



# AGAINST DISEASE

*The Impact of  
Hygiene and Cleanliness  
on Health*



The Soap and Detergent Association



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Hygiene and Cleanliness  
on Health*

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## Foreword

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The nostalgic image of the “good old days” is probably a fantasy when it comes to human health. Not only is it difficult to pinpoint a specific time frame when the “good old days” occurred, but in all probability, they never existed! Historical facts describe an endless struggle with devastating epidemics and unsanitary conditions leading to disease, particularly infant mortality and the early death of young adults. This situation prevailed in Western Europe and the U.S. until the beginning of the “health revolution” in the late 18th and early 19th centuries. The “health revolution” brought about a fundamental upset of the status quo in these two regions and the dawning of an era in which disease is no longer inevitable and early death no longer an accepted fate. Since the 1850s, every decade has been marked by improvements in human survival and life expectancy. Western Europe and the U.S. are clearly better off today than in those imaginary “good old days.”

The first 100 years of the health revolution can be credited to the control of infectious disease. A variety of medical, environmental, technical, and political innovations that were introduced as far back as 1850 interacted to gradually eliminate the sources or transmission routes of the “big killers.” Some of these innovations were deliberate, some were accidental, some were well-documented, some were obscure, and some are still subjects of historical speculation and debate.

A substantial but overlooked component of the health revolution was a sociocultural transformation in personal hygiene and cleanliness. The quarter-century 1890 to 1915, in particular, was the beginning of a mass change in bathing, laundering, and domestic hygiene practice in the United States and England. These nonmedical, behavioral changes were probably a major factor in the control of significant morbidity and mortality. A basic hypothesis is that personal hygiene and domestic cleanliness — including bathing, showering, laundering, dishwashing, and housecleaning — played an essential but subtle and generally ignored role in the revolution. To support this hypothesis, this book examines records of soap production and consumption, bathing and hygiene habits, epidemiological data, and morbidity and mortality data from not only the United States and England, but also other areas of the world.

Today, the health revolution continues in the form of personal hygiene and household cleanliness — two important disease-prevention strategies. This book includes an examination of the effectiveness of handwashing as well as household cleaning and disinfecting practices, today in removing and killing microbes.

The ultimate conclusion is that the current status of cleanliness and the resulting health benefits in developed countries shouldn't be taken for granted. They are only of relatively recent historical origin, are remarkably confined geographically, and *require continuous nurturing and promotion*. There are improvements yet to be achieved in developed countries, and sanitary diligence is as pertinent to health today as it was a century ago. Furthermore, it is proposed that the health revolution and the sanitary revolution are still in progress. There are great strides — including new cleanliness revolutions — yet to be made in some regions of the world.

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## Preface

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In 1984, The Soap and Detergent Association published the monograph *Cleanliness and the Health Revolution*. Authored by Dr. V. W. Greene, who at the time was Professor of Environmental Health and Professor of Microbiology at the University of Minnesota, that monograph brought together a largely ignored picture of the role that cleanliness has had in reducing the incidence of disease-related morbidity and mortality. This publication is an update of that original work, keeping much of the structure and content of Dr. Greene's original work, and adding updated and newly developed statistical data. In addition, information on personal hygiene and household cleanliness challenges and practices in the home are presented in a new chapter.

Special thanks to Jim Kain of The Procter & Gamble Company and Lori J. Kagan, MPH, for contributions to Chapter 4 and to the SDA member company experts who reviewed and commented on all the chapters.



CHAPTER

1



THE "GOOD" OLD DAYS?

*Disease, Despair, and Dying Young*

What about the reality of the “good old days”? In this chapter, we’ll review the health history of those days and demonstrate that health in times past may not have been as good as we imagine.

Indeed, the image of health in the “good old days” is usually ignored, often idealized in historical representations in books, movies, and television. Because of this, many people imagine that generations in prior history were fortunate, experiencing little disease; clean air and water; and lots of good, wholesome food. With this comes a sense that hygiene and cleanliness practices in the “good old days” were sufficient and would be protective in our daily lives today.

Since few of us experienced those days, we depend on historical records, which can be manipulated and misinterpreted. Moreover, many people have different perceptions about what constitutes a historical record. Many of our impressions about the past are based on images created in movies and historical novels, not on data. We identify with royal heroes, aristocratic heroines, dashing adventurers, dramatic events, and happy endings. But rarely do movies and novels describe the ugliness of smallpox, the pathos of infant diarrhea, and the rotting piles of waste. They hardly deal with the daily struggle and misery of the common people, nor the filth, disease, and suffering that they experienced. Let’s look at the historical record and see what those “good old days” were *really* like . . .

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## Filth and Waste

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We know that the ancient Romans developed sewers and public baths, the Greeks were concerned with physical beauty, clean skin, and healthy diets, and the Talmud (ca. 2,000 BC) promoted physical cleanliness as a prerequisite to physical and spiritual health. But Europe during the Middle Ages went

*Europe during the Middle Ages went a thousand years without a bath!*

a thousand years without a bath, and sanitation was as foreign as the toga!

By the 19th century in

Europe, the public sanitation practices and aims of ancient Greece and Rome had been lost.



▲ *Early Roman bathtub (ca. fourth – first century BC)*

Some insights into the causes behind this development come from John Simon, who claimed that the sanitary practices of the Romans and Greeks were in direct conflict with the monastic and ascetic values of early Christianity.<sup>1</sup> The fathers of the early church equated bodily cleanliness with the luxuries, materialism, and paganism of Rome. Their impulse toward an austere spiritual life actually encouraged physical neglect and lack of good personal hygiene.



However, during one period in post-Roman history, baths were built in connection with churches to accommodate pilgrims before they entered the sanctuaries. It's been speculated that these baths were eventually abandoned due to a lack of water supply.<sup>2</sup> In addition, medieval literature refers to handwashing being a common practice before and after meals.<sup>3</sup>

Even the children in Western Europe, including those of the well-to-do, were not bathed. Although within their means, a deliberate belief in bodily filth was pervasive among the wealthy. Note the records of Louis XIII whose legs were washed for the first time at the age of five and bathed for the first time at age seven.<sup>4</sup>

The years right up to the first half of the 1800s were years of filth, poverty, and disease in Europe and the U.S. And, a major component of the filth was human and animal fecal matter.

**Edwin Chadwick reports many examples of unsanitary conditions in 1842 England:<sup>5</sup>**

*“At Inverness there are very few houses in town which can boast of either water closet or privy, and only two or three public privies in the better part of the place exist for the great bulk of the inhabitants.”*

*“At Gateshead the want of convenient offices in the neighborhood is attended with many very unpleasant circumstances, as it induces the lazy inmates to make use of chamber utensils, which are suffered to remain in the most offensive state for several days and are then emptied out of the windows.”*

*“In London . . . I found the whole area of the cellars of both houses were full of night soil, to the depth of three feet, which had been permitted for years to accumulate from the overflow of the cesspools; upon being moved, the stench was intolerable, and no doubt the neighborhood must have been more or less infected by it.”*

*“In Glasgow . . . we entered a dirty low passage like a house door . . . to a square court . . . occupied entirely as a dung receptacle of the most disgusting kind. Beyond this court the second passage led to a second square court, occupied in the same way by its dunghill; and from this court was yet a third passage leading to a third court and a third dung heap. There were no privies or drains there, and the dung heaps received all filth which the swarm of wretched inhabitants could give . . .”*

*“At Greenock, a dunghill in one street . . . contains a hundred cubic yards of impure filth, collected from all parts of town. It is never removed . . . it is enclosed in front by a wall; the height of the wall is about 12 feet, and the dung overtops it; the malarious moisture oozes through the wall, and runs over the pavement.”*

In the early part of the 1800s, the U.S. fared no better. Both rural and city dwellers lived in a world of filth. Animal wastes were everywhere on farms, causing boots and clothing to be covered by manure.

City streets were used for disposal of food wastes and dishwater, as well as being covered with horse manure. In most cities, free-roaming animals, often pigs, scavenged the garbage, which kept the streets free of garbage but spread animal waste. Boston is known as an exception, where scavengers and manure collectors kept the streets cleaner than other cities. Regardless, citizens of U.S. cities of this period were exposed to foul odors from rotting trash and dead animals, as well as human waste.<sup>6</sup>

**New York, as recently as 1865, was described thusly:<sup>7</sup>**

*“Domestic garbage and filth of every kind is thrown into the streets, covering their surface, filling the gutters, obstructing the sewer culverts, and sending forth perennial emanations which must generate pestiferous disease. In winter, the filth and garbage, etc., accumulate in the streets to the depth sometimes of two or three feet.”*

*“In the sixteenth ward, the privies form one of the chief features of insalubrity. Nearly all of them are too small in size and too few in numbers and without ventilation or seat covers. About twelve were found filled to the floor timbers or within one foot of them.”*

Obviously, unsanitary conditions are not pleasant to discuss. In fact, it’s usually avoided or masked by such euphemisms as “soil” or “organic waste.” Even in our enlightened age — when there are no limits to topics or restrictions on words — we never defecate. Instead, we “go to the bathroom.” Imagine how difficult it was to talk about such things in Victorian times when syphilis couldn’t be mentioned and human anatomy was a *dirty* subject!

**Japan: Mid-1600’s to Mid-1800’s<sup>8</sup>**

*Sanitation in Japan from the mid-1600s to mid-1800s contrasted sharply with that in the U.S. and Europe. Human waste was an economic commodity in Japan for use in fertilizing crops, and therefore was carefully collected and managed in cities. And many cities of Japan were as large as or larger than European cities. For example, in the city that eventually became Tokyo (the largest city in the world by 1700), the collection of human waste kept it from streets and out of waste piles and cesspools, preventing people from coming in contact with it. Also, since sewage was not flushed into rivers in Japan, the contamination of rivers that served as water supplies, which became common in Europe, occurred on a much smaller scale in Japan, thereby reducing this factor as a source of infection outbreaks.*

## China: 11th Century<sup>9</sup>

*Reports of life in Hangchow, China in the 11th century indicate that the streets of the city were periodically cleaned by the public authorities and the trash hauled away by boat as a means to control epidemics. While cesspools were used by the rich, the poorer population relied on commercial scavengers for the daily collection of human waste for use as fertilizer.*

## The Age of Epidemics

In history, it appears that disease and death were so common that only the dramatic plagues and pestilences made an impression on the early writers. This might be the first lesson about our past:

*From time immemorial until well into the 19th century, infectious disease epidemics exacted their toll from everyone in every nation — rich and poor, saint and sinner, and city dweller and farmer.*

The sporadic nature and inevitability of such epidemics are shown in **Figures 1-1** and **1-2**. **Figure 1-1** presents the numbers of burials and christenings from the church records of a typical London parish in the 16th and 17th centuries; **Figure 1-2** shows the crude death rates in four American cities 300 years later. The data in the two graphs are not really comparable, but they do document one of the most important health realities of our past — epidemics of infectious disease.

In a way, these charts can be misleading. They emphasize the epidemic peaks and imply that between epidemics, health problems subsided to reasonable and acceptable levels. However, students of epidemiology and those familiar with current vital statistics would be appalled at the

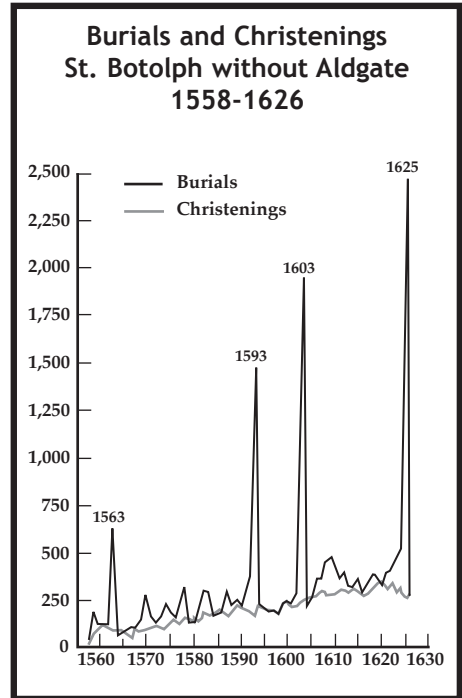
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*In these days, even the “good” years were still disasters by today’s standards.*

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baselines to which mortality rates returned between the dramatic outbreaks. This is the second important lesson we learn from health history:

*In these days, even the “good” years, when there were no remarkable disasters, were still disasters by today’s standards.*

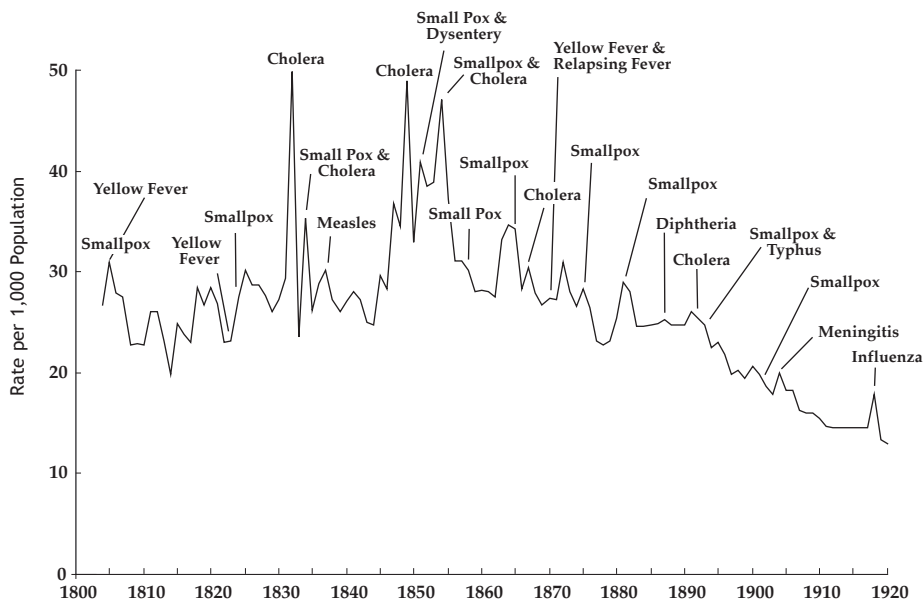


▲ **Figure 1-1.** Reprinted with permission of Cambridge University Press.



## Crude Mortality Rates in Four 19th-century American Cities

### New York City (1804-1918)



▲  
Figure 1-2 (cont'd)

### A description of New York in the 1800s illustrates the impact of disease:<sup>10</sup>

*“Smallpox, scarlet fever, measles, diphtheria were domestic pestilences with which the people were so familiar that they regarded them as necessary features of childhood. Malarial fevers . . . were regularly announced in the autumnal months as having appeared with their ‘usual severity’! The white plague or consumption was the common inheritance of the poor and rich. With the immigrant came typhus and typhoid fevers, which relentlessly swept through the tenement houses. At intervals, Asiatic cholera swooped down upon the city with fatal energy and gathered its enormous harvest of dead. Even ‘yellow fever,’ the great pestilence of the tropics, made occasional incursions . . . Failure to improve the unhealthy conditions of the city, and the tendency to aggravate them by a large increase of the tenement house population, offensive trades, accumulation of domestic waste, and the filth of the streets, stables and privy pits, then universal, caused an enormous sacrifice of life, especially among children.”*

The calculation of mortality rates and their interpretation is a science in its own right.<sup>11</sup> There are many subtleties and pitfalls involved, particularly when one wants to translate the results into accurate conclusions about causality and trends. Prior to 1800, most health information was anecdotal, and it wasn't much better than today's movies at describing the true health status of the community. Fortunately, since 1800, the data for Europe and the U.S. have become more reliable. Lemuel Shattuck and Edwin Chadwick published reports, governments started gathering vital statistics, and the denominators and numerators became more consistent.<sup>5, 12, 13, 14</sup>

From these sources, we gain a frightening picture of European health status. For example, **Figure 1-3** summarizes the average age of death among different social classes in England around 1840. The conclusion from these

*Children who survived the hazards of childbirth might have to live in a hurry, since the average age of death could be somewhere in the late teens or early twenties.*

data is the picture alluded to previously: Continual disease and early death was interrupted only by dramatic epidemics, which brought many to their deaths in a short time. It's a world enslaved by pestilence. Even the children who survived the hazards of childbirth — unless they were born with silver spoons in their mouths — might have to live in a hurry, since the average age of death could be somewhere in the late teens or early twenties.

Average Age of Death England 1837-1841			
	Professional Persons, Gentry, & Their Families	Tradesmen, Farmers, & Their Families	Mechanics, Laborers, Servants, & Their Families
<b>Manchester</b> (Manufacturing Center)	38	20	17
<b>Rutlandshire</b> (Agriculture)	52	41	38
<b>Liverpool</b> (Commercial)	35	22	15
<b>Wilts</b> (Agriculture)	50	48	33
<b>Bethnal Green</b> (Manufacturing)	45	26	16

▲  
**Figure 1-3**

Death, of course, was not the only feature of this history. Infectious diseases, violence, and traumatic accidents that didn't kill exhausted the productivity and quality of life of the survivors. For every recorded death, 20 to 30 persons became ill and weak, and they suffered.<sup>12</sup> This was the situation in the early 1800s in most of Western Europe and the U.S. when a new era known as the "health revolution" led to great changes in health. The next chapter explores this era and highlights some major factors that brought it about.

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## FIGURES

**Figure 1-1: Burials and Christenings, St. Butolph Without Aldgate, 1558–1626**

T. R. Forbes, "By What Disease or Casualty: The Changing Face of Death in London," in *Health, Medicine and Mortality in the Sixteenth Century*, C. Webster, ed., Cambridge University Press, 1979.

**Figure 1-2: Crude Mortality Rates in Four 19th-century American Cities: New Orleans, New York City, Philadelphia, Chicago ?**

M.P. Ravenel, *A Half Century of Public Health*, American Public Health Association, New York, 1929.

**New York City**

New York City Municipal Archives, "The Conquest of Pestilence in New York City: General Death Rate Since 1804," Department of Records and Information Services, New York, NY, undated.

**Figure 1-3: Average Age of Death, England, 1837–1841**

E. Chadwick, *Report on the Sanitary Condition of the Laboring Population of Great Britain*, London, 1842. Reprinted by Edinburgh University Press, 1965.



CHAPTER

2



THE HEALTH REVOLUTION

*Medical and Socioeconomic Advances*

Let's take a look at the health revolution and examine the multiple factors that led to the dramatic improvement in public health. First of all, the health revolution didn't happen all at once, as political revolutions often do. It may have started in the first half of the 19th century, and it's still continuing today! Some of the changes were obvious, like the control of the major epidemics — for example, the disappearance of malaria and smallpox in the state of Illinois, **Figures 2-1a** and **2-1b**. Other changes, like the control of nonepidemic diseases, were more subtle and were recognized only by

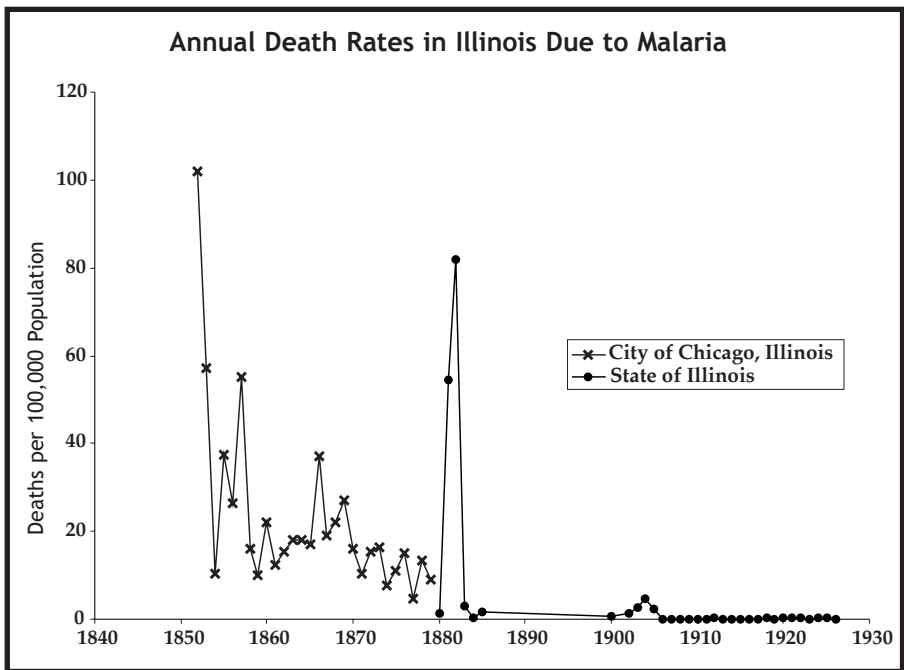
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*The health revolution never really eliminated all disease, all suffering, or all misery.*

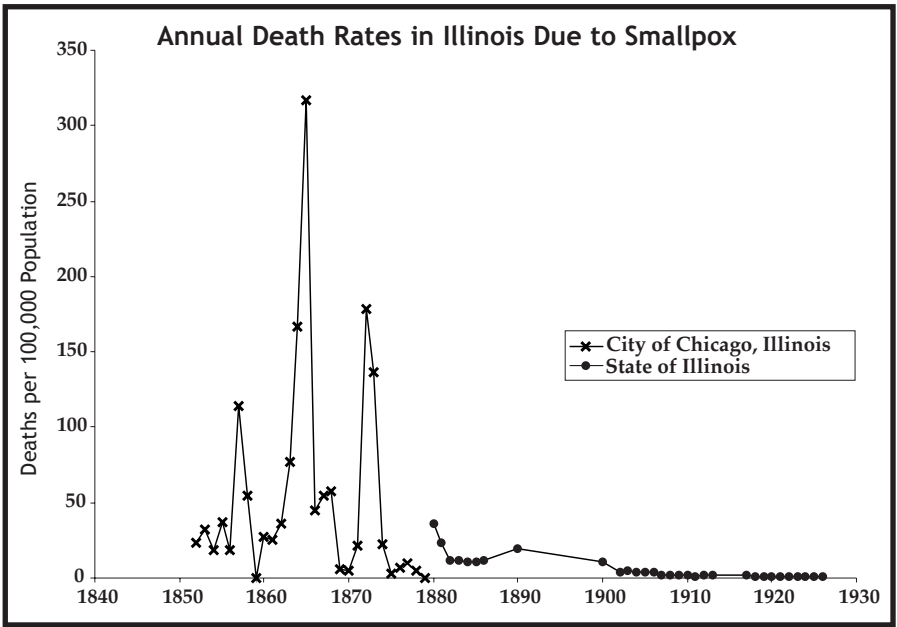
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examining the broader picture, years after the event. It's important to note that the health revolution never really eliminated all disease, all suffering, or all misery. People *still* get sick and die. They did in the past, do so today, and will do so in the future. What the health revolution really did was:

- Change the average age of death;
- Increase life expectancy at every age;
- Significantly lower the probability of a given person dying in a given year from a given cause.

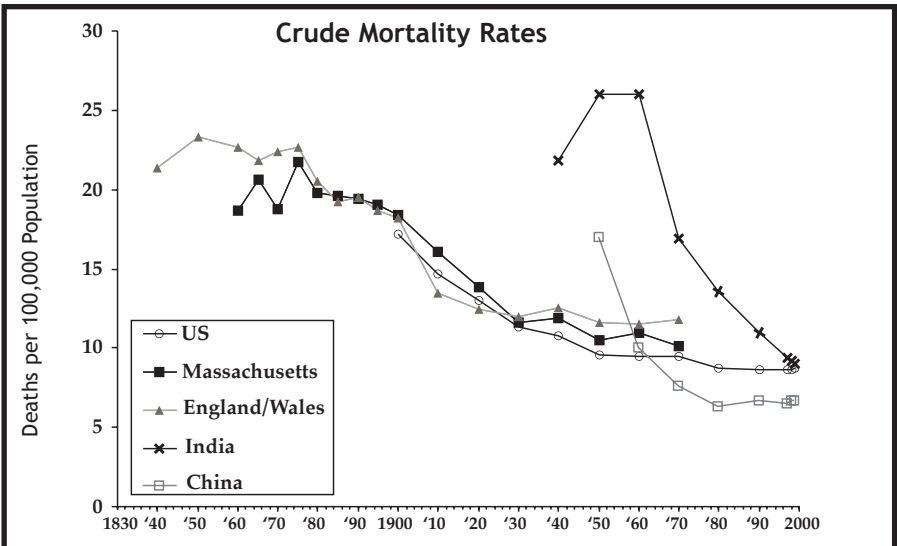


▲  
Figure 2-1a



▲  
Figure 2-1b

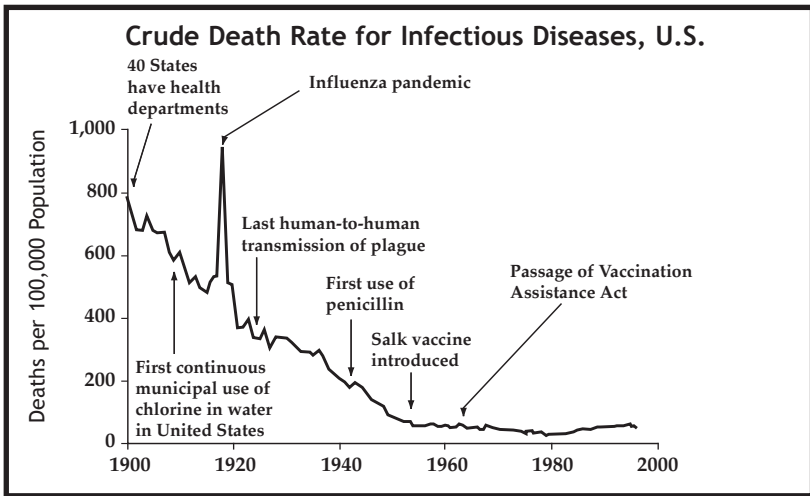
The total impact of the health revolution can be described quantitatively by the data in **Figure 2-2**, which shows the gradual, but persistent decline in crude mortality rates in the U.S., the state of Massachusetts, England and Wales, China, and India. From the middle 1800s until today, the crude death rate in the U.S. and England/Wales has been literally cut in half. In developing countries, the death rate shows a more dramatic decrease in more recent years. The good news is that the trend is still continuing, although at a slower rate.



