David B. Nash | Alexis Skoufalos
Raymond J. Fabius | Willie H. Oglesby

THIRD EDITION

Population Health

Creating a Culture of Wellness

THIRD EDITION

Population Health

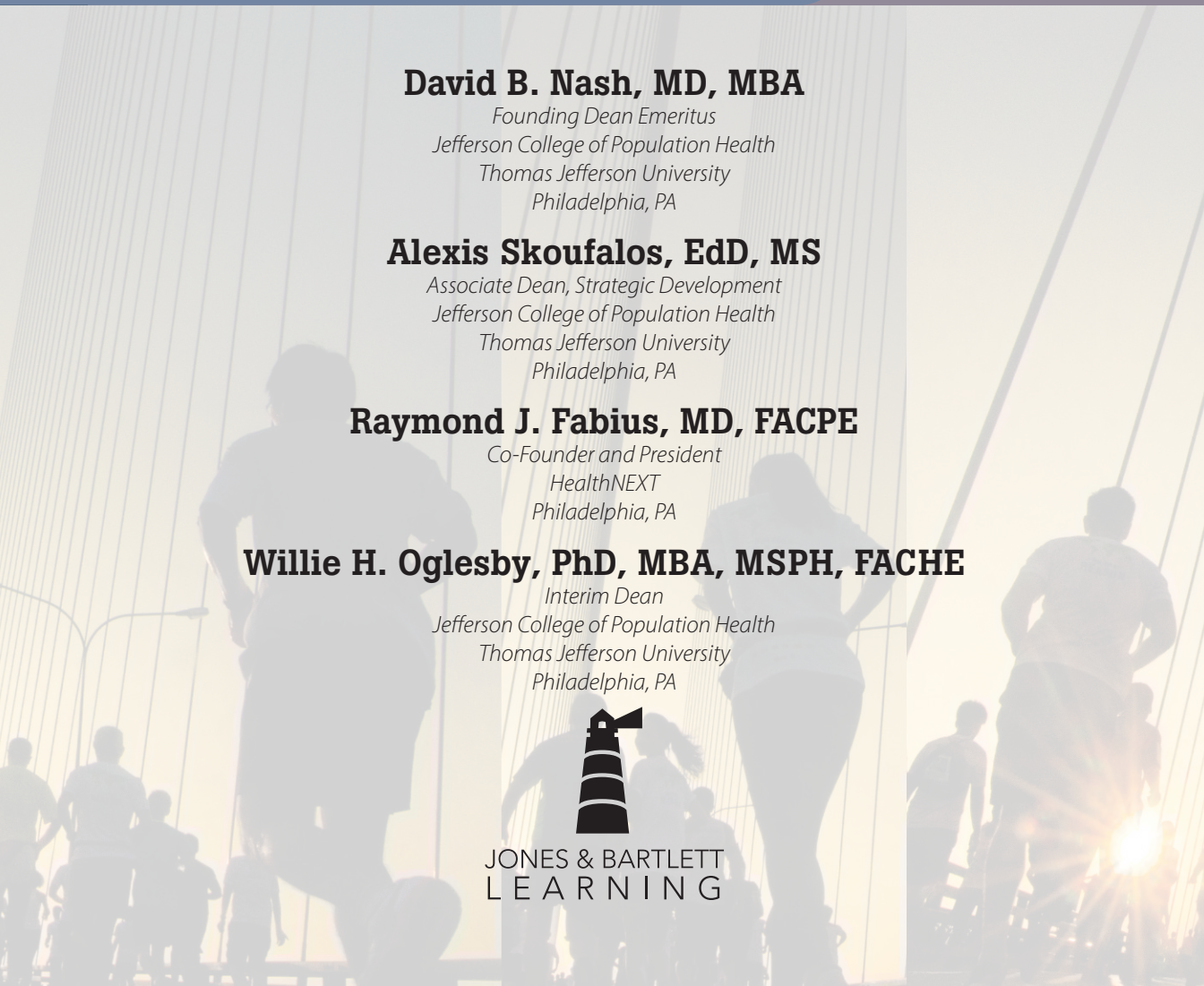
Creating a Culture of Wellness

David B. Nash, MD, MBA
Founding Dean Emeritus
Jefferson College of Population Health
Thomas Jefferson University
Philadelphia, PA

Alexis Skoufalos, EdD, MS
Associate Dean, Strategic Development
Jefferson College of Population Health
Thomas Jefferson University
Philadelphia, PA

Raymond J. Fabius, MD, FACPE
Co-Founder and President
HealthNEXT
Philadelphia, PA

Willie H. Oglesby, PhD, MBA, MSPH, FACHE
Interim Dean
Jefferson College of Population Health
Thomas Jefferson University
Philadelphia, PA



JONES & BARTLETT
LEARNING

World Headquarters
Jones & Bartlett Learning
5 Wall Street
Burlington, MA 01803
978-443-5000
info@jblearning.com
www.jblearning.com

Jones & Bartlett Learning books and products are available through most bookstores and online booksellers. To contact Jones & Bartlett Learning directly, call 800-832-0034, fax 978-443-8000, or visit our website, www.jblearning.com.

Substantial discounts on bulk quantities of Jones & Bartlett Learning publications are available to corporations, professional associations, and other qualified organizations. For details and specific discount information, contact the special sales department at Jones & Bartlett Learning via the above contact information or send an email to specialsales@jblearning.com.

Production Credits
VP, Product Management: Amanda Martin
Director of Product Management: Laura Pagluica
Product Manager: Sophie Fleck Teague
Product Specialist: Sara Bempkins
Senior Project Specialist: Dan Stone
Senior Marketing Manager: Susanne Walker
Manufacturing and Inventory Control Supervisor: Amy Bacus
Composition: codeMantra U.S. LLC
Cover Design: Michael O'Donnell
Rights & Media Specialist: Rebecca Damon
Media Development Editor: Troy Liston (TBD)
Cover Image (Title Page, Part Opener, Chapter Opener): © chomplearn/Shutterstock
Printing and Binding: LSC Communications

18847-9

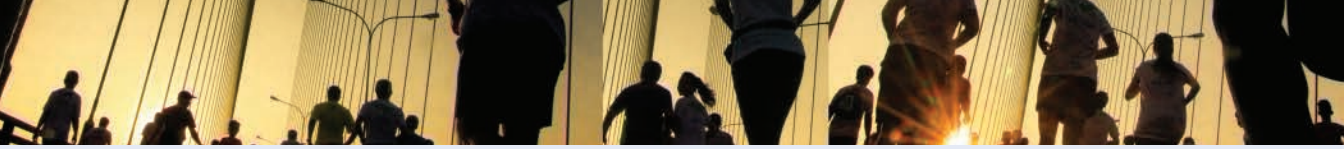
Library of Congress Cataloging-in-Publication Data
Library of Congress Cataloging-in-Publication Data unavailable at time of printing
Library of Congress Control Number: 2019913111

6048

Printed in the United States of America
23 22 21 20 19 10 9 8 7 6 5 4 3 2 1

Brief Contents

Contents



Foreword to the Third Edition

Population health was first defined by Kindig and Stoddard in 2003 as "the health outcomes of a group of individuals, including the distribution of such outcomes within the group."[1] The Institute of Medicine (IOM, now the National Academy of Medicine) built on this definition: in 2011, the IOM Roundtable on Population Health Improvement developed its working definition, in which "population health outcomes are the product of multiple determinants of health, including medical care, public health, genetics, behaviors, social factors, and environmental factors."[2] Indeed, population health involves the consideration of a broader array of determinants of health beyond health care or public health. Importantly, achieving population health requires the convergence of multiple sectors and disciplines.

Population health has never been more important. In the United States (U.S.), we are facing challenges achieving the triple aim (simultaneously improving the health of the population, enhancing the experience and outcomes of care, at a lower per capita cost).[3] Healthcare spending has been rising and is widely considered unsustainable; it already accounts for nearly 18% of the nation's gross domestic product.[4] Furthermore, such high rates of spending have not translated to better outcomes. U.S. health outcomes lag behind almost every other industrialized nation despite higher spending on health care.[5] For example, the U.S. lags behind similarly developed countries in terms of rates of all-cause mortality, premature death, thirty-day mortality following hospital admission, and hospital-acquired conditions. Furthermore, many groups in the U.S. face significant disparities across racial and ethnic lines and income levels. For example, the differences in life expectancy that Murray and colleagues (2006)[6] noted in their study "Eight Americas" suggest that we are living in different countries rather than different counties. Murray et al. found a difference of nearly 21 years between the healthiest of the epidemiologically clustered groups of Americans and the least healthy groups. To improve the health of the population, nationally or locally, we must overcome these disparities and focus on improving outcomes while also providing high-value care. It will take a collective effort to address the social determinants and ensure the integration of public health and primary care (IOM 2011,[7] IOM 2012[8]).

At the same time as we are facing all these healthcare challenges, the U.S. health policy landscape is evolving, offering new

opportunities for population health. In particular, the passage of the Patient Protection and Affordable Care Act (ACA) in 2010 was a major step toward the reform necessary to improve the health of the nation. An orientation toward population health is a strong theme throughout the ACA. Many provisions of the ACA enacted reforms to the health insurance market. The ACA expanded Medicaid and established health insurance exchanges for individuals and small businesses to buy health insurance. However, under the current U.S. administration and Congress, the future of the ACA has become uncertain. Nevertheless, the Trump administration has indicated that value-based care will continue to be a priority. In a March 2018 speech to the Federation of American Hospitals, the Department of Health and Human Services (HHS) Secretary Alex Azar noted, "*There is no turning back to an unsustainable system that pays for procedures rather than value. In fact, the only option is to charge forward—for HHS to take bolder action, and for providers and payers to join with us.*"[9] However, much work remains. Fee-for-service is still the dominant form of healthcare payment, health care and social services continue to be separate, and too many Americans lack access to the social and environmental conditions necessary to achieve good health.

In light of these conditions, how can we make progress toward population health?

This textbook serves as an important roadmap to achieving population health. Across 14 chapters divided into three discrete sections, it presents an overview of the current state of health in the U.S. and discusses the population health ecosystem, which encompasses the healthcare delivery and payment models, legal and regulatory landscape, and more, that provide the backdrop to all population health efforts. It places population health squarely in the context of multiple determinants of health. Importantly, it calls for a widespread culture change. Achieving population health will not be possible without a sustained focus on prevention and health promotion, accountability for outcomes, development of new payment and care delivery models, cross-sector collaboration, and a focus on health in all policies. The rise of new tools and technologies also presents an important opportunity. New sources of data combined with advances in informatics, analytics, and data science will allow for better prediction and management of risk. Consumer-facing technologies, such as wearables and apps, will provide patients with new opportunities to be engaged in their care.

As discussed in this book, all of these changes will require the engagement of multiple sectors, accompanied by the development of a skilled healthcare workforce with training across many different disciplines. In a recent paper, my coauthor and I have called for a new science and practice of convergence in population health. Convergence science has been defined as "an approach to problem solving that integrates expertise from life sciences with physical, mathematical, and computational sciences as well as engineering to form comprehensive frameworks that merge areas of knowledge from multiple fields to address specific challenges."[10] In our opinion, "in addition to harnessing advances in health care and biomedical research, population health requires the engagement of social, behavioral, economic, data, legal, and political science sectors and must involve

policy decisions and practice in all sectors. Improving the health of populations requires the collective participation of all stakeholders to converge on research, policy, and implementation that can influence health outcomes. ***Accordingly, population health needs to be reconceived as a new science and practice of convergence***."[11]

Universities and academic health sciences centers have an important role to play in advancing population health as a convergence science. They must create the culture, ecosystem, and incentives to bring relevant sectors together and establish frameworks that integrate knowledge from many disciplines and implement the new convergence science of population health. Institutions, such as the Jefferson College of Population Health, are leading the way by working to "prepare leaders with global vision to examine the social determinants of health and to evaluate, develop and implement health policies and systems that will improve the health of populations and thereby enhance the quality of life."[12] However, more work is needed.

Fortunately, we are at a turning point for making progress toward population health. The healthcare landscape is evolving: overall, we are seeing a shift from volume to value and a growing emphasis on prevention and health promotion, recognition of the importance of the social determinants of health, and the engagement of non-health sciences and sectors. Indeed, population health must be reimagined as convergence science and practice. Advances in technology and the entry of new stakeholders into the healthcare field, such as Uber, Amazon, JP Morgan, and Berkshire Hathaway's new healthcare partnership, further signal the growing recognition of the important role of population health. For these reasons, we are optimistic about the future health of citizens in the U.S.

