# Concepts and Methods in Infectious Disease Surveillance



## Edited by Nkuchia M. M'ikanatha and John K. Iskander



WILEY Blackwell

## **Table of Contents**

<u>Title page</u>

<u>Copyright page</u>

List of Contributors

**Foreword** 

**Preface** 

<u>Acknowledgments</u>

Acronyms and Abbreviations

<u>SECTION I: Introduction to Infectious Disease</u> <u>Surveillance</u>

<u>CHAPTER 1: Surveillance as a Foundation for</u> <u>Infectious Disease Prevention and Control</u>

**Background and Rationale** 

**Definitions** 

<u>Historical Development of Infectious Disease</u> <u>Surveillance</u>

**Conclusion** 

**References** 

<u>CHAPTER 2: The Legal Basis for Public Health</u> <u>Surveillance</u>

**Introduction** 

<u>The Roles of State and Federal Laws in Infectious</u> <u>Disease Surveillance</u>

The Limits of the Law

Examples from Recent Infectious Disease Outbreaks

<u>Key Summary Points for Public Health</u> <u>Practitioners</u> <u>References</u>

<u>CHAPTER 3: National, State, and Local Public Health</u> <u>Surveillance Systems</u>

Organization and Roles of Public Health Infectious Disease Surveillance Infrastructure in the United States and Steps in the Surveillance Process

Methods Used for Surveillance

<u>Resources</u>

Electronic Methods and Other Recent Innovations

**Conclusion** 

<u>References</u>

<u>CHAPTER 4: Quarantine and the Role of Surveillance</u> <u>in Nineteenth-Century Public Health</u>

<u>Overview</u>

**Introduction** 

Debating Quarantine and Yellow Fever, 1850–1880

<u>Summary</u>

**References** 

SECTION II: Specific Surveillance Systems

<u>CHAPTER 5: Surveillance for Vaccine-Preventable</u> <u>Diseases and Immunization</u>

**Introduction** 

<u>Step One: Understanding the Background: Burden</u> and Risk Factors of VPD Illness and Transmission Processes of the Target Pathogen</u>

Step Two: Understanding the Vaccines

<u>Step Three: Identify the Data Sources for Disease</u> <u>Surveillance and Their Availability, Strengths, and</u> <u>Weaknesses</u> <u>Step Four: Assessing the Performance: Conducting</u> <u>Post-Marketing VPD Surveillance and Assessing</u> <u>Vaccine Effectiveness</u>

<u>Step Five: Preparing for the Unexpected and</u> <u>Continuing the Evaluation</u>

<u>Conclusion</u>

<u>References</u>

<u>CHAPTER 6: Surveillance for Seasonal and Novel</u> <u>Influenza Viruses</u>

Introduction

<u>Clinical, Epidemiological, and Virological</u>

Characteristics and Implications for Surveillance

Possible Surveillance Schemes

Animal Influenza Surveillance

Surveillance during a Pandemic

**Monitoring of Vaccination Programs** 

**Conclusions** 

<u>Acknowledgements</u>

<u>References</u>

<u>CHAPTER 7: Population-Based Surveillance for</u> <u>Bacterial Infections of Public Health Importance</u>

