Chapter 22
Building the Infrastructure and Regulations Needed for Public Health and Fitness

Learning Objectives

1. To recognize the importance to the maintenance of good health of adequate public health regulations and an infrastructure that provides clean water and appropriate waste management
2. To see the lack of such amenities over many centuries, but the progressive development of public health bureaucracies dedicated to provision of an appropriate infrastructure, beginning during the Victorian Era.
3. To observe how responsibility for the provision of adequate housing for poorer city dwellers has been shared between government, benevolent entrepreneurs and charities.
4. To note the new challenges to public health presented by such issues as the abuse of tobacco and mood-altering drugs, continuing toxic auto-emissions, the epidemic of HIV/AIDS, a decreased acceptance of MMR vaccinations, and the ready spread of infectious diseases by air travel.

Introduction

Opportunities for the spread of communicable diseases have increased with the growth in size of cities. The success of urban living has depended in great part on governmental ability to maintain population health through the building of an adequate infrastructure to provide clean water and to dispose of waste, as well as the enactment of appropriate regulations to control the prevent the spread of infectious diseases. In this chapter, we will look at success in meeting these objectives in various communities from early history through the Classical Era, the Arab World, Mediaeval Europe, the Renaissance, and the Enlightenment to the Victorian Era, concluding with some comments on current challenges to public health.
Early History

Some early civilizations enacted quite specific health regulations, and some also developed an impressive health infrastructure, at least for their wealthier citizens. We will cite briefly examples from the Harrapan region of the Punjab, Egypt and Israel.

The Harrapan Culture  The Harrapan cities date back 2 millennia BCE, The Harrapan people were perhaps the first to pay significant attention to a healthy urban infrastructure. Multi-storied brick houses boasted wells and an effective covered sewage system. Public baths facilitated personal hygiene, and dykes protected the region against flooding. Laws also protected the community against the adulteration of grain and fats.

Egypt  In Egypt, pigs were regarded as unclean animals, and were avoided as sources of protein; further, the eating of other meat products was prohibited during the hotter parts of the year. The wealthier citizens used natron, a paste of ash or clay, to clean their hands, and for upper-class Egyptians the laundry supervisor was an important member of the domestic staff. There are ruins of a few public bath-houses built during the period of Greek domination, but most Egyptians were content to wash their bodies by a quick dip in a canal or river.

Israel  Moses (1391–1271 BCE) imported some early Egyptian regulations into Israel, and the priestly class elaborated 213 of 613 Biblical commandments that focussed upon health and personal hygiene. Items covered in these discourses of the Torah include rigid quarantine regulations, a variety of dietary restrictions, and a regular weekly Sabbath period of relaxation. Water, usually drawn from wells, was a precious commodity in ancient Israel, and excreta accumulated in cess-pits.

Classical Civilizations

Minoans  The Minoan culture (2000–1500 BCE) seems to have had some knowledge of the principles of public health. Networks of clay pipes provided upper class houses with water and sewage facilities, and aqueducts brought fresh water to the palace fountains and spigots from springs that were some 10 km away. Separate pipes cleared waste-water and the run-off from heavy rains, and the Minoan palace even had a footbath for weary travellers. However, provision for the lower echelons of society was less satisfactory. People still had to carry water from a local spring, and dysentery and typhoid fever were likely frequent problems for poorer Minoans.

Greece  Classical Athens viewed hygiene as the management of 6 non-natural things (air, exercise, diet, sleep, excretion and retention, and passions of the mind).
However, the city also made major public investments in infrastructure to provide clean water and treat sewage. There are reports of groundwater exploitation and water transportation from distant sources, together with storm water and wastewater systems, flood protection and drainage, and the construction of fountains, baths and other sanitary and purgatory facilities. Laws also required the inspection of wines to ensure the purity and soundness of these products.

**Rome** The ideas of classical Greece were further developed in Rome, where good health was seen as dependent upon a combination of bathing, wise eating, massage and exercise. Infrastructure included public and private baths, aqueducts as long as 350 km, and city-wide sewage systems. The private villas of wealthy citizens boasted indoor plumbing, with flush toilets, and baths were often included in their dream homes, sometimes staffed by one or more athletes. Ordinary citizens made wide use of public baths. A water commissioner named Frontinus (40–103 CE) reported that under his jurisdiction there were 856 baths in Rome alone. Visitors to the baths gave their belongings to slaves, and then entered the cold-plunge-bath. After exercising in this pool, they moved into a warm and humid room where they sweated and were massaged. They could then progress to a yet warmer room with a mosaic floor immediately above the furnace, finishing with a brief spell of dry sweating in the hottest room of the facility. Women used an adjoining, smaller set of baths.