Victor Dzau, MD
President, National Academy of Medicine

References

1. Kindig D, and Stoddart, G. What is population health? *American J Public Health.* 2003;93(3):380–383.
2. Roundtable on Population Health Improvement. Available at: http://nationalacademies.org/HMD/Activities/PublicHealth/PopulationHealthImprovementRT.aspx. Accessed December 2, 2018.
3. What is the Triple Aim? Available at: http://www.ihi.org/Topics/TripleAim/Pages/Overview.aspx
4. Martin AB, Hartman M, Washington B, Catlin A, and The National Health Expenditure Accounts Team. National Health Care Spending in 2017: Growth Slows to Post–Great Recession Rates; Share of GDP Stabilizes. *Health Affairs.* 2019;38(1):96–106.
5. OECD (2017), Health at a Glance 2017: OECD Indicators, OECD Publishing, Paris. http://dx.doi.org/10.1787/health_glance-2017-en
6. Murray, CJ, Kulkarni, SC, Michaud, C, Tomijima, N, Bulzacchelli, MT, Iandiorio, TJ, and Ezzati M. 2012. Eight Americas: Investigating mortality disparities across races, counties, and race-counties in the United States. *PLoS Medicine.* 2012;3(9):e260.
7. Institute of Medicine. For the public's health: revitalizing law and policy to meet new challenges. Washington, DC: The National Academies Press, 2011.
8. Institute of Medicine. 2012. Primary Care and Public Health: Exploring Integration to Improve Population Health. Washington, DC: The National Academies Press. https://doi.org/10.17226/13381
9. Remarks on Value-Based Transformation to the Federation of American Hospitals. Available at: https://www.hhs.gov/about/leadership/secretary/speeches/2018-speeches/remarks-on-value-based-transformation-to-the-federation-of-american-hospitals.html
10. Massachusetts Institute of Technology. Convergence: the future of health. Cambridge, MA: Massachusetts Institute of Technology, 2016. Available at: http://www.convergencerevolution.net/2016-report/
11. Dzau VJ and Balatbat CA. Reimagining population health as convergence science. *Lancet*. 2018 (August 4);392 (10145):367–368.
12. Jefferson College of Population Health. About Us. Available at: https://www.jefferson.edu/university/population-health/about.html

Preface

As I write this preface to the third edition of *Population Health: Creating a Culture of Wellness,* the Jefferson College of Population Health (JCPH) is celebrating a major milestone: our 10th birthday. In July 2008, the Board of Trustees of Thomas Jefferson University in Philadelphia, PA, voted unanimously to approve the creation of the nation's first College of Population Health.

The creation of our college was an integral part of the university's critical public commitment to improving the health of our citizens and an important step toward its goal of becoming a national leader in health sciences education. As the country's first college of population health, we felt then—and we reaffirm now—our particular and unique responsibility and burden. Our challenge is to train leaders for the future from across the healthcare stakeholder spectrum who will go forward and improve the health of the population. Ours was the first college to build the bridge between health and health care. This book provides a strong foundation for this bridge, and helps us to meet the challenge of creating tomorrow's leaders today.

A number of important questions still need to be addressed as the national population health agenda matures. Among these questions are, "What exactly is population health? How does it differ from public health?"

David Kindig's breakthrough paper, published in 2003, is the one that most thought leaders call out as having provided the best working definition of population health—namely, "the distribution of health outcomes within a population, the health determinants that influence distribution and the policies and interventions that impact the determinants."[1]

Kindig also provided us with the view that population health could be "the aggregate health outcome of health adjusted life expectancy of a group of individuals in an economic framework that balances relative marginal returns from the multiple determinants of health. This definition proposes a specific unit of measure of population health, and considers the relative cost-effectiveness of resource allocation to multiple determinants."[1]

There are five essential goals to consider when applying the population health concept across the continuum of care: 1) keeping healthy those who are well; 2) reducing health risks; 3) providing quick access to care for acute illness so that health does not deteriorate; 4) managing chronic illness to prevent complications, and 5) treating those with complex or catastrophic illnesses at centers of excellence where they can receive high-quality, high-value care. To accomplish these goals effectively, we will need to draw from sister areas of emphasis, such as health informatics, organizational design and

construction, and human factors engineering. We recognize now that collaboration is required to accomplish these goals effectively, and progress must be regularly assessed across the spectrum of care.

As we take the next steps forward, the leadership of Jefferson Health (our $5.2 billon delivery system) and the faculty of our college are beginning to coalesce around the differences between population health and public health. We strongly believe that population health connects prevention, wellness, and behavioral health science with healthcare quality and safety, disease prevention and management, and economic issues of value and risks, all in the service of specific populations. Like public health, population health builds on the science of epidemiology and biostatistics, but population health takes these disciplines in a new direction by means of applied metrics and analytics.

Historically, the U.S. healthcare system rewarded reactive care rather than proactive care and financially encouraged doctors to focus on treating acute episodes of illness and disease rather than managing those illnesses or diseases to avert future crises. In most cases, doctors were paid for piecework. That is, they were paid more for providing a higher volume and higher intensity of acute-care services. At the same time, doctors were underpaid, or not paid at all, to coordinate effective preventive health care to keep their patients out of the hospital. We must learn to focus our efforts (and incentives) upstream on prevention rather than working to fix problems after people become ill. To address obesity and its risks to health, instead of building yet another bariatric surgical operating room, we need to offer nutritional counseling and improve the quality of school lunches. Rather than building another cardiac catheterization laboratory, we need to focus on prevention as the core strategy to reduce the burden of coronary artery disease. If we want to make progress, it's more efficient and effective to "shut off the faucet" rather than constantly "mop up the floor."

It has been nearly 10 years since the passage of the Affordable Care Act, and there is value in examining the key trends that have emerged. The financial realities of the traditional payment system, prior to systemic reform, generated terrible conflicts of interests and pernicious incentives. If hospitals could be incentivized to succeed in their mission of truly improving health rather than merely filling beds, then patients and society would benefit. We believe, and we reaffirm with the third edition, that population health represents just such a paradigm shift and that it has already begun to tackle the transformation of our system now readily described as moving from volume to value. In fact, we believe that a good part of population health management could be readily described by the phrase "no outcome, no income."

Accumulating national evidence supports the central thesis of this third edition and is best exemplified by Dr. Victor Dzau's authorship of the Foreword of this book. In his leadership role at the National Academy of Medicine (NAM), Dr. Dzau impaneled the leading experts in the industry to reaffirm the idea that we must learn to "shut off the faucet" instead of always "mopping up the floor." In the watershed publication, *Vital Signs for the Nation*, the NAM made it explicitly clear that population health would be the lever to move 18% of the GDP in the right direction, and

that practicing population health would eventually help move our nation from #17 in the world with regard to the health of our population, to at least into the top 10, given the fact that we now spend nearly $3 trillion dollars a year, or $10,000 per person annually, including children.

I strongly believe that a "no outcome, no income" system must be characterized by the following: 1) practicing medicine based on the best available evidence and tying payments to those outcomes, 2) reducing unexplained clinical variation, 3) continually measuring and closing the feedback loop between physicians and the supply chain that supports them, 4) trading professional autonomy for clinical collaboration, and 5) engaging with patients across the continuum, especially capitalizing on advances in modern technology.

In addition to the NAM, other major groups, including the American College of Physicians (ACP) and the American Medical Association (AMA), have also endorsed population health. Indeed, the AMA has led a consortium of 30 medical schools through a process to completely revamp undergraduate medical education and align it with the tenets of population health. As of this writing, the 2nd edition has been deployed in more than 80 graduate programs nationwide and in schools of medicine, nursing, pharmacy, public health, and related health sciences. A decade ago, I found myself explaining the nomenclature regarding our field, and indeed our college, to virtually every colleague, on nearly a daily basis. As I traveled across the country, people were unfamiliar with the terminology of population health. Ten years later, the JCPH is at the forefront of a national movement to become more responsible stewards of the vast public resources for which we are accountable to our citizens. Perhaps our nation will become a world leader in providing a healthcare system characterized by the original Institute of Medicine's (now the NAM's) six domains of safety, effectiveness, efficiency, patient-centeredness, timeliness, and equity. Instead of a set of a half-dozen lofty and seemingly unattainable goals, population health has emerged as the roadmap for successfully closing the quality chasm and achieving improvement in health.

How Is This Book Organized?

This 3rd edition is focused on the expanding role of population health and its importance in bringing about a nationwide culture of wellness. The text has been completely revised and updated to incorporate considerable changes in the delivery system, and it recognizes the powerful role that new technology will continue to play in improving the health of the population.

This book is organized into 15 chapters, divided into three discrete sections. We have instituted one consistent definition of population health throughout the book, agnostic to whatever approach the nation continues to take to implement health reform. In Part Three, each chapter includes closing vignettes that help to illustrate the key take-home messages.

Part One, "**Population Health in the United States,**" lays the groundwork with a thorough review of the scholarship in the field. It helps to define the impact of the social determinants of health and takes a closer look at the impact of disparities on health.

Part Two, "**The Population Health Ecosystem,**" takes population health and analyzes the structures, systems, stakeholders, and the regulatory environment within the ecosystem itself. It ends with a serious discussion on workforce development to support improvement in the health of the population. This is a critical component of the long-range goals of our college, and is certainly consistent with the goals as elucidated by *Vital Directions* from the NAM.

The third section of the book, "**Creating Culture Change,**" recognizes that we must give our readers tools that will help them to leverage change. These include a better understanding of the science of prevention and health promotion and the use of technology to support consumer engagement. Of course, culture change continues to be an important tool in our toolbox.

The third edition concludes with a special section by Dr. Stephen K. Klasko, the visionary President and CEO of our health system. Dr. Klasko has stimulated a national discussion on the future of academic medicine and its role in promoting the health of the population.

Who Should Read This Book?

My co-editors and I are grateful for the participation of a large number of nationally recognized experts, and our own faculty, who helped to conceptualize and execute this third edition. While we, of course, believe every section contains important information for anyone who cares about how we might more effectively improve the health of the country, we recognize that for many, this may be their first exposure to the field. As a result, the book appeals to a broad spectrum of learners, including undergraduates in colleges and universities across the country, and professional schools of medicine, public health, health administration, nursing, and the pharmaceutical sciences.

Many dedicated people have played an important role in the genesis of this third edition. I would particularly like to thank our amazing university President and CEO Stephen K. Klasko, MD, MBA, for his continued visionary leadership and his ongoing and unwavering support of the Jefferson College of Population Health and me as the Senior Editor. I want to also recognize the steadfast support of our school from the Provost, Dr. Mark Tykocinski. With the recent merger of Thomas Jefferson University and Philadelphia University, Dr. Tykocinski now has ten deans reporting to him, with a student body of nearly 8,000. Selfishly speaking, I am proud that the College of Population Health is widely viewed as the innovation engine within the academic pillar that supports the entire Jefferson Health System.

As the Senior Editor, I continue to be very appreciative of the hard work of my co-editors Drs. Alexis Skoufalos, Willie H. Oglesby, and Ray Fabius. We are strongly supported by Ms. Sonja Sherritze, an accomplished medical editor. Sonja is deeply connected to our college in her role as Editor of *Pharmacy and Therapeutics*, a peer-reviewed journal for which I have had the privilege of being the Editor-in-Chief for nearly 20 years.

I am particularly grateful to the faculty and staff of the Jefferson College of Population Health who have boldly travelled this unmarked path with us in the successful launch and early growth of our college. I

am especially grateful to our relatively new colleague, Willie H. Oglesby, who helped conceptualize this third edition and was central in organizing the three-part strcture, and providing us with deep insight about the language surrounding the ecosystem of population health. Finally, we would also like to mention our gratitude to friends and family who have supported us as we pursued our passion for improving the health and well-being of the population.

At this important 10th anniversary, we are truly grateful to our current and future students who challenge us with their complex questions and whose quest for solutions will bring about much-needed improvements in population health in the future. It has been an incredible privilege for me, as the founding Dean, to lead this talented team, and I am confident that our students will go forth and make a world of difference. We will continue to build the bridge between health and health care.

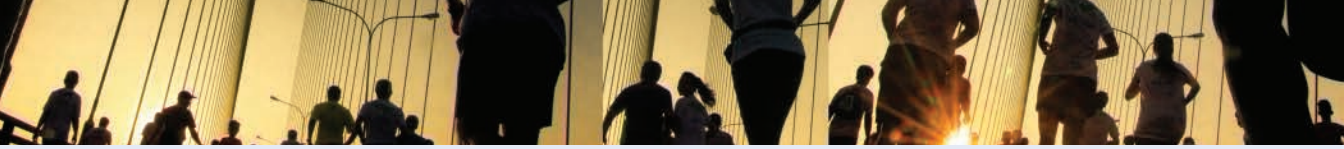
As all good editors know, we take full responsibility for any errors of omission or commission. Most importantly, we greatly value feedback from our readers and fellow pioneers in population health. We are particularly interested in the value of the text as a pedagogic tool as well.

I have always felt strongly that one of the tenets of good leadership is to help prepare those who will take the mantle tomorrow. I am supremely confident that this third edition of *Population Health: Creating a Culture of Wellness,* will provide just such a foundation for training the future healthcare leaders that our nation so desperately needs today to help nurture a healthier, happier, and more productive nation tomorrow.

David B. Nash, MD, MBA
Summer 2019

Reference

1. Kindig D, Stoddart, G. What is population health? *Am J of Public Health*. 2003;93(3):380–383.



The Optimistic Future for HealthCare: Population Health from Philosophy to Practice

Stephen K. Klasko, MD, MBA

David Nash has led the fight for the transformation of American health care—long before he founded Jefferson's College of Population Health more than 10 years ago. He stands at the most critical intersection of our time: across public health, personalized health, and the huge ecosystem that has created an overpriced and inequitable healthcare delivery system. I believe it is this intersection that will determine our future. And David has a favorite catch phrase that perfectly captures that future: "No outcome, no income."

But the disconnects that challenge an optimistic future remain strong, all the way from our popsicle-stick-and-glue federal policies to the way we select and license clinicians to our inability to coordinate and deliver complex care to the "superutilizers," the 5% of patients who account for 50% of the total cost.[1]

American healthcare delivery remains fragmented, unfriendly, often unsafe, and deeply inequitable. It is an industry that takes Star Trek–level medicine and grafts it onto a Fred Flintstone delivery system. We are all the worse for it.

The key is this: we know a lot about the social determinants of health. We know that 80% of what determines our health takes place outside the health delivery system. But we knew that 20 years ago. We knew it 10 years ago. We still don't know how to bring that knowledge home—to ensure that the billions of dollars we spend bolsters an individual's physical health, mental health, and indeed social health. We need to look outside the delivery system and work hand in hand with community partners, government, and industry to develop solutions to these complex problems.