**Introduction** 

History of ABCs

ABCs Sites and Infrastructure

ABCs Methods

Examples of Use of ABCs Data for Specific Pathogens

**Challenges and Opportunities** 

**Conclusions** 

**Acknowledgements** 

**References** 

**CHAPTER 8: Surveillance for Foodborne Diseases** 

Introduction

**Objectives of Foodborne-Disease Surveillance** 

Methods for Foodborne-Disease Surveillance

<u>Advances in the Detection of Foodborne Outbreaks</u> in the United States

**Conclusions** 

**References** 

Further Reading

<u>CHAPTER 9: Surveillance of Healthcare-Associated</u> <u>Infections</u>

**Introduction** 

National Healthcare Safety Network

Limitations of Rates for Interhospital Comparison

The Role of Microbiologic Surveillance in the Control and Prevention of HAI

**Conclusion** 

<u>References</u>

CHAPTER 10: Surveillance for Zoonotic Diseases

Introduction

**Transmission** 

Public Health Risk

**Emerging Zoonotic Disease and Global Impact** 

Zoonotic Disease Surveillance

**Bioterrorism** 

**Stakeholders** 

National Surveillance and Reporting

**Global Surveillance and Reporting** 

Examples of Surveillance for Zoonotic Diseases Conclusions

**<u>References</u>** 

<u>CHAPTER 11: Surveillance of Viral Hepatitis</u> <u>Infections</u>

**Introduction** 

**Clinical Background of Viral Hepatitis** 

**Epidemiology of Viral Hepatitis** 

<u>Purpose of Viral Hepatitis Surveillance</u>

**Surveillance Methods** 

Acute Viral Hepatitis

**Chronic HBV and HCV Infections** 

Progress in Viral Hepatitis Surveillance

Surveillance Mechanisms

**Conclusions** 

**References** 

<u>CHAPTER 12: Surveillance for Sexually Transmitted</u> <u>Diseases</u>

Introduction

Health Impact of STDs

**Objectives of STD Surveillance** 

Challenges in STD Surveillance

Strategies for STD Surveillance

**Conclusion** 

**References** 

<u>CHAPTER 13: Surveillance for HIV in the United</u> <u>States</u>

Introduction: Biology and Natural History of HIV

<u>Surveillance Implications of the Unique</u> <u>Epidemiology of HIV</u>

<u>The Impact of Stigma on the Development of HIV</u> <u>Surveillance Systems</u>

Surveillance Methods for HIV

Surveillance Activities Specific to HIV

Data Management

<u>Training and Technical Assistance for HIV</u> <u>Surveillance Staff</u>

Security and Confidentiality

**Uses of HIV Surveillance Data** 

**Expanded Surveillance** 

**Conclusion** 

<u>Acknowledgments</u>

**References** 

Additional Resources

<u>CHAPTER 14: Public Health Surveillance for</u> <u>Tuberculosis</u>

**Introduction** 

Laboratory Detection of *Mycobacterium tuberculosis* 

**TB Case Verification Criteria** 

<u>History of Tuberculosis Surveillance in the United</u> <u>States</u>

<u>Current Tuberculosis Reporting in the United</u> <u>States</u>

<u>Tuberculosis Surveillance Data Reporting and</u> <u>Publication</u>

<u>References</u>

<u>SECTION III: Methods Used in Surveillance and Data</u> <u>Analysis</u>

<u>CHAPTER 15: Analysis and Interpretation of</u> <u>Surveillance Data</u>

Introduction

<u>Challenge 1: Understand the Purpose and Context</u> <u>of Surveillance Systems</u>

<u>Challenge 2: Identify Baselines and Recognize</u> <u>Deviations</u>

<u>Challenges 3, 4, and 5: Interpretation of Meaning,</u> <u>Significance, and Degree of Certainty</u>

<u>Challenge 6: Communicate for Public Health</u> <u>Action</u>

Evolving Approaches to Disease Detection, Analysis, and Interpretation

**Conclusions** 

<u>Acknowledgments</u>

**References** 

<u>CHAPTER 16: Global Surveillance for Emerging</u> <u>Infectious Diseases</u>

**Introduction** 

**Overview of Surveillance** 

<u>Key Developments in Approaches to Global</u> <u>Surveillance</u>

**Remaining Challenges** 

 $\underline{Conclusion}$ 

**References** 

<u>CHAPTER 17: Infectious Disease Surveillance and</u> <u>Global Security</u>

**Introduction** 

**U.S-Based Global Disease Surveillance** 

<u>Challenges in Disease Surveillance for Global</u> <u>Security</u>

**Conclusions** 

**References** 

<u>CHAPTER 18: Implementation of the National</u> <u>Electronic Disease Surveillance System in South</u> <u>Carolina</u>

<u>Background: Organization of Public Health in</u> <u>South Carolina</u>

Surveillance Versus Surveillance Systems

Historical Perspective: The NETSS Era

Beginning of the NEDSS Era

<u>Options for Deployment of NEDSS-Compatible</u> <u>Software Systems</u>

Early Administrative and Technical Challenges

**NEDSS Technical Characteristics** 

**Resources for NBS Users** 

**Case Counting and Notifications to CDC** 

**Demonstrated Benefits of the NBS** 

<u>Summary</u>

<u>References</u>

<u>CHAPTER 19: Practical Considerations in</u> <u>Implementation of Electronic Laboratory Reporting</u> <u>for Infectious Disease Surveillance</u>