There were rigid state laws to guard the purity of food products and protect the public against bad quality and fraud. Documentation describes the watering of wine and the adulteration of olive oil.

It was once suggested that lead piping had caused a widespread poisoning of the Roman population. However, Vitruvius (c. 75–15 BCE) seemed aware of this danger: “Water conducted through earthen pipes is more wholesome than that through lead; indeed that conveyed in lead must be injurious, because from it white lead…. is obtained, and this is said to be injurious to the human system.” If indeed there was chronic lead poisoning in Rome, it more likely arose from syrups prepared by concentrating grape juice in lead kettles.

The return of the Roman legions from foreign expeditions exposed the population to many micro-organisms for which they had little natural immunity. The Antonine plague (165–180 CE) was probably smallpox. It quickly decimated the ranks of the legions, with a clinical picture of fever, diarrhoea, inflammation of the pharynx, and a pustular skin eruption on the 9th day. A similar plague raged under Cyprian, between 251 and 270 CE. One charlatan (Alexander the Paphlagonian, second century CE) made much money selling a protective oracle to hang over front doors; however, it did little to stem the infection!
The Arab World

In the hey-day of the Persian Empire, heat, cold, dirt, stench, old age and anxiety were all thought to contribute to ill-health. Cyrus the Great (590–530 BCE) thus taught his soldiers not to urinate or spit into running water. Dead matter was also carefully removed from water-courses, and the clothing of dead people was systematically burnt.

During the mediaeval era, interest in public health was much more advanced in the Islamic world than in Northern and Western Europe. Ali Ibn-Rabban (838–870 CE), a well-respected physician living on the south coast of the Caspian Sea, wrote in his seven-part medical work *Paradise of Wisdom* that: “No one should live in any country which does not have four things: a just government, useful medicines, flowing water and an educated physician.”

In the eleventh century, the Arabic biographer Al-Mussawir emphasized that the main duty of a monarch was the preservation of health and well-being in his subjects. Thus, Islamic legislation required physicians to pay regular visits to army units, prisons and people living in outlying areas. The practice of medicine was regulated through a religious office, the *Hisba*, headed by an official called the *Muhtasib* with some of the powers of a modern ombudsman. One function of the *Muhtasib* was to act as the city medical officer of health. He prevented people with elephantiasis from using the public baths, regulated the cleanliness of public places such as markets, and ensured that garbage collectors did not handle food.

One interesting example of applied hygiene was the method used to determine an appropriate location for construction of the main hospital in Baghdad (Chap. 16). The merits of various sites were compared by hanging up pieces of meat, and noting the location where decomposition proceeded the most slowly.

The city of Córdoba under Moorish rule further illustrates the infrastructure typical of the Arab world during the tenth century CE. Among other facilities, the city boasted 300 public baths.

Mediaeval Europe

In Northern and Western Europe, public health infrastructure such as aqueducts and sewers fell into disrepair following departure of the Roman garrisons, and during the Mediaeval Era the sanitary conditions in most cities were appalling. Positive developments were the development of quarantine procedures and the re-emergence of a few public baths. Food inspectors were appointed, and some cities also introduced zoning regulations, requiring malodorous trades such as tanning to be undertaken outside the city walls.

**Water Supply and Sewage Disposal** Untreated waste was thrown directly into the rivers of London and Paris, and travellers were advised: “wise men go over bridges, and fools go under them.” In 1349 CE, King Edward III ordered the Mayor of
London to: “cause the human faeces and other filth lying in the streets and lanes in the city top be removed with all speed to places far distant, so that no greater cause of mortality may arise…” A fourteenth century ordinance prohibiting the emptying of latrines into a creek near London’s City Wall remained largely ignored, so that in the fifteenth Century the stream was buried underground. Substantial populations of hogs and cattle roamed the streets of many large cities, adding to the urban stench.

Uncontaminated water was a rarity, and a lack of refuse disposal encouraged rat infestations. Infrequent bathing and unwashed woolen clothing led to a proliferation of fleas and other insect vectors of infection. During the mid-fourteenth century, two thirds of the European population was killed by the flea-borne bubonic plague (the “Black Death”, 1340–1348 CE). Many doctors deserted their patients during this epidemic, and others proposed preposterous remedies. Guy de Chauliac wrote: “so contagious was the disease…. that no one could see or approach the patient without taking the disease…For self-preservation, there was nothing better than to flee the region… to purge oneself with pills of aloes, to diminish the blood by phlebotomy and to purify the air by fire and to comfort the heart with senna and things of good odor and to soothe the humours with Armenian bole and resist putrefaction by means of acid things.” Chauliac unwittingly kept the rats and fleas away from Pope Clement VI, by surrounding his bedside with charcoal burners.