It is time to stop talking about population health and, instead, make it happen throughout America's massive healthcare enterprise. This book describes the different structures and stakeholders in the healthcare ecosystem, explains how they connect and complement one another, and offers all of us a clear resource to construct meaningful population health interventions. The next step is to embrace disruption, find creative partners, and seek the radical transformation that will build the optimistic future we all fight for.

Reading this book, and listening to David Nash speak, is like taking a series of golf lessons. The book can guide us to position ourselves to care for an entire population; tell

us what club to use to overcome inequities in food, education, and housing; and give us a feeling of where the fairways of success and sandtraps of the old model lie. But it is time for the leaders of healthcare organizations in all areas to actually solve these problems and deal with the rough across all sectors of the healthcare ecosystem—providers, hospitals, pharma, insurers, PBMs, and especially consumers themselves.

The Iron Triangle Lives

William Kissick outlined the famous Iron Triangle of Healthcare in the 1990s, based on his work on Medicaid in the 1960s. It remains true: there is an iron triangle of access, quality, and cost containment. Increasing or decreasing any side of that triangle changes at least one other side. [2] But we cannot kid ourselves—disruption is painful.

The Patient Protection and Affordable Care Act (ACA) did not escape Kissick's Iron Triangle. The ACA did exactly what it was supposed to do—it increased access to our broken delivery system and then hoped we would transform ourselves. Quite to the contrary, we have seen instead a debate in which everyone continues the game of pointing fingers at each other.

Incremental change will not be sufficient to break the Iron Triangle. Healthcare transformation requires disruption. Part of disruption involves creative collaboration. And some of it will lead to parts of the industry failing, especially if they cannot show outcomes that make sense to payers, but also to the new boss: patients.

Disruption Can Be Creative

I had the honor of taking part in a panel on the future of hospitals at the World Economic Forum in Davos, Switzerland, in January 2019. It gave me the opportunity to talk with people from multiple nations, with many different delivery systems and needs.

The experience reinforced my belief that health care must become global—we have to learn by "thinking globally," more than we like to admit in the United States. The global problem is stark: the World Economic Forum estimates that 100 million people a year are forced into poverty because they cannot afford to pay for health care, and far too many people simply do not have access to a basic package of health care.[3] That is as true in my hometown of Philadelphia, which hosts a prestigious array of academic health institutions, as it is in Johannesburg or Durban. In fact, Philadelphia has the dubious lead among major U.S. cities when it comes to the greatest disparity in average life expectancy—20 years between our richest and poorest zip codes.

That means it's time to embrace disruption. In my 2016 book, *We Can Fix Healthcare*,[4] I laid out 12 disruptors that could have been embraced by both political parties and become the basis for a new delivery system in the United States. I still believe we can do it, and in Davos, I advocated for several disruptors.

While disruption is painful, it can also be optimistic, creative, exciting, and good for the people involved. It can be especially great for the people at the center—patients, their families, and their communities.

Health Care with No Address

We need to use technology to create "health care with no address." As I said at the World Economic Forum, I cannot wait for a future Davos when we talk less about self-driving cars and more about self-healing humans. That future is closer than we think. Nor is the vision of phones and watches and clothes that monitor our health limited to the rich: cell phones have spread further than anyone anticipated. But if we don't shift our thinking, we cannot keep up. Shobana Kamineni of Apollo Hospitals in India was on the Davos panel and said: "In India, we cannot build enough hospitals. The mobile phone is the disruptive technology, and that is where the hospital will move."

To be clear: The iPhone will never be your primary care physician. Artificial intelligence (AI) is not a magic panacea. But we need to get to the point where most health care happens at home. That means we need to stop talking about "telehealth"—it's just health.

Is There an Avatar in the House? The Clinician in the Age of AI

In an age in which augmented intelligence will take over the tasks of memorization and robotics, we need clinicians who are selected and trained in ways that enhance their innate human qualities: to help them to be creative, communicative, and empathetic. I always begin with the DNA of the clinical system—the selection and licensing of clinicians. We still select clinicians, especially physicians, on the basis of biochemistry grades and memorization tests. Then we're surprised that doctors aren't more empathetic team builders. But when we attempt to select medical students with empathy, emotional intelligence, and leadership—the kids who built free clinics instead of studying biochemistry—those students face board exams that force them to compete with each other for residency slots based on memorization skills. Medical education has a lot that it needs to change.

Regardless of discipline, the clinician must be trained and licensed to be the human being in the room, even if that room is virtual. As Alibaba founder Jack Ma said at the World Economic Forum, "When we invented cars, we didn't teach our kids to run faster. When we invented planes, we didn't teach our kids to fly." Computers will replace our ability to crunch numbers and remember data, but they will never be as wise as we are. We need to produce clinicians who understand the human question, "What does this mean?"

I saw this firsthand as an obstetrician, after a baby was born with unanticipated Down syndrome. The first question the parents often ask is some form of "What does this mean?" I've seen good obstetricians answer by describing the genetic basis for Down syndrome. I've seen great ones answer by saying, "It means you've delivered a beautiful baby who will love you very much. And we will connect you with other parents who have delivered beautiful babies like yours so you can find out more, and share experiences."

There's no question that in the near future, there will be a robot/AI/he/she/it next to me when I deliver a baby. And there is no question that he/she/it will be better than we humans are at immediately naming whatever anomaly exists. But it will never understand what is going through the minds of the mother and father and what they need emotionally and spiritually. Technology will replace a good part of what doctors must do today, but the next generation of nurses and doctors will be greater teammates to patients when we stop trying to make clinicians better robots than the robots themselves.

The Crisis of Complex Care

At Jefferson, we have been pioneers in teaching "hot-spotting," with support from the Robert Wood Johnson Foundation; we are one of four national hubs for interprofessional education targeting "super-utilizers." This is critical because our globe has a crisis in what's called complex care—helping people who have multiple, frequently chronic illnesses combined with mental health challenges and complex social needs. The Jefferson Center for Interprofessional Education has trained teams of students to meet people who are caught in a cycle of emergency-room visits—for example, to repeatedly change a colostomy bag. That small pilot program showed cuts in cost, increases in empathy and self-efficacy for the students, and increases in optimism for the faculty mentors. The data are being readied for publication, but the bottom line is that it showed a significant reduction in emergency room visits and a notable reduction in length of stay in the hospital and in 30-day readmissions.

If we want self-healing humans, we need a platform of technology that makes it possible for interdisciplinary teams to deliver the simple human solutions that people need.

Equity Matters

We need a far more diverse group of clinicians. We must excite young women and men from all backgrounds about the profession of health care, give them the confidence to pursue it, and then accept them into our schools. I would rather see the kid who volunteered to build a free clinic get accepted to medical school than the kid who spent his or her time taking multiple MCAT prep courses while sitting at home studying biochemistry. We did this with the SELECT program at the University of South Florida, and it works: set a minimum bar of grades and/or MCAT scores, and then select students based on emotional intelligence and leadership. In Jefferson's JeffDESIGN curriculum, we eliminated the MCATs. It can be done.

To think globally and act locally demands that we create a truly global healthcare system. It is ridiculous that a well-trained clinical professional from another country must start over in the United States. That's why Thomas Jefferson University has created the first joint-MD program between the United States and the European Union. Based at Cattolica University in Italy, Italian students will be able to earn both Italian and American medical degrees that will allow them to practice on either continent.

Building on the global clinician, we further need an understanding of integrative medicine that does not sneer at holistic health developed in other countries. When I accidentally hurt myself in India, I was offered solutions related to movement and diet, not pain pills. Global health care is not an "either/or" (either "Western" or "Eastern") but a "both/and." Given our poor track record with chronic and non-communicable disease prevention, we need to embrace all forms of diagnosis, prevention, and treatment that have been shown to be effective, regardless of their place of origin.

These new professionals—the empathetic, creative, and communicative clinicians of the future—are the ones who will tackle health disparities; who will understand the integration of mental and physical health; and who will find solutions for social health, working with teams we haven't yet defined. We know health depends on employment, education, and opportunity—it's time we made zip code no longer the primary predictor of a person's destiny.

Yes, It Is About Health

We use a variety of words to describe the "movements" we need in healthcare delivery. But to me, combining integrative medicine, personalized medicine, and population health is possible. It means we have to think of "health" as physical, mental, and social. Once we do that, we can better serve individuals, their families, communities, and populations. That would be a true goal for an optimistic future.

There is plenty of pessimism about our ability to make these changes. One conference I sat through reminded me of the old quotation: "We're a crossroads. One road leads to total destruction, the other to utter despair. Let's hope we choose the right one." But that's not the future I see.

What I see is a future where the Iron Triangle is replaced by a diamond of consumer-centric care in which everyone has the ability to connect, and form human relationships; the ability to easily navigate the system on patients' own terms; and the ability to understand what they need to do. We need to replace the "winter is coming" rhetoric of the old healthcare delivery system with a new mantra of reimagining health care to create unparalleled value.

(Stephen K. Klasko, MD, MBA is President of Thomas Jefferson University and CEO of Jefferson Health.)

References

1. Mitchell EM. *Concentration of Health Expenditures in the U.S. Civilian Noninstitutionalized Population, 2014.* November 2016, AHRQ Statistical Brief #497. Available at: https://meps.ahrq.gov/data_files/publications/st497/stat497.pdf
2. Kissick WL. Medicine's Dilemmas: Infinite Needs Versus Finite Resources. New Haven: Yale University Press; 1994.
3. Klasko SK. Dispatch from Davos. *STATNews First Opinion*, January 26, 2019. Available at: https://www.statnews.com/2019/01/26/dispatch-from-davos-future-hospitals/
4. Klasko SK, Shea GP, Hoad MJ. We Can Fix Healthcare: The 12 Disruptors That Will Create Transformation. Mary Ann Liebert Inc.; 2016.

Contributors List

Jillian Baker, DrPH, EdM
Medical Scholarship Director
Rowan University School of Osteopathic Medicine
Stratford, NJ

Justin Beaupre, EdD, MHA, LAT, ATC
Postdoctoral Research Fellow
Main Line Health Center for Population Health Research etc
Main Line Health Center for Population Health Research at Lankenau Institute for Medical Research
Wynnewood, PA

Janice L. Clarke, RN, BBA
Project Director
Jefferson College of Population Health
Thomas Jefferson University,
Philadelphia, PA

Joe Coughlin, PhD
Director
MIT AgeLab
Massachusetts Institute of Technology
Cambridge, MA

Myles Dworkin, MD (c), MPH (c)
Thomas Jefferson University
Philadelphia, PA

Victor J. Dzau, MD
President
National Academy of Medicine
Washington, DC

Adam Felts, MFA
Technical Associate
MIT AgeLab
Massachusetts Institute of Technology
Cambridge, MA

Rosemary Frasso, PhD, MSc, MSc, CPH
Program Director
Public Health
Jefferson College of Population Health
Thomas Jefferson University
Philadelphia, PA

Livia Frasso Jaramillo, MSPH
Public Health Analyst
The Innovation Center (CMMI)
Centers for Medicare and Medicaid Services
Washington, DC

Stephen K. Klasko, MD, MBA
President
Thomas Jefferson University
Chief Executive Officer
Jefferson Health
Philadelphia, PA

Michael Kobernick, MD, MS-HSA, MS-PopH, FAAFP
Senior Medical Director
Health Plan Business
Blue Cross Blue Shield of Michigan
Detroit, MI

Amy Leader, DrPH, MPH
Associate Professor
Jefferson College of Population Health
Thomas Jefferson University
Philadelphia, PA

Y. Brian Lee, JD, MPH
Senior Associate
Alston and Bird, LLP
Washington DC

John McAna, PhD, MA
Associate Professor
Jefferson College of Population Health
Thomas Jefferson University
Philadelphia, PA

Russell K. McIntire, PhD, MPH
Assistant Professor
Jefferson College of Population Health
Thomas Jefferson University
Philadelphia, PA

Michael H. Park, JD, MPH
Partner
Alston and Bird, LLP
Washington, DC

Jennifer Puzziferro, DNP, RN-BC, CCM
Vice President of Case Management
RWJ Barnabas Health
Oceanport, NJ

Jennifer Ravelli, MPH
Assistant Dean for Student Affairs
Jefferson College of Population Health
Thomas Jefferson University
Philadelphia, PA

Martha Romney, MS, JD, MPH
Assistant Professor
Jefferson College of Population Health
Thomas Jefferson University
Philadelphia, PA

Robert Sachs, PhD
Sachs Talent Advisors
Benicia, CA

Somava Saha, MD, MS
Vice President
IHI
Lexington, MA

Harm J. Scherpbier, MD, MS
Chief Medical Information Officer
Health Share Exchange
Philadelphia, PA

Katherine A. Schneider, MD , MPhil, FAAFP
President
Delaware Valley ACO
Radnor, PA

Preethi Selvan, BS, MPH
Associate Professor
Clinical Study Coordinator
Sidney Kimmel Cancer Center
Jefferson Health
Philadelphia, PA

Vicki Shepard, ACSW, MPA
Vice President
Tivity Health
Franklin, Tennessee

Matthew Stiefel, MPA, MS
Senior Director
Center for Population Health
Kaiser Permanente
Care Management Institute
Oakland, CA

Karen Walsh, MS, MBA
Program Director
Population Health Intelligence
Jefferson College of Population Health
Thomas Jefferson University
Philadelphia, PA

PART I

Population Health in the United States

CHAPTER 1

The Population Health Promise

Raymond J. Fabius*

EXECUTIVE SUMMARY

The population health promise is to promote health and prevent disease; the strategy is to create a culture of health and wellness.

