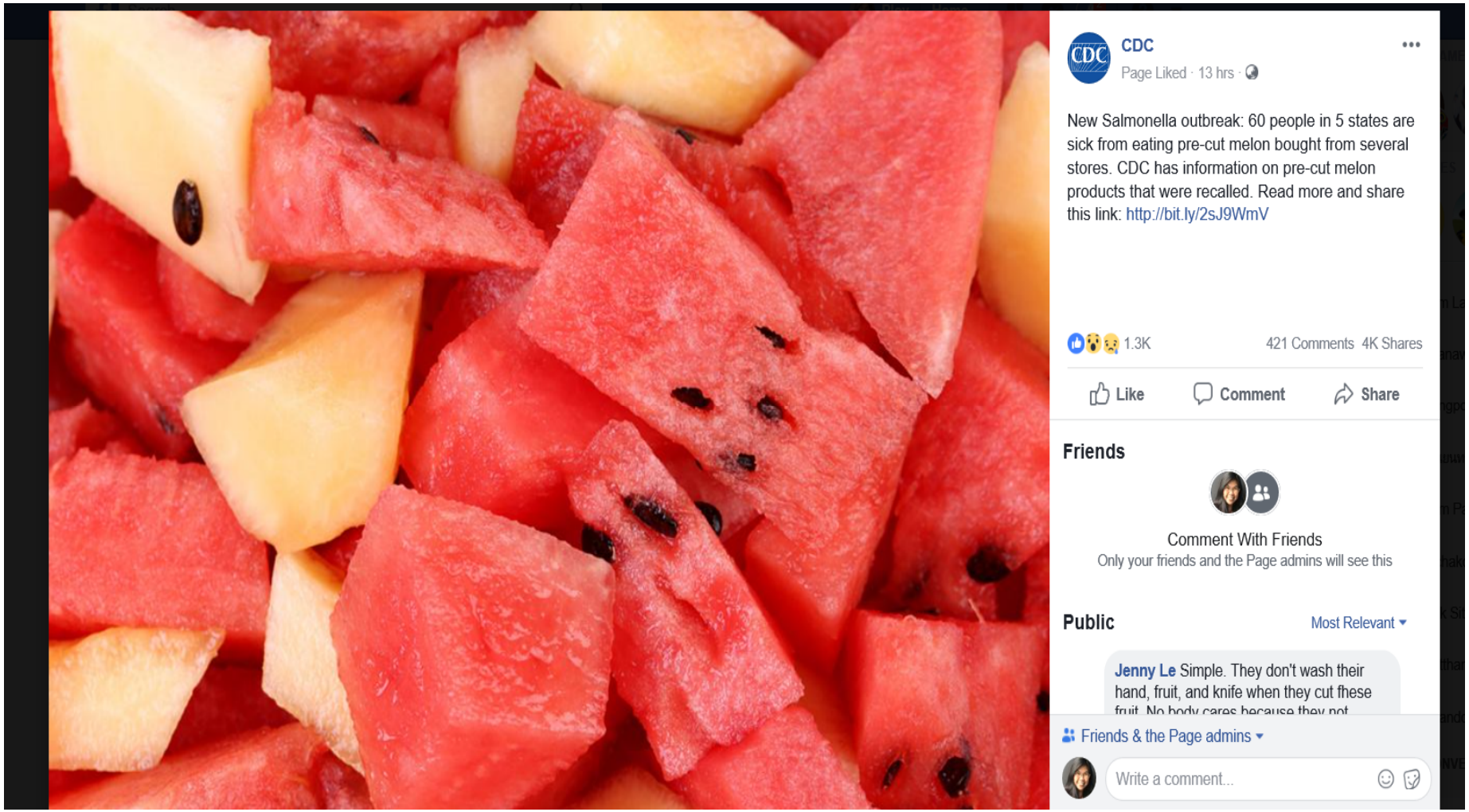
https://www.promedmail.org/index.php

Promed

- In early 2017, a new HPAI mutant was found in human patients; the same HPAI mutation of the H7N9 strain was eventually shown in several poultry farms and this was immediately reported to the OIE. Clinical disease and mortalities in commercial poultry were 1st reported from China to the OIE on [Fri 24 Mar 2017] (see 20170324.4924555). In the presence of clinical disease in poultry, its reporting and subsequent possibility of control have been boosted. Hopefully, the other part of the warning/prediction published in Ref 1, namely the frightening appearance of effective human-to-human HPAI H7N9 infectivity, will not be similarly realized.