**Development of Quarantine Procedures**  A few years following the Black Death, observant physicians hypothesized that ships arriving from overseas were contributing to the recurring epidemics of plague. At first, hostels for sick townsfolk and newly arrived visitors were set up outside the city, but this was not entirely effective in containing infection. Thus in 1377 CE, a *trentino* (30 days) of isolation on an uninhabited island was required at many European ports of entry. Subsequently, the isolation period was extended to 40 days, perhaps because of an ancient Greek doctrine that a contagious disease became manifest within 40 days. In Britain, recently arriving travellers were quarantined on *guardships*, anchored in the Thames Estuary (Fig. 22.1).

**Revival of Public Baths** Most of the Roman baths in Northern Europe had been abandoned by the Mediaeval Era, in part because of the high cost of heating the bath water, and in part because the church considered public bathing as a common prelude to venal sins. The church also had concerns about reinforcing belief in the supposed healing powers of Celtic water deities (Chap. 14). Nevertheless, as prosperity increased in the latter part of the Middle Ages, public baths were built or reopened in various parts of Europe.

In Britain, the King’s bath was built over the Sulis Minerva temple in the city of Bath, and Paris had established 26 public baths by the thirteenth century. In Germany, the tradition of river bathing had persisted from Celtic times, and a growing number of new public bath-houses were constructed during the 14th and 15th Centuries. Admission to a bath-house was expensive, and poorer Germans considered the payment of “bath money” a great blessing. The full luxury package of a spa treatment included washing, scouring and slapping of the body with a sheaf of twigs, a steam bath, rubbing to induce perspiration, swatting the skin with wet rags,
Fig. 22.1 In the years following the Black Death, many Nations quarantined newly arrived immigrants on an island for 40 days. In Britain, incoming travellers were held on guardships such as the Rhin, anchored in the Thames Estuary (Source: http://en.wikipedia.org/wiki/File:Quarantine_guardship_Rhin_1830.jpg)

scratching, hair washing, cutting and combing, lavendering, and blood letting. Unfortunately, some of the baths subsequently became the scene of debauchery, prostitution and infection, and by the sixteenth Century, many were closed for fears of spreading syphilis, leprosy and plague (Fig. 22.2).

**Personal Hygiene** Substantial quantities of soap were traded during the Mediaeval Era, but this was used more for the washing of wool than for cleansing of the skin. Monasteries boasted laundry rooms, and many women listed their trade as “laundry woman.” However, the laundering of clothes was an infrequent luxury for poorer people, and indeed many had no spare set of clothing, so that fleas flourished in the poorer households.

**Food Inspection** Basic foodstuffs such as wine, beer, bread, meat, fish and salt were frequently adulterated in Mediaeval times. To counter such abuses, several European governments appointed food inspectors. In Britain, in 1266, the Assize of Bread and Ale regulated the price of these staples in relation to the price of corn.

**The Renaissance**

Occasional Renaissance scholars expressed some interest in health promotion. The English diplomat and scholar Thomas Elyot (c. 1420–1546) wrote a book entitle the “Castell of Health,” summarizing the latest medical knowledge for those unfamiliar
with Greek, and the Venetian nobleman Luigi Cornaro (1464–1566) wrote a book on the art of living a long life. Santo Santorio (Chap. 27) also sought to put hygiene on a mathematical basis.

Most of Renaissance society showed little interest in public health or hygiene, as shown by the outbreak and management of the Great Plague. However, Boards of Public Health were set up in some cities. Two small advances in personal hygiene were the introduction of cotton clothing and a growing use of toothbrushes. Diligent housewives adopted a few other simple changes in household management to preserve the health of their families, and Cambridge University insisted on a direct control of its food supply.

**The Great Plague** The London “Plague” of 1665 CE was one in a series of European epidemics of bubonic plague dating back to the “Black Death.” The Great Plague claimed at least 70,000 lives in central London, this being about a half of the population who had not fled from the city. Indeed, the death count was probably underestimated, since publically appointed street monitors were open to bribery by those who did not wish to disclose that their house had become infected. Samuel Pepys commented that the prevalence of the disease was such that corpses could not removed during the hours of darkness (Fig. 22.3).