**Introduction** 

The Role of Clinical Laboratories in Surveillance

Benefits and Challenges in Implementation of Electronic Laboratory Reporting <u>Experiences and Lessons Learned from</u> <u>Implementation of Electronic Laboratory</u> <u>Reporting in Florida</u>

<u>Summary</u>

<u>References</u>

<u>CHAPTER 20: Use of Geographic Information</u> <u>Systems in Infectious Disease Surveillance</u>

Introduction

<u>An Overview of geographic information system</u> <u>Technology</u>

<u>Current Uses of the geographic information</u> <u>system in Infectious Disease Surveillance</u>

Integration of Spatial Information in geographic information system-Based Decision Support Systems

<u>Privacy Concerns, Spatial Scale Issues, and Data</u> <u>Quality Challenges</u>

Summary Points

<u>References</u>

<u>SECTION IV: Cross-Cutting Issues in Infectious Disease</u> <u>Surveillance</u>

<u>CHAPTER 21: Communication of Surveillance</u> <u>Findings</u>

**Introduction** 

<u>Three Essential Partners: Public Health</u> <u>Professionals, the Mass Media, and Lay Audiences</u>

Lessons Learned and Recommendations

<u>Summary</u>

<u>Acknowledgment</u>

<u>References</u>

<u>CHAPTER 22: Lessons Learned in Epidemiology and</u> <u>Surveillance Training in New York City</u>

**Introduction** 

The Public Health/Preventive Medicine Residency Program: Training Physicians in Public Health Theory and Methods

<u>The Health Research Training Program: Fostering</u> <u>Interest in Public Health across Disciplines:</u>

<u>The Epi Scholars Program: Providing Hands-on</u> <u>Training for Future Epidemiologists</u>

<u>Surveillance Scholars: Partnership with the MSPH</u> <u>at Columbia University</u>

EIS Officers and CSTE Applied Epidemiology Fellows: DOHMH Involvement in National

Training Programs

**Other Programs** 

Summary of Lessons Learned

**Conclusion** 

<u>References</u>

Additional Resources

<u>Index</u>

End User License Agreement

# **List of Tables**

Table 1.1 Ten diseases with the highest numbers of reported cases.

Table 2.1 Role of law in public health surveillance.

<u>Table 3.1 Potential uses of infectious disease</u> <u>surveillance data by level of the public health system.</u> Table 3.2 Case reporting and case notification.

Table 6.1 Summary of the three components of pandemic surveillance.

Table 7.1 Average annual incidence of meningococcal infection, Maryland college students, 1992–1997 [56]. Reproduced with permission of the American Medical Association.

Table 9.1 Definition of device-associated rates.

Table 9.2 Laboratory-confirmed bloodstream infections.

Table 10.1 Zoonotic diseases reportable to in humans and animals.<sup>5</sup>

Table 11.1 Summary of viral hepatitis A–E, inclusive of serologic tests in clinical use.

Table 11.2 Summary of viral hepatitis A–E risk history and screening recommendations

Table 11.3 Case definitions for viral hepatitis, nationally notifiable in the United States, 2012.

Table 12.1 Examples of strategies for STD surveillance.

Table 13.2 How HIV's epidemiology and its natural course, as well as the use of data, differ from most infectious diseases.

Table 13.1HIV infection stage\* based on age-specificCD4+ T-lymphocyte count or CD4+ T-lymphocytepercentage of total lymphocytes.

Table 13.3 Performance attributes, minimum performance measures, and activities to achieve maximum performance.

Table 14.1 National TB Surveillance System TB Case Classifications.

Table 14.2 Report of verified case of tuberculosis, Follow-up 1, and Follow-up 2 selected reporting variables.

Table 16.1 Comparison of key attributes and components of event-based and indicator-based surveillance.

Table 18.1Divisions of the DHEC Bureau of DiseaseControl with responsibilities related to diseasesurveillance and control.

Table 18.2 Advantages and disadvantages of adoption of <u>NBS.</u>

Table 19.1 Calculation for sensitivity and predictive value positive for a surveillance system.

Table 21.1 World Health Organization Outbreak Communication Guidelines.

Table 22.1 Formal training programs available at the New York City Department of Health and Mental Hygiene.

