

**JOSEPH A. SALVATO, JR.**

# **ENVIRONMENTAL SANITATION**

Emphasizes the practical application of sanitary and public health engineering theory and principles to the small community, installation, or facility.

**JOHN WILEY & SONS, Inc., Publishers**

# *Environmental Sanitation*

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Joseph A. Salvato, Jr., MCE, PE

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Sanitary and Public Health Engineer

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## *Preface*

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Workers in public health who have had experience with environmental sanitation and engineering problems have noted the need for a book in this field which is comprehensive in its scope and more directly applicable to conditions actually encountered in the field.

Teachers, students, and graduates of civil, chemical, mechanical, and sanitary engineering, as well as public health engineering, public health, and the sanitary sciences, have available for classroom use and future reference many excellent texts. However the practical and intelligent application of classroom theory and principles in the field is necessary to realize the benefits of fundamental data and research.

Many standard texts cover adequately the specialized aspects of the larger communities and establishments; but little detail information is available in one volume dealing with the rural and suburban environment. Therefore emphasis has also been placed in this text upon the practical application of sanitary and public health engineering theory and principles to the smaller community, installation, or facility of less than 1000 to 5000 persons. In addition, and in deliberate contrast so as to complement other texts, empirical formulae, rules of thumb, and sound judgment have also been applied where this could be done to advantage to illustrate how the best possible job could be accomplished under the particular circumstances. The soil percolation test and its interpretation is an example. It is sincerely hoped however that individual ingenuity and investigation will not be stifled, but rather challenged and stimulated to arrive at the best solution.

A special effort has been made to include design, construction, maintenance and operation details as they relate to the small plants and structures. Examples and drawings have been used freely to help in understanding and use of the subject matter.

Since the field is a very broad one, the following subjects specifically are covered:

1. Control of communicable diseases, insofar as this is possible by understanding and controlling the environment.
2. Location and planning of sites for camp, industrial, housing and similar uses.
3. Water supply sources, design, construction, treatment, storage, distribution, and operation.
4. Waste-water disposal and treatment, including small sewage disposal and treatment systems, excreta, refuse, industrial wastes; design, construction and operation.
5. Swimming pools and bathing beaches, design, operation and maintenance.
6. Food including milk, design of structures and equipment, sanitary inspection and control.
7. Insect, rodent, and noxious weed control.
8. Hygiene of housing, appraisal, basic elements of good housing, housing program, plumbing, ventilation, fringe areas and real estate subdivisions, camps and resort hotels, schools, migrant labor and trailer camps, and convalescent homes.
9. Environmental sanitation administration, health department organization, reporting, evaluation, planning, and enforcement.

Other disciplines, in addition to the engineer and sanitarian, will find much of value in this text. These would include the health officer, public health nurse, health educator, and sanitary inspector of towns, villages, cities, counties, and states, both in the United States and abroad. City and county engineers and managers, consulting engineers and architects, land planners and surveyors, agricultural engineers and farm extension personnel, contractors, resort and camp directors, can all gain directly from the contents. The many health workers who are applying the principles of environmental engineering, sanitation, and hygiene to reawakened and growing areas of the world will find the material in this text particularly useful in accomplishing their objectives.

The control of communicable diseases is discussed in some detail. This is necessary to show the proper application of preventive and curative measures to the environment. Without this important subject, the entire treatment of the material under consideration would be as incomplete as a text dealing with preventive medicine that failed to discuss water supply, sewage treatment, and other phases of sanitary engineering and environmental sanitation. It is just this type of coordination of subject matter and fullness which it is hoped will be accomplished.

I wish to thank Col. William A. Hardenbergh for his guidance and encouragement during the years of preparation of this manuscript. To Professor William C. Gibson, an old friend and classmate, I am indebted for his general review and many helpful suggestions. I also wish to acknowledge with grateful appreciation the assistance given by Dr. Wendell R. Ames and Arthur Handley for their critical reading of Chapter 1; Professor John E. Kiker for his review of Chapter 3 and for his many acts of kindness and professional support; Gerald A. Fleet, my good friend and classmate, for his review of Chapter 4; Nicholas A. Milone, former co-worker and friend, for his review of Chapter 6; and Richard M. McLaughlin for his general assistance.