People were confined to their homes if one family member was infected, thus virtually ensured the death of the entire household. Two watchmen were posted at the doors of infected homes for 40 days, at a cost of 16d per house per day, and the
victims received a public stipend of 8d per day to pay for food, fuel and medications. Believing that the disease was conveyed by *miasmata*, the College of Physicians recommended using bonfires to displace the infected air. There was probably some incidental benefit from these fires, since the smoke tended to drive away the flea-ridden rats that were vectors of the disease. The epidemic was eventually checked by the Great Fire, which consumed both the rats and the plague-infested slum dwellings.

**Boards of Public Health** In Europe, local Boards of Public Health were established; they adopted various measures for the containment of epidemics and the provision of social support to the community. In some cases, they designated specific physicians to attend plague victims, and in Florence, local doctors prepared a public information booklet that summarized current knowledge on plague prevention. A further responsibility of these Boards was to deal with doctors who failed to report communicable diseases in wealthy patients. One Roman doctor who was arrested for this offence was ordered to serve as resident physician at the local pest-house.

Outbreaks of the plague placed a severe financial stress upon some municipalities. In Milan, extra funding was needed to hire physicians and grave-diggers, to pay for operating a quarantine “pest-house,” and to reimburse the infected for two-thirds of the estimated value of their possessions, which were summarily burned. Some
municipalities set up immigration offices on mountain passes to control the arrival
of infected travelers, and others restricted imports, exports, market trading, travel
and funerals, although it was unclear how far these costly measures were successful
in reducing the toll of disease and mortality.

**Personal Hygiene and Household Management**  One positive development dur-
ing the Renaissance was the introduction of washable cotton clothing and sheets.
This greatly curtailed the spread of insect-borne diseases, particularly among those
with sufficient wealth to own several changes of clothing. Another innovation was
popularization of the bristle toothbrush. This device had been invented by the
Chinese in the thirteenth century, but did not become popular in England until the
late seventeenth century, beginning with the aristocracy.

Without necessarily knowing why, Tudor housewives achieved some steriliza-
tion of their dairy equipment by scouring with salt and hot water, and then exposing
utensils to bright sunlight. Infestation of houses by fleas was also countered by
sprinkling appropriate herbs beneath the rush mats that covered their floors.

**Control of Food Supply**  The Renaissance saw further occasional attempts to con-
trol the quality of food, particularly for the wealthy. Cambridge University insisted
that the direct supervision of their refectories was important to preserving the health
and well-being of their students.

**The Enlightenment**

One of those promoting hygiene during the Enlightenment was the physician James
MacKenzie, who in 1758 wrote a text on “the history of health and the art of pre-
serving it.”

The Enlightenment saw some improvement of health infra-structure Many
dwellings for the poorer citizens of Europe were now constructed of brick and
boasted glass windows. And Samuel Johnson (1709–1784) was urging a pro-active
response to the prevention of disease: “we must consider how many diseases pro-
ceed from our own laziness, intemperance or negligence... and beware of imputing
to God, the consequences of luxury, riot and debauchery.”

The Diderot *Encyclopédie*, first published in 1751, included a section on hygiene,
which was defined as: “*the things which mankind uses or handles... and their influence on our constitution and organs.*”

Gottfried Wilhelm Leibniz (1646–1716) was perhaps the greatest enthusiast for
public health during this era. He strove to establish a pattern of medical training that
was oriented towards public health and preventive medicine rather than the treat-
ment of disease. He reminded his colleagues that Hippocrates had registered every
successful cure, and he urged a similar meticulous recording of outcomes in order
to provide a modern preventive medicine data-base. He proposed that standardized
questionnaires should be developed to examine eating habits, and that careful mor-
tality statistics should be collected so that findings could be correlated with the local climate, air conditions and the nature of the soil.

A few other scientists such as Hales (who improved the water supply for his village of Teddington), and Bernouilli (with authored a probability study demonstrating the merits of vaccination) were also interested in public health. But concern about the provision of clean drinking water, adequate treatment of sewage and garbage, and protection against communicable diseases remained the exception rather than the rule, with most countries making a poor showing on indices of population health.

Clean Drinking Water  Francis Bacon published studies on the percolation, filtration, distillation and coagulation of water as early as 1627. Anton van Leeuwenhoek described the microscopic animalicules that he had seen in Dutch drinking water in 1680, and the French scientist Joseph Amy patented a water filter in 1746.