## **List of Illustrations**

<u>Figure 3.1 Public health surveillance data flow for state</u> <u>reportable and nationally notifiable diseases.</u>

Figure 4.1 Main Building of Philadelphia's Lazaretto quarantine station (ca. late 1880s). The Lazaretto station was built in 1799, 12 miles downriver from the Port of Philadelphia, in response to a series of devastating yellow fever epidemics in the city in the 1790s. Source: Photo from Henry Leffmann, Under the Yellow Flag (Philadelphia, 1896).

<u>Figure 4.2 René La Roche's map of the yellow fever</u> <u>epidemic at the Lazaretto in 1870, showing the</u> sequential locations of the brig *Home* (thought to have caused the outbreak) and the location of each patient at the time of the onset of symptoms. In La Roche's view, the map showed that each patient was immediately downwind of the infected vessel shortly before becoming ill and contracted the disease from the ship's foul air rather than through contagion. Source: *Remarks on the Origin and Mode of Progression of Yellow Fever in Philadelphia* (Philadelphia: E.C. Markley, 1871).

Figure 6.1 WHO Global Influenza Surveillance and Response System (GIRS), 2013. Source: Reproduced with permission from WHO.

<u>Figure 6.2</u> Influenza intensity, trends, and dominating strain in European Union countries, week 5, 2011. Source: European Centre for Disease Prevention and Control.

Figure 6.3 EIP influenza laboratory-confirmed cumulative hospitalization rates, 2009–2010 and the previous three seasons. \*The 2008–2009 EIP rate ended as of April 14, 2009, because of the onset of the 2009 H1N1 season. Source: Centers for Disease Control and Prevention.

Figure 7.1 Incidence of early- and late-onset invasive group B streptococcal (GBS) disease—Active Bacterial Core surveillance areas, 1990–2008, and activities for prevention of GBS disease

<u>(www.cdc.gov/groupbstrep/guidelines/downloads/Figure</u> <u>1\_GBS\_Decline.pdf</u>). ACOG: American College of <u>Obstetricians and Gynecologists; AAP: American</u> <u>Academy of Pediatrics. Source: Centers for Disease</u> <u>Control and Prevention.</u>

<u>Figure 7.2 Changes in invasive pneumococcal disease</u> <u>incidence by serotype group among children <5 years</u> old, 1998–2007 [20]. Seven-valent pneumococcal conjugate vaccine (PCV7) was introduced in the United States for routine use among young children and infants in the second half of 2000. Source: Reproduced with permission of OUP.

Figure 7.3 Changes in invasive pneumococcal disease incidence by serotype group among adults ≥65 years, 1998–2007 [20]. Seven-valent pneumococcal conjugate vaccine (PCV7) was introduced in the United States for routine use among young children and infants in the second half of 2000. Source: Reproduced with permission of OUP.

<u>Figure 8.1 Cycle of foodborne-disease surveillance,</u> <u>control, and prevention. Source: U.S. Centers for</u> <u>Disease Control and Prevention.</u>

<u>Figure 8.2</u> Surveillance steps that must occur for <u>laboratory-confirmed cases to be reported to</u> <u>surveillance. Source: Centers for Disease Control and</u> <u>Prevention.</u>

<u>Figure 9.1 Ventilator-associated pneumonia (VAP) rates</u> <u>by type of intensive care unit. Source: 2006 NHSN</u> <u>Annual Report, posted at</u> http://www.cdc.gov/nhsn/dataStat.html.

Figure 10.1 Transmission of zoonotic disease infections. Zoonotic disease transmission can occur directly through direct contact with animals (e.g., rabies) or indirectly through contact with an animal's environment (e.g., tapeworm) or through a vector (e.g., deer tick for Lyme disease). Source: Sameh Boktor, Pennsylvania Department of Health. Reproduced with permission of Sameh Boktor.

<u>Figure 10.2</u> <u>Plague maintenance cycle in the United</u> <u>States. Plague is caused by infection with *Yersinia*</u> *pestis,* which can result in various forms of disease depending on route of exposure (e.g., bubonic plague through person-to-person contact.) As shown in this figure, human and domestic animals bitten by fleas are at risk of plague infection. Source: Centers for Disease Control and Prevention.

Figure 12.1 Trends in chlamydia case rates among women aged 15–24 years [3], percentage of women aged 16–24 years tested for chlamydia through Medicaid [29], and use of NAAT for screening for chlamydia in women aged 15–24 tested in family planning clinics [54].