This manuscript may never have been completed but for the typing, patience, and understanding of my wife Hazel.

JOSEPH A. SALVATO, JR.

*Troy, N. Y.*  
*July, 1958*

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# ***Control of Communicable Diseases***

## **I**

Communicable diseases are those disturbances of health which can be transmitted to man. They may include illnesses caused by bacteria, bacterial toxins, viruses, protozoa, spirochetes, parasitic worms (helminths), poisonous plants and animals, chemical poisons, fungi, rickettsiae, certain yeasts, and molds. For control purposes, the communicable diseases are classified in four groups: respiratory diseases, water- and food-borne diseases, insect- and rodent-borne diseases, and miscellaneous diseases.

### **Respiratory Diseases**

These diseases are usually transmitted by discharges from the nose, mouth, throat, or lungs of an infected individual. Direct contact and particles in suspension, as well as contaminated articles, may spread these disease-causing organisms.

### **Water- and Food-Borne Diseases**

These diseases are usually transmitted by contaminated food or water and also by direct contact. They include the intestinal diseases and, in addition to those caused by harmful bacteria and other organisms, diseases caused by poisonous plants and animals used for food, toxins produced by bacteria, and foods accidentally contaminated with chemical poisons.

### **Insect- and Rodent-Borne Diseases**

These diseases are usually transmitted by blood-sucking arthropods (including insects and arachnida) and by the discharges or bite of rodents.

### **Miscellaneous Diseases**

These are a divergent group and are discussed separately.

### **Definitions**

Certain terms are frequently used in the discussion of communicable diseases with which one should become familiar. The definitions given

in *The Control of Communicable Diseases in Man*, published by The American Public Health Association in 1955, are considered most authoritative and are quoted completely in Appendix I for easy reference.

### Disease Control

Figure 1.1 shows that communicable diseases may be controlled or prevented by taking steps to regulate the "source," "mode of transmission," or the "susceptibility" of persons. Figure 1.1 is frequently pictured as a three-link chain. Although the diseases can be brought under control by eliminating one of the "links," it is far better to direct one's attack simultaneously toward all three links and erect "barriers" or "dams" where possible. Sometimes it is only practical to break one link in the chain. Phelps called this the "principle of multiple barriers. It recognizes as axiomatic the fact that all human efforts, no matter how well conceived or conscientiously applied, are imperfect and fallible." Therefore the number and type of barriers should be determined by the practicality and cost of providing the protections and the probable cost if the barriers are not provided. Cost is used in the sense not only of dollars, but also in terms of human misery, loss of productivity, ability to enjoy life, and loss of life. Here is a real opportunity for applying trained medical and sanitary engineering judgement to the problems at hand so as to obtain the maximum return for the effort expended.

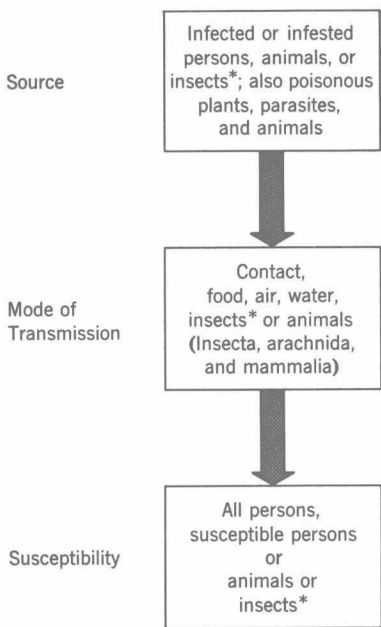


Fig. 1.1. Spread of communicable diseases.

\* Includes class insecta and arachnida.

### Control of Source

The sources of communicable diseases can usually be regulated or brought under control. An effective health department, with a complete and competent staff to prevent and control diseases that affect individuals and certain animals is usually established for this purpose. The preventive and control measures conducted by a health department might

include supervision of water supply, sewage, and waste; housing; milk and food; stream pollution; pools, beaches; industrial hygiene; insects and rodents; rural and resort sanitation; air pollution and radiological health; public health nursing; medical clinics, material and child health service, school health, dental clinics, nutrition, medical rehabilitation, accident prevention; communicable disease control, diphtheria immunization, smallpox and poliomyelitis vaccination, tuberculosis and venereal disease control; vital statistics and health education.