  As of [Wed 25 Oct 2017], 38 locations, in at least 11 of China's provinces, tested positive for HPAI H7N9 in birds and/or the environment. A table presenting them, by province and sampling site (Live bird markets, commercial farms, backyards) , is available in FAO's H7N9 situation update of 25 October 2017, at http://www.fao.org/ag/againfo/programmes/en/empres/h7n9/situation_update.html. Additional accumulating information on the issue, in animals and man, including a map, tables, figures, and links to 4 recent relevant publications, is to be found there as well. The next FAO update will be issued on [Wed 29 Nov 2017].

Social Media



Wrapping up

- Components of a surveillance system
  - Data Framework
  - A case definition
  - Data collection
    - Case definition
  - Data analysis
    - Time, Place, Person
  - Data interpretation
  - Data dissemination
    - Report to stakeholders & people

Types of a surveillance system

Types of Surveillance

- Active VS Passive
  - Active surveillance
    - Data collection performed by a surveillance team
    - A surveillance team regularly contact the reporters for the data
    - Accurate and timely, but Expensive!!
  - Passive surveillance
    - Routine notifiable-disease reporting
    - Simple, not burdensome
    - Incomplete, not so timely, not-so-good quality

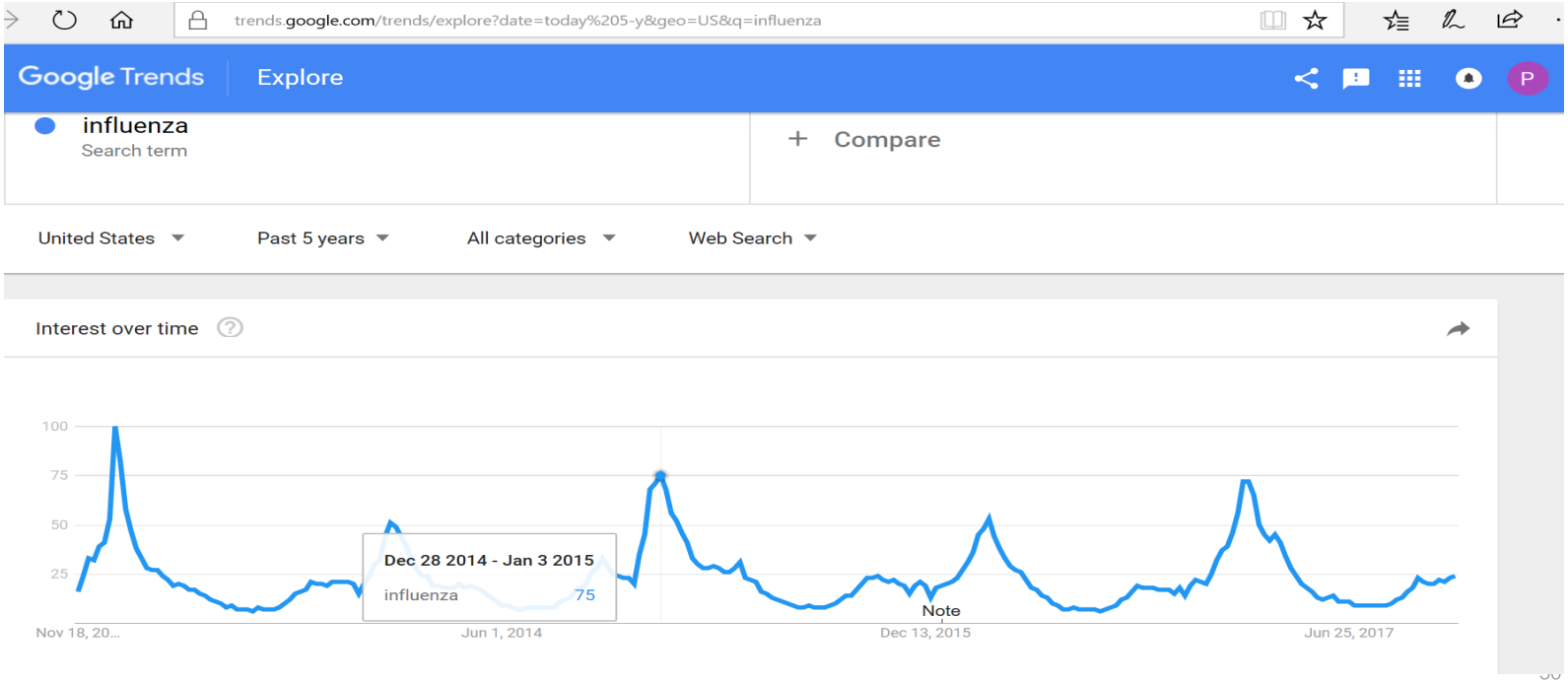
Types of Surveillance

- Diagnosis-based VS Syndromic
  - Diagnosis-based
  - Syndromic
    - Identify illness clusters early before diagnoses are confirmed
    - Monitor surrogate data sources
      - OTC prescription
      - school absenteeism
      - Symptoms-based