Figure 12.2 Percentage of Neisseria gonorrhoeae isolates with resistance or intermediate resistance to ciprofloxacin, 1990-2010, obtained from the Gonococcal Isolate Surveillance Project (GISP) [55]. Note: Resistant isolates have ciprofloxacin minimum inhibitory concentrations (MICs)  $\geq$ 1 µg/mL. Isolates with intermediate resistance have ciprofloxacin MICs of 0.125-0.500 µg/mL. Susceptibility to ciprofloxacin was first measured in GISP in 1990. Source: CDC, Sexually Transmitted Disease Surveillance, 2010. 2011, Department of Health and Human Services: Atlanta, GA.

<u>Figure 13.1 Viral load and antibody levels following</u> <u>initial HIV infection</u>

Source: Das G, Baglioni P, Okosieme O. Easily Missed? Primary HIV Infection. BMJ 2010; 341:c4583. Reproduced with permission of BMJ Publishing Group Ltd.

Figure 13.2 Sentinel events in HIV/AIDS case surveillance. Source: Nkuchia M. M'ikanatha, Ruth Lynfield, Chris A. Van Beneden and Henriette de Valk, eds. Infectious Disease Surveillance. Blackwell Publishing, 2007. Reprinted with permission of John Wiley & Sons. <u>Figure 13.3 Flow of electronic laboratory data in</u> <u>Michigan.</u>

<u>Figure 13.4 Flow of case reports, lab test, risk factor,</u> <u>demographic information in HIV Surveillance: South</u> <u>Carolina, calendar year 2010. Source: Division of</u> <u>Surveillance and Technical Support, South Carolina</u> <u>Department of Health and Environmental Control,</u> <u>Columbia SC.</u>

<u>Figure 14.1 Tuberculosis incidence rates, United States,</u> <u>2010. (Source: Centers for Disease Control and</u> <u>Prevention. Reported Tuberculosis in the United States,</u> <u>2010. Atlanta, GA: U.S. Department of Health and</u> <u>Human Services, CDC, October 2011.</u> <u>www.cdc.gov/features/dstb2010data/index.html.)</u>

Figure 14.2 Number and rate of tuberculosis (TB) cases among U.S.-born and foreign-born persons, by year reported—United States, 1993–2010. Source: Centers for Disease Control and Prevention, Division of TB Elimination, National TB Surveillance System.

Figure 15.1 This map is adapted from CDC Situation Awareness unit surveillance maps of Haiti, 2011. It identifies affected cities and treatment centers based on the best publically available data at the time and illustrates walking buffers around the treatment centers. The map superimposes information from CDC; the National Cholera Monitoring System; Haiti's Ministry of Public Health and Population (Ministère de la Santé Publique et de la Population, MSPP); MSPP's Division of Epidemiology, Laboratory and Research (Direction d'Epidémiologie, de Laboratoire et de Recherches, DELR); Haiti's National Public Health Laboratory (Laboratoire National de Sante de Publique, LNSP) (case data); the United Nations Stabilization Mission in Haiti (MINUSTAH) (Department boundaries); and the

Pan-American Health Organization (PAHO) (cholera treatment center) as of January 2011 onto a base layer developed from NASA [30]. John Snow's hand-drawn map of the residences of fatal cholera cases associated with the Broad Street pump in London in 1850 is inset. This figure illustrates the utility of integrating surveillance data into visualization products (specifically maps), of handheld computing devices for transmission of georeferenced surveillance data, and of spatial analysis combined with satellite imagery to assess risk factors. Source: Left image adapted from Snow, John. On the Mode of Communication of Cholera, 2nd edition. London: John Churchill, New Burlington Street, England, 1855. Reproduced with permission of Ralph R. Frerichs, University of California, Los Angeles School of Public Health Department of Epidemiology. Right image developed by Brian Kaplan with the CDC GRASP unit and with the Situational Awareness Unit of the Centers for Disease Control and Prevention Emergency **Operations**.

Figure 15.2 Percentage of all deaths attributable to pneumonia and influenza (P&I) by surveillance week and year—122 U.S. Cities Mortality Reporting System, United States, 2007-2012. This graph illustrates the periodicity of influenza infection and the seasonal range of associated baseline observations, the utility of time series forecasting, the determination of epidemic thresholds, and the potential for mathematical models to contribute to the scientific basis for public health policy. Source: Adapted from [10]. Centers for Disease Control and Prevention.