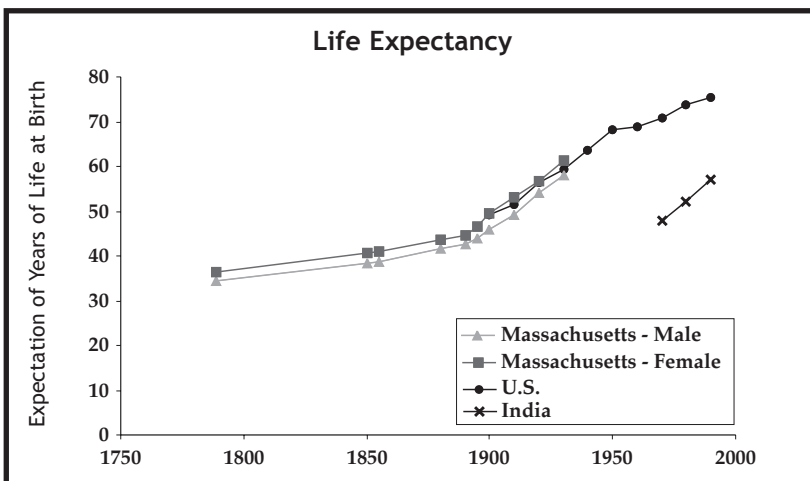
▲  
Figure 2-2

Crude mortality rates are not adjusted by age, sex, or race, but are calculated simply by counting the number of reported deaths and comparing them to the number of people living in the region during the given year. However, it's well known that older people are at greater risk of dying in a given year than younger people. If the data were age adjusted to account for the fact that the average population is older now than in the past, the curves would continue to go down instead of flattening out.

Figure 2-3 shows the crude death rate for infectious diseases where the dramatic impact of water chlorination, as well as medical advances, are noted. In the U.S., as the mortality rate went down, life expectancy was extended (Figure 2-4). Yet, lesser-developed countries, such as India, though improving, still have a much lower life expectancy than the U.S.

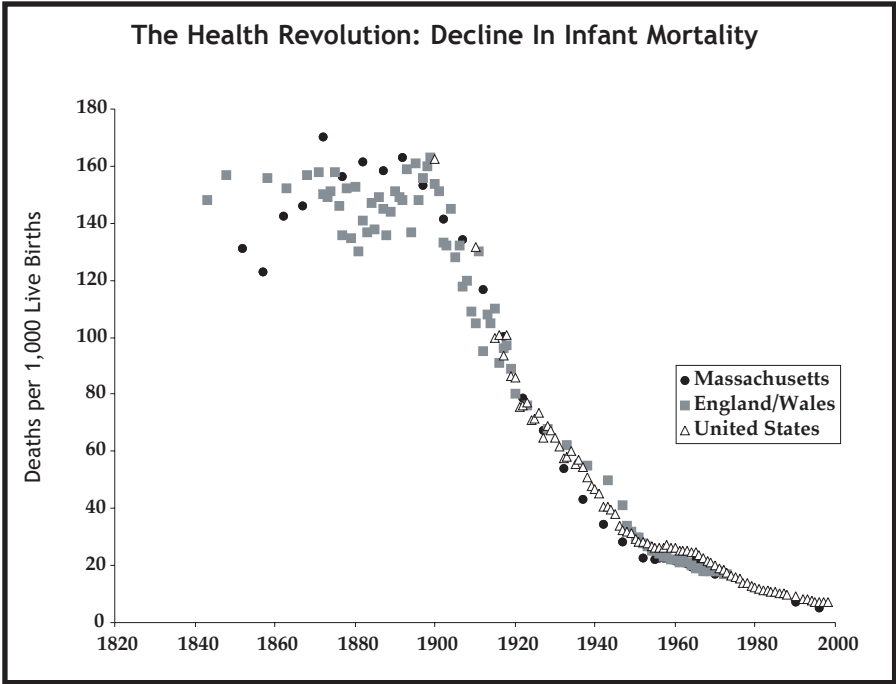


▲ Figure 2-3



▲ Figure 2-4

Without doubt, the most dramatic impact of the revolution was its influence on mortality of infants and children (**Figure 2-5**). This might also be its most gratifying feature. In the middle 1800s up to 1900 in the U.S., England and Wales, between 120 and 170 babies out of every thousand died in the first year of life. Today, the loss has been reduced twenty-fold in these regions!



▲  
Figure 2-5

Perhaps the most important effect of the revolution was a *change in attitude* toward disease and early death. Today, they aren't looked upon as inevitable. Instead, we now expect a newborn baby to live, a disease to be prevented or cured, and a life free from pain, debilitation, and sudden premature termination.

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## The Contributors

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Who organized this health revolution? Who led it? What weapons did they use? Why was it so remarkably successful? Folk knowledge usually attributes the health revolution to advances in medicine, surgery, and pharmacology, but most rational examinations of this proposition don't lend it much support.<sup>1,2</sup> In fact, the answers are really not that simple — health is a complicated phenomenon. At different times and in different places during the last 150 years, a remarkable number of innovations were introduced to modify our environment, our diet, our lifestyle, and our ability to cope with disease.

Thomas McKeown claims that the health revolution really started more than 200 years ago in the first half of the 18th century, long before the availability of reliable vital statistics.<sup>2</sup> To support his case, he cites birth and death data from France and Sweden. He also claims that the lack of good data in most countries until the 20th century contributes to an overestimation of immunization and medical therapy benefits. This is based on the fact that these measures had their major impact almost wholly after 1900.

Health innovations took many forms: medical, technical, engineering, political, sociocultural, and agricultural. Not one of the innovations by itself eradicated disease. The results were dramatic changes in mortality and life expectancy. But the control measures were actually incremental, individual, and limited to a specific disease, a specific locality, or a specific population. Some of these innovations were deliberate and carefully designed. Others were consequences of serendipity. Some innovations had an obvious and immediate impact on health status. Others had indirect or delayed outcomes. Some are well-understood. Others are still obscure. And, they interacted with each other. For example, all the factors listed below were substantial contributors to the health revolution.

### **Contributors to the Control of Infectious Disease** (not necessarily in order of importance)

<b>Medical Innovations</b>	<b>Environmental Sanitation</b>	<b>Social and Technological</b>
Vaccines	Disinfection Antiseptics, Sanitary Chemicals	Agricultural Technology
Antibiotics (and other antimicrobials)	Steam Sterilizers	Food Technology
Anesthetics	Pasteurization	Transportation
Diagnostic Tests (e.g., x-ray, serology, biochemistry)	Water Purification Technology	Education
Advances in Medical Techniques and Instrumentation	Sewage Treatment and Solid Waste Disposal	Sociocultural and Socioeconomic Changes
Advances in Surgical Techniques and Instrumentation	Swamp Drainage	Nutritional Changes
Advances in Pharmacology (e.g., insulin, antihypertensives, hormones)	Insect and Rodent Control	Housing Improvement
Prosthetic and Implantable Devices	Personal Hygiene	Health Services Organization and Financing
Discovery of Specific Microbial Pathogens	Air and Water Pollution Control	Hospital Construction
Advances in Hematology (blood transfusion, clotting control)		Communication Innovations
Advances in Molecular Biology and Genetics		



The major disagreements relate to the importance of each factor, both historically and presently. It's beyond the scope of this book to review and evaluate all the factors, but the following four will serve as illustrations:

1. Advances in medical treatment
2. Improvements in socioeconomic conditions
3. Advances in sanitation
4. Advances in personal hygiene

The first two factors will be discussed here. Three and four are reviewed in Chapter 3.

## Medical Advances

### Vaccines

Although it's estimated that smallpox caused as many as 20% of all deaths in London in the late 1790s, mortality declined rapidly with the availability of a smallpox vaccine.<sup>2</sup> Indeed, the story of smallpox is one of the glories of medical history. For the first and only time in human history, a disease has been deliberately eradicated with vaccines. As we can see from the time line below (**Figure 2-6**), no case of naturally occurring smallpox has been detected anywhere in the world since October 1977.

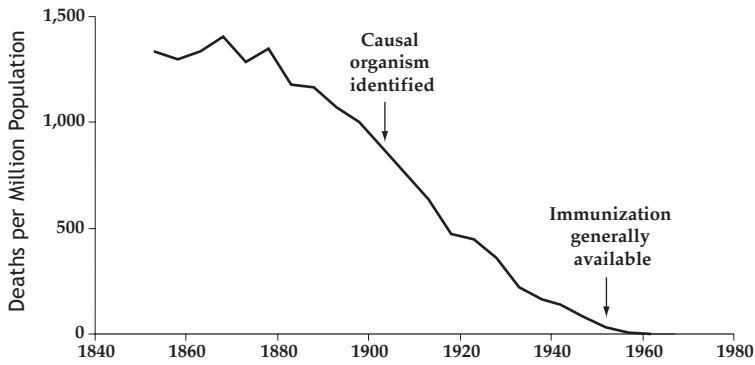
History of Smallpox					
1798	1852	1872-87	1967	1977	1980
Smallpox vaccine first introduced in England.	Smallpox vaccine made mandatory in England.	Smallpox vaccination vigorously enforced in England.	World Health Organization (WHO) launched aggressive program to eradicate smallpox globally.	Last natural case seen in Somalia.	Smallpox officially declared eliminated.

▲  
Figure 2-6

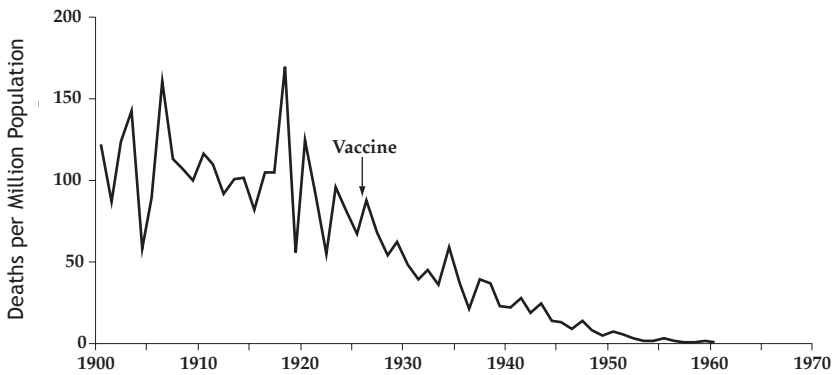
Other vaccines have successfully controlled whooping cough, measles, diphtheria, rubella, and polio (see the charts in **Figure 2-7** on the next few pages).

## Heroes of the Health Revolution: Vaccines

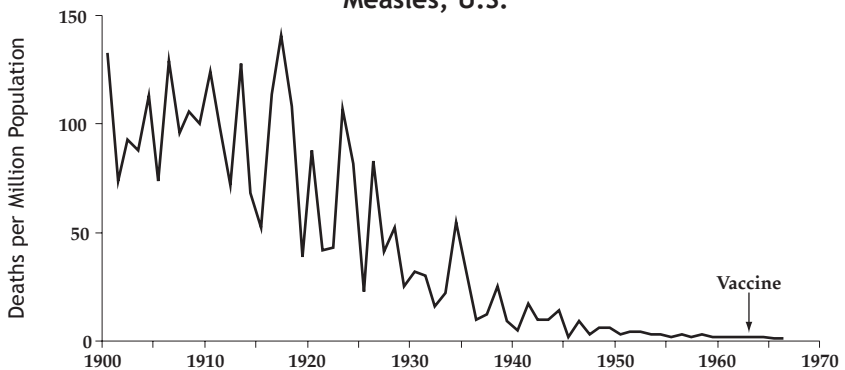
### Whooping Cough in Children Under 15 Years Old, England and Wales



### Whooping Cough, U.S.



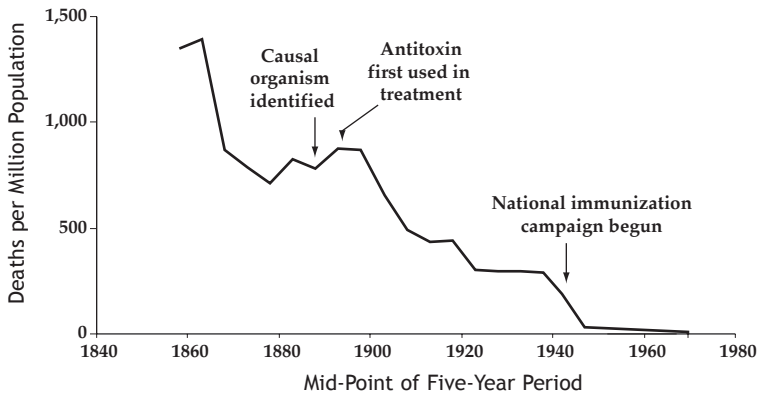
### Measles, U.S.



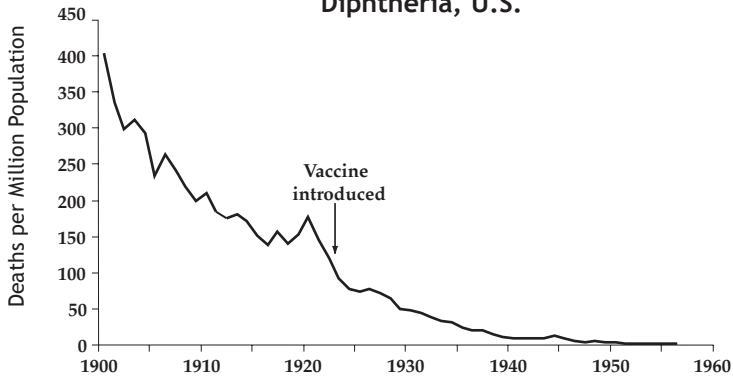
▲  
Figure 2-7

## Heroes of the Health Revolution: Vaccines (cont'd)

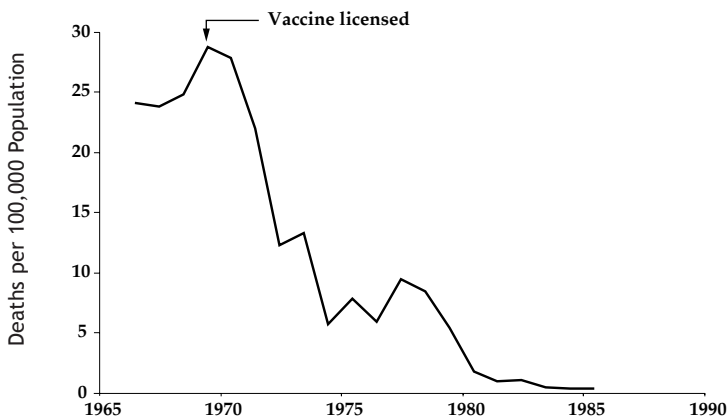
### Diphtheria in Children Under 15 Years Old, England and Wales



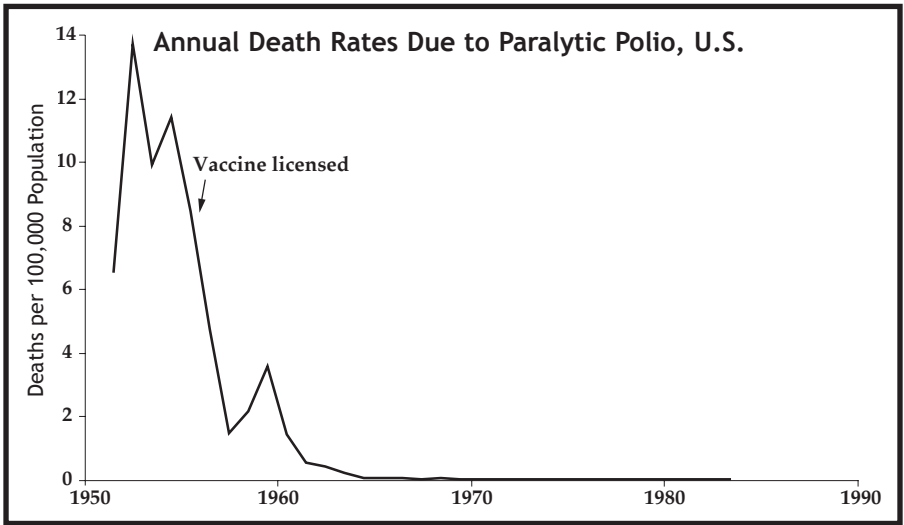
### Diphtheria, U.S.



### Annual Death Rates Due to Rubella, U.S.



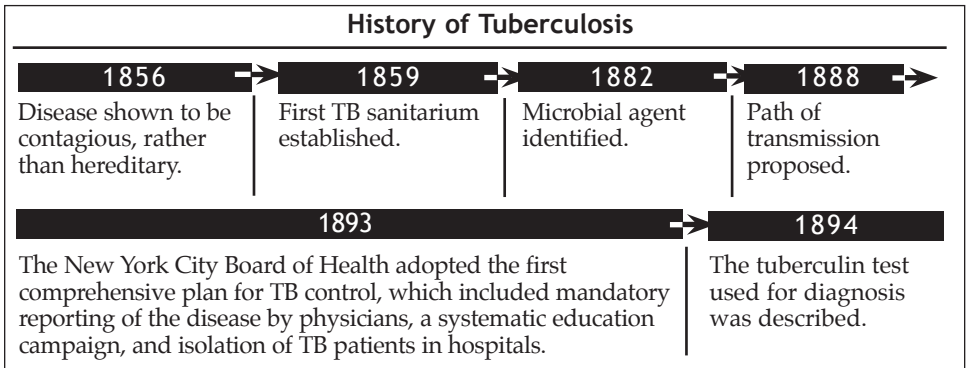
▲  
Figure 2-7 (cont'd)



▲  
Figure 2-7 (cont'd)

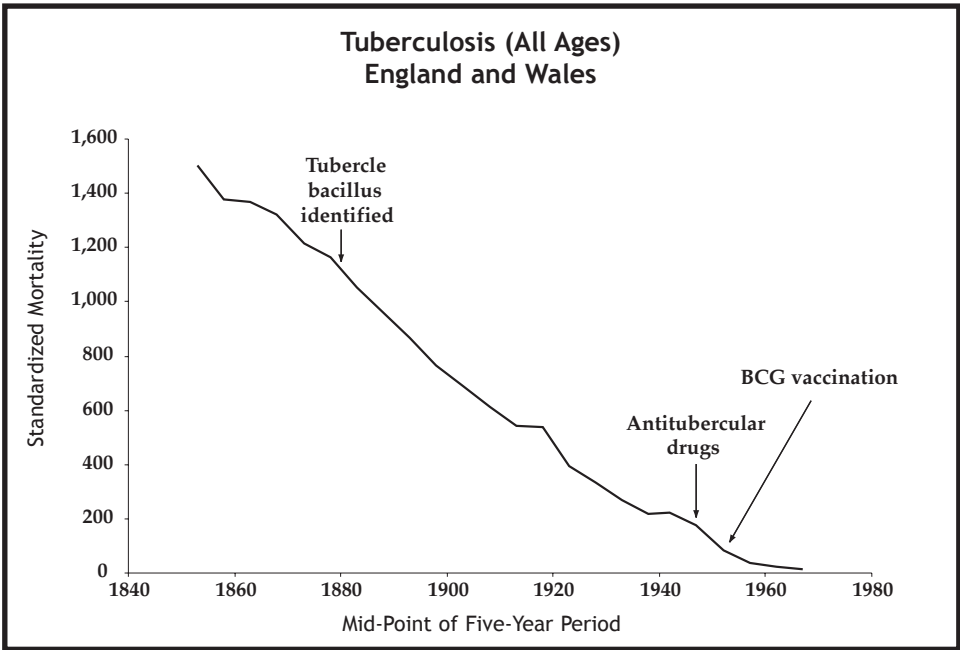
### The Control of Tuberculosis

No better illustration of the progressive nature of health improvement can be given than the story of tuberculosis (TB) in industrialized countries (Figure 2-8).<sup>3</sup>

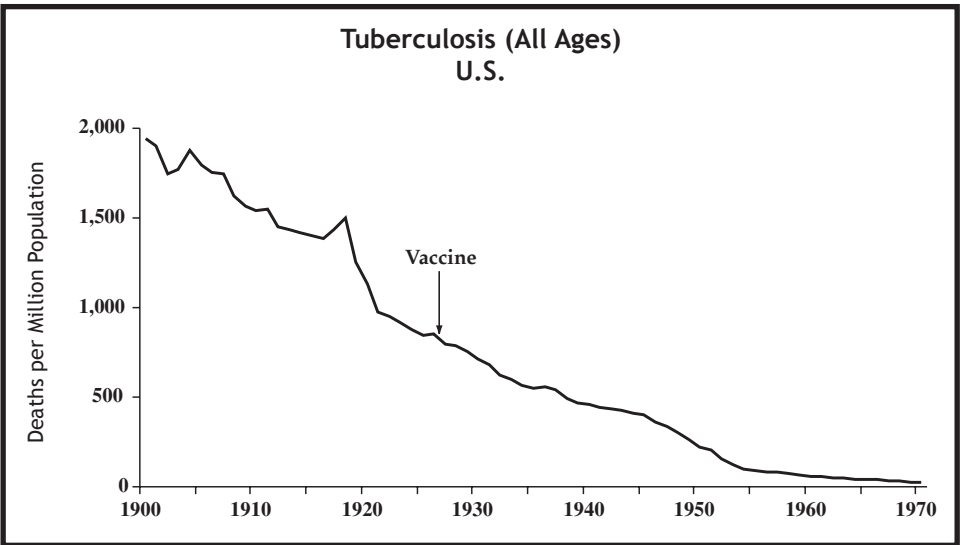


▲  
Figure 2-8

The net outcome of all of these contributions is shown in **Figures 2-9a** and **2-9b**. Tuberculosis was one of the leading causes of death, and certainly the one leading endemic cause of adult mortality in Western Europe and the U.S. through the 1800s — between epidemics of cholera, malaria, smallpox, and yellow fever. However, in England and Wales, its toll was reduced by more than 50% from 1838 to 1900, and by a further 99% since 1900 (**Figure 2-9a**). Similar declines in the death toll from tuberculosis occurred in the U.S. (**Figure 2-9b**). However, tuberculosis continues to be a scourge in developing nations and high-risk groups in developed nations throughout the world.



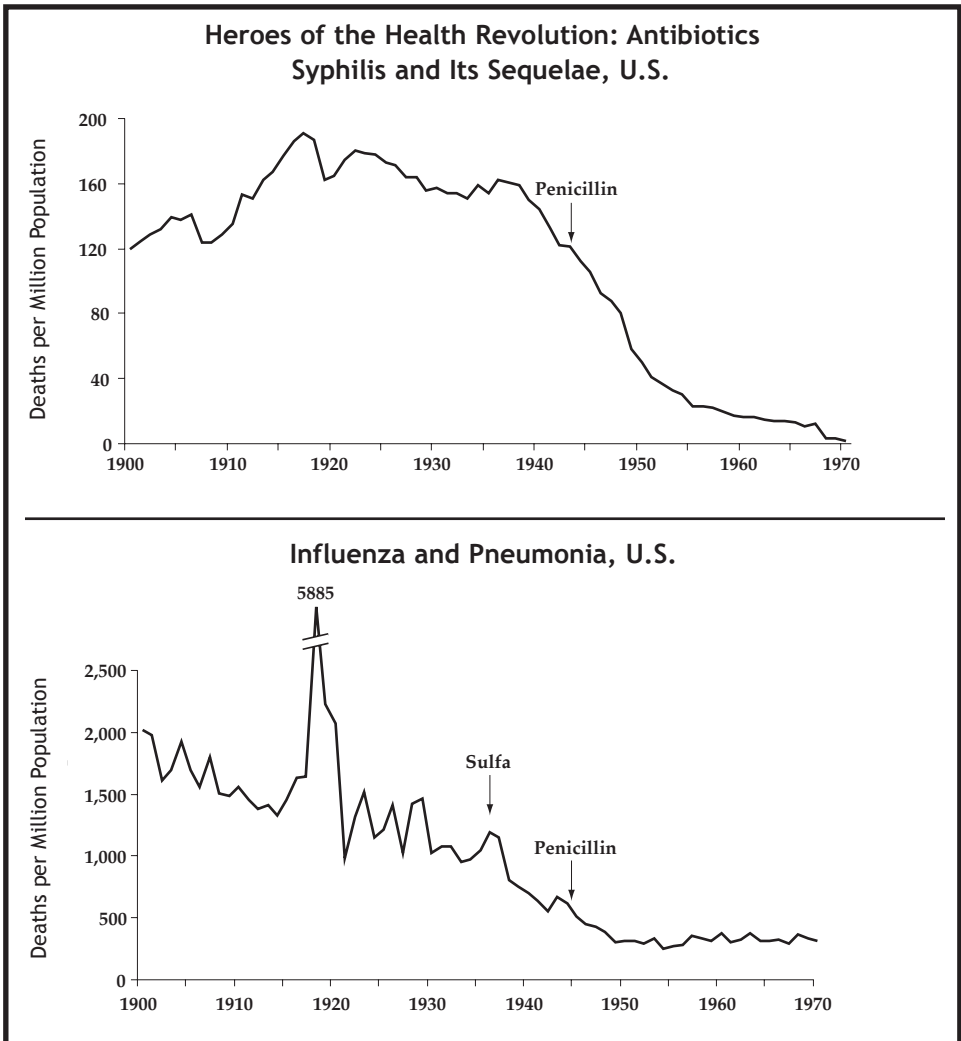
▲  
*Figure 2-9a*



▲  
*Figure 2-9b*

## Antibiotics

Another well-known medical advance that contributed significantly to the health revolution was the discovery of antibiotics. Their appearance in the health armory came relatively late — in the 1930s and '40s — well after the “big killers” were controlled. But, the impact of antibiotics on such diseases as pneumonia and syphilis (**Figure 2-10**), as well as on most streptococcal and some staphylococcal infections, fundamentally changed the practice of medicine and facilitated (along with anesthetics and electronics) the later miracles of modern surgery. In general, antibiotics are effective against bacteria, not viruses. Thus, the fact that the most important infectious diseases still afflicting us today are caused by viruses is good evidence of the impact of antibiotics.