Syndromic surveillance

- *Most of the time flu activity peaks between December and February*

https://www.cdc.gov/flu/about/season/flu-season.htm



Types of Surveillance

- Population-wide (Universal, Comprehensive) VS Sentinel
  - Population-wide
    - Gather data from all reporting source
  - Sentinel
    - Small group of reporting sources

Type of Surveillance

- Indicator-based VS Event-based
  - Indicator-based
    - Determine exactly what to be reported
      - e.g. Disease, diagnoses
  - Event-based
    - The criteria of event to be reported can be looser
      - e.g. Health-related events

Setting up a surveillance system

1. Establish **objectives**
2. Develop **case definitions**
3. Develop data **collection** system
4. Develop data collection instruments
5. Field test
6. Develop and test **analytical** approach
7. Determine **dissemination** mechanism and ensure access at different level
8. Determine **evaluation** methods

http://webapp1.dlib.indiana.edu/virtual_disk_library/index.cgi/4261834/FID1951/CD97/EPISUIT/LESS-PDF/Ch3_all.pdf

1. Establish objectives

- What do you need to knows?
- High-priority events for surveillance
  - Frequency
  - Severity
  - Cost
  - Preventability
  - Communicability
  - Public interest
  - Emerging issue
  - Others: impact, effectiveness, political, evaluate control, prevention measures
- Augmentation of surveillance data

Involvement of others in planning process**********

- Strengthen the potential that data needed will be collected
- Facilitate communication
- Facilitate consensus regarding priorities and methods
- **Who?**
  - Anticipated users
  - Clinicians
  - Policy makers
  - Hospitals
  - Professional groups
  - Lab
  - Health office
  - Program manager
  - Public/volunteer agencies
  - Other interest groups
  - Etc.

2. Develop **case definitions**

Elements

- Clinical and lab findings
- Time, place, person
- Epidemiological linkage

- Degree of certainty: suspected, probable, confirmed
- Sensitivity and specificity

Factors influencing changes in case definition

- Understanding of diseases
- Reported frequency, pattern of occurrence
- Different diagnostic criteria

3. Develop data **collection** system

- Factor determining data collection system
  - Several data sources
  - Balance with the purpose
  - Timeliness – important for fatal condition
- Data sources
  - Additional datasets to compliment surveillance data
    - Surveys
    - Vital statistics
    - Etc.
- Mechanism: types, variables,
  - Feedback to the reporters

4. Develop data collection **instruments**

- Standardization
  - Generally recognized computerized format
  - Facilitate analysis and comparison
- Ability to link to other systems
  - Privacy
- Limit to only those needed data

5. Field test*****

- Purposes
  - Facilitate implementation of feasible systems
  - Avoid changes after implemented on broader scale
  - Increase chance for expansion
  - Demonstrate how the data will be obtained, transferred
  - Identify difficulties in data collection and flow
  - Identify methods suitable for other condition2 broader scale
- Type of data collected, data sources, collection methods, procedures

6. Data analysis

- Considerations
  - Intended uses
  - Assure the data source and collection process are adequate
- Types of analysis, reporting formats, size of databases → Hardware and software
- Automated analysis?
- Supporting personnel?

7. Interpreting and disseminating information

- For decision making
- Interpretation
  - Know the audiences
  - A Compelling manner
  - Trends, comparison
- Dissemination
  - Routine, public access should be planned
  - Recommendations tailored to audiences
  - Clear and concise
  - Communication media
  - Audiovisual technology

8. Evaluation

- Periodic evaluation assures that the surveillance system remains vibrant
- Chance for development

Challenges of a surveillance system

Challenges with the implementation of an Integrated Disease Surveillance and Response (IDSR) system: systematic review of the lessons learned FREE

Revati K Phalkey, Shelby Yamamoto, Pradip Awate, Michael Marx

Health Policy and Planning, Volume 30, Issue 1, 1 February 2015, Pages 131–143,
https://doi.org/10.1093/heapol/czt097
Published: 20 December 2013 **Article history** ▾