The Patient Protection and Affordable Care Act (ACA) of 2010 codified and set in motion an array of programs and initiatives aimed at improving the health of the U.S. population. Although considerable progress is being made on many fronts—from making health insurance accessible to more Americans to increasing accountability for and quality of healthcare delivery and services—the need for population health management continues to be urgent.[1]

Population health refers broadly to the distribution of health outcomes within a population, the health determinants that influence distribution, and the policies and interventions that affect those determinants.[2,3] Accordingly, population health is holistic in that it seeks to reveal patterns and connections within and among multiple systems and to develop approaches that respond to the needs of populations. Population health tactics include rigorous analysis of outcomes. Understanding population-based patterns of outcomes distribution is a critical antecedent to addressing population needs in communities (i.e., patterns inform the selection of effective population health management strategies to diminish problems and develop approaches to prevent reoccurrence in the future).

Convened by the National Quality Forum in 2008, the **National Priorities Partnership** addressed four major healthcare challenges that affect all Americans: eliminating harm, eradicating disparities, reducing disease burden, and removing waste.[4] One of the priorities identified to address these challenges is *improving the health of the population*. While ambitious, this goal is fundamental to health care and healthcare reform. Improving the health of the population will require improved efforts to provide health insurance coverage, promote healthy behaviors, and prevent illness. The "silos" in healthcare delivery must be dismantled, and providers must work cooperatively to

* This chapter includes contributions made in the first and second editions by Valerie Pracilio, David B. Nash, Janice L. Clarke, and JoAnne Reifsnyder.

advance seamless, coordinated care that traverses settings, health conditions, and reimbursement mechanisms. Interdisciplinary teams of healthcare providers committed to diligent management of chronic conditions and providing safe, high-quality care will play a central role. The emergence of a preventive health focus within primary care will be required. The pattern of infrequent health checkups supplemented by more frequent visits for treatment of illness must become more balanced. Policy makers will be called upon to craft policies that support illness prevention, health promotion, and public health, and healthcare professionals must continue their efforts to enforce recommendations in communities. All of these efforts must align to promote health and wellness and to advance a new population health agenda. Population health is no longer a mere strategy—it is the solution that holds the greatest promise for creating *a culture of health and wellness*.

LEARNING OBJECTIVES

By the end of this chapter, the reader will be able to:

1. Explain the concept of population health.
2. Recognize the need for a population health approach to healthcare education, delivery, and policy.
3. Discuss the integration of the four pillars of population health.
4. Use this text as a resource for further population health study and practice.

KEY TERMS

Chronic care management
Compression of morbidity
Health determinants
Health policy
Healthcare quality
National Priorities Partnership
Patient safety
Population health
Population health management
Public health

Introduction

Although the term **population health** is not new, there is still no clear consensus on a single definition. In the evolving U.S. healthcare environment, where the need for positive change is evident and ongoing, population health is viewed across constituencies as a promising solution for closing key gaps in healthcare delivery. In the context of this text, population health is defined as the distribution of health outcomes within a population, the health determinants that influence distribution, and the policies and interventions that affect the determinants.[2,3]

Population health embraces a comprehensive agenda that addresses the healthy and unhealthy, the acutely ill and chronically ill, the clinical delivery system, and the public sector and private sector. While there are many determinants that affect the health of populations, the ultimate goal for healthcare providers, public health professionals, employers, payers, and policy makers is the same: healthy people comprising healthy populations that create productive workforces and thriving communities.

Population health is both a concept of health and a field of study.[2] Populations can be defined by geography or grouped according to some common element (e.g., employer, ethnicity, medical condition, provider organization). As the name implies, population health is inclusive of every individual and group, comprising a heterogeneous population that wears many labels. For example, a man of Mexican descent who works for a contractor and belongs to a carpenters' union may be a member of three different populations: the community of Mexican descent, his employer's organization, and the carpenters' union. To address needs at the population level, all of these associations must be considered.

As a field of study, attention must be given to multiple determinants of health outcomes, including medical care, public health interventions, and the social environment, as well as the physical environment and individual behaviors, and the patterns among each of these domains.[5] The purpose of this chapter is to promote an understanding of population health, to encourage discussions and engagement of key stakeholders (healthcare providers, public health professionals, payers/health plans, employers, and policy makers), and to foster the development and dissemination of strategies aimed at improving population health.

The Current State of Population Health

Health care in the United States is complex, and many would argue that its method of delivery bears little resemblance to a true system. Considering the characteristics of systems (e.g., interactivity of independent elements to form a complex whole, harmonious or orderly interaction, and coordinated methods or procedures), U.S. health care may well represent the antithesis of a system.

Despite devoting nearly 18% of its gross domestic product (GDP) to health care (projected to approach 20% by 2025),[6] the United States performs lower on five dimensions of performance (quality, access, efficiency, equity, and healthy lives) compared to similar developed countries, including Australia, Canada, Germany, the Netherlands, New Zealand, and the United Kingdom. The common element among the aforementioned nations is a universal healthcare delivery system, and some argue that the absence of universal health care in the United States explains the access disparities, inequity, and poor outcomes in addition to the exorbitant and uncontrolled costs.[7]

Unfortunately, the health status of the U.S. population does not reflect the high level of spending on health care. For example:

- One-third (33%) of U.S. adults went without recommended care, did not see a doctor when sick, or failed to fill a prescription because of costs in 2016.[8]
- Major disparities exist based on socioeconomic status. Roughly 28.5 million[9] Americans were still uninsured as of 2017, and 133 million Americans (almost half of the U.S. population, 45%) suffer from at least one chronic condition.[10]
- **Healthcare quality** is suboptimal, and **patient safety** is lagging.[8,11]
- The public health system continues to be egregiously underfunded.[12]

The passing of the ACA and the subsequent phased implementation of a broad range of regulations and initiatives aimed at improving the health of the U.S. population have brought about some positive change; however, it will take many years before the benefits are realized on a population scale,[1] and the need for **population health management** remains urgent. Recent governmental limitations placed on the ACA, including the December 2017 repeal of the individual mandate, have resulted in a steady increase in the number uninsured (13.7%, the highest rate since 2016).[13]

Because important advances in science and technology have contributed to increases in life expectancy in the 20th century, unprecedented growth in the population of older adults has introduced new pressures on healthcare providers, payers, and communities. Roughly two-thirds of Medicare recipients contend with two or more chronic conditions, and 16% deal with six or more. In 2015, 55% of Medicare fee-for-service beneficiaries had hypertension, 27% had ischemic heart disease, and 27% were diabetic.[14] Chronic conditions require frequent monitoring and evaluation, which places a strain on the healthcare system and makes the need for care coordination imperative. Perhaps most disturbing is the recent announcement from the Centers for Disease Control and Prevention (CDC) that the average life expectancy for Americans is declining.[15] Traditionally, the United States has supported a "sick care" system bolstered by payment policies that reward both consumers and providers for health care that is sought primarily when acute illness strikes or in an emergency. While caring for the sick will always be an integral part of health care, true population health can be achieved only by placing an equal emphasis on health promotion and disease prevention.

Population Health Defined

Population health is the distribution of health outcomes within a population, the determinants that influence distribution, and the policies and interventions that affect the determinants.[2,3] These three key components—health outcomes, **health determinants**, and health policies—serve as the foundation for this chapter.

Health determinants, the varied factors that affect the health of individuals, range from aspects of the social and economic environment to the physical environment and individual characteristics or behaviors.[16] Although some of these factors can be affected by individuals, some are external to an individual's locus of control. For example, individuals may be coached to adopt healthier lifestyles, thereby reducing their risk for lifestyle-related diseases (e.g., hypertension, diabetes, and smoking-related illnesses). The same individuals may be genetically predisposed to cardiovascular disease or may reside in geographic locations where exercise outdoors is unsafe or air quality is extremely poor—these health determinants are outside of their control.

Health determinants are a core component of the ecological model used in **public health** to describe the interaction between behavior and health.[16] The model assumes that overall health and well-being are influenced by interaction among the determinants of health.[17] Relationships with peers, family, and friends influence

behavior at the interpersonal level. At the community level, there are institutional factors (e.g., rules, regulations) that influence social networks. At the public level, policies and laws regulate certain behaviors.[13] These variables have a cumulative effect on health and the ability of individuals and populations to stay well in the communities where they live, work, and play.

Interaction among the determinants of health leads to outcomes, the second component of the population health definition. Population- and individual-level disparities and risk factors exert significant influence on health-related outcomes. General health outcomes could be improved by assuring access to quality health care for all populations, regardless of insurance status, with a primary focus on health maintenance and prevention to decrease health risks. Policy development is one mechanism used to support population health management and improvement. Support and guidance for these efforts is provided by policies at local, state, and federal levels. Laws that have promoted use of seat belts and infant care seats have had a profound impact on population health.[18]

Population health is not synonymous with public health. In fact, public health is a core element of population health that focuses on determinants of health in communities, preventive care, interventions and education, and individual and collective health advocacy and policies. The principal characteristic that differentiates population health from public health is its focus on a *broad set of concerns* rather than on just these specific activities.[2] Population health efforts generate information to inform public health strategies that can be deployed in communities. The combination of information gathered to define problems and build awareness and the strategies to address needs comprises population health management.

Consider Wendy McDonald, a hypothetical community member whose situation illustrates the importance of considering multiple factors when using a population health approach. Wendy is obese and lives in a lower-income community where healthy food is not readily available. Safe neighborhood parks and recreation centers are lacking, making physical activity a challenge. Inadequate health insurance restricts her ability to receive primary medical care or guidance from a healthcare provider on how to manage her weight, and she is unaware of the increased risk factors for disease it presents. On a positive note, she regularly attends a place of worship where she receives spiritual enrichment and social support. Additionally, she works as a waitress at the local diner. The population health conceptual model suggests effective approaches to care delivery in such situations. A primary care practice in communities such as Wendy's could be reengineered as a patient-centered medical home that applies a comprehensive, integrated approach to disease and **chronic care management** and supports health promotion and disease prevention, which would lead to better short- and long-term health outcomes. A community-based population health approach to address Wendy's challenges might include adding green space for recreation and supporting healthy food options through tax credits to food stores that offer them. The church she attends could organize farmers' markets, health risk assessments, and 5K walk/run events. The diner she works at could

provide health insurance. Underlying both of these approaches are policies that support community improvements, make health a priority that leads to better health outcomes, and may be shared with public health initiatives.

Donald Berwick, MD, President Emeritus and former CEO of the Institute for Healthcare Improvement (IHI), once remarked that health care has no inherent value, but health does. The population health promise requires a broader focus—one that encompasses health promotion and disease prevention as well as caring for the sick. Under the traditional healthcare model, individuals seek care to restore health when it is compromised and seek prevention primarily when they are fearful about potential loss of health. Under an aspirational model of health and wellness promotion, individuals would value their health and seek preventive care as a means to optimize it. Ultimately, the intrinsic reward of feeling well should be a major driver of population health in a true "culture of wellness."

Foundations of Population Health

The Care Continuum

Nearly all of us spend our lives striving to be well, mitigating actual and potential health risks, seeking treatment when acutely ill, managing chronic illness and recovering from catastrophic health events. The promise of population health is to allow more and more people the opportunity to live healthily and well for the vast majority of their lives—limiting illness and suffering. Research is now clear that the longer you can maintain your health, the shorter the period of significant illness before one dies. This is known as the **compression of morbidity**. We all hear about vital people who live well into their 90s and die in their sleep. It must be the goal of population health to markedly increase this experience within communities.

The Science

Health is a state of well-being; population health provides a conceptual framework for the study of well-being and variability among populations.[19] In the United States, the delivery of healthcare services receives the lion's share of health-related resources and attention, and yet it is only one of many contributors to and drivers of a population's overall health (e.g., the business and political communities). There is substantial, yet unrealized, opportunity to advance the population health agenda and to improve health through efforts focusing on personal behavior and health promotion within each of these spheres.[20]

The expectation that healthcare providers must care for their own patients in their own practice settings is rapidly changing as new models for affecting outcomes at the population level are introduced. Treatment of populations aims to increase recommended prevention and screening practices and improve adherence to recommended treatment in accordance with evidence-based, nationally recognized guidelines. These aims can be achieved only with teams of healthcare providers cooperating within and across settings. While one-at-a-time treatment has been the traditional approach to patient care, population-level interventions that integrate a set of common aims and standards are needed to support significant and sustainable health improvements in the

United States. This effort has been aided by the adoption of electronic medical records and the promotion and incentivizing their meaningful use to improve accessibility of actionable health information.[21]

Keeping well people well is a key priority in population health. The notion that health professionals should only see their patients on an annual basis (or less often) unless they are ill must give way to a clinical relationship based on maximizing health and preventing illness. Periodic and dedicated preventative health visits should be completed with the intent of delivering all evidence-based preventive care, from biometric health screening to health risk assessments and immunizations. Reducing health risks is also a key priority in population health. Once identified unhealthy behaviors like smoking, excessive alcohol consumption, and sedentary lifestyles must be aggressively addressed and changed using our advancing understanding of behavior change. Management of chronic disease is another key priority in population health. The fact that nearly half of all Americans have one or more chronic diseases is only partly explained by population growth and increases in longevity. The present and predicted burden of chronic disease is the strongest signal that current strategies for helping people get well, and stay well, are ineffective. The burgeoning population, and the prevalence of chronic illness that accompanies it, drives both cost and utilization of healthcare services and now threatens Americans' progress in life expectancy.