▲  
Figure 2-10

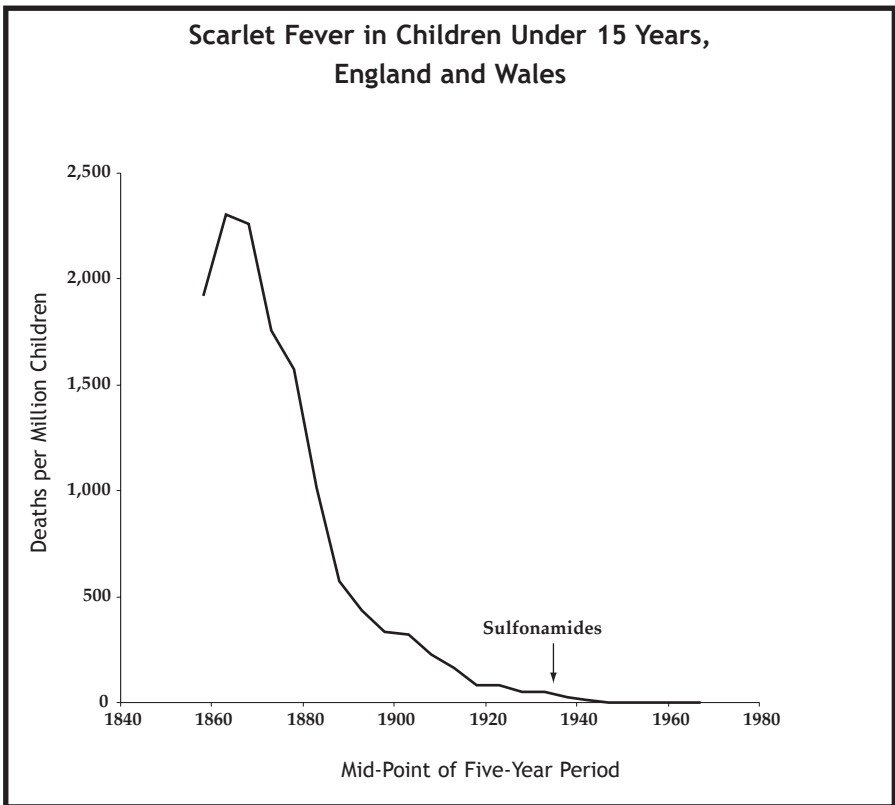
We typically think of the medical discoveries of vaccines, antibiotics, and the control of tuberculosis as sole contributors to our health improvement, but, surprisingly, they weren't the only contributors. In fact, there were nonmedical advances that may be even more important to the health revolution, as can be seen in the following section and Chapter 3.

## Improvements in Socioeconomic Conditions

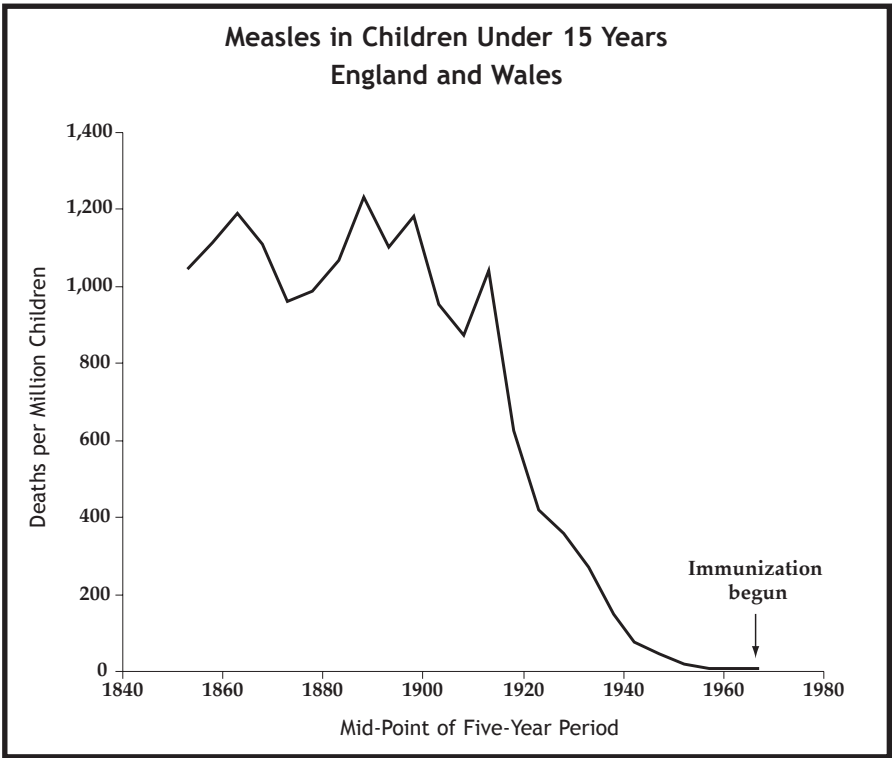
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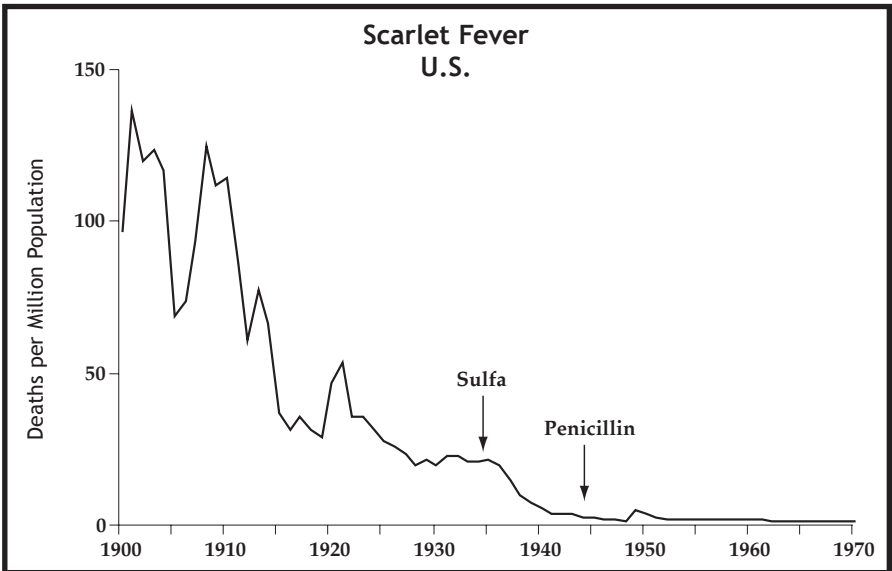
Were medical advances solely responsible for health improvement in the 1800s? Evidence tells us other factors were also involved. For instance, the long and consistent decline in TB mortality prior to 1900 illustrates an intriguing point. It's possible that the decline occurred for still unknown reasons. Additionally, British mortality rates declined decades *before* the introduction of the medical innovations that were credited with their decline.<sup>1,2</sup> **Figures 2-11a** and **2-11b** illustrate such a decline for scarlet fever and measles in England and Wales. This is also true in the U.S., for example, with scarlet fever (**Figure 2-11c**), tuberculosis (**Figure 2-9b**), and measles (**Figure 2-7**).



▲  
*Figure 2-11a*



▲  
*Figure 2-11b*



▲  
*Figure 2-11c*



**Edward Kass discussed improvements in socioeconomic conditions:<sup>1</sup>**

*“This decline in rates of certain disorders, correlated roughly with improving socioeconomic circumstances, is merely the most important happening in the history of the health of man. Yet, we have only the vaguest and most general notions about how it happened and by what mechanisms socioeconomic improvement and decreased rates of certain diseases run in parallel. We know that for many infectious diseases, such as poliomyelitis and perhaps infectious hepatitis, the trend is opposite, and for some, there is little or no socioeconomic effect. This does not detract from the overriding relationship that has been seen in most common communicable diseases in which there is a strong relationship between socioeconomic status and rates of mortality and morbidity.”*

Kass proposed that the indirect cause of infectious disease decline was improved housing and the consequent reduction of overcrowding. He dismissed the impact of nutrition. On the other hand, McKeown opted for nutrition.

Except for smallpox vaccination, most “medical interventions” that had any significant impact on life or death were introduced well *after* the major benefits of the health revolution were realized. However, this shouldn’t be misconstrued as a denigration of medical advances in the 20th century. To those of us who live in the 21st century, health innovations like the polio vaccine, insulin, antibiotics, and pacemakers, still border on the miraculous. They might be routine now, but they’re still the raw material of physical survival. Their *absolute* contribution to the revolution, however, should not be overestimated.

By 1900, most of the killer epidemics had disappeared from Western Europe and the U.S., and mortality from tuberculosis, though still a leading cause of death, had drastically declined. In addition, the killers of young children — diphtheria, measles, scarlet fever, and whooping cough — were in gratifying retreat. It should also be evident that the heroes of the revolution will probably be found in such diverse “nonmedical” enterprises as nutrition, housing, agriculture, environment, sociology, economics, and personal lifestyle changes.

In the next chapter, we’ll discuss the sanitary era, as well as the basic hypothesis that personal hygiene, including bathing, showering, and laundering, played an essential, but subtle and generally ignored role, in the reduction of infectious illnesses during the health revolution.

### TEXT

1. E. H. Kass, "Infectious Diseases and Social Change," *J Infect Dis* 123(1) (1971):110-114.
2. T. McKeown, *The Role of Medicine: Dream, Mirage or Nemesis* (Princeton: Princeton University Press, 1979).
3. J. A. Meyers, *Captain of All These Men of Death* (St. Louis: Warren H. Green, Inc., 1977).

### FIGURES

**Figures 2-1a,  
2-1b:**

**Annual Death Rates in Illinois Due to Malaria  
Annual Death Rates in Illinois Due to Smallpox**

I. D. Rawlings, *The Rise and Fall of Disease in Illinois*,  
The State Department of Health, Illinois, 1927.

**Figure 2-2:**

**Crude Mortality Rates**

**Massachusetts:** U.S. Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970, Bicentennial Edition*, Part 1, Washington, D.C., 1975.

**U.S.:** Accessed on 8/2001:

<http://www.infoplease.com/ipa/A0005131.html>.

The data on this website were obtained from the Department of Health and Human Services, National Center for Health Statistics: [www.dhhs.gov](http://www.dhhs.gov). The death rate for 1999 was accessed at: [http://www.cdc.gov/nchs/data/nvsr/nvsr49/nvsr49\\_03.pdf](http://www.cdc.gov/nchs/data/nvsr/nvsr49/nvsr49_03.pdf).

**India:** Year 1941 obtained from *Census Library Statistical Abstract*, India 1952–53. After 1941 accessed on 8/2001:  
<http://www.census.gov>.

**China:** Accessed on 8/2001:

<http://www.stats.gov.cn/english/index.html>.

**England/Wales:** Office of Censuses and Surveys, Her Majesty's Stationery Office, *The Registrar General's Statistical Review of England and Wales: For the Year 1973, Part I (A)*, London, 1975.

Her Majesty's Stationery Office, *Eighty-third Annual Report of The Registrar-General for England & Wales* (1920), London, 1922.

**Figure 2-3:**

**Crude Death Rate for Infectious Diseases, U.S.**

Reproduced from Centers for Disease Control and Prevention Morbidity and Mortality Weekly Report, *Achievements in Public Health, 1900-1999: Control of Infectious Diseases*, July 30, 1999/48(29): 621-629.

**Figure 2-4:**

**Life Expectancy**

**Massachusetts:** E. Sydenstricker, *Health and Environment*, Arno Press, 1972.

**U.S.:** NCHS National Trends and Comparisons, Vol. 1, No. 3, <http://www.cdc.gov/nchs>, 1929-1931 and 1919-1921 are approximated by taking the average of the values for the three years as given in Tables 6-5 of Volume II of *Vital Statistics of United States* (1992).

**India:** U.S. Bureau of the Census, International Database, <http://www.census.gov>.

**Figure 2-5:**

**The Health Revolution: Decline in Infant Mortality**

**Massachusetts:** U.S. Bureau of the Census, *Historical Statistics of the United States Colonial Times to 1970*, National Center for Health Statistics, *Health United States, 2000: With Adolescent Health Chartbook, Bicentennial Edition, Part 2*, Washington, D.C., 1975.

**England/Wales:** Office of Censuses and Surveys, Her Majesty's Stationery Office, *The Registrar General's Statistical Review of England and Wales: For the Year 1973, Part I (A)*, London, 1975.

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**U.S.:** F. E. Linder, and R. D. Grove, *Vital Statistics Rates in the United States 1900-1940*, Bureau of the Census, Department of Commerce, Washington, D.C., 1943.

R. D. Grove, and A. M. Hertz, *Vital Statistics in the United States 1940-1960*, Bureau of the Census, Department of Commerce, Washington, D.C., 1943.

National Center for Health Statistics, *Vital and Health Statistics: Trend in Infant Mortality by Cause of Death and Other Characteristics 1960-88, Series 20: Data from the National Vital Statistics, System No. 20*, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, January 1993.

U.S. Census Bureau, *Statistical Abstract of the United States, 2001*, revised June 4, 2002, <http://www.census.gov/prod/2002pubs/01statab/vitstat.pdf>.

National Center for Health Statistics, *Vital Statistics of the United States, 1992, Volume II, Mortality, Part A*, Washington, D.C.: Public Health Service, 1996.

**Figure 2-6:**

**History of Smallpox**

1798-1887: T. McKeown, *The Role of Medicine: Dream, Mirage or Nemesis*, Princeton University Press, 1979.

1967-1980: World Health Organization, 2001.

Figure 2-7:

## Heroes of the Health Revolution: Vaccines

### Whooping Cough in Children Under 15 Years Old, England and Wales

Office of Censuses and Surveys, Her Majesty's Stationery Office, *The Registrar General's Statistical Review of England and Wales: For the Year 1973*, Part I (A), London, 1975.

Events noted in figure (1905: Causal organism identified; 1951: Immunization generally available) from T. McKeown, *The Role of Medicine: Dream, Mirage, or Nemesis?*, Princeton University Press, 1979.

### Whooping Cough, U.S.

U.S. Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970*, Bicentennial Edition, Part 1, Washington, D.C., 1975.

Event noted in figure (1926: Vaccine developed) from Centers for Disease Control and Prevention, "Achievement in Public Health 1900-1999: Impact of Vaccines Universally Recommended for Children—United States 1990-1998," *Morbidity Mortality Weekly Report* 48(12): 243-248.

### Measles, U.S.

U.S. Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970*, Bicentennial Edition, Part 1, Washington, D.C., 1975.

Event noted in figure (1963: Vaccine licensed in U.S.) Centers for Disease Control and Prevention, "Achievement in Public Health 1900-1999: Impact of Vaccines Universally Recommended for Children—United States 1990-1998," *Morbidity Mortality Weekly Report* 48(12): 243-248.

### Diphtheria in Children Under 15 Years Old, England and Wales

Office of Censuses and Surveys, Her Majesty's Stationery Office, *The Registrar General's Statistical Review of England and Wales: For the Year 1973*, Part I (A), London, 1975.

Events noted in figure (Diphtheria, 1885: Causal organism identified; 1894: Antitoxin first used in treatment; 1942: National immunization campaign begun) from T. McKeown, *The Role of Medicine: Dream, Mirage, or Nemesis?*, Princeton University Press, 1979.

### Diphtheria, U.S.

U.S. Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970*, Bicentennial Edition, Part 1, Washington, D.C., 1975.

Event noted in figure (1923: Vaccine developed) from Centers for Disease Control and Prevention, "Achievement in Public Health 1900-1999: Impact of Vaccines Universally Recommended for Children—United States 1990-1998," *Morbidity Mortality Weekly Report* 48(12): 243-248.

**Annual Death Rates Due to Rubella, U.S.**  
**Annual Death Rates Due to Paralytic Polio, U.S.**

Centers for Disease Control and Prevention, MMWR Summary of Notifiable Diseases, United States, 1993, *MMWR Weekly* 42(53): 1-73, October 21, 1994.

Event noted in figure (1969: Vaccine licensed in U.S.) from Centers for Disease Control and Prevention, "Achievement in Public Health 1900-1999: Impact of Vaccines Universally Recommended for Children—United States 1990-1998," *Morbidity Mortality Weekly Report* 48(12): 243-248.

**Figure 2-8: History of Tuberculosis**

J. A. Meyers, *Captain of All These Men of Death*, Warren H. Green, Inc., St. Louis, 1977.

**Figure 2-9a: Tuberculosis (All Ages), England and Wales**

Office of Censuses and Surveys, Her Majesty's Stationery Office, *The Registrar General's Statistical Review of England and Wales: For the Year 1973*, Part I (A), London, 1975.

Events noted in figure (1880: Tubercle bacillus identified; 1947: Chemotherapy, 1953: BCG vaccination) from T. McKeown, *The Role of Medicine: Dream, Mirage, or Nemesis?*, Princeton University Press, 1979.

**Figure 2-9b: Tuberculosis, U.S.**

U.S. Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970, Bicentennial Edition, Part 1*, Washington, D.C., 1975.

Event noted in figure (1927: Vaccine developed) from Centers for Disease Control and Prevention, "Achievement in Public Health 1900-1999: Impact of Vaccines Universally Recommended for Children—United States 1990-1998," *Morbidity Mortality Weekly Report* 48(12): 243-248.

**Figure 2-10: Heroes of the Health Revolution: Antibiotics Syphilis and Its Sequelae, U.S. Influenza and Pneumonia, U.S.**

U.S. Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970, Bicentennial Edition, Part 1*, Washington, D.C., 1975.

University of Pennsylvania, "America's Golden Age of Medicine?," 1998, accessed on August 26, 2003: <http://caat.sas.upenn.edu/goldenage/index.htm>.

Agricultural Research Service, U.S. Department of Agriculture, ARS Timeline, accessed on August 26, 2003: <http://www.ars.usda.gov/is/timeline/comp.htm>.

**Figure 2-11a,  
2-11b:**

**Scarlet Fever in Children Under 15 Years Old, England and Wales  
Measles in Children Under 15 Years Old, England and Wales**

Office of Censuses and Surveys, Her Majesty's Stationery Office,  
*The Registrar General's Statistical Review of England and Wales:  
For the Year 1973, Part I (A)*, London, 1975.

Events noted in figure (Scarlet Fever: 1935, Sulfonamides;  
Measles: 1967, Immunization begun) from T. McKeown, *The Role  
of Medicine: Dream, Mirage, or Nemesis?*, Princeton University Press,  
1979.

**Figure 2-11c:**

**Scarlet Fever, U.S.**

U.S. Bureau of the Census, *Historical Statistics of the United  
States, Colonial Times to 1970, Bicentennial Edition, Part 1*,  
Washington, D.C., 1975.

Agricultural Research Service, U.S. Department of Agriculture,  
ARS Timeline, accessed August 26, 2003: <http://www.ars.usda.gov/is/timeline/comp.htm>.

CHAPTER

3

NYC Municipal Archives



HIDDEN HEROES OF  
THE HEALTH REVOLUTION  
*Sanitation and Personal Hygiene*

Since the mid-1800s, there has been a significant improvement in the public health of people living in the U.S. and Europe. It's proposed that changes in personal and domestic hygiene practices played an essential, but understated role in achieving this improvement. A corollary of this hypothesis is that sanitation and personal and household hygiene practices are responsible for much of the good health we enjoy today; and any significant decline in hygiene standards will result in increased health problems. This hypothesis will be critically analyzed in this chapter. Before examining the evidence, it's worthwhile to understand the challenges and technologies that apply in such an examination, as well as the recognized criteria for judging the relevance and adequacy of the evidence.

"Health" can be measured using indices for "good" health (e.g., lives saved, illness avoided) or, on the other hand, the antithesis of good health (e.g., death, disease). Here we'll "measure" community health by three commonly used guides:

1. General population mortality rates;
2. Infant and child mortality rates;
3. Life expectancy and death statistics.

It's suggested that during the 19th century, "sanitarians" in Europe and the U.S. awakened a sanitary consciousness among the common people and popularized cleanliness. This, in turn, led in whole or in part to the decline of such serious endemic diseases as infant diarrhea (a leading cause of death among children), typhus, trachoma, and certain skin diseases. If the hypothesis is true, this contribution cannot be dismissed as trivial. If it can be shown that such things as soap and water lowered the incidence of infant diarrhea, the direct contribution of personal hygiene to infant survival will become self-evident. Furthermore, if it can be shown that cleanliness interacts with other health determinates, such as nutrition and overcrowding, then changes in personal cleanliness must also have had an indirect impact on many other diseases, such as trachoma and typhus.

If the logic ends up being so compelling and the contribution so potentially important, how could the role of personal hygiene in improving health have been "understated" and "ignored"? The answers to this question illustrate the perceptions and scientific challenges that must be overcome in this type of analysis.

This lack of understanding could be partly due to ignorance of health revolution itself. If one doesn't know it occurred, then one doesn't really care about its underlying causes. And, most people just don't have the instinct to distinguish between "health then" and "health now." For example, in 1952 polio was viewed as a national emergency when there were 14 cases



of paralytic polio per 100,000 people. In comparison, those living in the era around 1900 witnessed 4,429 babies per 100,000 dying from infant diarrhea per year, which at the time might not have been considered exceptional! If polio was a scourge whose elimination brought honors to those responsible, how much more credit should be given to those who controlled a disease that was 300 times more tragic? Yet, we have forgotten the latter and don't even remember what they did.

It could be partly due to the low profile of the sanitary era itself. Today, we are so well attuned to the almost daily miracles of medical, surgical, and pharmacological interventions, anything done a century ago is a curiosity at best and primitive as a general rule. Only medical historians and demographers truly appreciate the health revolutions of the 19th century and pre-World War I sanitation. Further, such enterprises as water treatment and sewage disposal seem mundane. Today, they pale beside the

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*Despite the period's hidden or ignored identity, the sanitary era was a significant contributor to the health revolution.*

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"real" advances like kidney transplants and computer-assisted tomography. How can anyone get excited about soap, laundry detergents, and garbage collection when open-heart surgery is practically routine? Despite the period's hidden or ignored identity, the sanitary era was a significant contributor to the health revolution. Let's explore this era in more depth.

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## Advances in Sanitation

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Out of the filth, disease, and poverty of the early 1800s came sanitary reform. One of the more important contributors to the health revolution was the technological-sociological-environmental phenomenon known today as "the sanitary era" or the "public health campaign." However, getting past the filth took great efforts since sanitary practices weren't given nearly the same value or importance as they are today.

Today, clean people and surroundings are so much the norm that it's difficult to imagine an era when they weren't. Clean air and water are assumed to be a civic right. Litter-free streets and garbage disposal are traditional responsibilities of local government. Showers, toilets, baths, soaps, detergents, laundries, dishwashers, and vacuum cleaners are common features in our homes. All are associated with good health, good manners, good rearing, good housekeeping, and civilization itself! But today's accepted standards of environmental and personal hygiene are very recent concepts.

In the middle 1800s, a wave of disgust against environmental filth swept through Western civilization. The sanitarians of those years believed, quite mistakenly, that disease was caused by "miasmas," foul smelling emissions

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*Sanitarians of the mid-1800s believed, quite mistakenly, that disease was caused by “miasmas,” smelly emissions from decaying organic matter.*

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from decaying organic matter. For example, swamps and poorly drained farmlands smelled bad in the summer, just when people living near them became sick. Therefore, the sanitarians reasoned that the bad air, or mal-aria, must have been responsible for the illness. They took heroic steps to clean up the miasma sources — water, sewage, factories, and homes.

The sanitarians had experimental proof that controlling bad smells would control disease. Although their reasoning was wrong, their efforts paid off in health benefits. For example, they drained the swamps — coincidentally eliminating the breeding ground of the mosquito carriers. They installed sewage disposal systems, thus breaking the relentless cycle of cholera epidemics. Proper disposal of garbage helped control insects and rodents, which are reservoirs and carriers of disease. It’s been claimed that the major decline in mortality observed during the late 1800s and the early 1900s was due to innovations in environmental sanitation.<sup>1</sup> Advancements in sanitation worked hand-in-hand with science and social and political activism to move this cause forward.