- Non-sustainable financial resources
- Lack of co-ordination
- Inadequate training and turnover of staffs
- Erratic feedback
- Inadequate supervision from the upper level
- Weak laboratories capacities
- Poor availability of communication and transportation (particularly at the periphery)

Major public health surveillance systems in Thailand

Public Health Surveillance in Thailand

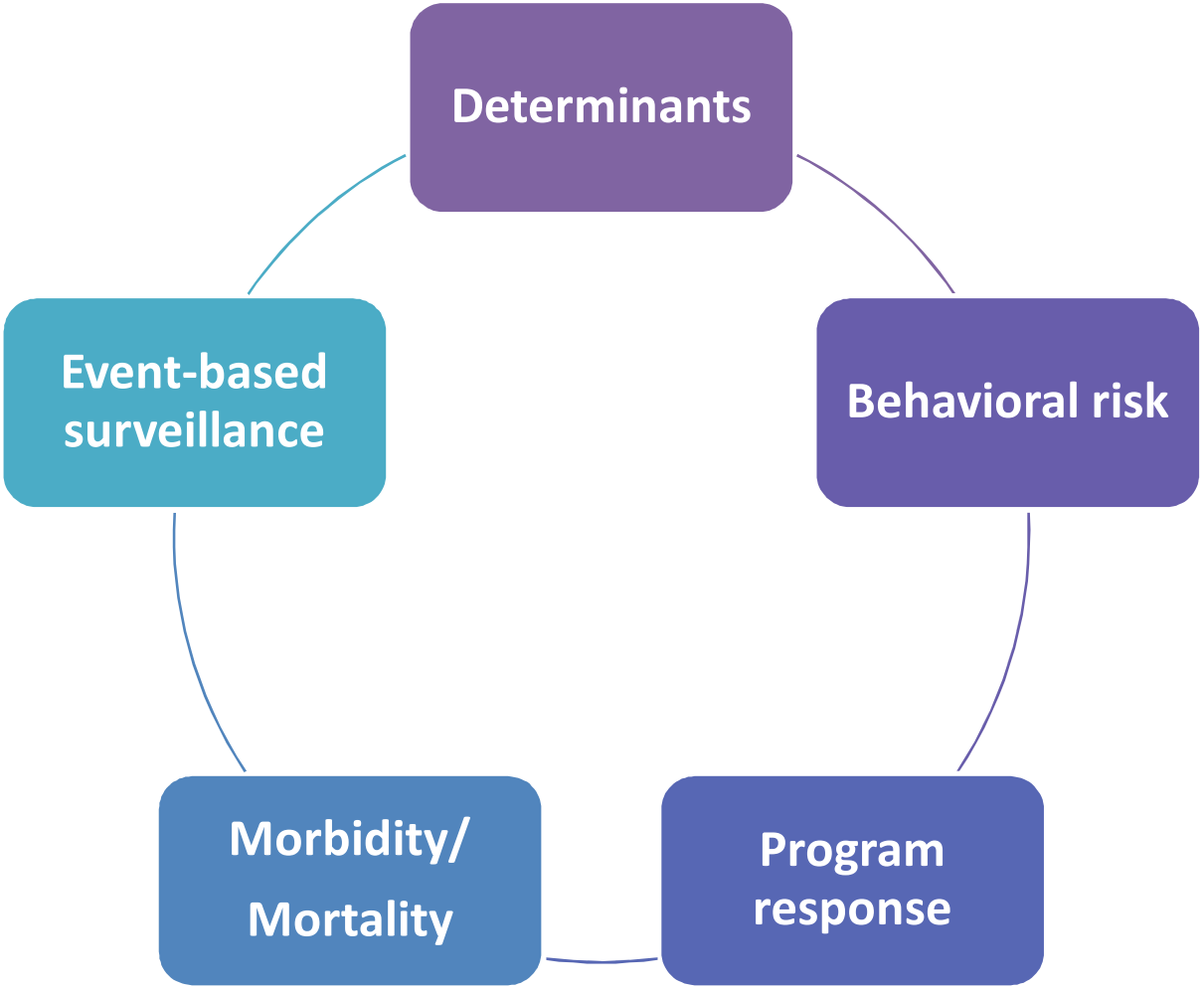
- In 2013, DDC Thailand reformed its working system
- Public health surveillance has become 1 of the 12 national health authority functions.
- The public health surveillance consists of 4 aspects
  - **Diseases and health threats – by DDC**
  - Health promotion
  - Food, drugs and health products
  - Health services