There is ample evidence to inform population health improvement strategies, but processes remain poorly defined and success is variable. Although numerous national goals for population health have been proposed and targeted outcomes have been defined, translating best practices into action is a daunting challenge. The Chronic Care Model (**FIGURE 1-1**) is a

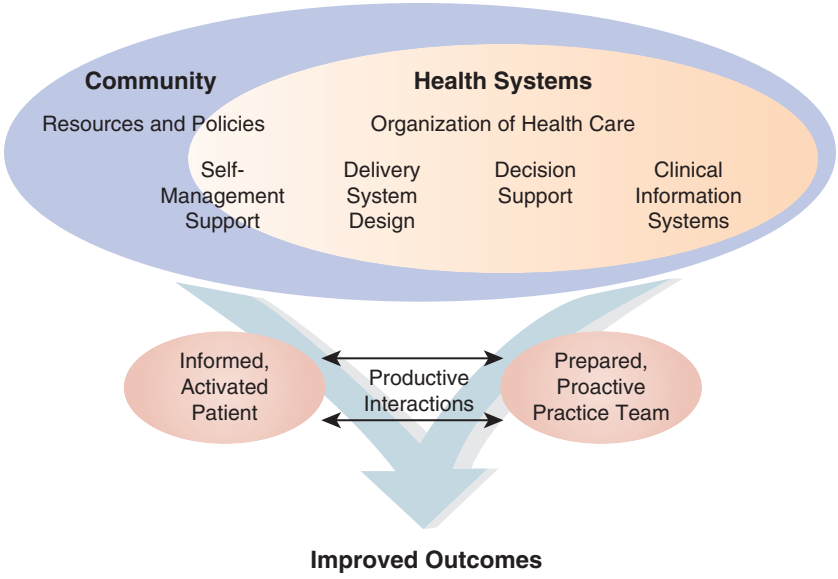


FIGURE 1-1 The Chronic Care Model.

well-regarded conceptual model for guiding the development of effective programs to provide better chronic care to patients; it is comprised of Patient Care and Practice Improvement Organization, Clinical Information Systems, Delivery System Design, Decision Support, Self-Management, and Community Resources. The devil is, of course, in the details: the emerging understanding of what is required to build "cultures of health" will be of value, as will the recognition of complementary activities in support of an improved delivery process (e.g., social and environmental factors).[22]

The greatest contributor to premature death from preventable chronic illness is patient behavior. Of the six model components, the degree to which patients are informed and activated is critical to improved patient outcomes. Informed, activated patients are more likely to learn self-management strategies and to adopt healthy behaviors. Providers need an array of tools to effectively help patients manage their health risks and chronic conditions. Because they typically have neither the time nor the resources to consult the evidence base during a patient encounter, they need robust clinical decision support tools at the point of care. The relationship between the patient and the healthcare provider can be greatly enhanced today through the use of technology. Many avenues of communication need to be leveraged—such as text messaging via secure patient portals, phone calls, and video chat, and incorporating data from wearables and other remote monitoring devices into medical records. These can provide helpful feedback, help to track compliance and adherence, and alert clinicians through an early warning system when health starts to deteriorate. Further, providers need a reimbursement model that rewards performance and outcomes while supporting the needed investment of time and money into appropriate interdisciplinary communication, collaboration, and follow-up, as well as access to interoperable technologies that permit data sharing in real time. All of these components must be supported by clinical information systems that track progress in the management of chronic conditions. These practice-based components, combined with community efforts (e.g., community-wide screenings, in-home support for elderly persons, nutritious school lunch programs) and active participation of patients who productively interact with healthcare providers, will support effective, quality chronic care management while reducing health risks and costs.[23]

One of the greatest challenges to improving the population's health is translating evidence into practice. Two state initiatives provide examples of population health strategies in action—one generating improvements, while the other is lagging behind:

- The Vermont Blueprint for Health is a state-led, nationally recognized initiative transforming healthcare delivery. At its foundation is the local Transformation Network, a network of Project Managers, Practice Facilitators, and Community Health Team Leaders who work with Patient-Centered Medical Homes (PCMHs), Community Health Teams (CHTs), and local health and human services leaders. This local network allows for rapid response to Vermont's health

priorities through statewide implementation of new initiatives. Their 2017 Annual Report highlights progress in reducing health and pharmacy expenditures, increasing investment into focused social services, near comprehensive engagement of the state's primary care providers, greater training in self-care of its citizen and improved data and analytics.[24] Vermont remains among the healthiest states in the United States.[25]

- In Wisconsin, David Kindig, a key thought leader in population health, is driving efforts to earn the designation of "healthiest state." For three decades, Wisconsin's ***Healthiest Wisconsin 2020: Everyone Living Better, Longer*** initiative of statewide community health improvement planning has targeted improving the health of all Wisconsin residents and communities. This plan's two key goals are to (1) improve health across the life span and (2) achieve health equity by eliminating health disparities among various segments of the population. Its mission is to ensure that Wisconsin's populace lives in healthy, safe, and resilient families and communities. *Healthiest Wisconsin 2020* fulfills Wisconsin Statutes section 250.07(1)(a), requiring the Department of Public Health to develop a public health agenda for the people of Wisconsin at least every decade. The initiative is both a state health plan and an ongoing process based in science, quality improvement, partnerships, and large-scale community engagement. Despite these efforts, Wisconsin has fallen from 11th in 2006 to 20th in the widely publicized America's Health State Rankings in 2016.[26,27]

Both the Vermont and Wisconsin initiatives demonstrate that population health extends beyond health care. Achieving health and well-being at the individual, population, state, and national levels requires the collective efforts of healthcare providers, public health professionals, payers and health plans, employers, and policy makers. That is why achieving success is difficult and can be elusive.

The Effect on and Response by the Marketplace

There is a shared responsibility for population health. Although the cost burden of health care is shared among all constituents, the distribution of costs is not always proportionate. With more than 60% of Americans obtaining health insurance coverage through their employers, businesses have a substantial stake in their employees' health.[28] As healthcare costs continue to escalate much faster than general inflation, businesses are searching for strategies to moderate their healthcare cost trend without compromising quality.

The health of its employees influences the economic health of a business—a healthy employee is more productive on the job and misses fewer days of work. The bottom line is that prevention and condition management programs generate a positive return on investment for employers. Studies have calculated returns as high as 6:1 and as low as 1.5:1.[29–31] In this scenario, everyone benefits—employees are healthier, businesses can operate more cost

effectively through improved employee performance and reduced health benefits costs, and health plans reduce outlays for preventable morbidity. In some cases, the productivity gains exceed the healthcare cost savings for employers.[32] Moreover, there is increasing evidence that companies focusing on the health and safety of their workforces produce greater returns for their shareholders.[33–35] Worksites are an ideal venue for promoting health and wellness because many consumers spend the majority of their time at work.

While the business case for promoting wellness is becoming increasingly clear, competing priorities present a challenge in many organizations. Corporate cultures, investment costs, incentives for participation in the initiative, and employees' underlying health behaviors are potential barriers to implementing a successful workplace wellness program. However, workplace programs may be effective in three major domains of health: promoting behavior change to prevent illness, supporting employees to self-manage existing chronic conditions, and assisting in the navigation of a complex and fragmented healthcare system.

Forty percent of premature deaths can be attributed to behavior. In fact, behavior is a key contributor to two of the leading causes of preventable death: obesity and smoking.[28] The healthcare costs alone attributable to smoking topped $170 billion a year in 2012.[36] Workplace smoking cessation programs have been effective in mitigating risk for the health effects of smoking. Employer involvement in health plan–supported disease management efforts or health advocacy programs provides employees with access to education and tools to properly manage their health risks and conditions as well as seek the most appropriate care. The best available evidence concerning employer sponsorship of health and wellness programs supports the premise that employees who are well provide the greatest benefit to their organization.[37–39] Many enlightened employers realize that health care is not a cost but rather an investment into their most precious resource—their workforce.

The Politics

Prevention, health, and wellness efforts must be supported by policy and regulation to advance the population health agenda. Building awareness is the first step toward making lasting change, followed by identifying population health needs and recognizing the importance of data and measurements on which causal inferences are based and actions are taken. Two examples, current rates of smoking and obesity in the United States, represent needs that must be addressed through population-based initiatives. The rate of adult smoking has yielded to successful public health improvement efforts, falling from 42% to 14% prevalence over the past 50 years,[40] while obesity has proven more resistant to positive change. Policies that drive population health efforts must be created at the local, state, and national levels to serve as the foundation of the population health infrastructure. Because implementation of population health improvement policies often requires significant resources, stakeholders face difficult decisions about priorities. Federal monies made health improvement initiatives possible in Vermont and Wisconsin initially.[24–26]

The healthcare workforce that will provide high-quality population-based health care in the future must be trained now, and education reform is under way to ensure the competency of future leaders and practitioners in health care, public health, business, and **health policy**. Finally, research is needed to inform strategies to address population health approaches. Similar to the potential benefits of disease management and wellness initiatives realized by employers, policies that support health and wellness will also contribute to the wealth of the nation.

Frameworks for Innovation

A few key initiatives provide a framework for innovation that aspires to make population health efforts the norm rather than the exception. As in all industries, common goals and objectives and guidelines and standards in health care provide an understanding of expectations and drive efforts to provide safe quality care.

Healthy People 2020

Since 1979, the U.S. Department of Health and Human Services (HHS) has been leading efforts to promote health and prevent disease through identification of threats and implementation of mechanisms to reduce threats. *Healthy People* sets national health objectives for a 10-year period based on broad consensus and founded on scientific evidence.[41] *Healthy People 2020* contains 38 focus areas and four overarching goals:

1. Attaining high-quality, longer lives free of preventable disease, disability, injury, and premature death
2. Achieving health equity, eliminating disparities, and improving the health of all groups
3. Creating social and physical environments that promote good health for all
4. Promoting quality of life, healthy development, and healthy behaviors across all life stages[42]

Public health professionals use the *Healthy People* objectives to drive community efforts based on defined needs. Containing both clinical and nonclinical measures, *Healthy People* also serves as a guide for population health efforts and a road map for interdisciplinary collaboration that leads to shared responsibility for health and wellness. Also important, it introduces the concept of cultural transformation and the benefits of leveraging social and physical environmental influences to elevate the health status of populations.

The development of objectives and priorities for *Healthy People 2030* is under way. The fifth edition of *Healthy People*, will aim at new challenges and build on lessons learned from its first four decades.[43]

Triple Aim

In 2007, the IHI launched the Triple Aim, providing an agenda for optimizing performance on three dimensions of care: the health of a defined population, the experience of care for individuals in the population, and the cost per capita for providing care for this population.[44] "Population" is defined by enrollment or inclusion in a

registry. Groups of individuals defined by geography, condition, or other attributes can be considered a population if data are available to track them over time. At the core of this initiative are efforts to optimize value. A number of integrators across the United States are working to implement strategies to achieve the Triple Aim. At the macro level, integrators pool resources and make sure the system structure and processes support the needs of the population. At the micro level, integrators ensure that the most appropriate care is provided to patients with respect to overuse, underuse, and misuse.[45] To successfully achieve the Triple Aim, healthcare institutions and delivery systems must reduce hospitalizations, apply resources to patient care that are commensurate with their needs, and build sustained relationships that are mindful of patient needs.[45] While a great deal of work remains to achieve optimal performance on the three objectives, the Triple Aim has built awareness and offers a framework for population health management.

Practical National Priorities and Goals—The CDC 6/18 Initiative

The U.S. Centers for Disease Control and Prevention (CDC) has identified six common and costly health conditions with 18 proven interventions. It is collaborating with partners, including healthcare providers, public health workers, insurers, and employers who purchase insurance, to improve health and control healthcare costs by:

- Giving partners rigorous evidence about high-burden health conditions and related interventions
- Highlighting disease prevention interventions to increase their coverage, use, and quality
- Aligning proven preventive practices with value-based ways of paying for healthcare

With this information, partners can make decisions that improve people's health and help control costs.

It calls for the following actions:

1. Reduce tobacco use
2. Control high blood pressure
3. Prevent unintended pregnancy
4. Control asthma
5. Improve antibiotic use
6. Prevent type 2 diabetes

This a ground-breaking effort because it calls for the collaboration of many of the constituents of health care to attach prevalent health risks and conditions where there are known effective interventions.[46]

In 2015, the Agency for Healthcare Research and Quality developed six National Quality Strategy (NQS) priorities. These areas of focus address much of the population health continuum while also focusing on the equally germane issues of health equity and patient safety[47]:

1. **Patient Safety:** Making care safer by reducing harm caused in the delivery of care
2. **Person- and Family-Centered Care:** Ensuring that each person and family is engaged as partners in their care
3. **Care Coordination:** Promoting effective communication and coordination of care
4. **Effective Prevention and Treatment:** Promoting the most effective prevention and

treatment practices for the leading causes of mortality, starting with cardiovascular disease

5. **Healthy Living:** Working with communities to promote wide use of best practices to enable healthy living
6. **Care Affordability:** Making quality care more affordable for individuals, families, employers, and governments by developing and spreading new health care delivery models

Achieving these national priorities requires health care and wellness to be fostered at the community level through a partnership between public health agencies, healthcare purchasers, and healthcare systems. The goal is to promote preventive services, healthy lifestyle behaviors, and high-quality, affordable healthcare. These priorities and projects will continue to spur action and innovation and serve as a model for population health improvement.

Preventive Strategies and Pillars of Population Health

To achieve the ambitious goal of improving the U.S. healthcare system, we must be prepared to broaden our current focus beyond acute, episodic health care. This implies a collective commitment to incorporating population-based primordial, primary, and secondary prevention strategies—as citizens and as healthcare providers—as well as better coordinating care for those suffering from chronic illnesses to mitigate complications, also known as tertiary prevention.