<u>Figure 15.3 Number of reported cases of Reye's</u> <u>syndrome in relation to the timing of public</u> <u>announcements of the epidemiologic association of</u> <u>Reye's syndrome with aspirin ingestion and in relation to</u> the labeling of aspirin-containing medications. Source: Adapted from [11] to illustrate the value of time series plotting and of context for interpretation.

Figure 15.4 Monthly measles time series for the United States, 1960–1990, at (top to bottom) four descending spatial scales: the United States, the West Division, the Pacific Region, and the state of California. Source: Adapted from [13] to illustrate the periodicity of infectious and vaccine preventable diseases, the impact of diminishing numbers of observations or regional bias in data collection on analysis, the use of both vertical chart axes to allow comparison of two time series, the use of solid bar charts (left-hand axis) vs. line traces (right-hand axis), and of the same data plotted using linear (left-hand axis) and logarithmic (right-hand axis) scales.

Figure 15.5 Selected notifiable disease reports, United States; comparison of provisional 4-week totals April 21, 2012, with historical data. Note that no measles cases were reported for the reporting week illustrated in this figure. This graph illustrates the utility of ratios and log scales for visualizing surveillance data, of the comparison of current to historic data, and of defined thresholds for interpretation of significance. Adapted from [12], Centers for Disease Control and Prevention.

<u>Figure 16.1 General phases of activity that occur during</u> <u>disease surveillance.</u>

<u>Figure 17.1 CDC Global Disease Detection and</u> <u>Response network. Source:</u> http://www.cdc.gov/globalhealth/gdder/gdd/regionalcent

ers.htm. Centers for Disease Control and Prevention.

<u>Figure 17.2 DoD Global Emerging Infections</u> <u>Surveillance network.</u> Figure 17.3 WHO's Global Influenza Surveillance and Response System map. \*Based on UN M49 classification of developing/developed countries. Source: Reproduced with permission of WHO.

http://gamapserver.who.int/mapLibrary/Files/Maps/GISR S\_20130425\_1.jpg.

<u>Figure 17.4 Mobile penetration in resource-limited</u> <u>settings. Source: Adapted from International</u> <u>Telecommunications Union. *Key Global Telecom* <u>Indicators for the World Telecommunication Service</u> <u>Sector. http://www.itu.int/en/ITU-</u> <u>D/Statistics/Documents/statistics/2013/ITU\_Key\_2005-</u> <u>2013 ICT\_data.xls (accessed January 23, 2014).</u></u>

Figure 19.1 Percentage of laboratory reports received by 57 public health jurisdictions through electronic laboratory reporting in the United States in 2013. The jurisdictions include 50 states, the District of Columbia, Puerto Rico, and five cities. As of July 31, 2013, a total of 54 of the 57 jurisdictions were receiving at least some laboratory reports through ELR. Source: Centers for Disease Control and Prevention, *Morbidity and Mortality Weekly Report*. September 27, 2013;62(38);797–799.

Figure 19.2 Poster used in Oregon to disseminate a list of conditions reportable by clinical laboratories. Immediately reportable conditions are highlighted with a telephone icon.

Source: http://public.health.oregon.gov/DiseasesConditi ons/CommunicableDisease/ReportingCommunicableDise ase/Pages/index.aspx. Reproduced with permission of Oregon Division of Public Health.

Figure 20.1 Distribution of human cases of West Nile virus disease in the continental United States, 1999– 2004. Source: Adapted from

http://www.cdc.gov/ncidod/dvbid/westnile/surv&control\_

archive.htm. Centers for Disease Control and Prevention.

Figure 20.2 Combining different types of data in a GIS.

Figure 20.3 Human plague case occurrence in the West Nile region of Uganda. Reported cumulative incidence per 1000 population (1997–2007) by parish [38]. (A) Model prediction of parishes characterized as elevated risk [38]. (B) Subparish-level model of areas predicted to pose an elevated risk of exposure to *Y. pestis* [39]. (C) Location of the area of interest is shown as an inset. Source: Reproduced with permission of The American Journal of Tropical Medicine and Hygiene [38].