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## Science and Social/Political Activism

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The triad “filth, poverty, disease” appears so frequently in the writings of the 1800s that it’s easy to see how they became associated as a cause-effect relationship. Chadwick was particularly interested in this association since he was the secretary to Great Britain’s Poor Law Commission. It was his job to deal with the causes and consequences of poverty.

In 1840 England, socially sensitive citizens believed that disease was “caused” by poverty. Thus, they advocated control of illness among the poor by providing grants of money to control poverty. Chadwick disagreed with the sequence of events and consequently with the remedial strategy. In 1842, he claimed that filth leads to disease and that disease, in turn, leads to loss of income and poverty.<sup>2</sup> What was his remedy for poverty? The government taking action to improve the sanitary status of the laboring class, which would improve their health and protect their earning power.

Whether or not Chadwick’s socioeconomic arguments had merit, his epidemiological arguments came exactly when the country was ready to receive them. Knowledge about the cause of disease was still in its infancy, but Chadwick lived and wrote at a time when the branches of several streams of scientific and social/political activism were cresting. Together, these streams were sufficient to result in the establishment of public health as a governmental responsibility in Great Britain and the U.S.

## Vital Statistics

One of the streams that contributed to the acceptance of Chadwick's advocacy was the development of vital statistics as a science. This permitted the objective measurement of the consequences of sanitary reform. What could be a more convincing argument regarding the success of a governmental health program than the measurement of lives saved and years added to life?

In England the establishment of vital statistics is credited to Chadwick and William Farr. In the U.S., Lemuel Shattuck is given credit. However, an intriguing piece of historical detective work by David and Abraham Lilienfeld traces the work of all three (and most statistician-sanitarian epidemiologists in the 19th century) to Pierre-Charles Louis, a French physician.<sup>3</sup> Some claim that the French sanitary movement of the early 1800s was inspiration for the rest of the world. Indeed, the first public health journal, *The Annales d'Hygiene*, originated in France in 1829.

## Origins of Disease

Another stream was the attempt to identify specific agents of origin for diseases. Coincidentally, during Chadwick's active period in sanitary reform, the following three classic studies on the epidemiology and control of infectious disease were published:

- **John Snow** showed that cholera was transmitted by a contaminated water supply.<sup>4</sup> He effectively terminated a London epidemic by persuading the local board of Guardians to remove the handle of the water pump in question.
- **William Budd** demonstrated that typhoid fever was not caused by bad odors, but rather by a disease agent carried via sewage to water and milk.<sup>5</sup>
- **Ignaz Semmelweis** showed in an 1861 publication that puerperal fever was transmitted by physicians who *did not* sanitize their hands between patients.<sup>6</sup>

## Social and Political Activism

Another stream was the liberal-humanitarian zeal that characterized early-19th-century England and was exemplified in writer Charles Dickens's crusade against child labor. Prison reform (including bathing facilities, whitewashed walls, ventilation, and separate rooms for the sick) is associated with John Howard — considered by Charles Edward Amory Winslow to be the first of the pioneer English sanitarians.<sup>7</sup> The social-sanitary campaign to protect industrial workers resulted in a series of 19th-century legislative acts — the early forerunners of today's labor and occupational health laws. There's no doubt that the sanitary revolution was, in part, a response to humanitarian concern for the lack of resources for proper hygiene.

## Sanitary Pioneers and Theories

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The pioneers of the sanitary era were all active prior to 1850 — Edwin Chadwick, John Snow, William Budd, and John Simon in England; Ignaz Semmelweis in Austria; and Lemuel Shattuck in Boston. They maintained that illness and death were associated with unsanitary conditions or practices, and they all advocated sanitary reform. Among the sanitary reformers, some supported the “miasma” theory of transmission and some were “contagionists.” Arguments among the advocates of these epidemiologic theories continued for decades — even after the germ theory of disease had been well-accepted.

From a practical point of view, all of the sanitarians recognized the relationship between filth and disease. The evolution of epidemiological reasoning from 1849 to 1878 is well described by Winslow.<sup>7</sup> The sanitary reformers were joined in the next decade by Florence Nightingale and Joseph Lister, who reformed medical and surgical care. Louis Pasteur and Robert Koch subsequently provided scientific evidence that the sanitarians’ aims — though not always their reasoning — were realistic.

## Legislation

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The payoff for the sanitarians’ efforts was legislation. Six years after Chadwick’s report was published, a General Board of Health was established in England in 1848. In 1855, Sir John Simon became the Central Medical Officer of this board. He was instrumental in the passage of a series of laws providing the basic taxation and regulatory powers necessary to implement the aims of the sanitarians (see below).

Establishment of Health Laws			
1858	1866	1867	1868
The <b>Medical Act</b> was passed to regulate credentials and qualifications of medical practitioners. In the same year, the <b>Public Health Act</b> was passed, establishing the Ministry of Health.	The all-encompassing <b>Sanitary Act</b> was passed. The act obligated local authorities to deal with environmental nuisances, child-labor abuses, factory conditions, poison control, food adulteration, sewage, water supply, housing, and hospital accommodations.	The <b>Merchant Shipping Act</b> was passed to “protect merchant seamen against sanitary neglects.”	The <b>Pharmacy Act</b> restricted the practice of pharmacy by unqualified persons.

In the same period across the ocean, Shattuck's report of 1850 became the basis of American public health.<sup>8</sup> Winslow called Shattuck's report "for breadth and clarity of prophetic vision . . . the most remarkable document in the history of Public Health."<sup>9</sup> In addition to recommending the establishment of state and local boards of health, Shattuck outlined the following:

- vital-statistics gathering
- tuberculosis control
- alcoholism control
- air pollution control
- mental-health care
- education reform
- housing development
- public bathhouse availability
- routine physical examinations

By 1869, Massachusetts established the first State Board of Health, and within nine years 16 other states followed.<sup>8</sup>

## Other Developments

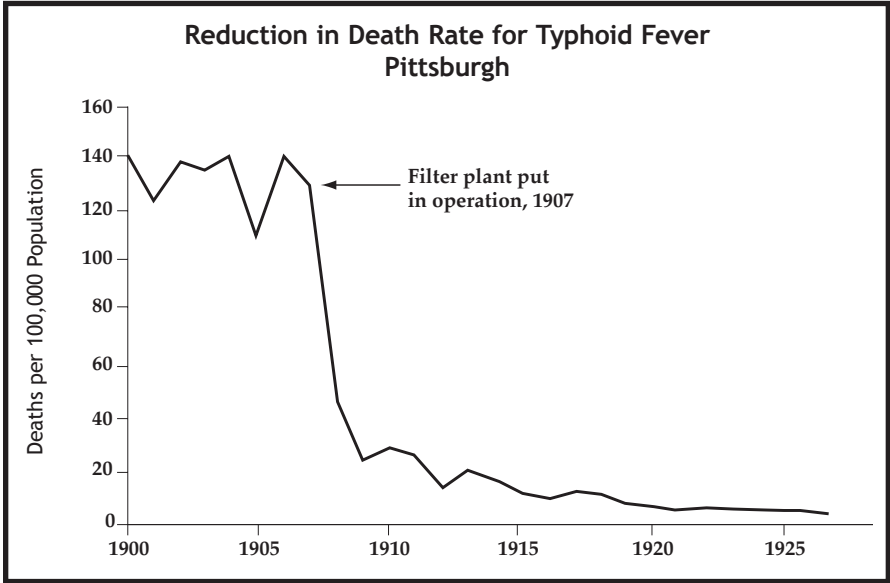
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During the sanitary era, the world was also introduced to milk pasteurization, autoclave sterilizers for hospitals, chemical germicides, and municipal water treatment systems. For example, **Figures 3-1 to 3-3** illustrate advances in water treatment and distribution in the U.S.

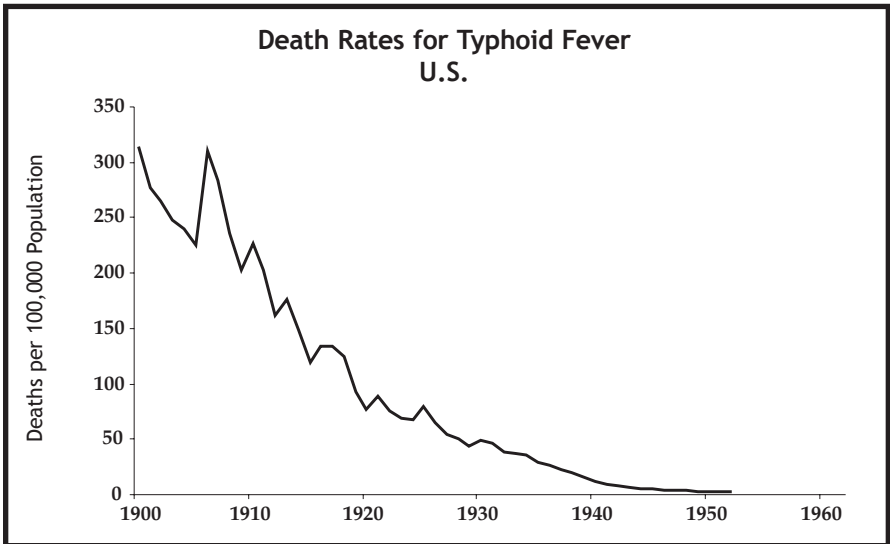
The bacteriological discoveries of Louis Pasteur and Robert Koch provided a scientific rationale for the experimental programs of the sanitarians. Western civilization became convinced that infectious disease was not inevitable. The health revolution was in full swing by the turn of the 20th century.<sup>7</sup>

Figure 3-1 is an example of the reduction in typhoid fever death rates resulting from municipal water treatment.



▲  
Figure 3-1

The impact of advances in water treatment can be further seen in changes in the deaths due to typhoid in the general U.S. population (Figure 3-2).



▲  
Figure 3-2

**Figure 3-3** illustrates the growth in availability of filtered municipal water supplies in the U.S. around the turn of the 20th century.

<b>Availability of Filtered Water to Urban Populations</b>	
<b>Year</b>	<b>Municipally Distributed Filtered Water (Population Served)</b>
1870	0*
1880	30,000
1890	310,000
1900	1,860,000
1910	10,805,000
1920	20,000,000**

▲  
**Figure 3-3**

\* Approximately  
\*\* Minimum

**An 1840s proposal of Chadwick was the collection and conveyance of sewage away from cities.**

Similar to Asian practices, he envisioned that sewage could be processed for sale to farmers for use as fertilizer. Unfortunately, the availability of more convenient forms of fertilizers, such as guano from South America and synthetic fertilizers, led to the sewage being discharged into water bodies, which led to a history of problems until sewage treatment became effective.<sup>10</sup>

In the years leading up to the health revolution, the custom of bathing wasn't a part of Western civilization. Indeed, except for the social relaxation of the aristocracy, religious rites, or miraculous healing, bathing was not readily accepted in most countries where the temperature was less than tropical.

**This medical officer's report to Chadwick around 1840 wasn't at all unusual:<sup>2</sup>**

*"I attended a man, woman and five children, all lying ill in one bedroom, and having only two beds amongst them. The walls of the cottage were black, the sheets were black, and the patients themselves were blacker still. It was indeed a gloomy scene . . ."*

While we might occasionally experience such scenes as above today in the U.S., they would really be public health curiosities, not common occurrences. Personal cleanliness is now an accepted value of society. But when and how did the personal hygiene transformation come about? This section will examine the transformation and show how personal hygiene habits changed *before* health improvements arrived.

### The Reformers

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The beginning of the personal hygiene transformation was brought about by the sanitary reformers, and again by legislation. The pioneers of the sanitary era weren't only advocates for improving environmental hygiene and public health infrastructures, they were also fervent advocates of personal hygiene. John Simon, for example, was always concerned with "organic decomposition — especially human excrement" — as well as "the less riotous forms of uncleanness" (distinguished from "accumulated obvious masses of filth"). He was also concerned that the average Englishman hadn't "reached any high standard of sensibility to dirt." Even more important than his legislative enactments was the need for "Education . . . the one far-reaching reformer," and "hygiene rules, not less important to mankind than the rules which constitute local authorities."<sup>11</sup>

In 1833, the reformers convinced the British government to reduce the soap tax, which was three pence per pound. In 1853, William E. Gladstone repealed the soap tax altogether, and British and Scottish soap production increased from 25,000 tons in 1801 to 83,000 tons in 1851 and 100,000 tons in 1872.<sup>12, 13</sup> Domestic use of soap in England was equivalent to 3.6 lbs. per person in 1801, increased to 8 lbs. in 1861, and almost doubled again by 1891.<sup>14</sup>



In 1846, John Coventry, a British surgeon, published an article entitled, "The Mischiefs of Uncleanliness and The Public Importance of Ablution."<sup>15</sup> He complained that the medical publications of the period made "very meager contributions to the subject of hygiene." After providing a "scientific" explanation of the importance of clean skin, and tracing the "large amount of disease and misery to uncleanliness," he recommended that public baths be provided for the laboring classes in England. These baths were similar to those available in Scotland and some cities on the continent.<sup>15</sup> An 1867 lecture by Dr. Edward Dillon Mapother to the Royal College of Surgeons in Dublin states: "I believe that health would be preserved and life prolonged if we ourselves were as assiduously 'groomed' as our horses."<sup>16</sup>

**Edwin Chadwick used the practical argument that:**

*"Skin cleanliness augments the nutritive effects of food . . . It should be preached to the poor, as an additional inducement to skin cleanliness, that the same food which is required to make four dirty children thrive, will serve to make five thrive whose skins are daily washed and kept clean."<sup>16</sup>*



▲  
Child being bathed by New York City Department of Health Little Mother's League  
(Reprinted with permission of NYC Municipal Archives)

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*It's easier to terminate an epidemic by dismantling a pump than it is to control endemic disease by changing a lifestyle.*

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These historical anecdotes, such as the one from Chadwick, are plentiful and sometimes even amusing, but the sanitary reformers were quite serious. For whatever reasons that motivated them — health, esthetics, fear of dirt, or scientific insight — they extended their sanitary obsession beyond water, sewage, swamps, and ventilation to dirty people and vermin-infested clothing. They used the

same weapons for this personal hygiene battle as they did for cleaning up the physical environment, namely legislation, preaching, and teaching. Their successes, however, were harder to measure and longer delayed. It's easier to terminate an epidemic by dismantling a pump than it is to control endemic disease by changing a lifestyle. Still, they persevered, and during the next 150 years, the sanitary consciousness and habits of Europe, the U.S., and elsewhere were gradually but fundamentally altered.

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## The Introduction of Baths and Bathing

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### Europe

In George Ryley Scott's history of baths and bathing, he explained that Victorian citizens really couldn't bathe, even if they wanted to, unless they enjoyed cold streams and polluted rivers.<sup>17</sup> In addition, there wasn't running water, heating fuel was expensive, soap was hard to get (or make), and there weren't facilities for personal hygiene. Bathing could be done in wash basins with some effort, but it wasn't part of the folk culture. Few private houses, even of the aristocracy, possessed "bathrooms." The rich and titled gathered at Turkish baths or spas, but did more socializing than bathing.

Until the middle 1800s, "the great unwashed" remained that way for two reasons: lack of desire and lack of opportunity to do anything about it. During the same time in Paris and Brussels, people could "hire" a warm bath in their own homes. Entrepreneurs provided portable bathtubs and hot water, with the tubs carried in a cart from the bathing establishment to the home, and then carted away again after use. In 1840, the cost of this service was equivalent to three English shillings.<sup>17</sup> With a British laborer earning 10 to 18 shillings a week, clearly only the wealthy could afford this service.



▲  
English Regency shower (circa 1810)

Some British employers did make sporadic attempts to “protect the health as well as the morals of their workers by influencing their personal cleanliness habits.”<sup>10</sup> In some factories and mines, hot wastewater from steam engines and smelters was poured into large basins so workers could take warm baths. In fact, some of these wastewater baths became so popular that factory owners opened them to the public and profited from the admission fees.

In 1844, a movement was started in London to provide bathing and laundering accommodations for the working classes, who had very limited access to hot water, bathtubs, sinks, or a place to bathe. A bathhouse and laundry was built, and became an immediate success!

#### **Chadwick describes two such enterprises:**

*“Some families subscribe a shilling each month, which entitles them to five baths weekly. Men and women bathe on alternate days and a bath keeper for each attends for an hour and a half in the evening . . .”<sup>2</sup>*

*“In Westminster . . . the establishment . . . (was reported) . . . of similar tepid swimming baths where only three pence is charged to persons of the working class. As many as 2,000 and 3,000 of this class have resorted to these baths in one day . . .”<sup>2</sup>*

In 1846, the English government passed the “Public Baths and Wash-Houses Act” for the “health, comfort and welfare” of the population. This was the forerunner of a series of statutes and amendments that sanctioned building loans to local governmental units for bathing facilities. The maximum charge for a second-class cold bath was one penny; a hot bath cost two pence.<sup>18</sup> By 1890, the prices had increased — a cold bath could be purchased for two pence and a warm bath for six pence. A clean towel came with the admission price, but a small bar of soap cost one penny more.<sup>19</sup> The movement spread to other countries in Europe, with France passing similar public bath legislation in 1850. Then Germany, Switzerland, Austria, Italy, and Belgium followed suit.

#### **Use of London Bathhouses**

- In the **1860s**, among the 10 baths in London, there were 1,001,041 baths taken in a given year, and 321,474 women used the laundry facilities.<sup>16</sup>
- Between **1896** and **1897**, two million people in England used the facilities.<sup>18</sup>
- Between **1904** and **1905**, this number grew to 6,347,158. It’s not known how many of these millions were repeaters, i.e., whether six million bathed once that year or 120,000 bathed every week. But it is known that only 18% were females.<sup>18</sup>

The glorious breakthrough in personal hygiene that should have come soon after 1846 took much longer than expected. An 1879 medical officer complained: "A healthy desire for bathing, not having yet been awakened in the wage-earning class, what guarantee has anyone for concluding that the baths, when provided, would be used? Just as one man can bring a horse to water, but a down cannot make it drink, it would be a comparatively simple feat to erect baths, but an exceedingly arduous one to get the uncleanly to use them . . ." <sup>20</sup>

Why wouldn't more of the public take advantage of the baths? First, public baths were only built in towns and boroughs that requested them. For nearly 50 years, most towns and boroughs ignored this opportunity. It wasn't until the 1890s that there was anything close to a spurt of enthusiasm for the program on a countrywide scale in England. Second, the bathing facilities were usually located in the slums of town. The majority of people equated public baths (not the recreational swimming pools) with public workhouses. According to contemporary critics, public baths were "as far from one's conception of a haunt of pleasure as it was humanly possible to make them. They were drab and dreary. Furthermore, they stank of officialdom and patronage." <sup>17</sup>

### **United States**

The history of baths and bathing in the U.S. up through the mid-1800s was not much different than in Western Europe at that time. With no running water in homes, bathing was largely left to occasional dips in ponds or streams. <sup>21</sup> Washing parts of the body and bathing started to come into the home during the mid-1800s via the kitchen and then rooms off the bedchamber, though indoor plumbing in any building was still extremely rare. <sup>22</sup>

From a story of American public baths published in 1896, the sanitary hero in the U.S. was Dr. Simon Baruch. <sup>23</sup> He advocated "rain baths" or showers as early as 1889, and he recommended they be established in schools, asylums, and in the poorer districts of large cities. His purpose was to "popularize bathing and protect the community against many diseases, without a large outlay of the people's money." By 1890, the public bath movement gained a foothold in the U.S.

**The following is a quote from the *Journal of the American Medical Association*, October 1892:**

*“If prevention be better than cure, then, to fund a great public bath would confer a grander blessing than to erect a hospital. To provide an institution which should bring refreshment and vigor to the overworked, healing to the sufferer, warmth, comfort, and self-respect to the victim of squalor, poverty and neglect, would be to raise a cenotaph more glorious than ever from Attic or Etruscan hands arose.”<sup>24</sup>*

## **Japan**

*Hygiene in Japan from the mid-1600s to mid-1800s contrasted sharply with that in the U.S. and Europe, which would have played an important role in reducing disease. A visitor’s account from the late 1600s to early 1700s reports: “. . . it is an invariable custom of both nobles and commoners to wash their hands every time after using the privy . . .” Other customs resulting from a strong avoidance of anything dirty, such as boiling water for tea, cooking food, separate eating utensils for everyone in the household, and removal of footwear when entering homes and buildings reduced viral and bacterial contamination, impeding the spread of disease. Public baths, which began to appear in the 1500s, also would have reduced the spread of disease.<sup>25</sup>*

## **China**

*Commercial baths were reported in Hangchow, China, as far back as 1072. During a stay in Hangchow in the 1260s, Marco Polo noted as many as three thousand commercial bathing establishments. Used by middle and lower classes, residents frequented them almost daily. Upper classes had a custom of taking a bath every ten days in the privacy of their own homes.<sup>26</sup>*

## The Big Transformation

Unfortunately, the public baths and laundries in the U.S. and England didn't have much impact on personal hygiene and health. However, they did influence, to some extent, the personal hygiene practices of hundreds of thousands, perhaps millions, who wouldn't otherwise have bathed. But the largest part of the population remained unaffected. Any modification of community mortality and morbidity rates by public baths would, necessarily, be slow and very difficult to ascertain.

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*The big transformation in personal hygiene didn't occur until running water could be provided to homes from municipal treatment and distribution systems.*

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The big transformation in personal hygiene didn't occur until running water could be provided to homes from municipal treatment and distribution systems. Along with water-heating devices, plumbing, baths and sinks, building improvements, and drainage systems, running water permitted the installation of true bathrooms in middle-class homes and the prospering labor class.

In England, home bathing and laundering became a social norm in the years immediately *before* and *after* World War II; in the U.S., it might have happened slightly earlier. Although these occurrences cannot be pinpointed, we wouldn't be too far off in identifying the years from 1890 to 1910 as the period of significant personal hygiene transformation in the English-speaking countries of Europe and North America.



Late Victorian bathtub (circa 1870–1910)



# The Growth in Availability of Hygiene and Cleaning Products

Events in the U.S. illustrate the availability of hygiene-related products to the masses. Advertisements, as well as washing machines and soap data, all point to the high level of interest in hygiene in pre-World War I America. The best pictures of the late 1800s and its hygienic maturation are found in the pages of the early Sears catalogues. The company was founded in 1895, and by 1897, the Sears catalogue listed three columns of advertising for soaps (both laundry and toilet), bluing, ammonia, and borax.

## From the 1897 Sears Catalog:

Procter and Gamble's Ivory soap sold for \$0.07 per bar or \$6.75 for a case of 100. China Soap's advertisement stated:

*"China Soap. Far exceeds any soap on the market. Best in the world for the laundry. Is bought by thousands and preferred to any other for the toilet. Better than Ivory; 100 eight oz. cakes to a box, \$3.50."*<sup>27</sup>

Again, the Sears catalogues present reasonable evidence that personal hygiene played a sufficiently important role in pre-World War I America (Figures 3-4 to 3-6). The purpose was to attract serious commercial attention. In Depression America, hygiene was evidently one of the big consumer interests (Figures 3-7 to 3-8).

## Advertisements for Soap and Bathroom Fixtures in Sears 1902 Catalogue

**LAUNDRY SOAPS.**  
**Sears, Roebuck & Co.'s Celebrated Family Laundry Soap.**  
 For only 2 cents for a box of 100 bars, a little less than 2 cents a bar, we offer our celebrated Sears, Roebuck & Co.'s Family Laundry Soap as the equal of laundry soaps that sell every where at 3 cents a bar and cost more. At our \$2.00 price per box of 100 bars we feel confident we are giving each value to laundry soap as is offered by no other house.  
 Our special family laundry soap is put up for us under contract by one of the best soap manufacturers in Chicago, a manufacturer who sells the same soap under another name to almost double the price. The cost of our family soap is figured on very large quantities, on the basis of the actual cost of the material and the labor, in which we add the average kind of a margin of profit, making our Family Laundry Soap the special leader of our soap department. Our Family Laundry Soap is an extra thick bar, convenient shape, hard pressed and rubs best. It is made of selected material, it is strictly first class in every respect, and there is no equivalent in the manufacture that will harm the most delicate fabric. It is a laundry soap that will help to make the laundry work much lighter. Every bar is put up under our handling guarantee, and if you do not find this soap equal to any soap you can buy from any counter at home at 3 cents a bar, we will refund it to us at our expense and we will refund your money.