Preventive Strategies

National experts and policy analysts agree that focusing on primordial and primary prevention strategies (e.g., healthy environments, healthy cultures, health promotion, and wellness activities) will ultimately improve the overall health of citizens and decrease the costs associated with overmedicalization. Three lifestyle modifications—eliminating and reducing tobacco use, eating healthy foods with portion control, and increasing regular physical activity—are consistently identified in population-based epidemiologic research as most likely to reduce the prevalence of chronic conditions. Utilizing secondary preventive services (e.g., cancer screenings, blood pressure and cholesterol monitoring, health counseling) promotes early detection of disease. Secondary prevention strategies seek to reduce barriers to early treatment or completion of therapy, thereby improving treatment outcomes and reducing disease chronicity. For example, detecting an early-stage breast cancer during mammography and initiating treatment may prevent the need for mastectomy or indeed be lifesaving.

Tertiary prevention focuses on minimizing disease complications and comorbidities through appropriate, evidence-based treatment and—critical to reducing healthcare costs—by coordinating and providing continuity of care for chronic conditions. This is best accomplished by incorporating the Chronic Care Model into healthcare systems and monitoring disease-specific indicators to ensure quality care and maximize quality

of life for patients and their families. Prevention and disease management are integral to maintaining population health and encouraging wellness. All healthcare professionals have a role to play.

The Four Pillars

Population health rests on four pillars[48] (**FIGURE 1-2**):

- Care Management
- Quality and Safety
- Public Health
- Health Policy

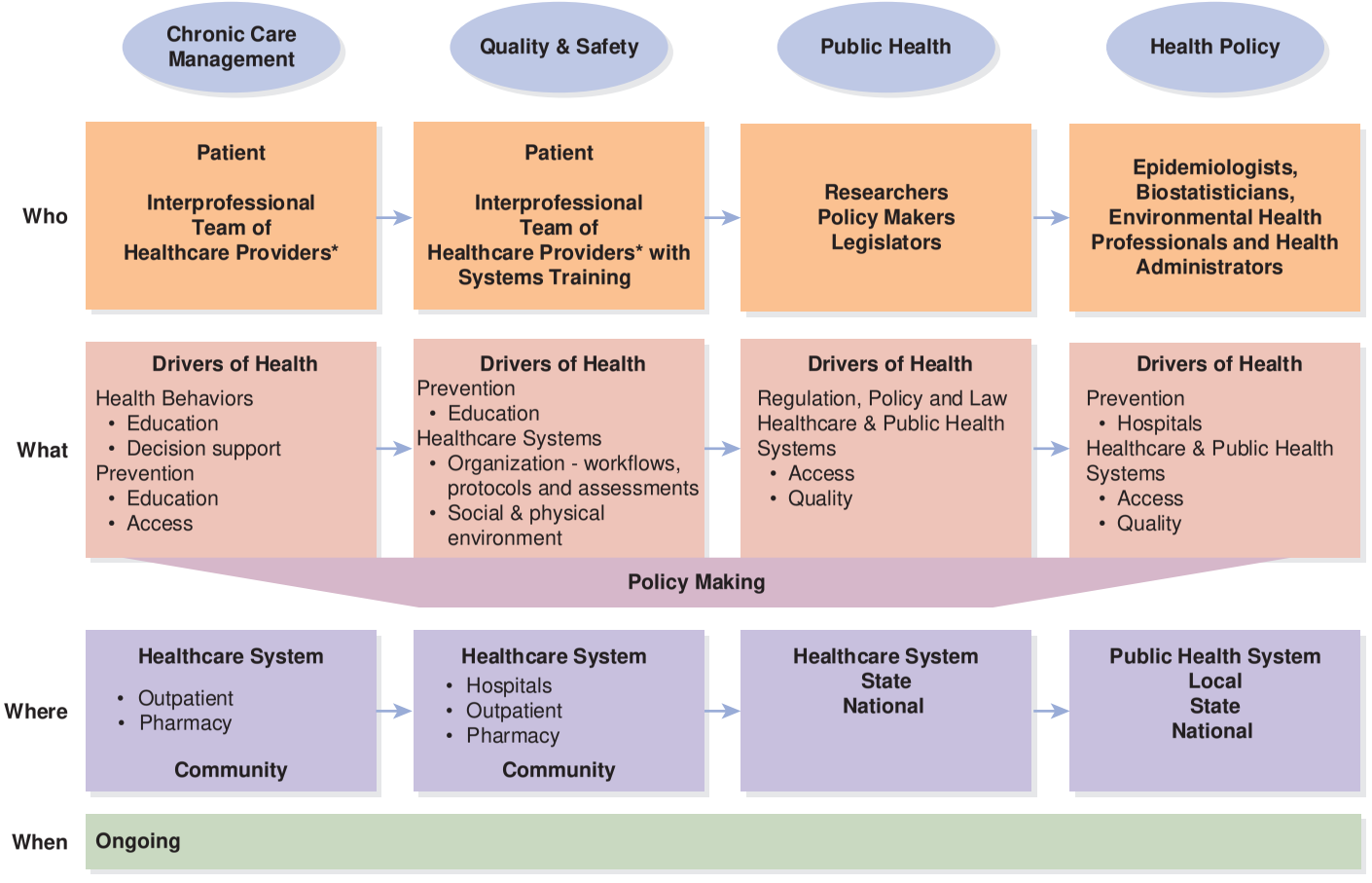
The interaction among each of these pillars in education and practice lays the foundation for achieving population health goals and strategies (**FIGURE 1-3**). National statistics show that only 55% of U.S. adults receive recommended preventive care, acute care, and care for chronic conditions, such as hypertension (high blood pressure) and diabetes.[11] Successful execution of these four pillars will markedly improve upon this metric, allowing many more people to receive evidence-based care and health-related services.

Care Management

When only slightly more than half of Americans receive care that they could benefit from, there is a need for collective efforts (involving patients, providers, public health, employers, health plans, and policy makers) to improve health and wellness. Given the large proportion of the population suffering from chronic conditions, it is clear that care coordination must be improved across the many settings where care is delivered and that evidence-based clinical management and effective self-management must be actively promoted. Behavior and prevention play important roles in chronic care management. Access to screening and counseling for chronic conditions is integral to successful treatment. Education is another key component in chronic care management because treatment decisions need to be made jointly by the patient and the provider. Patients' understanding of their diseases and treatment options is essential for well-informed healthcare decisions and adherence to treatment. In combination, these efforts support quality of life and function, contribute to the health of populations, and reduce the use of costly acute care for preventable problems arising from poorly managed chronic illness.

Quality and Safety

Quality and safety improvement rely on "activated" patients and provider teams that are motivated to examine the structure and organization of healthcare delivery and rectify the processes or workflows that lead to errors. In the two decades since the 1999 National Academy of Medicine report, *To Err Is Human*, a number of national and professional organizations have identified best practices and made recommendations on how to design systems and processes to make healthcare safer.[49] Synergy across these groups will be integral to achieving gains in quality and safety. Local, state, and national public health efforts must support and complement the work being done in local healthcare institutions. The resulting public attention and awareness of quality and safety goals can serve to activate consumers.



* An interprofessional team of healthcare providers includes both clinical (physicians, nurses, pharmacists, allied health professionals, dentists, radiologists) and nonclinical (healthcare administrators, quality, safety, and public health professionals) professionals.

FIGURE 1-2 The Four Pillars of Population Health.

Data from Booske BC, Kindig DA, Nelson H, Remington PL. What Works? Policies and Programs for a Healthier Wisconsin-Draft. University of Wisconsin Population Health Institute, January 2009.

Public health communities and healthcare systems serve as the foundation on which the population health infrastructure rests. Healthcare providers, researchers, policy makers, legislators, and public health professionals who work in the public health communities and healthcare systems partner with patients to focus on prevention and healthy behaviors. Professionals in chronic care management, quality and safety, public health, and health policy must work together to develop a framework to prevent conditions that burden the population both physically and economically. Interdisciplinary collaboration will strengthen the foundation of the population health infrastructure and lead to improved population health management.

FIGURE 1-3 An Interdisciplinary Model for Population Health.

Public Health and Health Policy

Through interaction with communities and healthcare institutions, public health professionals serve as educators and advocates. The third pillar, public health, provides a framework for identifying health determinants, health disparities, and disease burden and for implementing strategies to address community-wide health concerns. As the fourth pillar, policy efforts support population-focused care management, quality and safety, and public health (e.g., policy support in pay-for-performance initiatives that drive adoption of community-wide quality and safety standards). Taken a step further, making comparison data available for other healthcare constituents and consumers (i.e., transparency) creates a sense of accountability for performance and an impetus for improvement. Future policy changes supporting transparency and public accountability for health and wellness will be necessary to meet the population health promise. Activated patients are seeking out guidance in both cost and quality when choosing between provider and treatment options. Commercial and non-profit enterprises, including the Leapfrog Group,[50] are developing promising websites and apps to assist consumers in their search for information. Taken together, the population health goals, strategies, and implementation tactics associated with the four pillars of care management, quality and safety, public health, and health policy will drive population health efforts to achieve health and wellness.

Conclusion

The United States is faced with many challenges in health care, and the strategies used to address both existing and emerging issues will determine the future health status of our nation. To improve the health of the nation, our focus must shift from health care that is reactive to health care that is proactive and promotes health and wellness. Although population needs have been identified in current literature, a reproducible, population health action plan has yet to be established to address them. In the words of Goethe, "Knowing is not enough; we must apply. Willing is not enough; we must do."[51] It will require the collective efforts of many to truly create transformational change. This chapter is intended to prime readers for further exploration of population health efforts to promote health and wellness. In effect, it is a statement of population health's promise as well as a call to action.

Study and Discussion Questions

1. What is population health?
2. Why is a population health approach needed to promote health and wellness?
3. How do the four pillars of population health work together to improve population health?
4. What does the concept called "compression of morbidity" mean?
5. What do the four levels of prevention (primordial, primary, secondary and tertiary) represent?
6. What is your role in population health?

Suggested Readings and Websites

Readings

Agency for Healthcare Research and Quality. Priorities of the National Quality Strategy. Rockville, MD: Author. Available at http://www.ahrq.gov/research/findings/nhqrdr/nhqdr15/priorities.html (accessed May 5, 2019).

Centers for Disease Control and Prevention (CDC). CDC's 6/18 Initiative: Accelerating Evidence Into Action. Available at https://www.cdc.gov/sixeighteen/docs/6-18-factsheet.pdf (accessed May 5, 2019).

Dzau VJ, McClellan M, Burke S, Coye MJ, Daschle TA, Diaz A, et al. Vital Directions for Health and Health Care: Priorities from a National Academy of Medicine Initiative. Discussion Paper, National Academy of Medicine, Washington, DC. *NAM Perspectives* 2017; doi: 10.31478/201703e.

Maeshiro R (ed.) Responding to the challenge: Population health education for physicians. *Academic Med*. 2008;83(4):319–421. Population health education theme issue, available at https://journals.lww.com/academicmedicine/toc/2008/04000.

Kindig DA. Understanding population health terminology. *Milbank Q*. 2007;85:139–361.

Kindig D, Stoddart G. What is population health? *Am J Public Health*. 2003;93:380–383.

National Academy of Medicine (formerly the Institute of Medicine). *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, DC: National Academy Press; 2001.

National Academy of Medicine (formerly the Institute of Medicine). *To Err Is Human: Building a Safer Health System*. Washington, DC: National Academy Press; 2000.

Websites

County Health Rankings: http://www.countyhealthrankings.org/

Dartmouth Atlas of Health Care: http://www.dartmouthatlas.org/

The Population Health Alliance: http://www.populationhealthalliance.org/

Institute for Healthcare Improvement: http://www.ihi.org/ihi

Partnership to Fight Chronic Disease: http://www.fightchronicdisease.org/

Triple Aim: http://www.ihi.org/Engage/Initiatives/TripleAim/pages/default.aspx

References

1. Centers for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health Promotion (NCCDPHP): About Chronic Diseases. Available at https://www.cdc.gov/chronicdisease/about/index.htm (accessed March 21, 2019).
2. Kindig D, Stoddart G. What is population health? *Am J Public Health*. 2003;93:380–383.
3. Kindig DA. Understanding population health terminology. *Milbank Q*. 2007;85:139–161.
4. Agency for Healthcare Research and Quality. Priorities of the National Quality Strategy. Rockville, MD: Author. Available at http://www.ahrq.gov/research/findings/nhqrdr/nhqdr15/priorities.html (accessed March 21, 2019).
5. Kindig DA, Asada Y, Booske B. A population health framework for setting national and state health goals. *JAMA*. 2008;299:2081–2083.
6. Centers for Medicare and Medicaid Services. National Health Expenditure Projections 2015-2025. Available at https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/Proj2015.pdf (accessed March 21, 2019).
7. Schneider EC, Sarnak DO, Squires D, Shah A, Doty MM. *Mirror, mirror 2017: international comparison reflects flaws and opportunities for better U.S. health care*. New York: The Commonwealth Fund; July 14, 2017. Available at https://www.commonwealthfund.org/publications/fund-reports/2017/jul/mirror-mirror-2017-international-comparison-reflects-flaws-and (accessed March 21, 2019).
8. Osborn R, Squires D, Doty MM, Sarnak DO, Schneider EC. In new survey of 11 countries, US adults still struggle with access to and affordability of health care. New York: The Commonwealth Fund; November 16, 2016. Available at https://www.commonwealthfund.org/publications/journal-article/2016/nov/new-survey-11-countries-us-adults-still-struggle-access-and-affordability-of-health-care (accessed March 21, 2019).
9. Berchick ER, Hood E, Barnes JC. Health insurance coverage in the United States: 2017. United States Census Bureau, US Department of Commerce Economics and Statistics Administration. Sept 2018. Available at https://www.census.gov/content/dam/Census/library/publications/2018/demo/p60-264.pdf (accessed March 21, 2019).
10. Raghupathi W, Raghupathi V. An empirical study of chronic diseases in the United States: a visual analytics approach to public health. *Int J Environ Res Public Health*. 2018;15(3):431; doi: 10.3390/ijerph15030431. Available at www.mdpi.com/journal/ijerph (accessed March 21, 2019).
11. McGlynn EA, Asch SM, Adams J, Keesey J, Hicks J, DeCristofaro A, Kerr EA. The quality of healthcare delivered to adults in the United States. *N Engl J Med*. 2003;348:2635–2645.
12. Christopher GC, McGhee HC, Gracia JN. Creating Change through Leadership: Two Extraordinary Leaders, a Mother and Daughter, Share Their Experiences Promoting Racial Equity. Trust for America's Health Web Forum Series—Taking Action to Promote Health Equity. November 1, 2018. Available at http://dialogue4health.org/web-forums/detail/creating-change-through-leadership (accessed March 28, 2019).
13. Witters D. US uninsured rate rises to four-year high. *Gallup News*. January 23, 2019. Available at https://news.gallup.com/poll/246134/uninsured-rate-rises-four-year-high.aspx (accessed March 21, 2019).
14. Centers for Medicare and Medicaid Services. Medicare Chronic Conditions Dashboard: Region Level. Available at https://www.cms