Figure 22.1 Dr. Michael Phillips, EIS 2000 (far left), consults a map of Staten Island with epidemiologists Beth Maldin, Anne Labowitz, and Debjani Das (from left to right). Dr. Phillips, as a member of the Bureau of Communicable Disease of the NYC Department of Health, led the West Nile virus serosurvey in the fall of 2000, a year after the virus was first recognized in the Western Hemisphere. Source: Reproduced with permission of Don Weiss, Director of Surveillance, Bureau of Communicable Disease, New York City Department of Health and Mental Hygiene.

# Concepts and methods in infectious disease surveillance

EDITED BY

#### Nkuchia M. M'ikanatha

Surveillance Epidemiologist Pennsylvania Department of Health Harrisburg, PA, USA

#### John K. Iskander

CAPT, United States Public Health Service Senior Medical Consultant Office of the Associate Director for Science Centers for Disease Control and Prevention Atlanta, GA, USA

## WILEY Blackwell

This edition first published 2015 © 2015 by John Wiley & Sons, Ltd.

Materials appearing in this book are prepared by individuals as part of their official duties as United States government employees and are not covered by the above-mentioned copyright, and any views expressed herein do not necessarily represent the views of the United States government. Such individuals' participation in the Work is not meant to serve as an official endorsement of any statement to the extent that such statement may conflict with any official position of the United States Government. This applies to Chapters 1, 2, 3, 5, 7, 8, 10, 11, 12, 14, 15, 17, 20.

*Registered office:* John Wiley & Sons, Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

*Editorial offices:* 9600 Garsington Road, Oxford, OX4 2DQ, UK

The Atrium, Southern Gate, Chichester, West Sussex, PO19

8SQ, UK

111 River Street, Hoboken, NJ 07030-5774, USA

For details of our global editorial offices, for customer services and for information about how to apply for permission to reuse the copyright material in this book please see our website at <u>www.wiley.com/wiley-blackwell</u>

The right of the author to be identified as the author of this work has been asserted in accordance with the UK Copyright, Designs and Patents Act 1988.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, except as permitted by the UK Copyright, Designs and Patents Act 1988, without the prior permission of the publisher.

Designations used by companies to distinguish their products are often claimed as trademarks. All brand names and product names used in this book are trade names, service marks, trademarks or registered trademarks of their respective owners. The publisher is not associated with any product or vendor mentioned in this book. It is sold on the understanding that the publisher is not engaged in rendering professional services. If professional advice or other expert assistance is required, the services of a competent professional should be sought.

The contents of this work are intended to further general scientific research, understanding, and discussion only and are not intended and should not be relied upon as recommending or promoting a specific method, diagnosis, or treatment by health science practitioners for any particular patient. The publisher and the author make no representations or warranties with respect to the accuracy or completeness of the contents of this work and specifically disclaim all warranties, including without limitation any implied warranties of fitness for a particular purpose. In view of ongoing research, equipment modifications, changes in governmental regulations, and the constant flow of information relating to the use of medicines, equipment, and devices, the reader is urged to review and evaluate the information provided in the package insert or instructions for each medicine, equipment, or device for, among other things, any changes in the instructions or indication of usage and for added warnings and precautions. Readers should consult with a specialist where appropriate. The fact that an organization or Website is referred to in this work as a citation and/or a potential source of further information does not mean that the author or the publisher endorses the information the organization or Website may provide or recommendations it may make. Further, readers should be aware that Internet Websites listed in this work may have changed or disappeared between when this work was written and when it is read. No warranty may be created or extended by any promotional statements for this work. Neither the publisher nor the author shall be liable for any damages arising herefrom.

#### Library of Congress Cataloging-in-Publication Data

Concepts and methods in infectious disease surveillance / edited by Nkuchia M. M'ikanatha, John K. Iskander.

p. ; cm.

Includes bibliographical references and index.

ISBN 978-0-470-65939-7 (paper)

I. M'ikanatha, Nkuchia M., editor. II. Iskander, John K., editor.

[DNLM: 1. Communicable Disease Control. 2. Disease Notification. 3. Disease Outbreaks-prevention & control. 4. Public Health Surveillance-methods. WA 110]

RC111

616.9-dc23

#### 2014017664

A catalogue record for this book is available from the British Library.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

Cover image: Left-hand image: adapted from Snow, John. *On the Mode of Communication of Cholera*, 2nd edition. London: John Churchill, New Burlington Street, England, 1855. Reproduced with permission of Ralph R. Frerichs, University of California, Los Angeles School of Public Health Department of Epidemiology. Right-hand image: developed by Louisa Chapman with the Situational Awareness Unit of the Centers for Disease Control and Prevention Emergency Operations.