**TOILET SOAPS.**  
 On account of limited space we do not list a full line of laundry and toilet soaps in this catalogue. Two pages of our special grocery list are devoted to this department. Send 15 cents for year's subscription.  
**Dr. Raub's Celebrated Cutaneous Soap.**  
 No. 71188 Dr. Raub's Celebrated Cutaneous Soap. Twelve 2-cent cakes, per cake..... 24  
 Per box of 24 cakes..... 24  
**Williams' Jersey Cream Toilet Soap.**  
 No. 71189 Williams' Jersey Cream Toilet Soap. Price, per dozen cakes, \$1.50 per cake..... 15  
**Williams' White Glycerine Toilet Soap.**  
 No. 71190 Williams' White Glycerine Toilet Soap. Price, per box of 12 cakes, 10¢ per cake..... 10  
**Porcelain Bouquet Buttermilk Soap.**  
 No. 71191 Porcelain Bouquet Buttermilk Soap. Price, per box of 12 cakes, 8¢ per cake..... 8  
**Transparent Glycerine Soap.**  
 No. 71192 Transparent Glycerine Soap. Price, per box of 12 cakes..... 12  
**Miller's Glycerated Tar Soap.**  
 No. 71193 Miller's Glycerated Tar Soap. Price, per box of 12 cakes, 7¢ per cake..... 7  
**Fancy Castle Soap.**  
 No. 71194 Fancy Castle Soap. Price, per box of 12 cakes..... 12  
**Turkish Bath Toilet Soap.**  
 No. 71195 Turkish Bath Toilet Soap. Price, per box of 12 cakes..... 12  
**Genuine Turkish Bath Toilet Soap.**  
 No. 71196 Genuine Turkish Bath Toilet Soap. Price, per box of 12 cakes..... 12  
**Congo Coco Toilet Soap.**  
 No. 71197 Congo Coco Toilet Soap. Price, per box of 12 cakes..... 12  
**Cocoanut Oil Soap.**  
 No. 71198 Cocoanut Oil Soap. Price, per box of 12 cakes..... 12  
**Carbolic Acid Soap.**  
 No. 71199 Carbolic Acid Soap. Price, per box of 12 cakes..... 12  
**Lettuce Soap.**  
 No. 71200 Lettuce Soap. Price, per box of 12 cakes..... 12

**VERY BEST FAMILY SOAP**

At our special \$2.00 price for a box of 100 bars, you will make a saving of 1 cent in 100 per soap. No. 71191. Our special price, per box of 100 bars..... \$2.00  
 Price, for 50 bars..... \$1.00  
 Price, for single bars..... .02

**BATH SOAP SPECIALTIES.**  
**Enlarged Soap Holder.**  
**Improved Sponges and Soap Dish.**  
**Sponge Holder.**  
**Sponge and Soap Dish.**  
**Tower Baskets.**  
**Shower Bath Tubs.**

for Soap and Bathroom Fixtures

▲ Figure 3-4



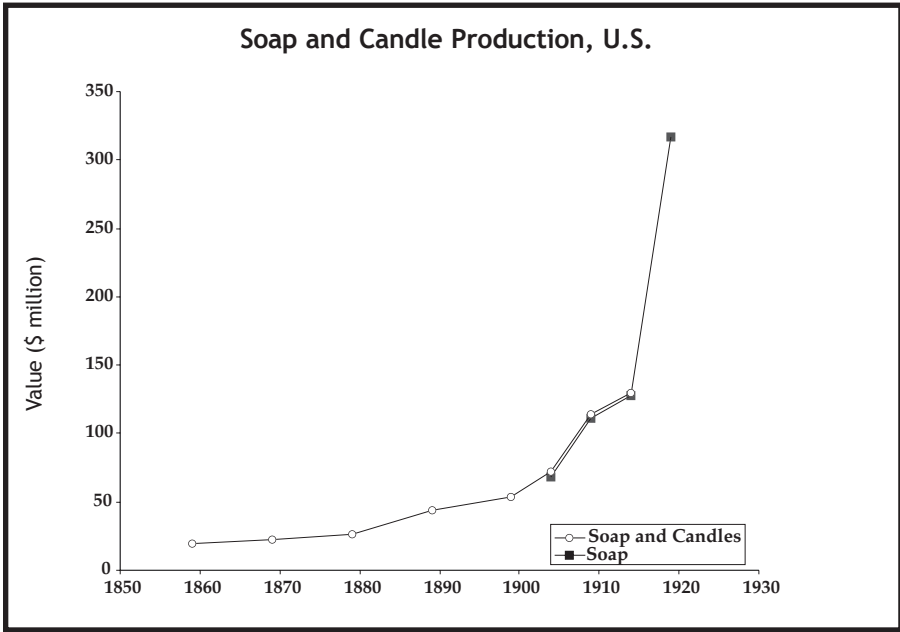




Jean LemMon describes the little-known history of home laundering. According to him, prior to the availability of hot running water, commercial laundry soap, and mechanical washers, the task of keeping a household's linens clean was grim and laborious.<sup>28</sup> The following changes that occurred in the U.S. in the 1800s eventually made the laundering task much easier.

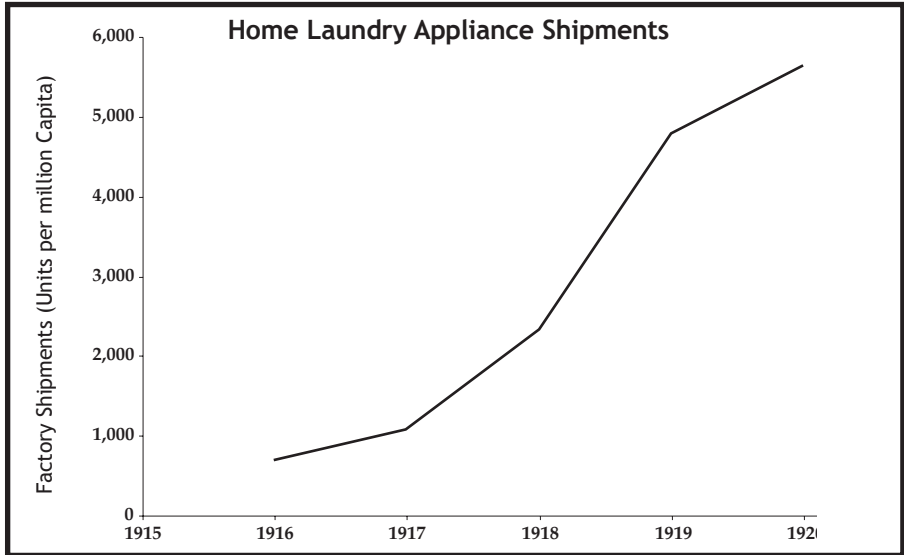
Laundry Developments in the U.S. <sup>28</sup>		
1851	1875	1910
The first motor-operated washing machine was built.	2,000 patents for mechanical washers had been issued.	A patent was issued for the swinging, reversible wringer. This provided a model for wringer washing machines that has endured for many years.

Soap production also increased dramatically during this time. In the late 1800s, the U.S. government began collecting information on the combined value of soap and candle production (Figure 3-9). Soap production began to be split out in 1904. From 1904 to 1916, the value of soap production in the U.S. increased more than 500% (Figure 3-9). Soap sales continued to increase until around 1940. From 1940 to 1970, synthetic soap (detergent) sales rose steadily as laundry products converted from soap to detergents.<sup>29</sup> The development of detergents (synthetic soaps) was driven by the shortage of fat and oil supplies for making soaps during WWI and WWII. Another driver was the military's need for a cleaning agent that would work in mineral-rich seawater and cold water.

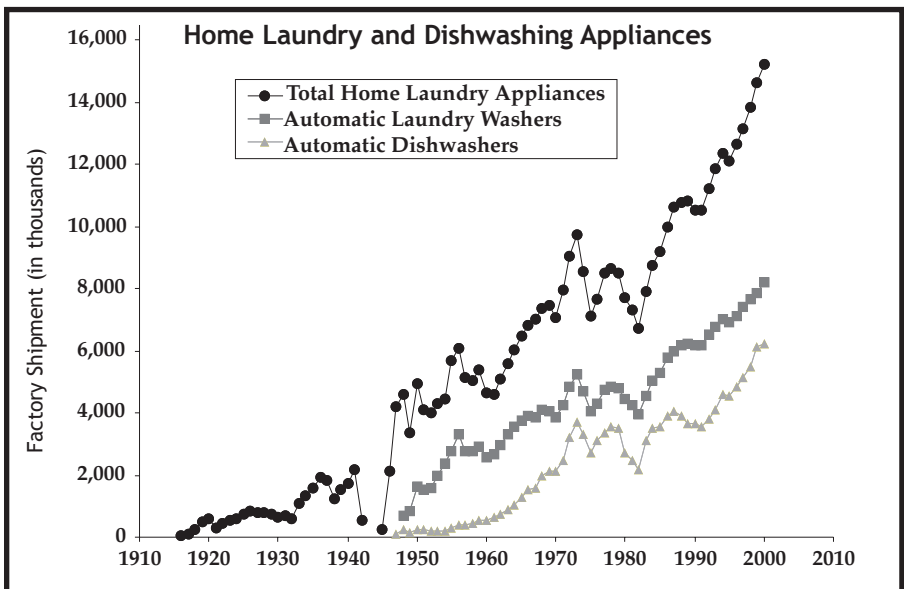


▲  
Figure 3-9

In addition, there were dramatic increases in the growth of laundry appliances. Annual home laundry appliance shipment rates increased more than eight times between 1916 and 1920 (Figure 3-10). After 1945, newly built houses used to accommodate the huge waves of immigrants were almost universally supplied with indoor plumbing, flush toilets, sinks, laundry facilities, and bathtubs or showers. Figure 3-11 shows the dramatic increase in shipments of both home laundry appliances and dishwashers in the U.S. in the post-World War II era.

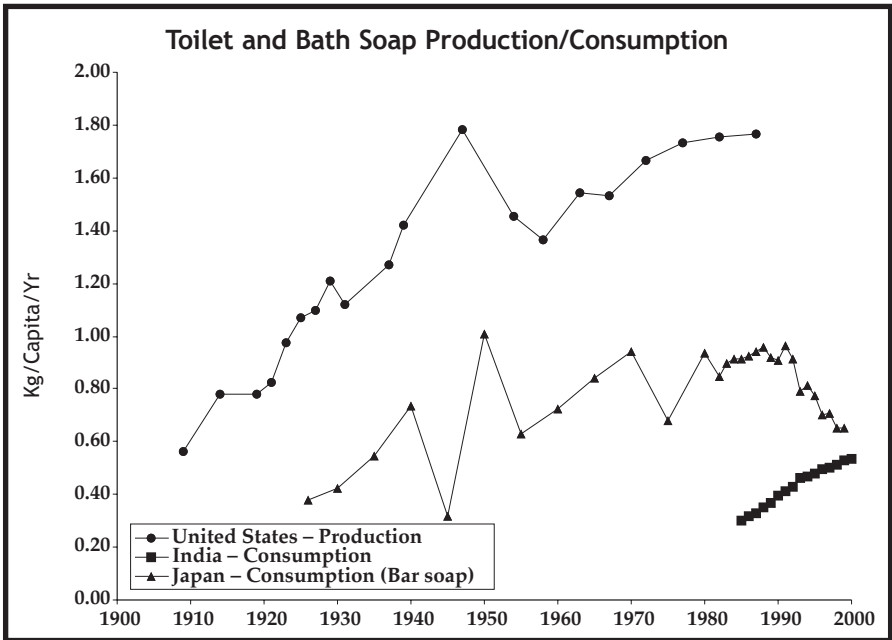


▲  
Figure 3-10



▲  
Figure 3-11

Additional evidence of advancement at the personal hygiene level in the U.S. is indicated by figures on toilet soap production from 1909 to 1987 (Figure 3-12), which show increasing per capita production.



▲  
Figure 3-12

Other countries show similar trends in the use of toilet and bath soaps.

Figure 3-12 shows per capita toilet and bath soap consumption for India and Japan. Toilet and bath soap use in India has been steadily increasing. The same is true for Japan, though bar soap use per capita has been decreasing from around 1990, when liquid soap was introduced.

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# Linking Personal and Household Cleanliness with Health

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## Validations and Methodologies

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Even those who know about the sanitary era and its revolutionary impact on death and disease over a century ago in the U.S. and Western Europe virtually ignore its personal hygiene aspect. This is probably because improvements in personal hygiene are not dramatic and are difficult to document. For example, it's relatively easy to pinpoint the installation of a sewer system, the establishment of a milk pasteurization program, or the completion of a swamp drainage operation. On the other hand, it's almost impossible to pinpoint behavioral changes, like personal hygiene habits. Bathing and laundering practices are sociocultural activities that were adopted at uneven rates among diverse populations over long periods of time.

In evaluating the contributions of personal hygiene to historical health changes and current health status, it's important to consider that many other social, behavioral, environmental, and medical changes have taken place concurrently. All of these other changes could reasonably be expected to modify the incidence of the same diseases whose control we are attributing to hygiene. An irrevocable fact of health history is that the use of any of the following — vaccines, soap, pasteurization, plumbing, autoclaves, showers — may interact with the introduction and use of the others, which makes their specific individual contributions hard to unravel.

## Interventional and Observational Study Designs

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Studies employing either *interventional* or *observational designs* provide other means of investigating hygiene and health relationships. An interventional study is one in which a study investigator imposes an intervention and observes changes in disease incidence. Intervention studies can be conducted on the same group of people, where disease incidence is compared before and after the intervention. Or it can be compared among groups of people who are randomized to either the intervention method or no change in practices. The strengths and limitations of intervention studies should be assessed by considering the methods used to design and conduct them. Such methods can include randomization, assessment and control of confounding factors, blinding, and other pertinent validity issues.

In an observational study, groups of people are observed or questioned concerning practices or exposures (i.e., without an imposed intervention) and assessed for subsequent changes in disease incidence. Observational studies report disease incidences in populations following certain hygiene practices.

To resolve our contention that cleanliness and personal hygiene changes actually contribute to the dramatic changes in the health status of populations, four separate but converging lines of evidence are employed:

1. Plausibility of the hypothesis from an epidemiological point of view.
2. Historical evidence that specific and documentable changes in personal hygiene practices during the last century and a half had an impact on several major components of mortality and morbidity.
3. Evidence from multiple populations, which shows that the health status of different geographic regions can be closely related to certain indices of personal hygiene and cleanliness.
4. Evidence from interventional and observational studies.

### Plausibility of the Hypothesis

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The most that can be expected from historical information, studies of populations in different geographic regions, or interventional and observational studies are associations. Perhaps it's an association between soap consumption and diarrhea decline, or between laundering frequency and typhus control. To many people, association between two variables is the same as causality. To the scientist — and in particular to the epidemiologist who studies the distribution and determinants of health in populations — association between two factors is just a first step. Before the epidemiologist can say, with any degree of confidence, that a given factor caused a given disease (or in our case, that a given factor was responsible for the control of a disease), she or he must climb a ladder of logic and reinforcement.

This isn't intended to be a short course in epidemiology, but the point is so important, we really cannot proceed to a critical analysis of our basic hypothesis without making this point clear: *Observed associations between personal hygiene practices and improved health are not enough to prove that one causes the other.*

The other rungs of the logic ladder are the following set of criteria (not prioritized) that have been suggested as an aid for distinguishing between noncausal and causal associations:<sup>30</sup>

1. **Strength of the Association** — What is the magnitude of association between the two variables? How often could such an association occur by chance alone (statistical significance)?
2. **Consistency of the Association** — Has the same association between a hygiene practice and health impact been shown among different populations? At different times? In different geographic regions? Using different research designs?
3. **Specificity of the Association** — Is this a unique association or is the same effect attributable to different causes? Does the cause produce one effect?
4. **Time Dependence** — Did the “outcome” occur after the “cause” was introduced? Was there enough delay between “cause” and “outcome” to suggest true association? How can we be sure, when two factors are associated, that one is the cause and the other the effect? Can they both be effects of a third, unsuspected cause? If the cause is removed or reversed, does the outcome also change?
5. **Biological Plausibility** — Are the two associated factors logical candidates for a biological “cause and effect” association? Is there a biological mechanism consistent with the hypothesis?
6. **Biological Gradient** — Is there evidence of a dose-response relationship between the number of infectious organisms and transmission or occurrence of disease?
7. **Experimental Evidence** — Do the studies describe changes in health when hygienic measures are introduced?

A fuller discussion of tools to characterize epidemiological relationships between two or more factors, and the occurrence of an effect is presented elsewhere, including examples of the application of these criteria.<sup>31</sup>

These criteria are not meant to be used as “hard-and-fast rules” for either accepting or rejecting causal relationships.<sup>30</sup> One of the implications of holding steadfast to these criteria and ignoring other basic scientific principles would be the pitfall of basing causality on findings from studies that are methodologically flawed. Hence, the criteria should not be applied in the absence of rigorous evaluation of the scientific quality of each study.



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## Impact of the Health Revolution on Infant Mortality

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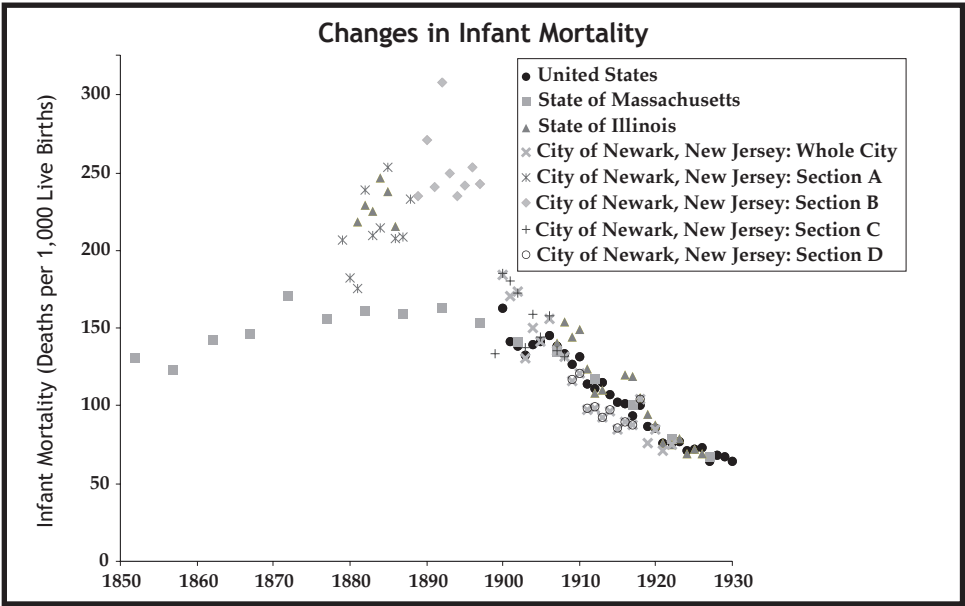
The most dramatic impact of the health revolution was its influence on the mortality of infants and children. We examine infants' and children's morbidity and mortality rates because children are more susceptible to many diseases than adults. Prior to 1915, the most important cause of infant death in the U.S. was diarrhea — the most common cases being *cholera infantum* and *teething disease*. Cause-specific mortality data prior to 1900 are hard to come by for several reasons. The causes of infant death, as recorded in 19th-century death certificates, are difficult to interpret, and diarrhea is often reported in diverse terms.



▲  
*Children near an apartment building*  
(Reprinted with permission of NYC Municipal Archives)

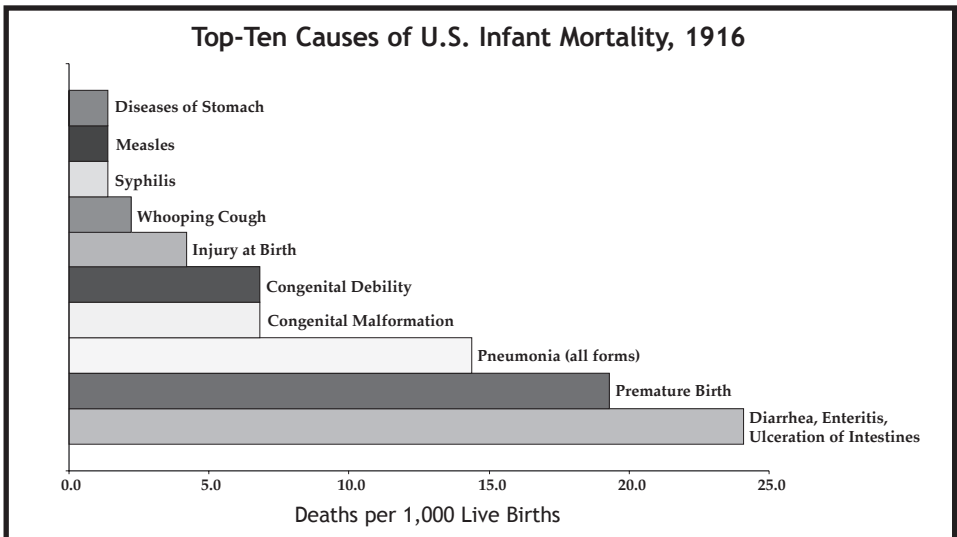
Infant mortality begins a sharp decline in the U.S. around 1890 (**Figure 3-13**). To further illustrate this fact, diarrhea mortality in Baltimore among children less than two years old consistently dropped every decade from 1870 (265/100,000) to 1920 (90/100,000).<sup>32</sup> This trend of declining infant mortality rates has continued in more modern times (see **Figure 2-5** in Chapter 2).



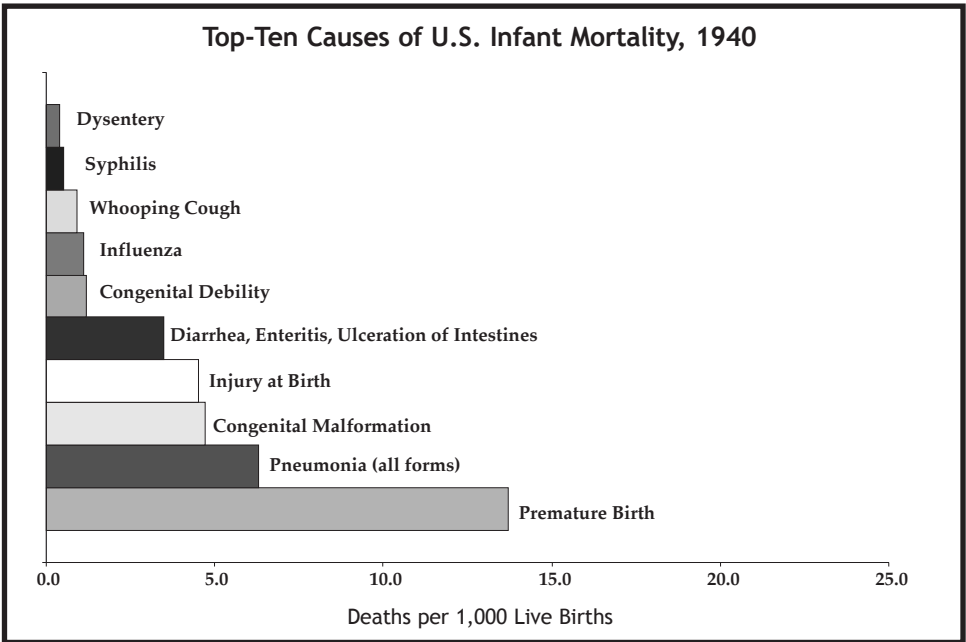


▲  
Figure 3-13

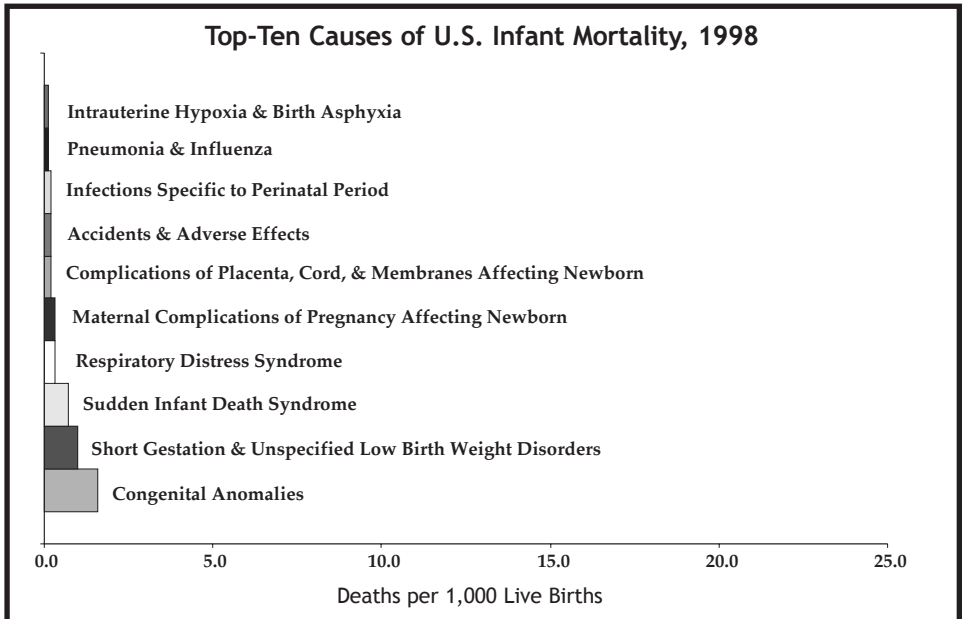
Figures 3-14a, b, and c illustrate the trends for the leading causes of infant mortality by comparing 1916, 1940, and 1998. Diarrhea and related diseases were the number-one killer in 1916. Six of the top causes of infant deaths were infectious diseases. Even as late as the 1940s, six of the top-ten causes of infant death (which included diarrhea) were of an infectious nature, whereas by 1998 mortalities due to infectious diseases were only two of the top-ten causes (in addition to having much lower rates compared to 1916 and 1940).