.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Dashboard/chronic-conditions-region/cc_region_dashboard.html (accessed March 21, 2019).
15. Centers for Disease Control and Prevention. Life expectancy at birth, by sex, United States: 2006-2016. Available at https://www.cdc.gov/nchs/index.htm (accessed March 21, 2019).
16. World Health Organization. The determinants of health. Available at http://www.who.int/hia/evidence/doh/en/ (accessed March 21, 2019).
17. U.S. Department of Health & Human Services, National Institutes of Health, National Cancer Institute. *Theory at a glance: a guide for health promotion practice*. Bethesda, MD: Authors. 2005. Available at http://www.sbccimplementationkits.org/demandrmnch/wp-content/uploads/2014/02/Theory-at-a-Glance-A-Guide-For-Health-Promotion-Practice.pdf (accessed March 21, 2019).
18. U.S. Dept of Transportation, National Highway Safety Administration. Traffic safety facts: research note. January 2019. Available at https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812662 (accessed March 21, 2019).
19. Gebbie K, Rosenstock L, Hernandez LM, eds. *Who will keep the public healthy? Educating public health professionals for the 21st century*. Washington, DC: Institute of Medicine of the National Academies; 2003. Available at https://www.ncbi.nlm.nih.gov/books/NBK221695/ (accessed May 5, 2019).
20. Dzau VJ, McClellan M, Burke S, Coye MK, Daschle TA, Diaz A, et al. Vital Directions for Health and Health Care: Priorities from a National Academy of Medicine Initiative. Discussion Paper, National Academy of Medicine, Washington, DC. *NAM Perspectives* 2017; doi: 10.31478/201703e.
21. Office of the National Coordinator for Health Information Technology. MACRA and meaningful use. Available at https://www.healthit.gov/topic/meaningful-use-and-macra/meaningful-use-and-macra (accessed March 21, 2019).
22. Cigna. Creating a culture of health. Available at https://www.cigna.com/assets/docs/improving-health-and-productivity/837897_CultureOfHealthWP_v5.pdf (accessed March 21, 2019).
23. Institute for Healthcare Improvement. Changes to improve chronic care. Available at http://www.ihi.org/resources/Pages/Changes/ChangestoImproveChronicCare.aspx/ (accessed March 21, 2019).
24. State of Vermont, Department of Vermont Health Access. *Blueprint for Health in 2017 Annual Report*. Waterbury, VT: Author. Available at http://blueprintforhealth.vermont.gov/sites/bfh/files/Vermont-Blueprint-for-Health-Annual-Report-2017.pdf (accessed March 21, 2019).
25. United Health Foundation. America's Health Rankings 2017 Annual Report. Minneapolis, MN. Available at https://www.americashealthrankings.org/learn/reports/2017-annual-report/findings-state-rankings (accessed March 28, 2019).
26. Wisconsin Department of Health Services. Healthiest Wisconsin 2020. Available at https://www.dhs.wisconsin.gov/hw2020/index.htm (accessed March 21, 2019).
27. University of Wisconsin Population Health Institute. Health of Wisconsin report card 2016. Available at https://uwphi.pophealth.wisc.edu/health-of-wisconsin-report-card-2016-2/ (accessed March 21, 2019).
28. Baicker K, Cutler D, Song Z. Workplace wellness programs can generate savings. *Health Aff*. 2010;29(2):304–311.
29. Health Enhancement Research Organization and Population Health Alliance. *Program Measurement and Evaluation Guide: Core Metrics for Employee Health Management*. 2015. Alexandria, VA: Society for Human Resource Management. Available at https://www.shrm.org/ResourcesAndTools/hr-topics/benefits/Documents/HERO-PHA-Metrics-Guide-FINAL.pdf (accessed March 21, 2019).
30. Mattke S, Liu H, Caloyeras JP, Huang CY, Van Busum KR, Khodyakov D, Shier V, Exum E, and Broderick M. Do workplace wellness programs save employers money? Santa Monica, CA: RAND Corporation, RB-9744-DOL, 2014. Available at https://www.rand.org/pubs/research_briefs/RB9744.html (accessed March 28, 2019).
31. Walton J. Wellness programs generate a 6:1 ROI. *Work Design Magazine*, January 31, 2018. Available at https://workdesign.com/2018/01/wellness-programs-for-healthy-workplace/ (accessed March 28, 2019).

32. Fabius R, Thayer RD, Konicki DL, Yarborough CM, Peterson KW, Isaac F, et al. The link between workforce health and safety and the health of the bottom line: tracking market performance of companies that nurture a "culture of health." *J Occup Environ Med*. 2013;55(9):993–1000.
33. Fabius R, Loeppke R, Hohn T, Fabius D, Eisenberg B, Konicki DL, Larson P. Tracking the market performance of companies that integrate a culture of health and safety: an assessment of Corporate Health Achievement Award applicants. *J Occup Environ Med*. 2016;58(1):3–8.
34. Goetzel RZ, Fabius R, Fabius D, Roemer EC, Thornton N, Kelly RK, Pelletier KR. The stock performance of C. Everett Koop Award winners compared with the Standard & Poor 500 Index. *J Occup Environ Med*. 2016;58(1):9–15.
35. Grossmeier J, Fabius R, Flynn JP, Noeldner SP, Fabius D, Goetzel RZ, Anderson DR. Linking workplace health promotion best practices and organizational financial performance. *J Occup Environ Med*. 2016;58(1):16–23.
36. Xu X, Bishop EE, Kennedy SM, Simpson SA, Pechacek TF. Annual healthcare spending attributable to cigarette smoking: an update. *Am J Prev Med*. 2015 Mar; 48(3):326–333. Available at doi: 10.1016/j.amepre.2014.10.012 (accessed March 21, 2019).
37. Society of Human Resource Management. Why employee well-being matters to your bottom line. Available at http://www.shrm.org/about/foundation/products/documents/6-11%20promoting%20well%20being%20epg-%20final.pdf (accessed March 21, 2019).
38. Robert Walters. The value of promoting employee health and well-being. Available at https://www.robertwalters.com/content/dam/robert-walters/corporate/news-and-pr/files/whitepapers/health-and-wellbeing-white paper-aus.pdf (accessed March 21, 2019).
39. White M. The cost-benefit of well employees. *Harv Bus Rev*. December 2005. Available at http://hbr.org/2005/12/the-cost-benefit-of-well-employees/ar/1 (accessed March 21, 2019).
40. Centers for Disease Control and Prevention. Smoking is down, but almost 38 million American adults still smoke. [Press release.] January 18, 2018. Available at https://www.cdc.gov/media/releases/2018/p0118-smoking-rates-declining.html (accessed March 21, 2019).
41. U.S. Department of Health and Human Services Office of Disease Prevention and Health Promotion. *Healthy People 2020: History and development of Healthy People*. Available at http://healthypeople.gov/2020/about/history.aspx (accessed March 21, 2019).
42. U.S. Department of Health and Human Services Office of Disease Prevention and Health Promotion. *Healthy People 2020: Leading health indicators development and framework*. Available at https://www.healthypeople.gov/2020/leading-health-indicators/Leading-Health-Indicators-Development-and-Framework (accessed March 21, 2019).
43. U.S. Department of Health and Human Services Office of Disease Prevention and Health Promotion. *Healthy People 2030: Development of the national health promotion and disease prevention objectives for 2030*. Available at https://www.healthypeople.gov/2020/About-Healthy-People/Development-Healthy-People-2030 (accessed March 21, 2019).
44. Institute for Healthcare Improvement. An overview of the IHI Triple Aim. Available at http://www.ihi.org/Engage/Initiatives/TripleAim/pages/default.aspx (accessed March 21, 2019).
45. Dentzer S. The "Triple Aim" goes global, and not a minute too soon. *Health Aff*. 2013;32(4):638.
46. Centers for Disease Control and Prevention. The 6/18 initiative: accelerating evidence into action. Available at https://www.cdc.gov/sixeighteen/index.html (accessed March 28, 2019).
47. Agency for Healthcare Research and Quality. Priorities in Focus. January 2017. Rockville, MD: Author. Available at http://www.ahrq.gov/workingforquality/reports/priorities-in-focus.html (accessed March 28, 2019).
48. Nash DB. Population health mandate: a broader approach to healthcare delivery. Boardroom Press, Feb. 2012. San Diego, CA: The Governance Institute.
49. National Academy of Medicine (formerly the Institute of Medicine). *To Err Is Human: Building a Safer Health System*. Washington, DC: National Academy Press; 2000.
50. The Leapfrog Group. Health care choices. Available at http://www.leapfroggroup.org/ (accessed March 21, 2019).
51. Internet Encyclopedia of Philosophy. Johann Wolfgang von Goethe. Available at http://www.iep.utm.edu/goethe/ (accessed March 21, 2019).

CHAPTER 2

Epidemiology

Russell McIntire
John McAna
Willie H. Oglesby

EXECUTIVE SUMMARY

This chapter provides a broad overview of the field of epidemiology and basic epidemiologic methods. Epidemiology works to measure the burden and search for the causes of disease among populations. Population health practitioners use epidemiologic methods to gather the scientific evidence for planning, implementing, and evaluating interventions to improve the health of populations. Descriptive epidemiology measures the burden of disease by generating morbidity and mortality rates to describe the extent of disease and death among groups. Analytic epidemiology uses experimental and observational study designs to uncover and understand the factors that cause disease. The application of epidemiologic principles and methods has become increasingly important in population health due to emerging infectious and chronic diseases, changing technologies, and shift in focus of health systems toward population-based health outcomes.

LEARNING OBJECTIVES

By the end of this chapter, the reader will be able to:

1. State the major objectives of epidemiology.
2. Define characteristics of descriptive and analytic epidemiology.
3. Discuss distinctions between epidemiology and medicine.
4. List sources of epidemiologic data.
5. Describe methods used in applied epidemiology.

KEY TERMS

Analytic epidemiology
Cohort
Descriptive epidemiology
Determinant
Disease surveillance
Distribution
Epidemic
Experimental studies
Health disparities
Incidence
Morbidity
Mortality
Observational study
Pandemic
Prevalence

Introduction

Population health improvement efforts are informed by data from a variety of sources, including electronic medical records, population-based surveys, birth and death records, claims data, community input, expert opinion, and many others. Population health practitioners use these data to highlight health issues that should be addressed, identify sub-populations disproportionately affected, monitor and evaluate intervention efforts, and uncover factors contributing to disease and death.

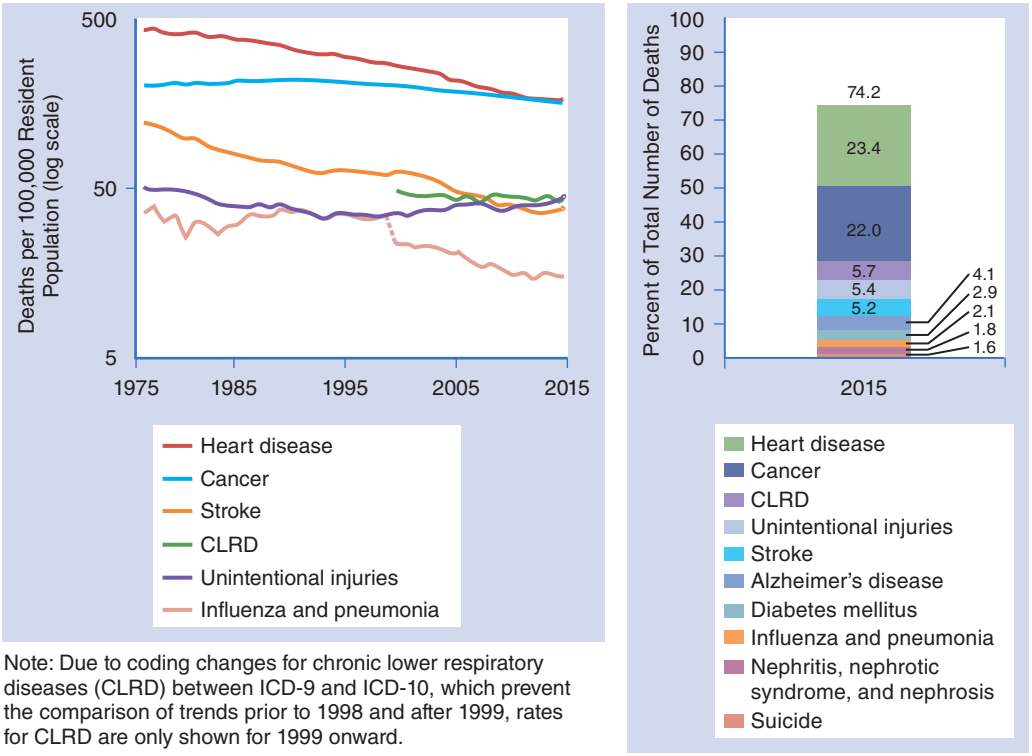
Public health interventions, such as vaccination campaigns, seat belt use laws, workplace safety, and inspections to ensure safe food supplies have contributed to the dramatic increases in length and quality of life among people in the United States in the past century.[1] However, the aging population, economic instability, changes in technology, and emerging areas of concern such as obesity and the opioid epidemic are creating serious challenges that population health practitioners need to address in order to maintain the progress we have made.

