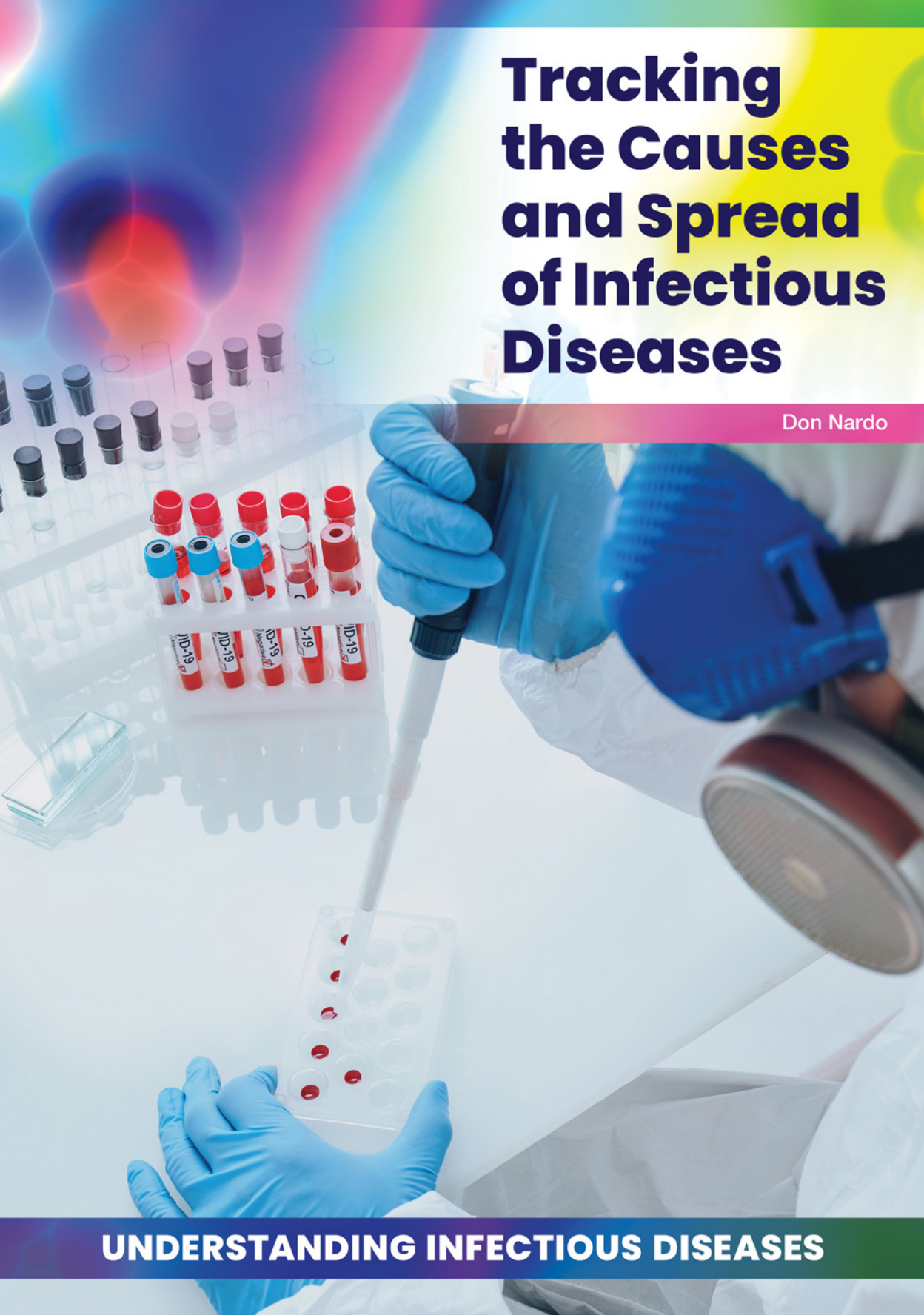
Tracking the Causes and Spread of Infectious Diseases

Don Nardo



UNDERSTANDING INFECTIOUS DISEASES

About the Author

Classical historian, amateur astronomer, and award-winning author Don Nardo has written numerous volumes about scientific topics, including *Destined for Space*, winner of the Eugene M. Emme Award for best astronomical literature; *Tycho Brahe*, winner of the National Science Teacher's Association's best book of the year; *Planet Under Siege*; *Climate Change*; *Deadliest Dinosaurs*; and *The History of Science*. Nardo, who also composes and arranges orchestral music, lives with his wife, Christine, in Massachusetts.