▲  
Figure 3-14a



▲  
Figure 3-14b



▲  
Figure 3-14c

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*Nutrition, pasteurization, and personal hygiene all played important roles in improving the health of infants and children.*

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Nutrition, pasteurization, and personal hygiene all played important roles in improving the health of infants and children. In fact, the dramatic decrease in infant mortality in the U.S. from about 150–250 per 1,000 live births prior to 1890 to about 70 per 1,000 live births in 1930 can be attributed mainly to the decline of diarrheal diseases that are prevented

by proper nutrition, milk pasteurization, and personal hygiene. However, discussion is needed about the degree of impact that nutrition and pasteurization had on infant mortality and health improvement in general.



*Children at lunch*

(Reprinted with permission of NYC Municipal Archives)

## The Role of Nutrition

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Nutritional improvements have been cited by Thomas McKeown as major factors contributing to the decline of infant mortality. However, he reached this conclusion by deductive reasoning rather than direct evidence.<sup>33</sup> His hypothesis might account for the general decline of infant mortality through the 1800s, but he didn't provide data to account for the sharp decline in infant mortality between 1890 to 1915.

## The Role of Pasteurization

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The role of pasteurization, on the other hand, is a public health classic. Mazýck Ravenel describes its role. Pasteurization benefits are much more plausible than “nutrition.” Also, pasteurization was introduced closer in time to the decline in mortality at the turn of the century. However, pasteurization wasn't generally introduced into the U.S. until the early 1900s, and it wasn't really accepted until a few years later.<sup>33,34</sup> The few available data on milk consumption suggest that 1910 to 1920 was the earliest time period with sufficient consumption of pasteurized milk to have a noticeable impact on the infant mortality rate.<sup>35</sup>

Thus, pasteurization and nutrition cannot account entirely for the marked infant mortality decline between 1890 to 1910.

## The Role of Personal Hygiene

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As mentioned earlier, the steep decline in infant mortality began in 1890, a period in which neither nutrition or pasteurization would be expected to account for it. Considering data from the states of Massachusetts and Illinois, as well as areas within the City of Newark, New Jersey, declines of about 20 to 60% occurred by 1910 (**Figure 3-13**). Personal hygiene changes are a reasonable explanation, as indicated by the rapid growth in soap production in this time period (**Figure 3-9**). Handwashing and bathing decrease the potential transmission to infants of diarrhea agents, which can liberally contaminate the skin of people who don't wash their hands after defecation.

These declines have continued, as illustrated by infant mortality rates in Massachusetts prior to 1890 compared to today in the U.S. as a whole (see **Figure 2-5** in Chapter 2). In the mid-1800s, 130 to 170 babies out of every 1,000 died in the first year of life. Today, that loss has been reduced more than 25 fold!

These data are an indication that hygiene may have played a role in the decline in death rates and disease prevention during this time period.

## The Interrelationship Between Health and Hygiene Around the World: The Case of Infant Mortality

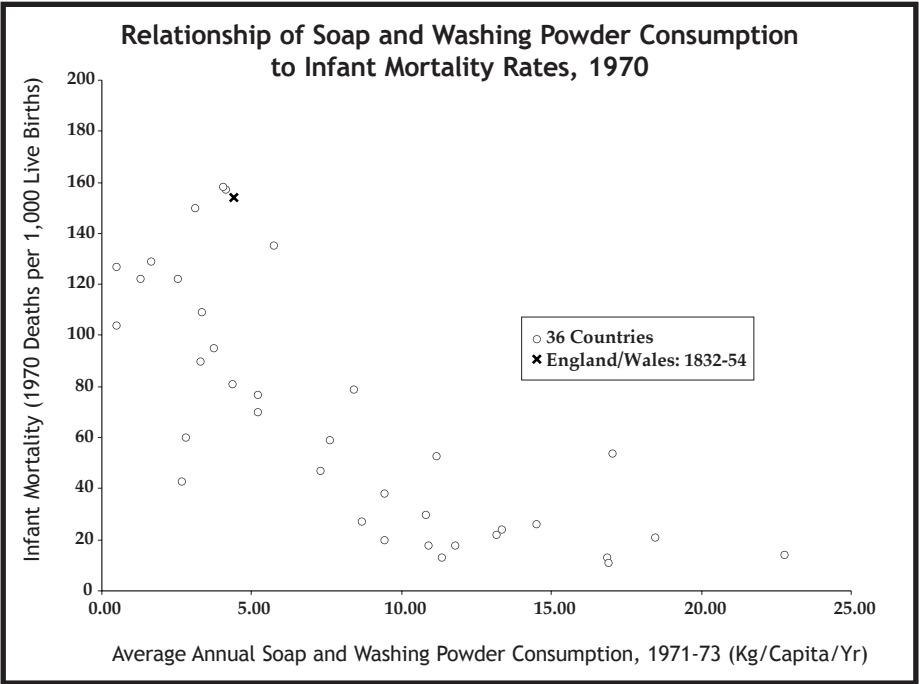
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Another way to analyze the relationship between personal hygiene and health is to examine geographical data. If we can show a correlation between hygiene practice and health status among populations in different countries and climates, who have different social systems and diets, and even do so over time, we can help strengthen the link between hygiene and health. Moreover, we will further support this endeavor by showing that the same personal hygiene habits are associated with the same disease problems in all of these areas.

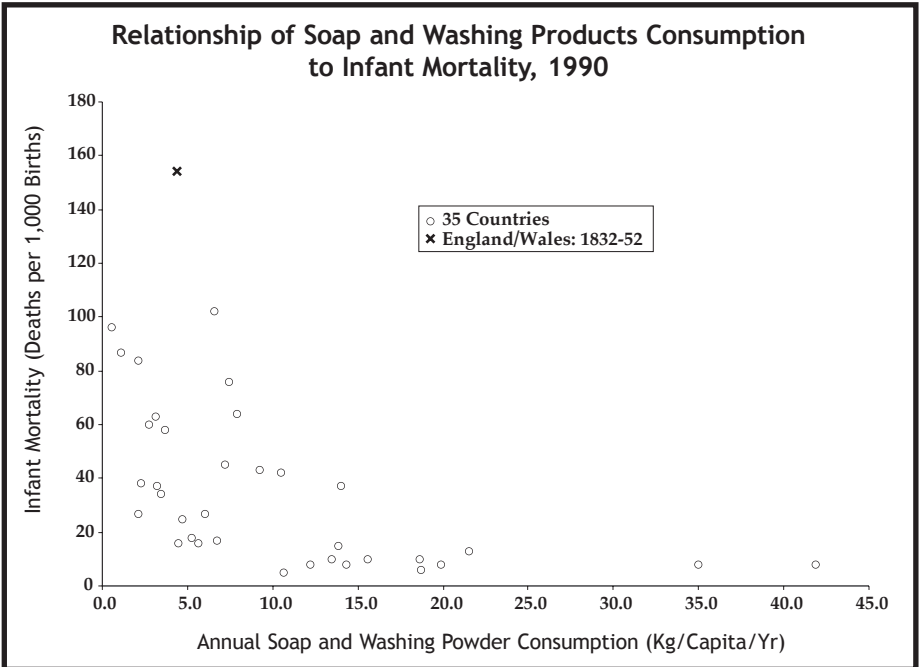
In each country, health determinants — genetics, environment, diet, lifestyle, and politics — are unique and combine to show various health outcomes. Thus, any common thread (e.g., soap and detergent use) if measured in each country, would require controlling for the various baseline risk factors specific to each country. At the very least, it's possible to study areas where the infant mortality is either lower, higher, or equal to that experienced in 19th-century America. Then the hypothesis that soap use and personal hygiene are associated with beneficial health outcomes can be tested.

Examples relating soap and washing powder consumption around the world to infant mortality rates are presented in **Figures 3-15a** and **b**, which demonstrate a relationship between increased consumption of these products and lower infant mortality rates. **Figure 3-15a** represents an attempt to correlate soap and washing powder consumption in 1971–73 and infant mortality rates in 1970 for 36 countries for which these data are available. **Figure 3-15b** shows the same relationship for 35 countries in 1990 where similar data are available.

Interestingly, historical data for the period 1832–1854 in England and Wales on infant mortality in comparison to soap production fit in well with the multinational data from the 1970s and 1990s (**Figures 3-15a** and **b**).

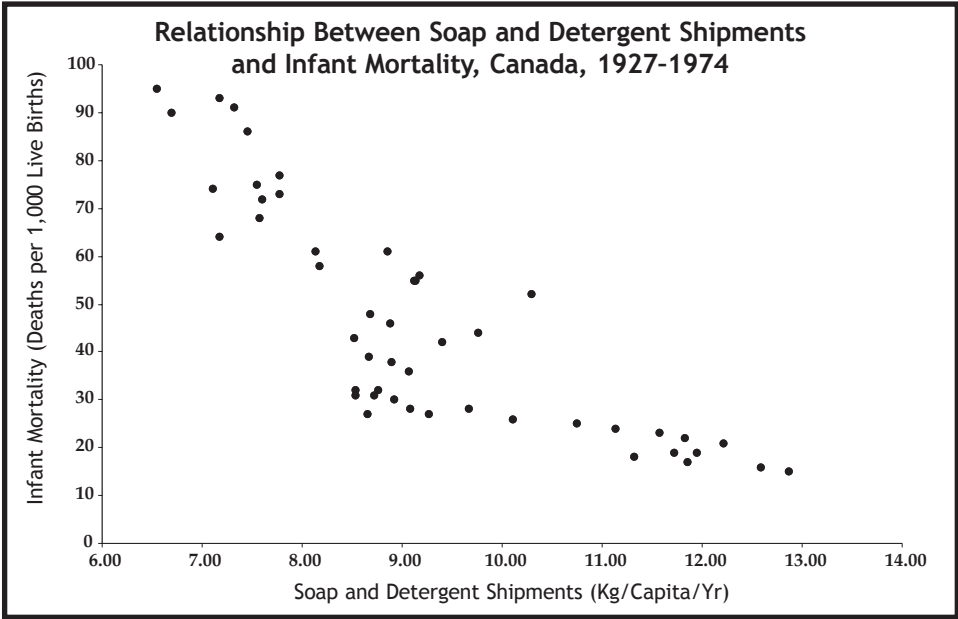


▲  
Figure 3-15a

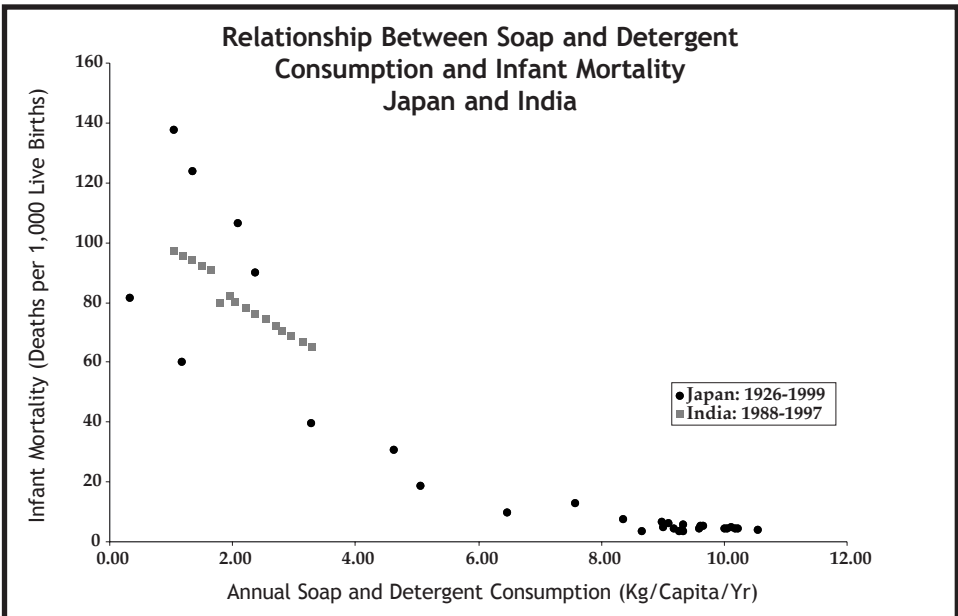


▲  
Figure 3-15b

Another way to look at these types of data is to examine relationships that exist between infant mortality and soap and detergent consumption spanning a wide time period within a single geography. **Figures 3-16a** and **3-16b** show such a relationship in data from Canada, Japan, and India.



▲ *Figure 3-16a*



▲ *Figure 3-16b*

These are rudimentary correlations that must be interpreted with great caution; but the fact that any relationship at all exists between infant mortality decreases and increasing shipment or production of soaps and detergents across geographies in the same time period, across time in the same geography, and even across time and geographies is encouraging.

In societies where the bathing and laundering practices are well established, many of the infectious illnesses related to inadequate hygiene are under control. In certain at-risk groups, such as the immunocompromised, and in lesser-developed countries where environmental and personal hygiene measures are economically out of reach, the diseases are still very prevalent. Furthermore, though differences in the extent of other advances, such as nutrition and milk pasteurization, can be temporally related to some of these diseases, those advances alone probably don't explain the dramatic differences in mortality and morbidity witnessed among the geographic regions in question.

## ===== Other Associations Between Hygiene and Disease =====

Similar associations can also be documented between historical changes in cleanliness and declines in other diseases, such as typhus and trachoma, though the data for these conditions are more fragmentary. Improved levels of personal and environmental hygiene, particularly hand hygiene and laundering, and to a lesser extent dishwashing, cleaning, and disinfection of hard surfaces, would lower the chance of spread of these diseases. For example, in the U.S. there have been no major epidemics of typhus since 1893 — the last small outbreak occurred in 1921. Trachoma was a troublesome problem to public health officials between 1890 and 1915 among the immigrant populations and the coal miners of Appalachia. In some counties of Tennessee, West Virginia, and Kentucky, the incidence rate was 10 to 15% of all persons examined. The condition was brought under control by classical public health strategies: exclusion of infected children from school, personal hygiene instruction by public health nurses, educational programs, sanitation, and hospitalization where necessary.<sup>36, 37, 38, 39</sup> In endemic areas, mass treatment campaigns with antibiotics reduce frequency. However, without improvement of general sanitary conditions, reinfection occurs and the disease regains its original high levels of frequency.



## Evidence of Links Between Hygiene and Health

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We've looked at trends and data that show the link between hygiene and health, but now current epidemiological evidence supports this link from a critical evaluation of 30 interventional studies and 24 observational studies.<sup>40</sup> As mentioned earlier, an interventional study is one in which a study investigator imposes an intervention and observes changes in disease incidence. Intervention studies can be conducted on the same group of people, where disease incidence is compared before and after the intervention. Or, disease incidence can be compared among groups of people who are randomized to either the intervention method or no change in practices. In an observational study, groups of people are observed or questioned concerning practices or exposures (i.e., without an imposed intervention) and assessed for subsequent changes in disease incidence.

Despite methodological strengths and limitations, the weight of evidence from the 53 studies collectively indicate a significant reduction in infectious illness attributed to changes in hygiene practices or behaviors. The reduction in infections was appreciable and generally greater than 20%. Most of the observational studies reported a strong association between risk factors related to inadequate hygiene and infection. The consistent findings in both the intervention and observational studies support the conclusion that hygiene interventions other than infrastructure implementation are important for preventing infections.

While these results may not be surprising or “new,” they are nevertheless important because they demonstrate that even in an era of unprecedented cleanliness and improved public health infrastructure, there's a continued, measurable, positive effect of personal and community hygiene. However, attributing a specific hygiene intervention to a reduction in illness is difficult since it's virtually impossible to isolate the effects of specific hygiene measures. Therefore, the magnitude of reduction in illnesses attributed to a specific intervention or practice alone cannot be assessed through these studies.

Other studies can be consulted for evidence for a causal link between hand hygiene and infections.<sup>41, 42, 43</sup>

## Personal Hygiene and Its Impact on Typhoid

As far as back as 1890, personal hygiene could be seen playing a positive role in the prevention of typhoid fever in nurses and among females in other occupations in the U.S. In an obscure table from the 1890 U.S. census, a statistician summarized the proportions of deaths due to typhoid fever.

**Proportion of deaths due to typhoid fever per 1,000 deaths from all causes (Females, 1890)<sup>44</sup>**

Laundresses	32.18
Nurses	44.57
Servants	48.50
All Occupations	51.48
Milliners, Dressmakers	69.43
Teachers	72.89
Mill and Factory Operators	87.89

From this table, one could speculate:

- Nurses didn't succumb to typhoid fever because of sanitary training.
- Servants weren't susceptible because they worked for employers who compelled them to practice personal hygiene.
- Laundresses were lowest on the list because their hands were always immersed in hot, soapy water!

## Bringing Back Infection

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Just as personal and environmental sanitation practices improve mortality and reduce morbidity rates, the reverse is also true — as hygiene practices become worse, health declines. During wars and the resultant formation of large groups of individuals living in displaced refugee conditions, hygienic facilities and practices become disrupted, generating epidemics and the rapid spread of infectious diseases. The Polish ghettos, which were established in 1940 as a consequence World War II, clearly illustrate this fact.

One-and-a-quarter-million persons lived in the most unsanitary conditions. They inhabited dwellings without heat, water, or plumbing; lacked soap, disinfecting materials, drugs, linens, shoes, and clothing; had a scarcity of hospitals, bathing establishments, laundries, and a greatly depleted number of physicians and medical personnel. From an average of 10 per 1,000 in the immediate prewar years, the Jewish mortality rate rose to 137/1,000 in September 1941! Many people died from starvation, violence, tuberculosis, pneumonia, and typhoid.<sup>45</sup>

As an example of the role of disease, **Figure 3-17** illustrates the return of typhus fever in Warsaw after almost two decades of decline.

<b>The Return of Typhus Fever</b>		
<b>Time Period</b>	<b>Population</b>	<b>Rate Per 100,000 Population</b>
1921	Poland	132
1931	Poland	44
1937	Poland	11
March 1940	Warsaw	21.6
March 1940	Warsaw Ghetto	53.6
April 1940	Warsaw	23.5
April 1940	Warsaw Ghetto	61.0

▲  
*Figure 3-17*

It's widely recognized from more recent events that wars and conditions in refugee camps, during which hygienic facilities and practices become disrupted, inevitably generate epidemics and the rapid spread of infectious diseases.<sup>46-51</sup>

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## Conclusions

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When it comes to health, we are clearly better off today than in those imaginary "good old days." Every possible indicator used to measure health verifies this. For example, we live longer today, get sick less often, have healthier children with a better chance to survive to old age, eat better, and are even physically stronger than any other generation that left a documentable history behind.

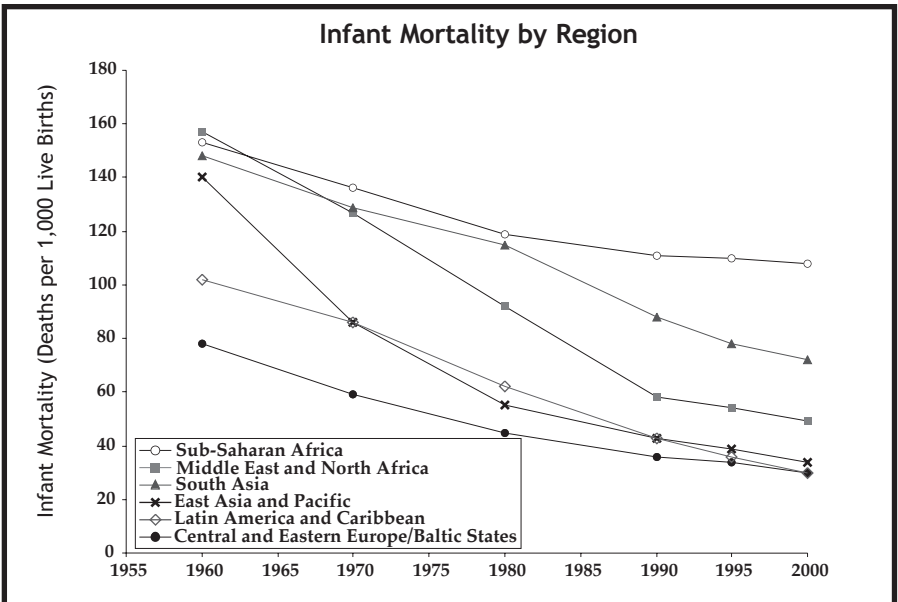
Clearly, the health revolution has had a dramatic impact on our lives. For example, **Figure 3-18** shows that the total mortality experience for children in the U.S. decreased by 22-fold between 1900 and 1998.

Age-Specific Mortality Rates, U.S. (per 1,000 living persons in that age group)		
Age Group	1900	1998
Under 1	162.4	7.5
1-4	19.8	0.3
25-34	8.2	1.1
45-54	15.0	4.2
65-74	56.4	24.9
Crude Death Rate	172	8.7

▲  
*Figure 3-18*

And it's getting better every day. For nearly the last 100 years, the prospects for living for every age group, including infants, toddlers, young adults, the middle aged, and senior citizens, have improved in the U.S.

However, while improvements continued in many other countries around the world in the latter part of the 20th century, there are still regions of the world where significant improvements can be made (**Figure 3-19**).



▲  
*Figure 3-19*

The World Health Organization reported that for 2000, 3.1% of deaths (1.7 million) around the world were due to unsafe water, sanitation, and hygiene. Combining the years of life lost due to premature mortality and years lost due to disability — a statistic referred to as “disability-adjusted life years” (DALY) — these risk factors accounted for 3.7% of worldwide DALYs, or 54.2 million DALYs.<sup>52</sup> Thus, improvement in these risk factors could protect millions of years of healthy, productive lives.

By every criterion that we choose to measure community health status — infant mortality, general mortality, age-adjusted mortality, life expectancy, epidemics, or endemic disease incidence — we can demonstrate the impact of the health revolution in numerous societies that kept health records.

Numerous factors on multiple levels determine the health status of a population. Intervention on one or more of these levels may affect community health. For example, it may be possible to modify determinants, such as host susceptibility, environment, lifestyle, socioeconomic status, and availability or accessibility of personal and community health services.

During the last century in the U.S. and Western Europe, the following profound changes occurred in all of these determinants:

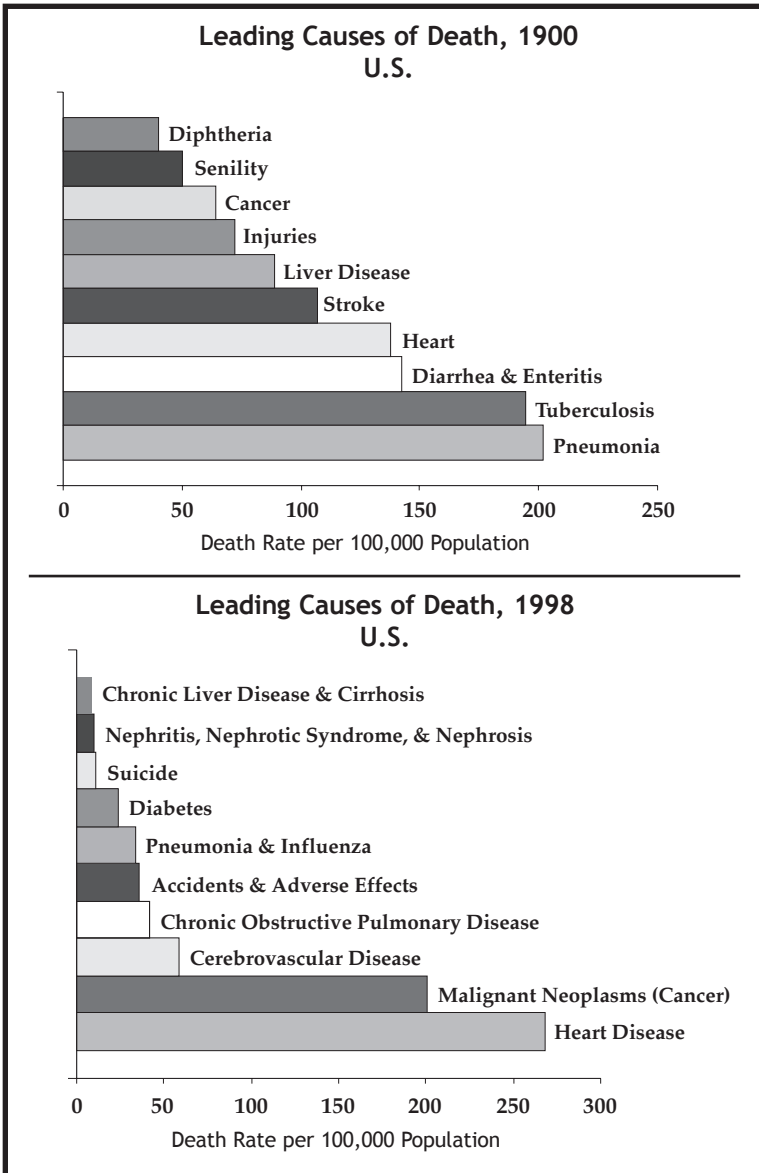
1. Sanitary engineers cleaned up the water supply, drained the swamps, improved refuse disposal, and built sewage-disposal systems (i.e., they changed the environment).
2. The discoveries of the epidemiologists and the bacteriologists provided a scientific basis for disease prevention and treatment using vaccines and antibiotics (i.e., they changed host susceptibility).
3. Governments became involved in the training and licensing of health-care professionals and hospitals (i.e., they changed availability and accessibility of personal and community health services). Health departments with police and taxation powers were organized. Health services became available to people as a right rather than a charity.
4. There was a revolution in personal hygiene practices (i.e., changes in lifestyle). Soap consumption increased, public bathhouses and laundry facilities were made available, and houses and tenements were provided with running water, sinks, bathtubs, and toilets.
5. Economies began an upward trend in prosperity that followed industrialization (i.e., changes in socioeconomic status).