Leading Causes of Death in the United States

Currently, chronic diseases represent the majority of the causes of death in the United States. Of the 10 leading causes of death among U.S. residents in 2015, 7 were chronic diseases, 2 were behavioral (unintentional injuries and suicide), and only 1 was caused by infectious disease (influenza and pneumonia).[2] Heart disease and cancer have remained the top 2 causes of death in the United States for the past 40 years (**FIGURE 2-1**).

Determinants of Causes of Death and Disease in the United States

It is important to identify the major causes of death and disease among populations, but natural questions emerge: Why do people get sick? How do they acquire the diseases that lead to disability and death? What are the societal conditions, genetic factors, health behaviors, and environmental exposures that cause disease? A **determinant** is a definable entity that causes, is associated with, or induces a health outcome,[3] such as death or disease. Determinants might be easily recognizable factors such as biological agents that cause infection (such as viruses, bacteria, parasites), carcinogens (such as cigarette smoke, asbestos), or physical injuries (accidents, violence) that cause disease. Alternatively, determinants may be less specific factors, such as stress, physical inactivity, eating unhealthy foods, or sleep deprivation. Determinants are not



Note: Due to coding changes for chronic lower respiratory diseases (CLRD) between ICD-9 and ICD-10, which prevent the comparison of trends prior to 1998 and after 1999, rates for CLRD are only shown for 1999 onward.

FIGURE 2-1 Leading Causes of Death.

Data from National Vital Statistics System. NCHS, Health United States, 2016.

just the things that make people sick; they can also be the things that make people healthy, such as wearing a condom during sex, getting immunizations, or seeking other preventative medical services.

Distributions and Health Disparities

The frequency of disease and mortality from disease vary among different population subgroups. For example, the 2008–2012 mortality rate from prostate cancer was higher among African Americans compared to non-Hispanic whites, Hispanics, Asian and Pacific Islanders, and American Indian and Alaska Natives in the United States.[4] These variations show how disease in populations has different **distributions** depending upon demographic, social, or behavioral characteristics of people. Demographic subgroups that have higher occurrence of disease compared to other groups are defined as having **health disparities**. Eliminating health disparities is a major priority of public health interventions and governmental planning initiatives, such as the Healthy People initiatives, by the U.S. Department of Health and Human Services.[5,6]

What Is Epidemiology and Why Is It Important?

Epidemiologists produce the scientific evidence about the determinants and distribution of major health issues that impact our lives. Before we discuss the definition and functions of the field of epidemiology, we must define health. There are many definitions of health, but one of the most well established is from the World Health Organization (WHO): "Health is the state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity."[7] This definition focuses not just on the state of one's body but also on mental health and describes health in active terms as the confluence of physical and mental states, not just the lack of disease diagnosis.

Population Medicine

Epidemiology is often referred to as "population medicine" due to its focus on the health of groups of people. This is a major distinction from the field of medicine, where the primary focus is on individual patients. In epidemiology, the "patient" is the group, which in epidemiology parlance is called a cohort. A **cohort** is a group of people assembled or observed by researchers in order to learn about the extent or causes of health problems. Cohorts have similar demographic, risk factor, or health outcome characteristics. They may be a particular demographic group, neighborhood, or even a group organized by time, such as those born during a certain calendar year in a geographic location.

Epidemiologists explore the distribution and causes of disease among groups of people and are not as often focused on individual people's clinical diagnoses. As a result, the epidemiologic and clinical descriptions of a disease may be quite different. The clinical description of type 2 diabetes would include specific signs and symptoms such as frequent urination, weight loss, blurry vision, numbness in the extremities, and other diagnostic patient characteristics. The epidemiologic description of diabetes includes factors that put individuals at higher risk of developing diabetes, including age over 45, overweight or obesity, lack of physical activity, family history of diabetes, racial or ethnic minority, and other characteristics associated with higher frequency of diabetes in populations.

Epidemiology collects, analyzes, and interprets data regarding the distribution and determinants of disease among populations. This information is used to plan interventions to reduce the population burden of disease. Epidemiologic studies fall into two major categories, *descriptive* and *analytic*. **Descriptive epidemiology** focuses on summarizing the impact and extent of health-related events among particular groups. **Analytic epidemiology** focuses on searching for the determinants of diseases.

When patients present with bloody stool and kidney failure at a hospital, medical professionals and lab technicians collect and analyze the stool samples to determine the presence of the pathogen responsible, such as *E. coli*. Epidemiologists are the professionals who aggregate case reports and search for patterns among cases to determine the source of the infectious agent. If the epidemiologic investigation shows commonalities among cases that point to a potential source of the

infection, epidemiologists make a plan for preventing further transmission of the disease. For example, if everyone who was sick consumed food from the same restaurant, epidemiologists might recommend temporarily closing down the restaurant to remove the source of the pathogen. Identification of the causes or determinants of disease is essential to take actions to prevent future cases and reduce the burden of the disease among populations.

"What Is Upon the People"

The word *epidemiology* is composed of the Greek words, *epi,* which means "upon," *demos*, which means "people," and *logy* which means "the study of." In essence, epidemiology is the study of "what is upon the people." This definition makes sense, as population health practitioners use epidemiology to identify what diseases are affecting populations. Identifying the causes of health among populations is the first major function of epidemiology. The second function is to use this knowledge to intervene to reduce the burden of disease among populations.[8] Epidemiology is an action-oriented science because it is focused on the end result of improved health among populations. Epidemiologists do not characterize the distribution and determinants of disease for actuarial purposes or for rote record keeping. The ultimate goal of all epidemiologic investigations is to inform interventions that will reduce the impact of disease on populations.

Objectives of Epidemiology

To that end, the objectives of the discipline of epidemiology that are used to achieve this goal include the following[9]:

1. **To determine the burden of disease among populations:** This objective is achieved through descriptive studies that generate rates of disease among groups of people in order to identify and compare distributions of disease. Interventions to improve health should then be focused on geographic areas or demographic subgroups with the highest burden of disease. This objective is critical for health planners and policymakers when choosing how to distribute resources or create priorities for disease prevention and treatment services.
2. **To determine the causes or etiology of disease:** Individual epidemiologic studies of different design combine to form the evidence base for the causes of disease. No one epidemiologic study, regardless of the strength of the study design or analysis, is sufficient by itself to determine that a risk factor, or exposure, causes disease. Determining causation is a slow process that improves and develops over time as new research is released through the peer-review process.
3. **To study the natural history and progression of disease:** Not all diseases have the same burden among populations. Some diseases, such as rabies, are lethal and have a high fatality rate yet affect a small percentage of people in populations. Some diseases, such as arthritis, are not fatal yet affect

a large percentage of people and are linked to genetics, behavior, and demographic characteristics such as age. Measuring the characteristics of diseases as they manifest, progress, and affect people during different life stages is important to identify and evaluate interventions to reduce the population impact of disease.

4. **To evaluate health care services and interventions:** This objective aligns with the discipline of outcomes research. Researchers use epidemiologic methods to compare outcomes between groups that received healthcare or programmatic services versus those that did not receive services.
5. **To provide a knowledge base:** Epidemiologic studies produce the body of literature used by population health decision makers to implement the most efficient and effective population health programs, interventions, and policies. Decision makers need to take actions to improve the health of populations after considering the full context of the breadth of knowledge about specific health topics.

History of Epidemiology

Epidemiology is as old as the discipline of medicine. The Greek physician Hippocrates wrote extensively around 400 B.C. about his medical observations. In one of Hippocrates' most famous treatises, he discussed the importance of the physical, environmental, and social environment on the development of disease.

> Whoever wishes to investigate medicine properly, should proceed thus: in the first place to consider the seasons of the year, and what effects each of them produces, for they are not at all alike, but differ much from themselves in regard to their changes. Then the winds, the hot and the cold, especially such as are common to all countries, and then such as are peculiar to each locality. We must also consider the qualities of the waters … which the inhabitants use, whether they be marshy and soft, or hard, and running from elevated and rocky situations, and then if saltish and unfit for cooking; and the ground, whether it be naked and deficient in water, or wooded and well-watered, and whether it lies in a hollow, confined situation, or is elevated and cold; and the mode in which the inhabitants live, and what are their pursuits, whether they are fond of drinking and eating to excess, and given to indolence, or are fond of exercise and labor, and not given to excess in eating and drinking.[10]

This line of thinking represented a rational account of the origins of disease and makes no mention of supernatural or religious causes of death or disease. While the scientific community conducted empirical investigation into the causes of

disease, it was not common among the general public to make rational connections between the environment and health outcomes. As poverty has always been a risk factor for disease development, theologians, politicians, and even some physicians believed that diseases arose, at least in part, from consequences of laziness, weak constitutions, fear, impiousness, blasphemy, or other moral failings that were often imputed to people living in poverty.

During the early history of epidemiology, infectious diseases caused the largest burden of **morbidity** and **mortality**.[11] Two thousand years after Hippocrates, in 1662, John Graunt published *The Nature and Political Observations Made Upon the Bills of Mortality*, which was the first epidemiologic study of weekly trends in natality and mortality among residents of London. This was one of the first applications of descriptive methods to compare population rates between important demographics such as age and sex and to quantify seasonal variation in disease occurrence. Graunt identified higher mortality rates among men compared to women and higher infant mortality compared to the general population. His work was an important foundational study not just for epidemiology but also the practical application of statistics to describe health issues.

John Snow and Cholera in London

Few epidemiology texts omit a discussion of John Snow's investigation of cholera in London in the mid-1800s. At the time, the scientific community had no knowledge of germ theory, and the causes of the major infectious diseases were therefore unknown. Physicians and health officials believed the miasma theory, which followed that stagnant, foul-smelling air was the mechanism through which cholera and other mortal diseases infected humans. This line of thinking was common and had a long history. For example, in Hippocrates' treatise *On Airs, Waters and Places* (quoted above), the weather and the air were the first major risk factors discussed. Physician John Snow hypothesized that, contrary to popular belief, infected water was the source of cholera outbreaks, though he did not have the technology to isolate the infectious agent, the bacterium *Vibrio cholerae*. Through keen observations and application of the scientific method, Dr. Snow identified that the proportion of deaths in the 1854 London cholera outbreak correlated with the source of people's water. Specifically, neighborhood residents whose municipal water systems were sourced upstream of London had dramatically lower rates of cholera mortality compared to residents whose water system was from sources downstream, which included the unfiltered sewage of London residents. Based on the results of this natural experiment, and a door-to-door investigation of water-drinking behavior, illness, and death due to cholera in the Soho neighborhood of London, Dr. Snow convinced officials to remove the handle on the Broad Street water pump to remove the source of disease transmission. This series of epidemiologic investigations resulted in one of the first and most well documented evidence-based epidemiologic interventions. John Snow has since been called the father of modern epidemiology.

Epidemiologic Transition

Because of improved living conditions, sanitation, and public health interventions such as vaccines, the major causes of morbidity and mortality in most of the world have transitioned from infectious in nature to non-infectious, or chronic disease. The Framingham Heart Study, which began in 1948, was an early and influential longitudinal study in which investigators assembled a cohort of almost 5,200 healthy, non-diseased residents of Framingham, Massachusetts, to evaluate the links between risk factors and chronic diseases. Seventy years later, this study continues and has provided the foundation for much of what we know about the links between lifestyle and morbidity and mortality due to cardiovascular disease.[12] Since the 1950s and 1960s, researchers have established the causal link between smoking and lung cancer and diseases of almost all of the systems of the body. Smoking is, by far, the leading single cause of preventable death in the world.[13] In the United States, smoking and secondhand smoke are responsible for almost 500,000 deaths per year.[6]

Modes of Practice of Epidemiology

Epidemiology is concerned with the distribution and determinants of health and diseases, morbidity, injuries, disability, and mortality in populations. It is of utmost importance that the decisions made by population health practitioners are based on sound evidence. Public and private hospital administrators, health department employees, payers, and other employees working for health industries need to make decisions about the distribution of resources to focus on services that best utilize the skills and training of practitioners, meet the health needs of populations, reduce the burden of disease, and increase the quality of life for members of populations. Epidemiologic methods are integral to determining the best evidence to inform decisions.

Quantification

In order to make evidence-based decisions to improve population health, risk factors and disease outcomes must be quantified empirically. The central aim of epidemiologic methods is to quantify the evidence underpinning public health decisions. Although qualitative research is also important, epidemiologic investigations are never complete without quantifying the distribution or determinants of disease. Health professionals need to measure the number of health "events" in order to determine a risk or rate, which summarizes the extent of the problem. Often health professionals start out by counting the cases of disease that occur among a certain population; this is the numerator, describing the frequency of the event during a certain time interval. The denominator is the number of individuals in the population who were at risk of being a case during the same time interval. The next step might be to further summarize the data by demographic subgroups such as age, gender, race, socioeconomic status, and very importantly, exposure category (whether or not cases were exposed to some particular risk factor).

At the heart of epidemiologic investigations are the research questions and the