Printed in the United States

For more information, contact:
ReferencePoint Press, Inc.
PO Box 27779
San Diego, CA 92198
www.ReferencePointPress.com

Picture Credits:
Cover: Kiselev Andrey Valerevich/Shutterstock.com

6: ©Look and Learn/Bridgeman Images
10: nullplus/iStock
14: Underwood Archives/UIG/Bridgeman Images
18: Tarker/Bridgeman Images
21: Anthony Bannister/NHPA/Photoshot/Newscom
25: Kateryna Kon/Shutterstock.com
27: Associated Press
32: Associated Press
34: CDC/Science Photo Library
38: ©SZ Photo/Waldemar Hauschild/Bridgeman Images
40: Malota/Shutterstock.com
44: Associated Press
46: Leonie Broekstra/Shutterstock.com
50: Jess Gregg/Shutterstock.com
53: faboi/Shutterstock.com

LIBRARY OF CONGRESS CATALOGING-IN-PUBLICATION DATA

Names: Nardo, Don, 1947- author.
Title: Tracking the causes and spread of infectious diseases / by Don Nardo.
Description: San Diego, CA : ReferencePoint Press, [2022] | Series: Understanding infectious diseases | Includes bibliographical references and index.
Identifiers: LCCN 2021008863 (print) | LCCN 2021008864 (ebook) | ISBN 9781678201647 (library binding) | ISBN 9781678201654 (ebook)
Subjects: LCSH: Epidemiology--Juvenile literature. | Communicable diseases--Epidemiology--Juvenile literature. | Epidemics--Juvenile literature. | Public health surveillance--Juvenile literature.
Classification: LCC RA653.5 .N37 2022 (print) | LCC RA653.5 (ebook) | DDC 614.4--dc23
LC record available at https://lccn.loc.gov/2021008863
LC ebook record available at https://lccn.loc.gov/2021008864

CONTENTS

Disease Detectives' Basic Methods

When John Snow, the world's first true disease detective, was solving the mystery of what caused the 1854 cholera outbreak in London, scientists had known of the existence of germs for close to two centuries. The earliest microscopes had revealed a previously unknown world of organisms too tiny for the unaided eye to see. The problem was that for a long time, scientists did not realize that some of these microbes cause various diseases. In fact, the general view in those days was that germs were more or less harmless and served no important purpose in nature.

Thus, even though Snow showed that cholera spread as the result of something harmful in certain water sources, most scientists did not yet recognize that germs were the culprit. It was not until the 1860s through the 1880s that a small group of biological pioneers proved the link between certain microbes and a host of deadly diseases. The revelation that germs cause many diseases made it easier for early epidemiologists to track the spread of those maladies because they now knew what to look for. Even so, most medical researchers of the late 1800s and early 1900s continued to search for cures. The first few generations of disease detectives took a different path, however. They worked to determine how various diseases spread. Such knowledge, they believed, would make it easier for medical

authorities to predict, control, and maybe even halt some disease outbreaks. And they were correct.

Developing Epidemiological Methods

The early disease detectives found that much of their work could not be done in the confines of a laboratory. Instead, to track down the source of a disease, they often needed to go out into the field—traveling to distant towns, villages, farms, forests, lakes, and other physical settings. There, they could collect water and soil samples and interview the residents of the areas affected by a disease in order to gather clues to solve the mystery of how that sickness spread.

Collecting soil samples and interviewing people are two of the techniques used by early epidemiologists. Each was a tool they could employ to accomplish their work. Over time, they learned to combine these individual tools into complex investigations that they came to call field studies. By the early twentieth century, they had developed three major kinds of studies, and these remain the mainstay of epidemiology today.

field study

A scientific investigation conducted outside of a laboratory setting

The first and perhaps most basic of the three is the case series study, sometimes called a clinical study. Since it was first used in the late 1800s, a prominent physician points out, it has "profoundly influenced the medical literature and continues to advance our knowledge in the present time."[5] A case series study is often inspired by a report of one or more people who recently have become ill and sought help from doctors. If the doctors conclude that their patients have a contagious disease, or if they cannot identify the disease, they will likely ask an epidemiologist to do a case series study. It consists of looking closely at the overall circumstances of the patients.