Historical and epidemiologic trends in personal hygiene and community health were reviewed in this chapter. Such personal hygiene practices as bathing and laundering gradually became popular among the masses in Europe and the U.S. in the few decades before the turn of the 20th century and became an established social-behavior feature of the U.S. and England during the quarter century 1890–1915. This sociocultural modification was temporally correlated with declines in infant diarrhea — the leading cause of infant mortality during those years, as well as such diseases as typhus and trachoma.

In some societies where social, economic, and public health infrastructure has aided creating an environment where high levels of hygiene products and education are widely available, many of the infectious illnesses related to inadequate hygiene are under control, although these diseases are still prevalent in certain risk groups. Furthermore, although several other advances, such as milk pasteurization and improved nutrition, can be etiologically and temporally related to some of these diseases, the causal evidence (e.g., temporal sequence, consistency, biologic plausibility) is consistent with the hypothesis that personal hygiene is one other factor that helped to determine the decline. This may be one of the more silent victories of public health and continues to be an important disease prevention strategy, even in this “modern” era when the “gospel of germs” has waned in popularity.<sup>53</sup>

Our new health challenges are highlighted in **Figure 3-20**, which lists the leading causes of death across all ages in the U.S. in 1900 and 1998.

**Figure 3-20** illustrates the phenomenon that we are all too familiar with today — the prominent rise of chronic diseases.



▲  
*Figure 3-20*

Consequently, we're dealing with two sides of the same coin. A major reason for the lack of chronic diseases in the past is simply that very few people lived long enough to incubate illnesses that take decades to manifest themselves. If you die at age 40 from tuberculosis, your coronary arteries don't have time to become clogged with atherosclerotic plaques.

This doesn't mean we should tolerate our current health problems as a "new fate," but we must continue the health revolution and solve the chronic diseases like our predecessors solved the infectious ones. At the same time, we must prevent the "good old days" from returning in places where they are a distant past. Even as we learn how to prevent and treat heart disease, cancer, and stroke, we can't presume that our current freedom from plague and pestilence is assured. We didn't get where we are without some effort, and new and reemerging infections are always present. In fact, numerous new and emerging infections have been identified in the last two decades, such as Ebola virus, west Nile virus, hanta virus, and human immunodeficiency virus (HIV).

As demonstrated in the preceding sections, hygiene improvements at the individual and community levels, such as sanitary living conditions and practices and potable water and sewage facilities, have played a major role in reducing morbidity and mortality from infections, particularly those transmitted by the fecal-oral and direct contact routes. However, even in developed countries where there's access to improved water supply and sanitation, such infections continue to be a problem, especially in high-risk settings in which susceptible individuals gather, such as child-care and elder-care centers. In developing countries, infections carry an even greater burden of morbidity and mortality, especially in areas where public health infrastructure and medical care are inadequate or unavailable. At the beginning of 2000, approximately one billion individuals globally lacked adequate water supply and more than two billion lacked access to adequate sanitation. The majority of people that don't have access to these basic infrastructures live in developing countries.<sup>54</sup>

**The Global Water Supply and Sanitation Assessment 2000 Report provided by the World Health Organization lists the following three key hygiene behaviors that are of the greatest likely benefit to health, particularly in developing countries:<sup>54</sup>**

1. Handwashing with soap (or ash or other aid)
2. Safe disposal of children's feces
3. Safe water handling and storage

In the next chapter, we will explore personal hygiene and household cleaning practices today, along with their impact on public health.



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CHAPTER

4



PERSONAL HEALTH

*Bringing Good Hygiene Home*

It's a new day as far as personal hygiene and household cleanliness are concerned. Research on infections over the past few decades has focused on hospitals, day-care facilities, and schools, but little attention was paid to the home. Today, the increase of foodborne illness and a growing need for home health care have focused renewed interest on hygiene and cleanliness in the home.<sup>1</sup>

“Hygiene” refers to conditions or practices by which people maintain or promote good health by keeping themselves and their surroundings clean. Even in our contemporary society, good hygiene practices continue to be the primary disease-prevention strategy. As described earlier, hygiene is one of the *silent* victories of public health. This chapter focuses on hygiene in the newest frontier of disease prevention — the 21st-century home.

Do personal hygiene and household cleanliness practices affect the risk of spreading infectious disease? In this chapter, we'll review the “hygiene barrier” concept and the range of hygiene needs within the home environment, and discuss disease-causing microbes — their sources, how they spread, and how their transmission can be controlled by proper personal hygiene and household cleaning practices. This information offers a framework for developing practical home strategies to manage risk from infections.

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## The Hygiene Barrier

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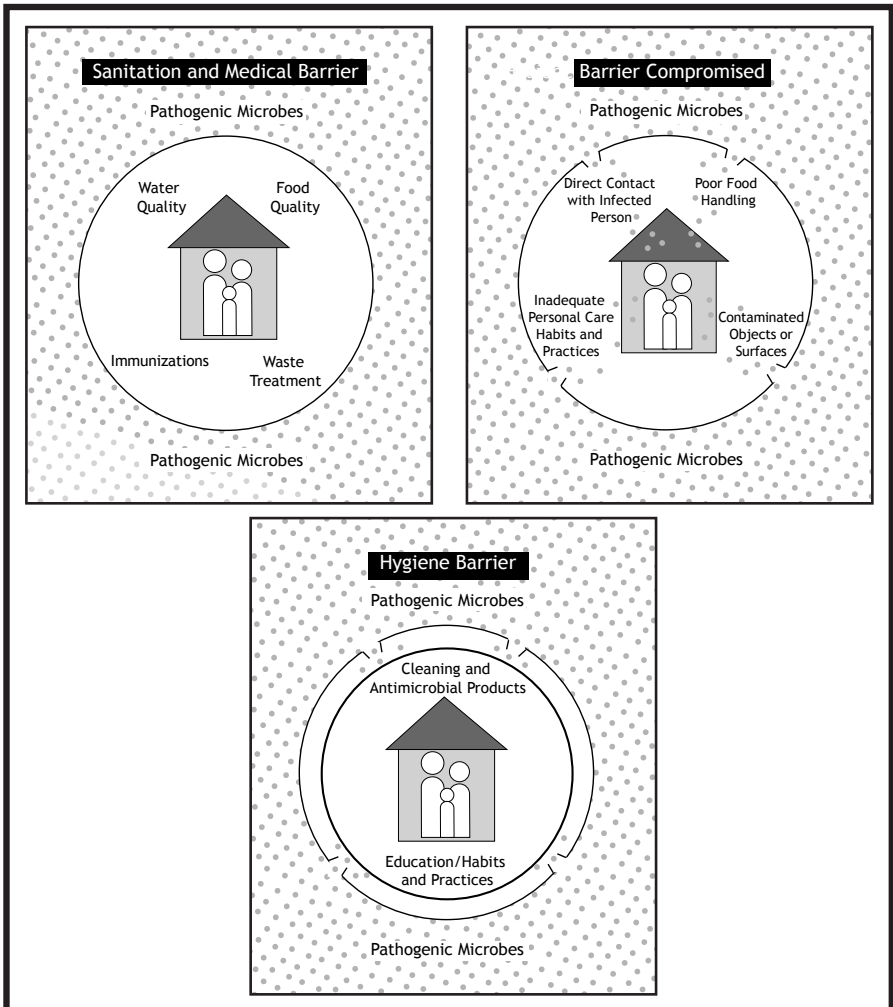
A “hygiene barrier” gives us the freedom to experience our lives and do so without the impediments of debilitating diseases or the tragedy of premature death. It is a direct result of the innovations brought about by the health and sanitary revolutions that have swept regions of the world. Through the combined benefits of improved food and water quality and home and personal cleaning practices, the hygienic quality of our environment dramatically reduces routine exposures to pathogenic microorganisms. This reduction in pathogen exposure results in dramatic reductions in infectious diseases and premature death. As is the case with most societal breakthroughs, many people in developed countries have grown to accept reduced rates of illness as the norm, and outbreaks that once would have been accepted as an unavoidable part of life are now viewed as crises of public health requiring swift and decisive interventions.

Along with the reductions in pathogen exposure and illness, susceptibility to many disease-causing organisms has increased. Therefore, it is important to continually look for ways of improving and maintaining the high levels of hygiene.

The barrier provided by sanitation and medical advances is not perfect — it can be easily compromised (**Figure 4-1**). Even in the developed world, where public health standards are high, infectious diseases are still a part of everyday life. Exposure to disease-causing microorganisms can

occur as a result of contact with an infected individual, consumption of contaminated food or water, contact with contaminated objects or surfaces, or inadequate personal care habits, all of which compromise the barrier. Understanding and implementing good hygienic cleaning in the home can help reduce the risk of illness by maintaining a “hygiene barrier” that reduces these exposures. Practical knowledge about when and where to clean or use antimicrobial products is equally as important as what product to purchase and how to use it to achieve the best results. The subsequent sections of this chapter provide information to help bring home hygiene into practice.

### Maintaining the Hygiene Barrier: A Home Hygiene Strategy



▲  
Figure 4-1

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## Hygiene Needs in the Home

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*In any given day, the typical home can provide the functions of a hotel, a restaurant, a day-care center, a medical center, or a pet shop.*

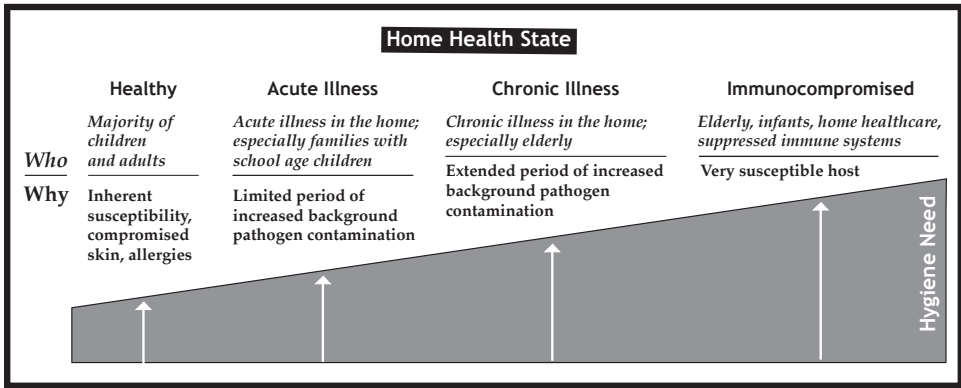
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The home is a dynamic environment where many different types of activities can be performed by a wide range of individuals, all of whom can vary in age, health, and susceptibility. In any given day, the typical home can provide the functions of a hotel, a restaurant, a day-care center, a medical center, or a pet shop. Given the wide array of situations that can be present in a home, it is not difficult to imagine that there is a parallel array of potential hygiene needs that accompanies the individuals and activities that make up a typical

household day. This continuum of needs correlates with the relative health status of those who live in a household and is illustrated in **Figure 4-2**.

- At any given time, the majority of households are made up of **healthy** individuals with a normal susceptibility to illness. If exposed, they can certainly become sick, but they are not especially susceptible and their symptoms and recovery are somewhat predictable. In these homes, the need for hygiene exists, but is primarily targeted at avoiding known risk situations.
- If **acute illness** (gastrointestinal, for example) is present in the home, the need for hygiene increases because there are now additional risks associated with environmental contamination. The chance of more family members becoming ill increases due to the potential of direct person-to-person contact or contact with contaminated surfaces. The number of households where some type of acute illness is present can be relatively large, though smaller than the number of “healthy” homes.
- Hygiene needs in the home increase even more when those with **chronic illness** are living there. In such cases the need for extra hygiene lasts longer, but typically involves an even smaller portion of the general population.
- The highest attention to hygienic cleaning in the home is reserved for the portion of the population that is considered to be **immunocompromised**. This group consists of infants, the elderly, and those with suppressed immune systems due to chronic illness or medical treatments they receive. This can be a significant portion of the population. For example, this population is estimated to be as high as 20% of the overall U.S. population.<sup>2</sup> Exposures to pathogens must be minimized for this group, since their immune systems are least well equipped to fight off disease.<sup>3,4</sup>

## Needs Continuum for Home Hygiene



▲  
Figure 4-2

## Pathogen Contact and Disease

Bacteria and viruses exist throughout our environment and can spread to individuals through direct and indirect contact.

**Direct contact** includes person-to-person contact with mucous, blood, and other body fluids, including the fecal–oral route. An individual can also contaminate one region of the body with microbial flora from another area (referred to as endogenous infection). Other means of transmission include direct contact with airborne droplets produced by sneezing and coughing.<sup>5</sup>

**Indirect contact** with pathogens occurs by transmission through a contaminated object — usually the hands, but also surfaces. For example, a parent who changes a baby’s diaper infected with *Shigella* and then prepares a family meal without washing his or her hands could transmit the pathogen to others in the family. Using a cutting board to prepare raw chicken, which can be contaminated with *Salmonella*, and then using the same cutting board to slice fresh fruits and vegetables would be another example. Indirect contact is a common mode of transmission, often responsible for *E. coli* O157:H7 outbreaks caused by consuming undercooked contaminated meat or other uncooked foods.

As examples of the diseases that can be prevented by good personal hygiene and household cleaning practices, *The American Public Health Association (APHA) Handbook on Control of Communicable Diseases in Man* lists scores of human diseases that can be transmitted from person to person (or from animals to persons) by contaminated hands or from soiled objects. Some of these diseases are listed in **Figure 4-3**. These are the types of diseases where improvements in **personal hygiene** and **household cleanliness** would lower the chances of their spreading.

**Examples of Diseases Whose Transmission Is Mitigated by Personal Hygiene, Environmental Hygiene, and/or Household Cleaning<sup>6</sup>**

Amebic Dysentery	Measles
Balantidiasis	Meningococcal Meningitis
Chicken Pox	Molluscum Contagiosum
Cholera	Paratyphoid Fever
Conjunctivitis	Pediculosis
Dermatophytosis (Ringworm)	Pleurodynia, Epidemic
Diarrhea of Early Childhood	Poliomyelitis
Diphtheria	Rubella
Enterobiasis (Pinworm)	Salmonellosis
Food Poisoning ( <i>E.coli</i> , Staphylococcal)	Scabies
Gastroenteritis, Viral	Shigellosis (Bacillary Dysentery)
Hepatitis A	Staphylococcal Disease
Herpangina	Streptococcal Disease
Hydatidosis	Trachoma
Keratoconjunctivitis, Epidemic	Typhoid Fever
Larva Migrans	Typhus Fever
Lassa Fever	Verruca Vulgaris (Warts)
Lymphogranuloma Venereum	Yaws
Marburg Virus Disease	

▲  
Figure 4-3

## ==== Infectious Disease in the Home ====

Every day everyone shares their homes with infectious bacteria and other microbes. As a result, the home environment plays a significant role in the transmission of infectious disease.<sup>7</sup> Each year 76 million Americans develop food poisoning,<sup>8</sup> with about 20% of reported foodborne illnesses occurring in the home.<sup>9</sup> Seventy to ninety percent of *Salmonella* infections are thought to be associated with the home environment.<sup>10-13</sup> In the U.K., cross contamination has been implicated in about 6% of foodborne outbreaks within the home, while poor hand hygiene is responsible for about 4%.<sup>14</sup>

Most indirect exposure to potentially harmful germs in the home occurs as a result of cross contamination. Cross contamination is the transfer of potentially harmful germs from one surface to another, including the hands or food. For example, lower levels of washing hands and surfaces in the home after handling ground beef have been associated with infections of *E. coli* O157:H7.<sup>15</sup>

The home environment has been implicated in the spread of salmonellosis among young children.<sup>16</sup> Bacterial isolates obtained from children infected with *Salmonella* and samples taken from multiple locations in the home, such as the vacuum cleaner, dirt surrounding the front door, and a refrigerator shelf, as well as from household members and pet animals, were identical, indicating the *Salmonella* was transmitted from a common source.

Microbes can be brought into the home by one family member and spread to others. For example, children can carry infectious agents picked up in child-care settings, schools, or play groups into the home, leading to up to 50% of household members becoming infected.<sup>10,17,18</sup> Intrafamilial spread of bacteria and infections has been demonstrated in a number of other studies.<sup>19-22</sup> Bacteria brought into the home can be transferred directly from person to person (direct contact), typically via hand contact, or by a person touching a surface in the home previously contaminated by another person or by contaminated objects (indirect contact).

The remainder of this chapter examines microbes in the home and how to control them on surfaces and the hands.

#### **Microbial Risk Modeling**

Techniques for microbial risk modeling for early detection and prevention of future health risks within the home and community have recently been developed.<sup>23-25</sup> Some of these models include Hazard Analysis and Critical Control Point (HACCP) and Quantitative Microbial Risk Assessment (QMRA).<sup>24,25</sup> The reader is referred to these sources for details on this rapidly evolving area.

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## **Microbes in the Home: Where They're Found**

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Microbes can thrive wherever there is an ample source of nutrients and water. Studies have shown that areas in the kitchen, bathroom, and laundry can serve as reservoirs for the growth of microbes. Bacteria, like *Pseudomonads* and *E. coli*, as well as molds, prefer areas with high humidity, such as drains, sinks, shower stalls, toilets, and basements. Other bacteria such as *Staphylococci* and *Bacilli* prefer drier surfaces like counter tops or skin.

The following sections take a room-by-room look at the typical home and describe some of the unique hygiene issues associated with the different environments encountered.

*The most heavily contaminated sites in the home are those that remain moist, such as sponges, dishcloths, and drain areas, or that are frequently touched, such as kitchen sink faucet handles.*

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Poor food storage and preparation practices, along with moist surfaces, contribute to kitchens being bacteria-friendly environments. When not properly cleaned and/or disinfected, counter tops, cutting boards, and other kitchen surfaces provide an optimum environment for survival of microbes.<sup>26</sup> The most heavily contaminated sites in the home are those that remain moist, such as sponges, dishcloths, and drain areas, or that are frequently touched, such as kitchen sink faucet handles.<sup>27</sup>

According to the Centers for Disease Control and Prevention (CDC), between 1983 and 1992, improper storage temperatures and poor personal hygiene by the food handler in commercial settings were the main contributors to foodborne illness.<sup>12</sup> Unfortunately, these faulty practices are also common in the home. Specific risk factors for outbreaks of infections due to foodborne pathogens in the home kitchen include improper food storage, undercooking food, and cross contamination, which may be responsible for 30% of *Salmonella* outbreaks in the home.<sup>28</sup>

An example would be the cross contamination that occurs when vegetables are cut up on the same cutting board that was just used to cut up raw chicken.<sup>29</sup> The germs from the raw chicken end up in the vegetables. When the vegetables are eaten, the germs can cause illness. Bacterial cross contamination can occur from raw chicken to counter tops, faucet handles, refrigerators, cupboards, doors, oven handles, and condiment containers.<sup>30</sup>

Cross contamination is not limited to the kitchen. Surfaces and hands can become contaminated during simple everyday tasks such as taking out the trash, handling soiled laundry, or grooming the family pet. As discussed previously, these risks are even greater when illness is already present in the home.

Drying alone is not sufficient to eliminate contaminating organisms. Although drying reduces the number of organisms on clean, laminate surfaces, large numbers of bacteria have been found on contaminated surfaces as many as 24 to 48 hours after drying.<sup>31</sup> Furthermore, large numbers of organisms are found on hands after they touch contaminated surfaces.<sup>31</sup> Since plain soaps or detergents *do not necessarily kill* microorganisms, cleaning contaminated surfaces using a dishcloth and detergent or soap and water may actually spread microbes.<sup>23,30</sup>



### Poor Hygiene Practices Caught on Tape

Studies of Australian and U.S. home kitchens caught many disease-spreading practices on videotape.<sup>8,9,32</sup> The most common unhygienic practices included:

- infrequent and poor handwashing, especially prior to preparing meals
- pets in the kitchen
- hand contact with the face, mouth, nose, and hair during food preparation
- inadequate or no attempt to clean surfaces during food preparation
- use of the same towel for hands, dishes, floors, and covering food!

Consistent with these observations, 25% of respondents to telephone surveys in Australia did not recognize handwashing as important in reducing cross contamination and foodborne illness.<sup>33</sup>

Observations that meats are often improperly stored, not promptly refrigerated, and undercooked in the home<sup>8,9</sup> further emphasize the importance of proper management of these potential reservoirs of microbes through good hygiene. Poor storage practices – e.g., putting meats on higher refrigerator shelves than produce used in uncooked salads – can lead to transfer of bacteria if the meat drips onto the produce. Bacteria that grew on the meat due to improper storage and handling were not often killed during preparation.

### Sponges/Dishcloths

Of the many sites of bacterial contamination that can be examined in home kitchens, sponges and dishcloths have the highest bacterial densities.<sup>27</sup> For example, after wringing out a household sponge, a hundred thousand to a million bacteria can be left on your hands.<sup>34</sup> Microorganisms can be picked up from contaminated surfaces onto sponges and dishtowels, resulting in significant contamination of other kitchen areas and hands when they are used again for cleaning,<sup>31,35-38</sup> including pathogenic organisms.<sup>30,35,38</sup> Unfortunately, use of the *same* cloth for *multiple* purposes is a common practice in many homes.<sup>8,10,27,36</sup> And you don't have to have visible illness in the home in order to be spreading infectious microorganisms. For example, it has been found that active cases of *Salmonella* infection don't have to exist in the home for *Salmonella* to be on dishcloths.<sup>28</sup>

Drying alone is not sufficient to eliminate microorganisms from contaminating dishcloths. Large numbers of bacteria have been found on soiled cloths as many as 24 to 48 hours after drying.<sup>31</sup> Also, large numbers of microorganisms have been found on hands after they touched these contaminated dishcloths.<sup>31</sup>

**A study of 140 cellulose sponges and 56 cotton dishcloths from households in four U.S. cities found:<sup>37</sup>**

- 13 different bacterial species were present.
- *Pseudomonads* were the most commonly isolated group.
- *Salmonella* was isolated from 15% of the sponges and 14% of the cloths.

## Dishwashing

Pathogenic bacteria in dishwashing water can be transferred to the dishes being cleaned.<sup>28,38</sup> In dishwashing, the temperature of the dishwashing water can influence the survival of these bacteria.<sup>28</sup> For dishes washed by hand, the dishwashing water temperature is often below 122° F (50° C) at the start and will continue to drop during the dishwashing process. This temperature isn't high enough to destroy most microorganisms. Washing dishes in detergent and water is only effective in removing bacteria if followed by a rinsing step.<sup>30,39</sup>

## Microbes in the Bathroom

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*Like the kitchen, the bathroom can be a reservoir of large numbers of microorganisms — again, particularly in wet areas.*

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Like the kitchen, the bathroom can be a reservoir of large numbers of microorganisms — again, particularly in wet areas. For example, in homes where a family member had salmonellosis, four out of six toilets tested positive for *Salmonella* under the recess of the toilet bowl rim. This area is difficult to reach with household toilet cleaners. In one toilet, *Salmonella* was still present four weeks after the infection, despite the use of cleaners. After the toilet was artificially contaminated, flushing it led to contamination of the toilet seat and lid. In fact, in one instance, *Salmonella* was isolated from an air sample taken after flushing.<sup>40</sup> Examination of hand towels and bathroom floors in homes found 44% and 20% contaminated with *Staphylococcus aureus*, respectively.<sup>41</sup>

## Microbes in the Laundry

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While the kitchen and the bathroom are logical places for introducing and spreading pathogens, the clothes washing machine seems a less likely place for their growth and spread. However, changes in laundering practices over the years have increased the potential for disease transmission via the washing machine.<sup>31,35,36,42</sup> Today's common laundering practices can allow bacteria to remain in laundered items after standard washing and rinsing. For example:<sup>10,42</sup>

- Smaller volumes of water are used for washing, leading to higher concentrations of microorganisms in wash waters.
- Fewer bacteria are killed at the lower wash water temperatures used today.
- Fewer people use bleach.
- People rarely hang their clothes and linens outside, where the sunlight can aid in denaturing many microbes, although prolonged drying at high temperatures is effective in reducing the numbers of bacteria.
- Ironing, which causes steam to penetrate and reduce microbes in the fabric, has become less common.

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*Today's common laundering practices can allow bacteria to remain in laundered items after standard washing and rinsing.*

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Microbes can survive and multiply in damp clothes that have been washed in detergent and stored at room temperature.<sup>43</sup> And it's not just items that are contaminated with bacteria before a wash, such as underwear or dishcloths that are contaminated after washing. Even sterile clothing and bed linens placed in a wash with fabric contaminated with bacteria and viruses themselves become contaminated by the transfer of the microbes into the wash water and then

onto the other fabrics in the load.<sup>44</sup> Thus, the greatest concern during the laundering and drying process is contamination of the hands resulting from the handling of not just soiled laundry, but also washed laundry. The latter can occur when wet laundry is transferred from washing machines to dryers.