Surveillance on Diseases and health threats

5 major health problems

1. Communicable disease
2. HIV/AIDS and tuberculosis
3. Non-communicable disease
4. Injury
5. Environmental and Occupational diseases

5 Dimensions of surveillance



Example: Rabies surveillance

Data Sources	Determinants	Behavioral risk	Program response	Morbidity/ mortality	Event-based surveillance
National institute of health	Rabies virus in human				
Bureau of General Comm. Dis. Ctrl.		Vaccination behavior	Exposed patients receiving PEP rabies vaccine		
Bureau of Epidemiology				Morbidity rate Mortality rate Case-fatality rate	Abnormal Events
Department of livestock dev.	Rabies virus in animal Number of rabid animals				
Unknown		Behaviors among farmers/wildlife officers	PrEP among risk population		

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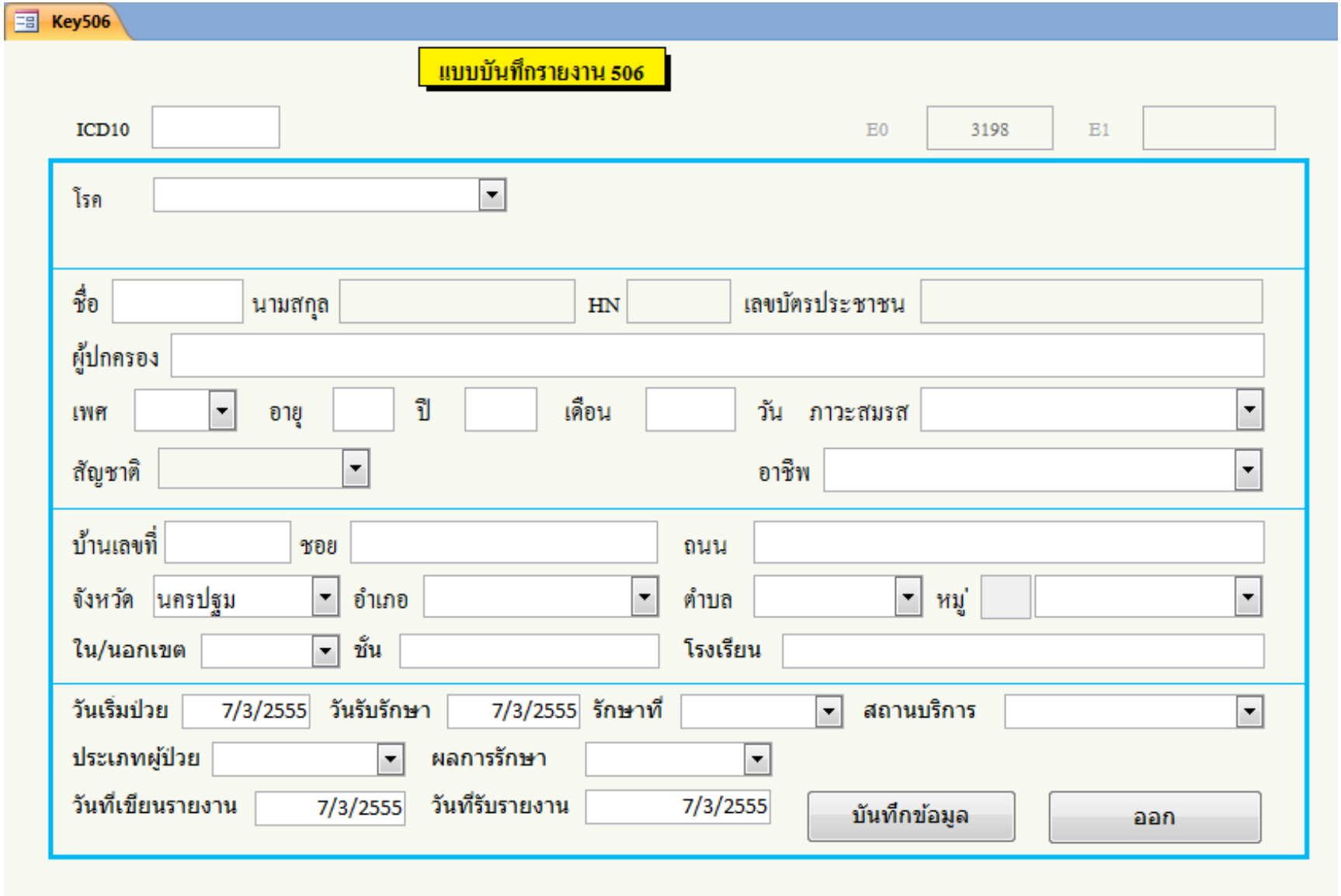
Surveillance systems by DDC-MOPH