However, the quality of water in most large cities left much to be desired. Philippe de la Hire (1640–1718) mapped the area around Paris, seeking to improve the water supply to Versailles, probably as much to service the palace ornamental fountains as to provide clean drinking water in the town, and he built a massive aqueduct for this purpose (Fig. 22.4). He further suggested that householders should install a sand filter to purify the water collected from the roofs of their dwellings, although he noted that one alternative source of water, from underground aquifers, was rarely polluted.

In 1804, Paisley, Scotland became the first British city to establish a municipal water treatment plant. It used a sand filter that had been developed by Robert Thom. In 1806, Paris also constructed a large water treatment facility on the Seine; here, river water was allowed to settle for 12 hours, and was then passed through sponge pre-filters and main filters that contained sand and charcoal.

Despite these advances, the residents of Broad St., in Central London, faced a massive outbreak of cholera as late as 1854, because they were drawing water from a shallow well that was located close to a cholera-contaminated cess-pit.

Treatment of Sewage and Garbage  Too often, the city dwellers of the Enlightenment continued to pass sewage into open gullies or cess-pits that were
close to wells, and garbage was thrown directly onto the street. However, in 1706, the Conseil Supérieur of New France ruled that in order to reduce infection, the houses in Quebec City must have latrines, and that garbage must be carried to the River St. Lawrence, rather than simply thrown out of the door.

**Population Health during the Enlightenment** Vital statistics provide simple objective indices of overall population health during the Enlightenment. At birth, the average European could expect to live no more than 35 years. A third to a half of the population died before reaching the age of 16 years. Those who survived to their mid-teens lived into their 50s or even their early 60s, and at the age of 21 the aristocracy could expect to live a further 43–50 years; this was an improvement over the 25 years of adult survival typical of the fourteenth century.

Survival prospects were much worse in North America than in Europe during the Enlightenment. Many of the population succumbed to fevers, intestinal diseases, and, in the case of the African slaves, to harsh working conditions. A quarter of European immigrant children did not survive until their first birthday, and half of all marriages ended in the death of one partner before their seventh wedding anniversary. Epidemics of beri-beri, smallpox, malaria and yellow fever wreaked havoc among early colonists. Two of every three deaths were attributed to typhoid, dysentery or salt poisoning. In an attempt to reduce this terrible toll, newly arrived immigrants were initially isolated in “guest houses.” Replacement of contaminated water by wine, beer or cider, a reduced consumption of infected clams, and a scattering of the population to areas where there were copious fresh water springs reduced deaths from typhoid and dysentery, but progress in reducing overall mortality was slow.

In early Canada, dispersal of the population along the major rivers made major epidemics less likely than in the urban settlements of the United States, but isolation, accidents and harsh winters made Canadian life expectancy worse than those in either Europe or the U.S. Only a small fraction of the population lived beyond 40 years, and many of the children suffered from rickets and anaemia. Typhus and smallpox were also recurrent problems.

**The Victorian Era**

The Victorian era was marked by growing government responsibility for the health of the public in large European cities. There was a gradual improvement in the quality of housing, and demographics showed a burgeoning birth rate. Social reformers also succeeded in abolishing child labour and slavery from Western Society (Chap. 23). In this section, we will discuss the role of Boards of Health, continued deaths from poisoning, and improvements in housing conditions.

**Boards of Health** Major epidemics of influenza, cholera, typhus, typhoid fever and scarlet fever sparked a deep concern about population health in Victorian England. In London, England, cholera killed 14,137 people in 1848–49 and
10,738 in 1853 (Chap. 24). However, leaders of a new sanitary movement such as Edwin Chadwick (1800–1890) and Thomas Southwood Smith (1788–1861) began to recognize that ill-health of the individual soon became ill-health of the population. They thus made urgent calls for the provision of clean drinking water, proper removal of refuse and sewage treatment. Chadwick and Smith sat as commissioners on London’s General Board of Health that regulated the water supply and sewer connections for all new housing in the city, and provided adequate burial grounds for those who died. The quality of London’s drinking water was rapidly upgraded, and money was spent on methods of preventing death during childbirth. The Public Health Acts of 1848 and 1875 also established public baths and wash-houses, and by the 1870s, health-conscious municipalities were building public swimming pools.

In Lower Canada (Quebec), a physician was appointed as Health Officer in 1816, with the primary responsibility of monitoring the sick and starving people who were arriving on immigrant ships from Europe. By 1823, a strengthened five-member Board of Health was supervising quarantine arrangements on Grosse Isle, in the St. Lawrence River near to Quebec City. Nevertheless, the number of immigrants was such that this holding facility was at times overwhelmed, and cholera periodically reached Quebec and Montreal, killing between 10–15% of the population. In 1847, 5424 people also died of typhus while they were quarantined at Grosse Isle. A Central Board of Health for both Upper and Lower Canada was created in 1849. Compulsory vaccination against smallpox was introduced in the early 1860s.