### **Control of Mode of Transmission**

The means whereby specific agents may become the vehicle for the transmission of disease are numerous. Prevention of disease requires the continual application of control measures by a responsible person in authority.

### **Control of Susceptibles**

(a) There are many diseases to which all persons are considered to be generally susceptible. Among these are measles, impetigo contagiosa, the common cold, ascariasis, chickenpox, amebic dysentery, bacillary dysentery, malaria, trichinosis, and typhoid fever. Then there are other diseases such as influenza, meningococcus meningitis, pneumonia, undulant fever, and food poisoning to which some people apparently have an immunity or resistance. In any case, every known measure should be taken to protect those who are susceptible.

(b) In order to reduce, where it is possible, the number of persons who may be susceptible to a disease at any one time, certain fundamental principles are followed to improve the general health. This may be accomplished by instructions in personal hygiene, immunization, and conserving or improving the general resistance of the individual to disease by a balanced diet and serving good food, by fresh air, sufficient sleep, rest, and the avoidance of fatigue and exposure.

(c) Immunization can be carried out by the injection of vaccines, toxoids, or other immunizing substances for the prevention of or lessening the severity of specific diseases. Smallpox, typhoid and paratyphoid fevers, and tetanus are some of the diseases against which all in the armed forces are routinely immunized. Children are generally immunized against diphtheria, tetanus, whooping cough, poliomyelitis, and smallpox.

## **RESPIRATORY DISEASES**

### **Definition**

The respiratory diseases are a large group of diseases spread by discharges from the mouth, nose, throat, or lungs of an infected individual.

The disease-producing organisms are disseminated in coughing, sneezing, talking, spitting, by dust, and by direct contact as in kissing, eating contaminated food, using contaminated eating and drinking utensils or common towels, drinking glasses, and toys.

### Group

(a) A list of respiratory diseases and their incubation periods are shown here. The reader is referred to *Control of Communicable Diseases in Man* for greater details.

(b) Many of the diseases listed in Tables 1.1 and 1.2 are also transmitted in other ways besides through the respiratory tract. Scarlet fever, streptococcal sore throat, and diphtheria, for example, may also be spread by contaminated milk, particularly raw milk. Infectious hepatitis may be carried by sewage-contaminated water. Smallpox, chickenpox, mumps, infectious mononucleosis, meningococcus meningitis, and others may also be transmitted by contact with infected persons.

### Control of Source

(a) Since the source of a respiratory disease is usually the infected individual, control would logically start with him. The individual should be taught the importance of personal hygiene and cleanliness, particularly when ill, to prevent the spread of his disease to his friends and associates. Such things as avoiding spitting on the floor, covering up a cough or sneeze with paper tissue, and staying out of circulation (away from people) while ill, are some of the simple yet important precautions that are not always followed. Every effort should be made to detect and promptly hospitalize the seriously ill.

(b) Before being admitted to a camp or school, children should have been vaccinated against smallpox and poliomyelitis, and immunized against diphtheria. They should be given a complete physical examination and a careful history should be taken to learn of any past illnesses. Children with serious physical defects must be placed under special supervision provided for the purpose or not be admitted. Those with defective vision, diseased tonsils, or dental caries are usually required to have these conditions corrected. Children having the symptoms of any communicable disease should be treated or, if deemed necessary, vaccinated to lessen the severity of a particular disease and declared noninfective by a physician before being admitted. Upon arrival at camps or boarding schools, and periodically thereafter, the campers or students should be given a physical inspection. A form of quarantine can be applied, when deemed advisable, as during an epidemic or high incidence of an illness, by keeping new guests separate from the old groups during an orientation