The principal pieces of information that the disease detectives look for in the study are key factors that most or all the patients have in common. To determine that, the investigators ask a series

of questions to find out "what," "when," "where," and "who." The "what" is largely the symptoms, or the diagnosis given by the doctors. The "when" is the approximate day each person became ill. The "where" includes the neighborhood where the patients live, as well as daily routines such as where they recently shopped or ate or visited. The "who" consists of personal details such as gender, age, and type of work of the individual patient and other members of the household.

A Famous Case Series Study

A well-known example of a case series study occurred in Sydney, Australia, in 1941. There an eye surgeon named Norman McAlister Gregg noticed an abnormally large number of cases of babies with eye cataracts. He had seen thirteen in a single year in his own practice alone—a number that seemed unusually high.

Attempting to gather information that might shed light on the issue, Gregg used a tool employed regularly by epidemiologists—the case series study. He devised a series of questions intended

Early epidemiologists collected soil samples to track down the source of diseases. To do so, they needed to go out into the field.

to find out what, if anything, the babies and their mothers had in common. These inquiries asked about various aspects of the mothers' daily routines, the kind of food they ate, their social lives, and so forth. One question related to recent illnesses. That is, had they or someone else in the family been ill in the past few years?

That last question proved vital. Indeed, one factor almost all the women had in common was that they had either been exposed to or contracted rubella, or German measles. From this fact revealed by the study, Gregg suspected something that scientists proceeded to prove—that a fetus in the womb exposed to rubella can suffer certain birth defects, including cataracts.

case series study

A scientific investigation that searches for factors that most or all members of a group of sick people share

How Do Two Groups Differ?

Another major method that epidemiologists employ is the case control study. It consists of a detailed examination of a number of sick people in a given region. The disease detectives try to determine what is different about the members of that group from people in that area who have *not* come down with that sickness. That is, how do the lives and habits of the sick individuals differ from those of the rest? This is another way to reveal how a disease spreads through an area, laying the groundwork for containing the spread.

A case control study conducted by epidemiologist Nathan Shaffer in 1987 offers a striking example. Shaffer sought to help doctors in the small African nation of Guinea-Bissau stop a large cholera outbreak. He first tried to find the main source of the disease. It was well known since John Snow's time that cholera usually spreads through contaminated water. Indeed, Shaffer later recalled, "the epidemic was spreading up and down the coast, [so] right away I suspected shellfish."[6]

Tracking Down a Food-Borne Illness

One of many successful US epidemiological field studies conducted in recent decades occurred in 2004. The Massachusetts Department of Public Health received word of an outbreak of the serious liver disease hepatitis A in Marshfield, a small town located a few miles south of Boston. During the span of only a few weeks, twenty cases of the disease emerged, and local epidemiologists immediately got to work. Knowing that hepatitis A is often caused by eating contaminated food, they interviewed the sick individuals about their daily eating habits. From this data, the investigators suspected that restaurant food was the culprit. But which of the five local Marshfield restaurants served that food? To answer that question, the scientists conducted a case control study to compare the restaurant choices of the sick people to those of locals who did not get sick. Nineteen of the patients answered a special questionnaire, as did thirty-eight healthy people who ate at local restaurants. By comparing the answers given by members of the two groups, the scientists were able to narrow the search down to a single eating establishment. Sure enough, lab tests of the food the restaurant served confirmed that it was the source of the outbreak.

Shaffer was right. But though he had shown how people living on the coast had gotten cholera, he now faced a more difficult mystery. Several people in an inland village who never fished on the coast had also come down with cholera. To find out why, Shaffer used a case control study to compare the recent activities of people on the coast to those of the people in the village. It revealed that one of the villagers had briefly been a dockworker on the coast. That man had died of cholera, and when his body was shipped home, some villagers washed it before burying it. Those same people then prepared the funeral feast. In this way the cholera germs passed from the dead man to several of the villagers.

Long-Term Information Gathering

The third primary type of investigation regularly employed by disease detectives is the cohort study, in which the detectives follow the members of a group of people over time. According to epidemiologists Dag S. Thelle and Petter Laake:

SOURCE NOTES

Introduction: Birth of a New Medical Science

1. Quoted in Judith Summers, *Soho: A History of London's Most Colorful Neighborhood*. London: Bloomsbury, 1989, p. 113.
2. Quoted in Peter Vinten-Johansen, "In Fairness to Snow," John Snow Archive and Research Companion, October 19, 2013. http://johnsnow.matrix.msu.edu.
3. Addison Brickson, "John Snow and Epidemiology," ArcGIS Online. www.arcgis.com.
4. Quoted in Ralph R. Freriches, "Reverend Henry Whitehead," UCLA Department of Epidemiology. www.ph.ucla.edu.