In the United States, organization of sanitary reform began rather later than in Canada. The city of New York enacted the Metropolitan Health Bill in 1866, creating a 9-person Board of Health. Immigrants were processed on Ellis Island, just outside New York City. The original wooden structure was quickly destroyed by a catastrophic fire, but a stone replacement building opened in 1900. Many immigrants spent only a few hours in the facility, but those with contagious disease were summarily denied admission to the United States.

Continued Deaths from Poisoning Many Victorians died from eating adulterated or diseased food. One report to the British Privy Council (1863) estimated that 20% of meat came from diseased cattle. Flour was expensive, and bakers frequently adulterated it with chalk (to whiten it) and alum; often, the bakers also kneaded the mixture with their bare feet. An act prohibiting the adulteration of food was passed in 1860, but its enforcement was an option for local authorities, so that it was not very effective. Cooking was typically done in tin-lined copper pans; wealthier citizens replaced the pots when the tin had worn away, but the poor could not afford to do this, and in consequence they sometimes developed copper poisoning. Other sources of poisoning in the Victorian home were leaking gas pipes, lead used in white paint, and arsenic used to colour wallpapers.

Improvements in Housing Conditions In the early nineteenth century, the sudden influx of country folk into the major cities of Europe created hideous slums: “In big, once handsome houses, thirty or more people of all ages may inhabit a single room.”
Housing gradually improved over the Victorian era, as many workers accumulated sufficient funds to purchase modest but well-built homes.

Enlightened industrialists also constructed model housing estates for their employees. Robert Owen (1771–1858) organized a Model Community for his workers at the New Lanark mills, in Scotland, complete with a nursery school. He envisaged an even more ambitious employee housing project in New Harmony, IN, but this project failed within two years. The Quaker chocolate manufacturer George Cadbury (1839–1922) built a model village for his employees around his factory at Bournville, near Birmingham, and in the U.S. George Pullman, the railway carriage czar, built a model town at Pullman, IL, in 1885.

Charitable foundations such as the Peabody Trust began to replace the worst of London’s slums with solidly-built if Spartan apartments (Fig. 22.5). The first Peabody block, at Spitalfields, included 57 dwellings for the poor, 9 shops complete with accommodation for the shopkeepers, and on the top floor baths and laundry facilities for a total cost of £22,000.

In the United States, building codes were improved during the Victorian era, and a National Housing Association was founded in 1910, under the aegis of the Commission on the Congestion of Population in New York. There were also attempts to persuade philanthropists to build model tenements at low rents; buildings were bought, renovated, and then rented to relocated slum dwellers who were given “friendly instruction” on management of their new households.
Current Challenges to Public Health

Despite substantial progress in the delivery of public health, there remain a number of continuing challenges in the twenty-first century. Current issues include the definitive control of the sales of tobacco and mood-altering drugs, the regulation of automotive emissions and other source of urban air pollution, management of the HIV/AIDS epidemic, concern over a growing reluctance to accept childhood vaccinations, and the management of infections spread by international air travel.

Control of Cigarettes and Mood-Altering Drugs  In the Edwardian era, cigarette manufacturers had promoted their wares as the cure for various respiratory conditions such as asthma and hay fever. But in 1912, the American physician Isaac Adler pointed to a growing incidence of lung cancer, and he speculated that the abuse of tobacco and alcohol might be responsible. Anti-smoking groups developed in Germany following World War I, and a magazine (German Tobacco Opponents) was published from 1919 to 1935. The Nazi regime was opposed to smoking, with Hitler declaring it a waste of money. In particular, women who smoked were considered as unsuitable to be German wives and mothers. During World War II, the axis powers made much propaganda from the fact that Hitler, Franco and Mussolini were non-smokers, whereas Churchill, Roosevelt and Stalin were all heavy users of tobacco.

Evidence of the toxicity of tobacco steadily accumulated during the Modern era. In 1929, Fritz Linkint Dresden demonstrated an increased prevalence of lung cancers in smokers. His research was confirmed in 1939, with a case-control study by Franz Hermann Muller of Cologne. During the 1950s, Ernst Wynder at the Sloan-Kettering Institute in New York and Richard Peto and Bradford Hill at Oxford University advanced even more compelling evidence that cigarettes were carcinogenic. Hill concluded that consuming 35 cigarettes per day increased the odds of dying from lung cancer as much as forty-fold.