- Communicable disease surveillance (R506)
- HIV/AIDS&TB
- Non-communicable disease surveillance
- Injury surveillance (IS)
- Env/Occ disease surveillance
- Event-based surveillance

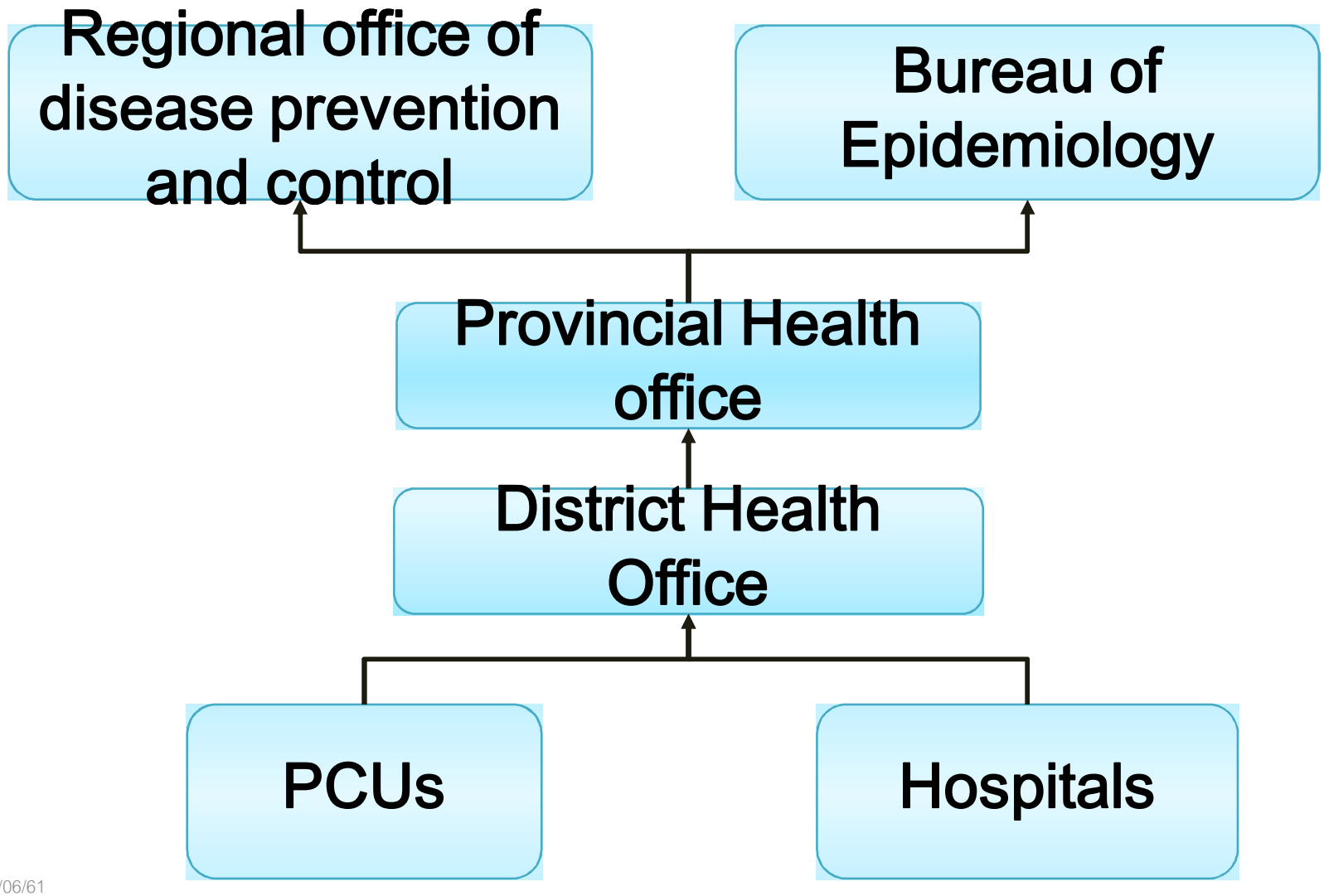
R506 surveillance system

- The main communicable disease surveillance in Thailand
- Established in 1968, starting from 14 diseases
- Data sources
  - Hospitals: district and provincial level
  - Primary care units: subdistrict level
- Currently, there are 64 diseases in the system
- Free access through BoE website for aggregated information
- By law, the notifiable disease must be reported to provincial health office within 7 days after the patient was found.