Chapter One: Disease Detectives' Basic Methods

5. Mohammad H. Murad et al., "Methodological Quality and Synthesis of Case Series and Case Reports," *BMJ Evidence-Based Medicine*, April 2018. https://ebm.bmj.com.
6. Quoted in Peter Jaret, "The Disease Detectives," *National Geographic*, January 1991, p. 34.
7. Quoted in ScienceDirect, "Cohort Studies," 2021. www.sciencedirect.com.
8. Brenda Wilson, "AIDS Study Marks 25th Year," *All Things Considered*, NPR, April 24, 2009. www.npr.org.
9. Andrew W. Artenstein, "The Discovery of Viruses: Advancing Science and Medicine by Challenging Dogma," Science Direct, 2012. www.sciencedirect.com.

Chapter Two: The Mystery of Sleeping Sickness

10. Quoted in Dana L. Bivens, "African Sleeping Sickness in British Uganda and in Belgian Congo, 1900–1910: Ecology, Colonialism, and Tropical Medicine," VCU Scholars Compass, 2015. https://scholarscompass.vcu.edu.
11. Victoria Austin, "African Trypanosomes—Where Did They Go?," *BugBitten* (blog), BioMed Central, February 3, 2017. https://blogs.biomedcentral.com.

American College of Epidemiology (ACE)
www.acepidemiology.org

The ACE promotes the science of epidemiology as a crucial tool in fighting disease. The group sponsors scientific meetings and aids would-be epidemiologists by helping expand their educational opportunities. The website contains helpful COVID-19 resources, including links to articles in the *Journal of the American Medical Association* (*JAMA*).

American Public Health Association (APHA)
www.apha.org

APHA promotes better public health in the United States by bringing together and pooling knowledge among a wide range of medical and public health organizations and professionals, including epidemiologists. The website tells how to earn college credits for courses in medicine and health care and lists job openings in those areas.

Coronavirus Disease (COVID-19),
US Department of Labor/OSHA
www.osha.gov/SLTC/covid-19

This excellent site contains numerous links leading to a wide range of information about COVID-19, including medical facts, symptoms, control and prevention, how workers can avoid contracting the virus, the importance of wearing masks, and much more.

International Epidemiological Association (IEA)
www.ieaweb.org

With more than one thousand members in more than one hundred nations, the IEA promotes regular communication and sharing of ideas and research among epidemiologists everywhere.

FOR FURTHER RESEARCH

Books

Barbara Krasner, *Pandemics and Outbreaks*. New York: Greenhaven, 2020.

Joshua Loomis, *Epidemics: The Impact of Germs and Their Power*. Nashville: Turner, 2020.

Hal Marcovitz, *The COVID-19 Pandemic: The World Turned Upside Down*. San Diego: Brightpoint, 2020.

Harmindar K. Sran Rehs, *Washing Germs Down the Drain!!* Denver: Outskirts, 2020.

Sonia Shah, *Pandemic: Tracking Contagions, from Cholera to Coronaviruses and Beyond*. New York: Picador, 2020.

Internet Sources

Boston University School of Public Health, "John Snow—the Father of Epidemiology," 2015. https://sphweb.bumc.bu.edu.

Centers for Disease Control and Prevention, "COVID-19 Vaccine," 2021. www.cdc.gov.

College of Physicians of Philadelphia, "Ebola Virus Disease and Ebola Vaccines," 2018, https://ftp.historyofvaccines.org.

Johnny Denenea, "The History of Legionnaires' Disease," Legionnaires' Lawyer, 2021. https://thelegionnaireslawyer.com.

Steve Hendrix, "A Mystery Illness Killed a Boy in 1969; Years Later, Doctors Believed They'd Learned What It Was: AIDS," *Washington Post*, May 15, 2019. www.washingtonpost.com.

Owen Jarus, "20 of the Worst Epidemics and Pandemics in History," Live Science, March 20, 2020. www.livescience.com.

Andrew Joseph, "'A Huge Experiment': How the World Made So Much Progress on a COVID-19 Vaccine So Fast," Stat, July 30, 2020. www.statnews.com.

Christopher Klein, "Remembering the Legionnaires' Outbreak," History.com, 2020, www.history.com.

INDEX

Note: Boldface page numbers indicate illustrations.