Table 1.1. Respiratory Diseases

Disease	Communi- cability, in days*	Incuba- tion period, in days	Disease	Communi- cability, in days*	Incuba- tion period, in days
Chickenpox (v)	-1 to +6	14 to 21	Pertussis (b)	-7 to +21	7 to 10
Common cold (v)	-1 to +5	$\frac{1}{2}$ to 3	(whooping cough)		
Diphtheria (b)	14	2 to 5	Plague,		
German			pneumonic (b)	In illness	3 to 4
measles (v)	4	14 to 21	Plague,		
Influenza (v)	7	1 to 3	bubonic (b)	—	2 to 6
Measles (v)	-4 to +5	10	Pneumonia (v)	†	1 to 3
Meningococcal			Smallpox (v)	14 to 21	7 to 16
meningitis (b)	†	2 to 10	Scarlet fever and		
Mumps (v)	-2 to +9	12 to 26	streptococcal		
			sore throat (b)	†	2 to 5

(b) bacteria; (v) virus.

NOTE: For greater details see *The Control of Communicable Diseases in Man*, American Public Health Association, 8th edition, 1955.

\* Period from onset of symptoms.

† Meningococci usually disappear within 24 hours after chemotherapeutic or anti-biotic treatment. Pneumococcus eliminated within 3 days after penicillin treatment. Streptococcus eliminated within 24 hours after penicillin treatment.

Table 1.2. Respiratory Diseases, Other

Disease	Communi- cability, in days	Incuba- tion period, in days	Disease	Communi- cability, in days	Incuba- tion period, in days
Coccidioido- mycosis (f)	Open lesions	10 to 21	Poliomyelitis (v)	21 to 42	7 to 21
Infectious			Psittacosis (v)	In illness	6 to 15
hepatitis (v)	-3 to +3	10 to 40	Q Fever (r)	—	14 to 21
Infectious			Vincent's		
mononucleosis (?)	—	4 to 14	infection (b) (s)	—	Unknown
			Tuberculosis (b)	Extended	28 to 42

(f) fungus; (v) virus; (?) unknown; (s) spirochete; (b) bacteria; (r) rickettsiae, airborne.

NOTE: For greater details see *The Control of Communicable Diseases in Man*, American Public Health Association, 8th edition, 1955.



period of several days to preferably 2 weeks. Strict quarantine is rarely justified as a control measure, except in the case of smallpox and possibly diphtheria.

### Control of Environment

(a) This can be expressed as control of the means whereby the surroundings and its make-up may affect the individual. If a person is ill with a communicable disease, the next step is to prevent others from becoming ill with the same disease. Essentially then, this problem reduces itself to isolation (if possible or necessary), air control, dust suppression, food sanitation, the control of water supply and sewage disposal, immunization, and good personal hygiene. Since it is not yet practical to control, for example, all the air that one breathes, it is obvious that control of the environment is not simple. One can, however, apply known control measures and hope for a reasonable degree of success.

(b) Besides the air-borne method of respiratory disease transmission, direct contact with a freshly contaminated common drinking cup, towel, or eating utensil, for example, and indirect contact through the consumption of food or milk contaminated with pathogenic microorganisms is possible.

(c) Protection of the environment will be of little value unless it is combined with education and protection of the individual from excessive fatigue, chilling, undue exposure to inclement weather, and improper clothing. Add to this improvement of the environment.

(d) Immunization and chemoprophylaxis can be used to advantage in the protection of the individual, as previously mentioned.

### Typical Epidemic Control

Outbreaks of illnesses such as influenza, measles, smallpox, poliomyelitis, and other diseases still occur. At such times the people become apprehensive and look to the health department for guidance, assurance, and information to quiet their fears.

An example of the form health department assistance can take is illustrated in the precautions released June 1, 1951, by the Illinois Health Messenger for the control of poliomyelitis. These recommendations are quoted here, even though the disease can now be controlled by vaccines, for the principles are generally applicable to other epidemics.

#### GENERAL PRECAUTIONS DURING OUTBREAKS

1. The Illinois Department of Public Health will inform physicians and the general public as to the prevalence or increase in incidence of the disease.
2. *Early diagnosis* is extremely important. Common early signs of polio are headache, nausea, vomiting, muscle soreness or stiffness, stiff neck, fever, nasal