Cover design by Andy Meaden

# **List of Contributors**

#### Lennox K. Archibald

Hospital Epidemiologist Malcom Randall Veterans Administration Medical Center North Florida/South Georgia Veterans Health System Gainesville, FL, USA

#### Lori R. Armstrong

Epidemiologist Division of Tuberculosis Elimination Centers for Disease Control and Prevention Atlanta, GA, USA

#### **David S. Barnes**

Associate Professor Department of History and Sociology of Science University of Pennsylvania Philadelphia, PA, USA

#### **Casey Barton Behravesh**

Commander, U.S. Public Health Service

**Deputy Branch Chief** 

Outbreak Response and Prevention Branch

Division of Foodborne, Waterborne, and Environmental Diseases

National Center for Emerging and Zoonotic Infectious Diseases

Centers for Disease Control and Prevention

Atlanta, GA, USA

#### **Kyle T. Bernstein**

Director

Applied Research, Community Health Epidemiology, and Surveillance

Population Health Division

San Francisco Department of Public Health

San Francisco, CA, USA

#### **David L. Blazes**

Director, Military Tropical Medicine

US Navy Specialty Leader for Infectious Diseases

Uniformed Services University of the Health Sciences,

Bethesda, MD, USA

#### **Eric Brenner**

Medical Epidemiologist

South Carolina Department of Health and Environmental Control

Columbia, SC, USA

#### Louisa E. Chapman

Captain, U.S. Public Health Service

Medical Epidemiologist

Public Health Surveillance Program Office

Office of Surveillance, Epidemiology, and Laboratory Services

Centers for Disease Control and Prevention

Atlanta, GA, USA

#### **Elizabeth Chuang**

Assistant Professor Department of Family and Social Medicine Palliative Care Services Montefiore Medical Center Bronx, NY, USA

#### **Daniel R. Church**

Epidemiologist/Viral Hepatitis Coordinator Bureau of Infectious Disease Hinton State Laboratory Institute Massachusetts Department of Public Health Jamaica Plain, MA, USA

#### **Bruno Christian Ciancio**

Head, Epidemiological Methods Section Surveillance and Response Support Unit European Centre for Disease Prevention and Control Stockholm, Sweden

### Alfred DeMaria, Jr.

State Epidemiologist, Medical Director Bureau of Infectious Disease Hinton State Laboratory Institute Massachusetts Department of Public Health Jamaica Plain, MA, USA

#### **Rebecca J. Eisen**

Research Biologist Division of Vectorborne Diseases Centers for Disease Control and Prevention Fort Collins, CO, USA

#### Lars Eisen

Associate Professor Department of Microbiology, Immunology and Pathology Colorado State University Fort Collins, CO, USA

#### James J. Gibson

Director of Disease Control and State Epidemiologist (Retired)

South Carolina Department of Health and Environmental Control

Columbia, SC, USA

## **Carolyn Greene**

Deputy Commissioner

Division of Epidemiology

New York City Department of Health and Mental Hygiene

Queens, NY, USA

### **Gillian A. Haney**

Director

Integrated Surveillance and Informatics Services

Bureau of Infectious Disease

Hinton State Laboratory Institute

Massachusetts Department of Public Health

Jamaica Plain, MA, USA

### Lee H. Harrison

Infectious Diseases Epidemiology Research Unit

**Division of Infectious Diseases** 

University of Pittsburgh Graduate School of Public Health and School of Medicine

Pittsburgh, PA, USA

#### **Richard S. Hopkins**

Department of Epidemiology Colleges of Public Health and Health Professions and of Medicine University of Florida Gainesville, FL, USA

#### **Gail Horlick**

Senior Legal Analyst Office of Scientific Integrity Centers for Disease Control and Prevention Atlanta, GA, USA

#### John K. Iskander

CAPT, United States Public Health Service Senior Medical Consultant Office of the Associate Director for Science Centers for Disease Control and Prevention Atlanta, GA, USA

## Ruth A. Jajosky

Epidemiologist Division of Health Informatics and Surveillance Center for Surveillance, Epidemiology and Laboratory Services Office of Public Health Scientific Services Centers for Disease Control and Prevention Atlanta, GA, USA