Other damning evidence came from cellular pathology, animal experimentation and the demonstration of toxic chemicals in cigarette smoke. However, for a substantial part of the Post-Modern era, public health workers had to combat a deliberate campaign by the cigarette manufacturers to confuse and deceive the general public. The manufacturers were well aware of the damning facts by the early 1950s, but their misleading propaganda was able to increase U.S. cigarette sales to a peak of 630 billion units in 1982. As late as 1960, only a third of U.S. doctors considered smoking as “a major cause of cancer,” and 43% of physicians were still smoking on a regular basis.

Beginning in the mid 1970s, there was a dramatic decrease in the social acceptability of cigarette smoking, and growing restrictions were placed on public areas where smoking was permitted. This resulted from demonstrations that passive exposure to cigarette smoke gave rise to small but significant increases in the risks of chronic respiratory disease and asthma in childhood, and carcinoma of the lungs and cardiovascular disease in adults. Public polls showed a growing acceptance of public health measures to control smoking in public spaces. Cigarette manufactur-
ers went to particularly great pains to obfuscate the risks of passive exposure to cigarette smoke, but adverse effects were clearly demonstrated during the 1980s, not only by epidemiological research, but also by the exposure of volunteers to machine-generated cigarette smoke while they exercised in closed chambers.

Public health workers continue to face many challenges in reducing the sales of tobacco products, as manufacturers doggedly resist measures to reduce consumption through increased taxation, prohibition of sponsorships, and plain packaging. They constantly seek methods of creating new addicts, both through extensive advertising in third world countries and through such tactics as the marketing of electronic cigarettes. As recently as 2015, cigarette smoking still accounted for 11.5% of deaths world-wide.

The toll from cigarettes is now compounded by the effects of mood-altering drugs. Several countries (including Canada) have abandoned attempts to prohibit the marketing of marijuana, with as yet no clear standards of dosages compatible with worker and road safety, and an ever growing segment of the North American population is becoming addicted to powerful opiates, with a high risk of deaths from overdoses. British Columbia alone had 914 deaths from opiate overdoses in 2016, despite providing emergency workers with supplies of the antidote naloxone.

**Control of Urban air Pollution** The Modern era saw a dramatic drop in the sulphur dioxide/large particulate smog associated with coal fires in many developed societies, but air pollution problems have continued from coal-fired power station and automotive emissions, particularly during thermal inversions.

The exposure of cyclists and pedestrians to carbon monoxide was studied during the 1970s. Substantial concentrations of carbon monoxide were recorded on congested city streets, particularly if air movement was impeded by tall buildings, but any build-up of carboxyhaemoglobin in the blood stream was reversed quite quickly when the individual moved to a less polluted area. The only adverse clinical effect from carbon monoxide exposure was a somewhat earlier onset of angina if a person with coronary atherosclerosis exercised on a heavily polluted street.

Chamber experiments by Steve Horvath in Santa Barbara, CA, and Larry Folinsbee in Toronto documented acceptable ceilings of exposures to the ozone that was formed by the action of sunlight upon the nitrogen oxides from vehicle and aircraft exhaust. The threshold concentration causing a minor disturbance of respiratory function in healthy exercisers was around 0.75 p.p.m., a level that was exceeded in some North American cities on heavily polluted days.

To date, in many cities improved automotive emission controls have done little more than match the increase in vehicle registrations, and places such as Paris and Beijing have needed to forbid the access of drivers to the centre of cities on alternating days in order to reduce pollution levels. Since ozone levels show a marked diurnal cycle, one immediate remedy for the active individual is to exercise at less heavily polluted times of the day (early morning or late at night). The ultimate
solution to the problem of automotive exhaust probably lies in the replacement of gasoline-driven by electric or hydrogen-powered vehicles.

The Epidemic of HIV/AIDS The HIV/AIDS epidemic officially began in the U.S. in 1981, when the Centers for Disease Control reported a clustering of cases of *Pneumocystis pneumonia* among homosexual men in Los Angeles. It was quickly realized that the condition was not limited to homosexual individuals, but was seen also in intravenous drug users, haemophiliacs and others receiving blood transfusions. Thus, in August 1982, the CDC coined the new term AIDS. A year later, Luc Montagnier and his associates at the Pasteur Institute in Paris discovered the virus responsible for this disease.