คำแนะนำในการติดตั้งโปรแกรม 506 Vision 4.04

R506: Data Flow



Diseases to be reported in R506 as of May 2018

- Acute Flaccid Paralysis
- AEFI
- Anthrax
- Chickenpox
- Chikungunya
- Cholera
- D.H.F.
- D.H.F.shock syndrome
- Dengue fever
- Diarrhoea
- Diphtheria
- Dysentery, uns.
- Dysentery,Amoebic
- Dysentery,Bacillary
- Encephalitis uns.
- Eosinophilic Meningitis
- Filariasis
- Food Poisoning
- Encephalitis uns.
- Eosinophilic Meningitis
- Filariasis
- Food Poisoning
- H.conjunctivitis
- Hand,foot and mouth disease
- Hepatitis A
- Hepatitis B
- Hepatitis C
- Hepatitis D
- Hepatitis E
- Hepatitis uns.
- Influenza
- Japanese B encephalitis
- Kala azar
- Leptospirosis
- Malaria
- Measles
- Measles c Complication
- Melioidosis
- Meningitis,uns.
- Meningococcal Meningitis
- Mumps
- Mushroom poisoning
- Paratyphoid
- Pertussis
- Pneumonia
- Poliomyelitis
- PUO
- Rabies
- Rubella
- Scarlet fever
- Scrub Typhus
- Streptococcus suis
- Tetanus
- Tetanus neonatorum
- Trichinosis
- Typhoid

13 Dangerous communicable diseases

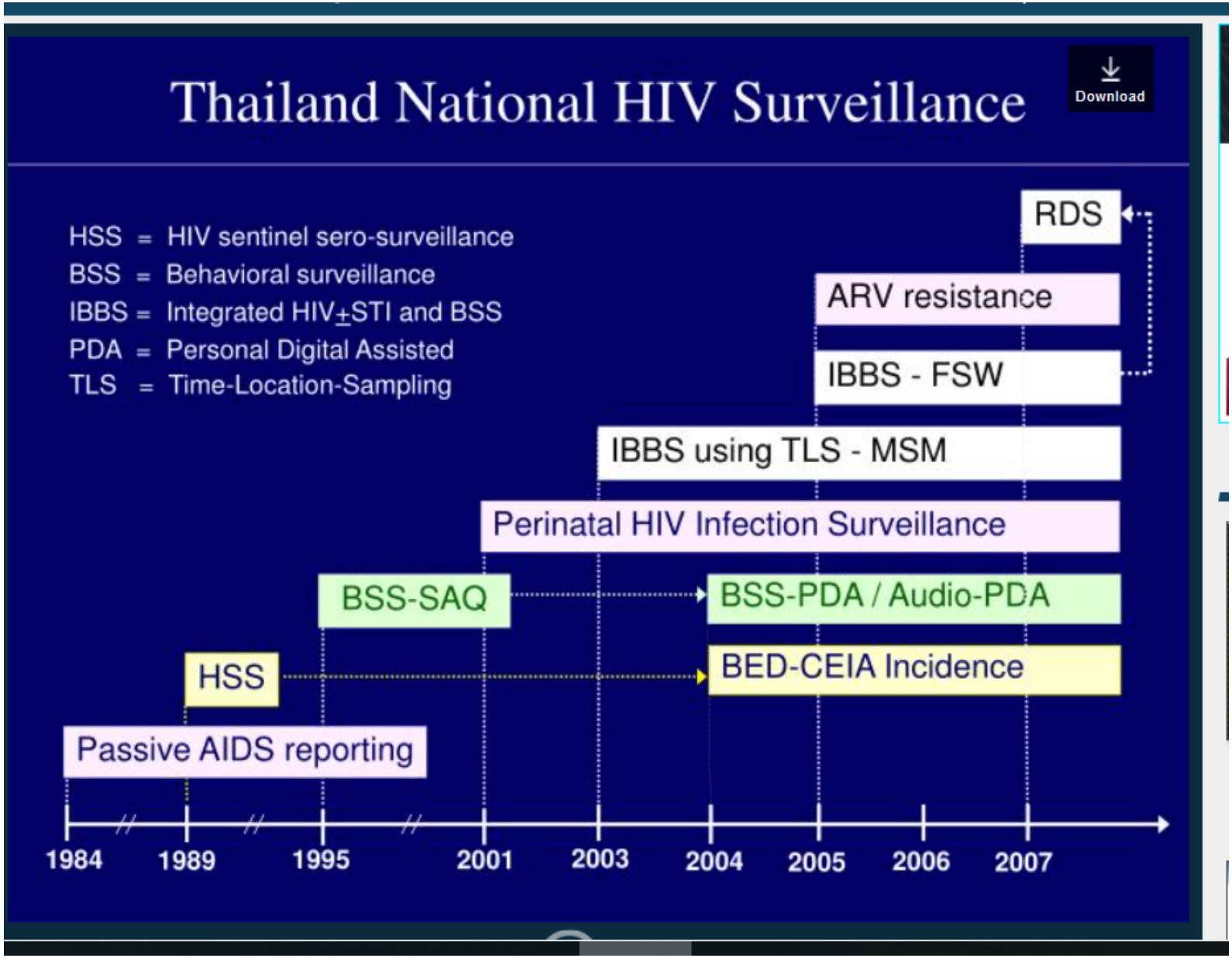
- Plaque
- Smallpox
- Crimean-Congo HF
- West Nile fever
- Yellow fever
- Lassa fever
- Nipah virus disease
- Marburg virus disease
- Ebola virus disease
- Hendra virus disease
- Severe acute respiratory syndrome (SARS)
- Middle East respiratory syndrome (MERS-Cov)