Besides contaminating other laundry in a wash load, microorganisms in the wash leave the washing machine contaminated, leading to subsequent loads of laundry becoming contaminated.<sup>44</sup> The lack of bleach use in communal laundry facilities has been correlated with the spread of microbes and higher rates of infectious disease symptoms among household members.<sup>45</sup>

Drying after washing and rinsing provides the greatest reduction in bacteria and viruses.<sup>43,44</sup> For reference, a typical home dryer reaches a temperature ranging from 110° F (43° C) on a low setting to 185° F (85° C) on a high setting.<sup>46</sup> For individual dryers, you can check the dryer's use and care manual or call the manufacturer's 800 number to learn their temperature ranges.

### Microbial Survival During Laundering

In a study to evaluate the survival of bacteria and intestinal viruses during washing and drying in U.S. homes, sterile cotton swabs were inoculated with *Mycobacterium fortuitum* (*M. fortuitum*), *Salmonella Typhimurium*, *Staphylococcus aureus*, *E. coli*, rotavirus SA1, hepatitis A virus, and adenovirus type 40. The contaminated swabs were then added to sterile cotton underwear, T-shirts, and a pillowcase that contained an organic load typical of home laundry. The results follow:<sup>44</sup>

- Wash and rinse cycles alone reduced intestinal viruses in the laundry by 87 to 98% and bacteria by >99%.
- During the drying cycle, survival of viruses exceeded survival of bacteria.
- Drying was most effective for reducing (in decreasing order) *S. typhimurium*, *S. aureus*, and *M. fortuitum*.
- Detectable levels of *E. coli* were not found after drying. Together, washing and drying reduced all bacteria by at least 99.99%, adenovirus type 40 by 99.91%, hepatitis A virus by 99.8% and rotavirus by 98.6%.
- The test organisms contaminated other laundry in the machine, as well as the washing machine itself, which led to the contamination of subsequent loads of laundry.

### Transfer of Microbes Elsewhere Around the Home

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Other surfaces around the home can be sites of bacterial and viral transfer. Infection from the transfer of bacteria and viruses from common household articles to the hands is possible from daily contact with these objects.<sup>47,48</sup> Transmission from door handles, telephone receivers, faucet handles, and sponges has been shown to occur, with transfer to hands from hard, nonporous surfaces being highest.<sup>34</sup> Subsequent transmission to other people can occur from hands contaminated this way.<sup>48</sup>

## Controlling Infectious Microbes in the Home

In the home, the first line of defense against infectious disease is cleaning and disinfecting.

**Cleaning** is the mechanical *removal* of dirt and soil from an object or area. Detergents and water are the preferred products for cleaning. Under normal conditions, cleaning is adequate for most households. However, in some circumstances, such as illness in the family or handling of potentially contaminated food, disinfection may be necessary.

**Disinfection** is the chemical *inactivation* or *killing* of microbes. Products containing substances such as alcohol, sodium hypochlorite bleach, quaternary ammonium compounds, and phenolics, can be disinfectants, depending on the formulation and use of the product. In many countries, government authorities must approve ingredients as antimicrobial agents and approve product formulations containing an approved ingredient as being efficacious against specific microbes or microbes in general.

### Disinfectant and Sanitizer Products in the U.S.

In the U.S., the Environmental Protection Agency (EPA) approves all antimicrobial ingredients used in products for inanimate objects (e.g., hard surfaces, fabrics) based on their efficacy in reducing microbes and on their safety. The agency also requires companies to show the effectiveness of their finished products in order to label them as “disinfectants” or “sanitizers.” Be sure to look for those words when buying disinfectants, sanitizers, or cleaning products that disinfect. Many other countries have similar approval and labeling requirements.

### Cleaning to Remove Bacteria and Viruses

The benefit from removing bacteria and viruses increases as follows: doing nothing < rinsing with water < washing with a soap or cleaner < washing with an antimicrobial product.

It is important to recognize that washing is only one step in the whole process. Our hands can be filthy but not much of a problem if we don't touch our eyes or mouths, or don't touch food just before eating it. However, we unconsciously do all of these things on a regular basis. Therefore, we need to frequently wash our hands and clean surfaces, such as counter tops, faucet handles, and handles on doors, cabinets, and refrigerators. Also, since we cannot see bacteria or viruses, it is important that we thoroughly clean surfaces immediately after they are contaminated — otherwise someone else will unknowingly contact the contaminated surface or we'll forget where the mess is.

### Bacterial Inactivation

Detergent with hot water alone produces no overall reduction at bacterial sites in the kitchen, bath, and toilet.<sup>39</sup> Rather, contamination can increase due to mechanical breakup of microbe aggregates and subsequent spreading of bacterial cells. Chemical disinfectants (e.g., sodium hypochlorite, phenolic-based disinfectant products) can substantially reduce bacterial contamination in the home, and maintain low levels for three to six hours.

#### ▶ Maximizing Product Benefits Through Proper Use

Disinfecting in the home is dependent on *following the directions for use, not just on the contents* of the product itself. During a 30-week study in Arizona, 14 homes were supplied with various disinfectant products, without specific instructions on how to use the products. Microbiological contamination of kitchen and bathroom sites in each home was studied.

Subsequently, most of the disinfectants were removed, specific disinfection products were introduced, and a cleaning schedule was established. While the greatest reductions in coliform bacteria occurred after the products were initially supplied, the introduction of the cleaning schedule led to even greater reductions in microbes in the kitchen and bathroom sites.<sup>49</sup> These results are consistent with the findings of another study, which demonstrated that disinfectants reduced contamination more when used in a timely manner after contamination by food or hands.<sup>50</sup>

### Bacterial Inactivation: Room-by-Room

This section examines rooms in the home and specific areas in them, indicating opportunities for bacterial inactivation.

#### *The Kitchen*

So much activity and food preparation takes place in the kitchen that it is a virtual hot spot for bacterial growth and spread. When counter tops, cutting boards, and other kitchen surfaces are not properly cleaned and/or disinfected, microbes survive and proliferate.<sup>26</sup> Kitchen studies frequently follow Gram negative bacteria like *Enterobacteria*, *Campylobacter*, and *Salmonella*, as these bacteria are sometimes found as natural contaminants on foods. If they are not eliminated during cooking, they can cause severe food poisoning.

## Sponges and Dishcloths

Sponges and dishcloths used with hypochlorite disinfection products have significantly lower bacterial contamination.<sup>27</sup>

## Food Preparation and Other Surfaces

Using soap and water to clean home surfaces can actually increase contamination if *not followed by rinsing*.<sup>39</sup> This suggests that when rinsing is impractical or not feasible, cleaning alone may be insufficient and disinfection may be necessary.

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*Using soap and water to clean home surfaces can actually increase contamination if not followed by rinsing.*

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Cleaning with detergent and hot water alone does *not* significantly reduce *Campylobacter* and *Salmonella* from contaminated kitchen areas. However, when cleaning is supplemented with sodium hypochlorite bleach there is a significant reduction in the number of bacteria on contaminated sites, such as counter tops and faucet or refrigerator handles.<sup>27,30</sup> Sodium hypochlorite bleach

has been shown to be effective at inactivating a wide range of pathogenic bacteria.<sup>49,51-56</sup> Treating cutting boards with a kitchen disinfectant after preparing chicken contaminated with bacteria reduces the spread of bacteria to almost undetectable levels.<sup>29</sup> Use of an antibacterial kitchen cleaner soon after contamination of surfaces by contact with food or hands results in significantly greater reductions in surface contamination, including fecal coliforms, compared to delayed or nonuse of the product.<sup>50</sup> The combined use of an antibacterial kitchen cleaner and an alcohol hand gel has been shown to reduce cross contamination of *E. aerogenes* from cutting boards and hands and, subsequently, to salad vegetables during simulated meal preparations.<sup>29</sup>

Disinfection in conjunction with the use of disposable paper towels is reported to be the best procedure for cleaning surfaces contaminated by raw meat juices.<sup>57</sup>

### **Food Chemicals and Non-antibacterial Products vs. Commercial Disinfecting Products**

There have been proponents for using food chemicals and non-antibacterial products in place of commercially prepared products to disinfect bacteria on surfaces in the home. The effectiveness of a variety of homemade cleaning solutions and commercially prepared products against several intestinal bacterial pathogens has been studied.

After both short (30-second) and long (5-minute) exposures, commercial products were found to be more effective against pathogenic organisms than two food products commonly found in the home — vinegar and baking soda.<sup>58</sup> Commercial bleach and an antibacterial kitchen cleaner were much more effective at reducing pathogenic microorganisms than either vinegar or baking soda. A disinfectant spray and hard surface cleaner also produced consistently higher reductions, though not as great. The commercial disinfectant products inactivated (killed) both antibiotic-susceptible and -resistant bacteria. While vinegar had very little effect after short exposure time, it had activity similar to the commercial products against these organisms after a long (5-minute) exposure.

The Gram positive bacterium *Staphylococcus aureus* is a frequent skin contaminant that can cause severe food poisoning if it proliferates on food. In a study of common kitchen disinfectants, only hypochlorite bleach effectively inactivated *S. aureus*, *Salmonella typhi*, and *E. coli*. Concentrated ammonia and vinegar were effective against *S. typhi* and *E. coli*. Borax, ammonia, baking soda, vinegar, or dishwashing detergent showed no antimicrobial activity against *S. aureus*.<sup>52</sup>

### ***In the Bathroom***

In the bathroom, splashing and aerosol droplets are responsible for transferring contamination from toilets and sinks to surrounding areas in the bathroom. Using a chlorine bleach-based, in-toilet block effectively reduces the level of contamination in the toilet. The bleach, however, doesn't affect surrounding areas. This suggests that direct shedding of skin or hand contact can contaminate the toilet seat, handle, and floor.<sup>59</sup>

### ***In the Laundry***

Reductions in infection risk have been associated with the use of hot water and bleach during laundering.<sup>60</sup> Warmer washing temperatures, such as 131° F (55° C), are effective in reducing bacterial levels.<sup>61,62</sup> Colder washing temperatures may increase the cross contamination rate of articles that are washed together.<sup>62</sup> Sodium hypochlorite bleach is effective in reducing bacterial counts when either hot or cold water is used.<sup>63,64</sup> Therefore, attaining maximal reduction in bacteria in both the washing machine and fabrics depends on the use of bleach and water temperature.<sup>62-65</sup> However, relying on wash water temperatures to achieve meaningful reductions in bacteria is impractical in the U.S., since water heaters are typically set at 120° F (48° C).



## Viral Inactivation

A range of disinfectants has been shown to be capable of inactivating viruses.<sup>66</sup> For example, sodium hypochlorite bleach has been shown to inactivate a wide range of viruses.<sup>55,56,67-77</sup> Other studies have gone on to show significant decreases in viral transfer from surfaces to fingers,<sup>78,79</sup> and interrupting infections rates via oral transfer from surfaces due to the use of disinfecting products.<sup>80</sup> A review of transmission and occurrence of viral infections in the home, as well as in community settings, is available elsewhere.<sup>66</sup>

### ▶ Effect of Disinfecting Agents on Viral Transfer

The four disinfecting agents shown in **Figure 4-4** have been evaluated for their ability to prevent the transfer of human viruses from stainless steel disks to the fingers of volunteers as compared to tap water.<sup>78</sup> The figure presents the reduction of viruses on the surface of the disks resulting from the various treatments.

The presence of rotavirus was not detected on fingers that had contact with disks treated with disinfectant spray, bleach, and the phenolic-based product, but contact of the disks treated with tap water or quaternary ammonium-based product resulted in the transfer of 5.6% and 7.6% of the residual virus, respectively.<sup>78</sup> The rhinovirus was not detected on the fingers of volunteers who had contact with the disks treated with the spray or bleach. Transfer of 3.3% and 8.4% of the residual viruses occurred from disks treated with the phenolic product and the quaternary ammonium product, respectively.<sup>79</sup>

A particularly impressive study was one in which eight volunteers licked dried human rotavirus that had not been treated with anything, and *all* became infected. In an extension of this study, an alcohol and phenolic-based disinfectant spray applied to the virus interrupted the transfer of the virus; none of the 14 volunteers who licked the spray-treated virus became infected, whereas 13 out of 14 who licked the unsprayed virus became infected.<sup>80</sup>

<b>Effect of Disinfecting Agents</b>		
	<b>Reduction on disk surface</b>	
	<b>Rotaviruses<sup>78</sup></b>	<b>Rhinovirus<sup>79</sup></b>
<b>Household Liquid Bleach</b> (6% sodium hypochlorite diluted to 800 parts per million free chlorine)	97.9%	99.7%
<b>0.1% o-phenylphenol (OPP) and 79% Alcohol Disinfectant Spray</b>	>99.9%	> 99.9%
<b>Phenol product</b> (14.7% phenol diluted 1:256 in tap water)	95%	62.3%
<b>Quaternary Ammonium-based Product</b> (7.1% quaternary ammonium compound diluted 1:128 in tap water)	54.7%	14.7%
<b>Ammonia</b>	—	~15%
<b>Tap Water</b>	52.3%	53.3%

▲  
*Figure 4-4*

This body of information suggests that a product containing an ingredient with disinfectant properties, such as alcohol, bleach, or a phenolic, may be very useful for home use if a household member is ill with an infectious disease or highly susceptible to infectious disease.

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## Hand Hygiene: =====

### A Timeless Defense Against Infection

Cleaning hands is very important in preventing infection. For example, a major recent study has found that handwashing with soap prevents diarrhea and acute lower respiratory tract infections, which are the leading causes of childhood death globally. Handwashing with daily bathing was also shown to prevent impetigo.<sup>81</sup>

But how often does the average person wash his/her hands? Public awareness about the importance of personal hygiene has increased due to highly publicized and serious foodborne illness outbreaks. These incidents have raised questions about food safety and the hygienic practices (particularly handwashing) of food handlers. The concern extends to homemakers, child-care providers, educators, sales personnel, and those who have physical contact with the public. Despite public awareness, the average person simply doesn't wash his/her hands frequently enough, nor for a long enough time. For example, a handwashing study conducted by the American Society for Microbiology (ASM) found that 95% of people say they wash their hands after using a public restroom, but only 67% of people actually do so.<sup>82,83</sup>

### ► What Hand Hygiene Studies Show

In 2000, the American Society for Microbiology (ASM) conducted a telephone survey of more than 7,000 people in the U.S.<sup>82</sup> The results were:

- **81%** of the respondents claimed to wash their hands prior to handling or eating food.
- **48%** reported that they do not wash their hands after petting an animal.
- **33%** reported that they do not wash their hands after coughing or sneezing.
- **22%** reported that they do not wash their hands after handling money.

Good hand hygiene practices lead to reduced risk of infection.<sup>15,84,85</sup> The major benefits of hand hygiene for the general public are the removal of infectious agents found on hands and spread by the fecal–oral route, from the respiratory tract, and from contaminated food.<sup>30,86,87</sup> Handwashing is necessary *before* and/or *after* behaviors that are associated with microbial contamination, especially using the toilet, diapering, and preparing or eating food. In one study, it was estimated that adequate handwashing by food preparers in the home could have prevented 34% of *E. coli* O157:H7 infections in the study population.<sup>15</sup>

For cleaning hands, there are generally three types of products available:

#### 1. Plain Soaps

Generally, plain soaps *do not kill* microorganisms, but rather wash them off with the soap, with the help of friction and rubbing. As a result, the majority of microorganisms picked up in daily life are removed. Handwashing with plain soap and water for 15 seconds reduces skin bacterial counts by 50 to 90%, and washing for 30 seconds reduces counts by 90 to 99%.<sup>88</sup> For general home use — when household members are healthy — plain soaps are adequate for removing microbes.<sup>89</sup>

#### 2. Antibacterial Soaps

In addition to washing off microorganisms, antibacterial soaps contain ingredients that actually inhibit the growth of and/or kill germs on the hands. They are detergent-based products, requiring traditional handwashing with water. Some are also used for face and body washing. Antibacterial soaps can also reduce bacteria on the skin and the rates of superficial skin-related infections.<sup>3</sup> Triclocarbon and triclosan are common antimicrobial active ingredients used in soap.<sup>90,91</sup>

However, two recent studies of households using plain soaps and antibacterial soaps have failed to show reductions in infection rates due to the presence of antibacterial ingredients in the soap. In one study, antibacterial products did not reduce the risk for symptoms of viral infections in the home compared to nonbacterial products. This finding was not surprising since the products

were antibacterial and not antiviral and, therefore, would not be expected to reduce viral infections.<sup>60</sup> Another found significant reductions in symptoms among members of households using both plain and antibacterial soaps, but no significant differences in outcomes between users of the two types of products.<sup>81</sup>

### **3. Hand Sanitizers (nonsoap products)**

Hand sanitizers are non-detergent-based, antibacterial products in the form of hand rinses, gels, or wipes, which usually contain alcohol as the antibacterial ingredient. They rapidly kill a broad spectrum of microbes, including bacteria, viruses, and fungi.<sup>91</sup> However, they are not effective against bacterial spores.<sup>91</sup> They can be used when no running water or towels are available. Since these products are not good cleaning agents, they *are not* a substitute for handwashing, especially when hands are visibly soiled.<sup>92</sup>

## **Epidemiology Studies from Community Settings — Schools, Adult, and Child-care Facilities**

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In more recent years, information relating hand hygiene to reduced transmission has been developed in institutional settings, such as schools, adult-care settings, and child-care settings. Since home environments can include activities or situations similar to these institutional settings, a summary of some of the studies in these settings is worthwhile.

### **Schools**

Absenteeism among elementary school teachers and students can be significantly reduced when an alcohol gel hand sanitizer is used in schools as part of a hand hygiene program, including handwashing instructions to students.<sup>93</sup> Overall, absenteeism due to colds, flu, and gastrointestinal disease decreased by 20% among students and 10% among teachers in 16 schools and 1,600 students involved in one study. Another study involving elementary school students examined the effect of handwashing education programs and the use of an alcohol-based hand sanitizer in five schools and among 290 students.<sup>94</sup> The students receiving the education and using the sanitizer had 51% fewer absences than those who did not receive the education or use the product.

Other school studies have examined the use of an alcohol-free sanitizer containing benzalkonium chloride as the active ingredient. Illness-related absenteeism declined 42% among elementary students using a benzalkonium chloride-based sanitizer along with routine handwashing, compared to students routinely washing their hands but not using the product.<sup>95</sup> Elementary students supplied bottles of a benzalkonium chloride-based sanitizer were 33% less likely to be absent due to illness than students supplied hand sanitizers with no active ingredient.<sup>96</sup>

These types of hand hygiene programs have had similar results in university residence halls.<sup>97</sup> Students in residence halls receiving hand hygiene education and fitted with hand sanitizers had 15 to 40% reductions in upper respiratory illness symptoms. Overall, illness rates declined 20%. They had 43% fewer missed school and work days.

### **Adult Day-care Centers**

Reductions in respiratory illness in adult day-care centers occur with the introduction of an infection control program, including handwashing education and the use of an alcohol foam.<sup>97</sup> Use of an isopropanol hand rinse in addition to intervention hygiene instruction significantly reduces the occurrence of symptoms of intestinal disease in family day-care homes.<sup>98</sup>

### **Child-care Centers**

Child-care centers have been identified as the source of rotavirus in 25 to 40% of the outbreaks of diarrheal illness. Formulations of chlorhexidine gluconate with ethanol, quaternary ammonium compounds with isopropyl alcohol, ethanol, and ethanol with o-phenylphenol have found to be effective in inactivating rotavirus on surfaces.<sup>99</sup>

Infection prevention programs in child day-care centers and preschool programs, including hygiene education, increased frequency of handwashing, the use of disinfectants, regular cleaning of the centers and regular washing of toys, have been demonstrated to significantly reduce infections in both children and personnel.<sup>100-102</sup>

#### **Handwashing Procedures**

Despite the fact that frequent and proper handwashing practices are important in preventing infection, the average person still does not wash his/her hands often or long enough. According to the Centers for Disease Control and Prevention,<sup>103</sup> it is especially important to wash your hands:

- Before, during, and after you prepare food
- Before you eat and after you use the bathroom
- After handling animals or animal waste
- When your hands are dirty
- More frequently when someone in your home is sick

It's also important to use the proper procedure:

- Wet your hands and apply a liquid or a bar soap. Bar soap should be placed on a rack and allowed to drain.
- Rub your hands vigorously together and scrub all surfaces.
- Continue for 10 to 15 seconds (about the length of time it takes to sing a short song, such as "Happy Birthday"). The soap combined with the scrubbing action helps dislodge and remove germs.
- Rinse well and dry your hands.

### ▶ When to Use Hand Sanitizers and Antibacterial Soaps

Since hands serve as one primary mode of fecal–oral and respiratory transmission of microbes, an antibacterial soap or hand sanitizer should be used when an individual is:

- In close physical contact with high-risk individuals — e.g., infants, the very old, or people with weakened immune systems
- Infected with an organism and may potentially transmit the organism by the direct-contact route — e.g., diarrhea, upper respiratory infection, skin infections
- In close contact with an infected individual
- Working in a setting where the spread of infectious disease is likely — e.g., food preparation, or crowded living quarters, such as chronic-care residences, prisons, child-care centers, and schools, including preschools.

Hand sanitizers may be most practical to use in the following circumstances:

- When immediate antibacterial activity is needed
- After encounters that result in a high probability of contamination
- Where soap, running water, and/or clean towels are not readily available

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## Healthy Hands

The skin is the most important and first-line barrier to infections because it has natural antibacterial properties. Therefore, it is vital that hands be kept as clean and healthy as possible.

Some soaps, when used excessively for handwashing, can alter the skin's antibacterial properties by changing its pH. They do this by reducing fatty acids and, subsequently, the microbial flora.<sup>104</sup> The skin's water content, humidity, pH, intracellular lipids, and rates of shedding each play a role in retaining the skin's protective barriers. Very frequent handwashing with soaps, as encountered in professional healthcare settings (e.g., 10 to 20 times per work shift) can cause dry skin, irritation, cracking and other problems.<sup>105,106</sup>

A solution to retaining the skin's protective barriers is the use of moisturizers, which prevent dehydration, damage to the skin's protective barriers, scaly skin, and loss of skin lipids. Moisturizers may even help prevent the spread of microorganisms from the hands.<sup>107,108</sup> They also restore the water-holding capacity of the keratin layer and increase the width of corneocytes.<sup>109,110</sup> For individuals with dry or damaged skin, it is important to use emollients or lotions to replace lost fatty acids and keep the hands hydrated. Reviews about hand and skin hygiene have been published and can be consulted for more information.<sup>111,112</sup>

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## Conclusions

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This chapter began by highlighting the many diseases from *The American Public Health Association Handbook on Control of Communicable Diseases in Man* that are mitigated by personal and household hygiene practices. Good hand hygiene, surface cleaning and disinfection, and laundering practices, in particular, can lessen the chances of spreading these diseases.

Microbes can spread and grow in the home, particularly in the kitchen, bathroom, and laundry areas. The highest counts of microbes in the kitchen and bathroom are found in wet areas around the sink, in sponges and cloths used for wiping and/or drying kitchen surfaces, and in the areas around the bathroom sink.

Water temperature can influence the survival of microbes during dishwashing and laundry practices. For the laundry, drying is the most reliable method for destroying microbes. Attaining maximal reduction in bacteria in both the machine and fabrics depends on the use of bleach or disinfecting detergents, as well as the water temperature.

Successful strategies for reducing microbial risks in the home include both the selection of appropriate cleaning and disinfecting products and proper cleaning practices. The behavioral aspects of infection prevention in the home, such as food-handling practices, warrant increased public attention and education. Routine cleaning is often sufficient, but in some cases, such as infection of a household member, it may not adequately reduce contamination. In order to maximize the removal of microbes, care should be taken to use disinfecting products according to their instructions. In general, these products have a role as part of a household hygiene strategy. However, the effectiveness of disinfectants depends on how they are used.

Overall, evidence from homes, as well as institutional settings, clearly demonstrates that personal hygiene and cleaning continue to be very valuable disease-prevention strategies today. It is increasingly important that proper home hygiene and cleaning practices are followed to reduce the risk of spreading disease.

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## Epilogue

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In the last hundred years, one basic truth hasn't changed — diseases, or at least some diseases, are still related to dirt. Personal and household hygiene may have passed a critical health threshold in parts of the world some time in the last century. Undoubtedly, some societies have a large safety factor built in today — a hygienic status that can tolerate a considerable amount of neglect and regression before community mortality and morbidity rates are affected. But the basic truth is that the health threshold does exist.

Mankind's past, present, and future is an ongoing struggle against disease agents — microbiological and chemical. The struggle is sometimes dramatic. More often, it's unheroic and mundane. This is the case with personal hygiene. It doesn't make the headlines, and it doesn't have charismatic advocates. Personal hygiene is such a routine practice and so confounded with esthetics, cosmetics, and folklore that it is almost impossible to convince anyone of its significant health relevance.

There are millions of people today who owe their health and lives to such trivial things as soap and water, laundry detergent, and plumbing. We may take it all for granted, but this isn't new. It is the traditional experience of those who work in public health — those concerned with prevention rather than cure, with promoting health rather than coping with disease. Nevertheless, this fact is clear: good personal and household hygiene practices, although often overlooked in the past, remain vital contributors to good health.

Considering the tens of millions of years of lives still lost today due to mortality and disability associated with unsafe water, poor sanitation, and poor hygiene, significant opportunities for improvement lie ahead. Reverting these lost years to healthy, productive years not only would bring economic freedom, but also social freedom — freedom to create, participate in the political process, and enjoy one's family and friends. Thus, great contributions in hygiene and sanitation are still necessary to bring these freedoms to disadvantaged people around the world.

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