Much effort has since been devoted not only to finding highly effective anti-retroviral agents, but also in devising measures to reduce transmission of the disease. Particular emphasis has been placed upon the wearing of condoms during sexual intercourse, in providing sterile needles for intravenous drug users through programmes of needle exchange and supervised injection sites, in closer control of blood banks and in ensuring sterility during drug injection treatments of tropical diseases. Nevertheless, success in controlling the epidemic has as yet been only partial. In the U.S. the disease had already claimed 575,000 lives by 2006; a further million were living with the disease, and 56,000 fresh cases were diagnosed in that year. In rural Africa, the situation remains even worse, with as many as a third of young adults currently infected.

Decreasing Acceptance of Childhood MMR Vaccinations During the early part of the Post-Modern Era, successful childhood vaccination campaigns brought the incidence of mumps, measles and rubella to a very low level in most developed countries, and the WHO set the year 2015 CE for the total elimination of measles and rubella from the European region.

However, the percentage of children receiving vaccination has decreased in recent years, with parents weighing the low current risk of infections relative to the supposed dangers of developing meningo-encephalitis and autism. Fears that vaccination would cause autism stemmed from a paper published by the British physician Andrew Wakefield, in 1998. Extensive research found no evidence to support his claims, and the British Medical Journal recently declared that the original article was fraudulent. Further, the British General Medical Council found Wakefield had been guilty of serious professional misconduct, and he was struck from the Medical Register. There have since been small outbreaks of measles consequent upon the decreased proportion of vaccinations in Britain and in Canada, and unfortunately many of the general public remain convinced that vaccination can cause autism.

Spread of Infections Through Air Travel Infectious diseases can now spread very rapidly, due to the ever-growing number of people who engage in global air travel. This problem is well exemplified by an epidemic of SARS (severe acute respiratory syndrome). This began in mainland China in November of 2002, and due to delayed reporting by the Chinese authorities it spread rapidly around the world. The WHO issued a global health alert on April 11th 2003. Fortunately,
application of rigid quarantine measures contained the epidemic, with relatively few deaths in North America, and by July 5th 2003, the WHO was able to declare that the SARS epidemic was over.

**Practical Implications for Current Policy**

Many of the major epidemics of earlier eras were due largely to poor hygiene - a lack of clean water, poor sewage treatment, and an inadequate control of people who were already infected. Although we often assume that these issues have now been resolved, it is important to recognize that in many third world countries supplies of clean water and adequate supplies of food are still lacking, with shortages often exacerbated by ethnic conflicts.

The same issues of clean water, waste disposal and burial of the dead could still arise in wealthier countries today if there were to be an earthquake, a typhoon or a Tsunami, and emergency services must be prepared to give the highest priority to an early re-establishment of the basic health infrastructure following any natural disaster.

Issues in the adulteration of food have now been largely overcome in developed society, but the current obesity epidemic underlines that problems still have to be resolved in terms of persuading food processors to avoid tactics designed to persuade consumers to overeat.

For those who can afford housing, the modern single-family home is generally well-equipped to optimize the health of those who are living in it. Massive tower blocks are less suited to a healthy and active lifestyle, particularly for families with young children. Moreover, ever-increasing minimum specifications for housing, a growing world population and a lack of land is presenting public health agencies with the issue of a growing proportion of homeless individuals in many large cities.

Globalization is presenting new challenges to public health, not only with the rapid spread of infections, but also with the international enforcement of regulations on issues ranging from emission controls on cars to the quality of foods and medications. The ideal forum for developing appropriate preventive measures would seem the World Health Organisation, but unfortunately (as with many international bodies) its effectiveness is often limited by political considerations, including threats from some nations to slash funding unless criticism of their practices is shelved.

**Questions for Discussion**

1. Are the infrastructure constraints of an earlier era still compromising public health in third world countries?
2. Does the provision of a healthy residential community for workers make good business sense to an entrepreneur?
3. Is there ever justification for a parent not immunizing a young child against measles, mumps and rubella?
4. What will be the likely new challenges to public health agencies over the next 20 years?

Conclusions

Some early societies had an infrastructure that provided clean water and the removal of sewage, but since this was usually available only to wealthy citizens, its impact upon the course of epidemics was limited. Major cities such as London did not build a comprehensive infrastructure until the middle of the Victorian Era, when appropriate initiatives were taken by newly formed Boards of Public Health. Although the traditional concerns of public health have now been largely met in developed societies, new challenges are constantly arising. These include the control of tobacco products and mood-altering drugs, the reduction of automotive emissions and other forms of urban pollution, management of the HIV/AIDS epidemic, overcoming a growing reluctance to vaccinate infants, and countering the rapid spread of infections by air travel.

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