Report to BoE in 3 hours

พรบ.โรคติดต่อ 2558 ตามประกาศ สธ. ลงวัน 3 มิถุนายน 2559

Surveillance systems by DDC-MOPH

- Communicable disease surveillance (R506)
- HIV/AIDS&TB
- Non-communicable disease surveillance
- Injury surveillance (IS)
- Env/Occ disease surveillance
- Event-based surveillance



Pasakorn Akarasewi. Overview of the HIV Epidemic and the National HIV/AIDS surveillance.

Surveillance systems by DDC-MOPH

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- Event-based surveillance

NCD surveillance

- Behavioral risk factors surveillance system (BRFSS)
  - Age 15-74, every 5 years
- NCD surveillance
  - Established in 2003: Cardiovascular disease and hypertension
  - In 2006, stroke and chronic lung disease were added

Surveillance systems by DDC-MOPH

- Communicable disease surveillance (R506)
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Injury Surveillance (IS)

- Started planning in 1993
- In 1995 - 5 tertiary hospitals
- In 1997 - 28 tertiary hospitals
- From 2010 to present - 33 hospitals
- 2017 – IS-online
- Data collected
  - Accidents (Transportation and non-transportation)
  - Self-harm
  - Assault
  - Unintended injuries
  - Legal intervention/ war

Injury surveillance

Table 1 Proportion of severe injuries and death from drowning, by water scene,Thailand, 2015

Accidental drowning and submersion	severe injuries	Death
(ICD 10)	%	%
Drowning and submersion while in the bath-tub.(W65)	3.04	1.67
Drowning and submersion following fall into bath-tub.(W66)	0.57	0.84
Drowning and submersion while in swimming-pool.(W67)	3.23	1.67
Drowning and submersion following fall into swimming-pool.(W68)	1.90	0.84
Drowning and submersion while in natural water.(W69)	36.43	39.33
Drowning and submersion following fall into natural water.(W70)	7.59	7.53
Other specified drowning and submersion.(W73)	8.35	7.53
Unspecified drowning and submersion.(W74)	38.89	40.59
Total	100.00	100.00

Source of data: 33 IS Sentinel hospitals, Injury Surveillance (IS) Bureau of Epidemiology, Department of Disease Control, Ministry of Public Health

Surveillance systems by DDC-MOPH

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Env/Occ surveillance

- **Data sources**
  - Health data
    - National electronic health record
    - R506/2
    - IS
    - Event-based surveillance
    - Routine health check-up for employees
    - Etc.
  - Environmental data
    - Types of working places
    - Chemicals: pesticides
- **Health problems under surveillance**
  - Diseases related to agricultural activities
  - Diseases related to industrial activities
  - Diseases related to pollutions

Surveillance systems by DDC-MOPH

- Communicable disease surveillance (R506)
- HIV/AIDS&TB
- Non-communicable disease surveillance
- Injury surveillance (IS)
- Env/Occ disease surveillance
- Event-based surveillance

Event-based surveillance system

- Established in 2010
- Collects abnormal events
  - Communicable diseases
  - injury
  - Env/occ health threats e.g. chemical leakage, floods
  - Any abnormal events – disease outbreak in animals
- Improve timeliness of the response

THANK YOU