

Oxford textbook of public health

VOLUME 4

Specific applications

Edited by

Walter W. Holland, Roger Detels, and

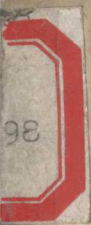
George Knox

with the assistance of

Ellie Breeze



1987.9.26



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Walter W. Holland, MD, FRCGP, FRCP, FFCM

Professor of Clinical Epidemiology and Social Medicine,
Department of Community Medicine, and Honorary Director,
Social Medicine and Health Services Research Unit,
St. Thomas's Hospital Medical School (United Medical Schools),
London SE1 7EH, England.

Roger Detels, MD, MS

Professor of Epidemiology and Dean,
School of Public Health, Center for Health Sciences,
University of California, Los Angeles, CA 90024, USA.

George Knox, MD, BS, FRCP, FFCM

Professor of Social Medicine, Department of Social Medicine,
Health Services Research Centre,
University of Birmingham Medical School,
Edgbaston, Birmingham B15 2TG, England.

Ellie Breeze, MSc

Research Assistant, Department of Community Medicine,
St. Thomas's Hospital Medical School,
(United Medical Schools), London SE1 7EH, England.



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I. Holland, Walter W. II. Detels, Roger

III. Knox, George

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Preface

It is not an easy task to follow in the footsteps of such a renowned editor as Professor Hobson. We were, however, very honoured when, on the retirement of Professor Hobson, the Oxford University Press approached us about taking up the challenge of revising Hobson's *Theory and practice of public health*. Since this work first appeared in February 1961 Professor Hobson was responsible for taking it through no less than five editions. Many eminent public health academics and practitioners have contributed to this book and it has been recognized as a standard textbook on the subject. Sadly, Professor Hobson died after a long illness at the end of November 1982. After an early training in public health starting as a medical officer of health and then as a specialist in hygiene and epidemiology in the army, he went on to be a lecturer in social medicine at Sheffield University, becoming professor in 1949. From 1957 until his retirement, he served in a variety of posts at the WHO, where his major responsibilities were always concerned with education and training. His interest in this and in the international aspects of health were well exemplified by the first edition of *Theory and practice of public health*. One of the major strengths of the book has been its international nature and its link to the WHO.

On accepting the daunting task of revising this major work our first step was to look dispassionately at its role within public health, a field which has evolved and changed greatly over the last 25 years. We decided that although this book is held in great esteem in the western world it was appropriate now to introduce major revisions and thus, increase its relevance to the problems facing us as we approach the twenty-first century. A particularly important advance has been the recognition in recent years that the problems in public health facing developing countries are quite different to those facing the developed world. The interests of WHO, quite correctly, have been focused on developing countries. We consider that this book should concentrate on presenting a comprehensive view of public health as it relates to developed countries. (Perhaps there is a place now for a comparable textbook concerned specifically with developing countries.) This is not to say however, that the content will not prove relevant and of interest to the student of public health from a developing country.

The *Oxford textbook of public health* attempts to portray the philosophy and underlying principles of the practice of public health. The methods used for the investigation and the solution of public health problems are described and examples given of how these methods are applied in prac-

tice. It is aimed primarily at postgraduate students and practitioners of public health but most clinicians and others concerned with public health issues will find some chapters relevant to their concerns. It is intended to be a comprehensive textbook present in the library of every institution concerned with the health sciences. The term 'public' is used quite deliberately to portray the field. Public health is concerned with defining the problems facing communities in the prevention of illness and thus studies of disease aetiology and promotion of health. It covers the investigation, promotion, and evaluation of optimal health services to communities and is concerned with the wider aspects of health within the general context of health and the environment. Other terms in common use, such as community medicine, preventive medicine, social medicine, and population medicine have acquired different meaning according to the country or setting. This gives rise to confusion and we have avoided their use since this book is directed to a world-wide audience. Public health, we believe, is more evocative of the basic philosophy which underlies this book.

The first volume aims to lead the reader through the historical determinants of health to the overall scope and strategies of public health. Volume 2 is concerned with the process of public health promotion and Volume 3 with the investigative methods used in public health.

The final volume of this series attempts to pull together all the threads of the earlier volumes which have considered the theory, policies, strategies and research methodologies that form the basis of public health endeavour. Specific diseases and the needs of specific groups within a community have been touched on in greater or lesser detail, in earlier volumes. Here, the major disease groups, systems of the body, and special care groups are treated systematically to review the public health issues they raise, and the extent to which the methodologies described earlier have been applied to their control and prevention.

The volume is divided into three sections, the first of which is concerned with the application of public health methods to specific disease processes including acute infectious episodes, diseases related to nutrition, trauma, developmental defects, degenerative neurological diseases, psychiatric conditions, and neoplasms. Each chapter attempts to review the public health impact of the diseases in question, including their epidemiology and the contribution of public health measures. Of particular emphasis is the potential for prevention that enquiry into the aetiology has revealed, and the role of public health interventions in implementing programmes of prevention.

Leading on from specific disease states, the next section looks at the role of public health in relation to the various systems of the body. The intention is not to provide an exhaustive description of the conditions affecting each system, but to discuss the facets of the system where public health investigation has had (or indeed in some cases has failed to make) a major contribution. It will be evident to the reader that the extent to which the public-health approach has contributed to research and strategies to prevent and treat conditions affecting the various systems of the body varies tremendously. The cardiovascular system and the respiratory system provide classical examples of the application of the public health approach to a health problem. Extensive epidemiological research has clarified the causation of these conditions and public health measures form the basic framework for implementing control measures. Investigations of gastrointestinal diseases, metabolic and endocrine disorders, and conditions affecting the genito-urinary system have on the other hand, relied more on clinical than public health orientated research. The chapters dealing with these systems however describe the epidemiological work that has been carried out and its relevance to clinical practice. The chapter on the genito-urinary system, for example, illustrates the value of national and international comparative studies in informing policy decision makers of different management practices and outcomes. The problems presented by the investigation of musculo-skeletal and dental conditions are clearly demonstrated in this section of Volume 4.

The final section of this volume treats the unique problems and health service needs of special client groups. Again, this is not intended to be comprehensive or exhaustive, the emphasis being placed on demonstrating the application of public health approaches to a variety of different problems. These include investigations to identify the needs of special client groups and the extent to which these needs are satisfied, and the application of public health measures to solving the problems of these groups.

The chapter on acute emergencies is an excellent example of the ways in which epidemiological investigation can be applied to surgical conditions, providing evidence from which conclusions can be drawn about the most appropriate form of treatment. The chapter on adolescence demonstrates the relevance of a multidisciplinary approach to health problems, and the difficulties of tackling some of the problems experienced by adolescents in the changing society around us. The discussion of handicap – both physical and mental – illustrates the application of epidemiological and public health methodology to both the preven-

tion as well as the development of care policies for specific groups of individuals.

Health care policy decision-making is fraught with difficulties as is illustrated by the chapter on maternity care, theoretically the simplest of examples, but one which demonstrates the complexity of the issues involved. The chapter on the special needs of the elderly also shows how complicated the problems facing modern public health are. In outlining the difficulties faced by the unemployed and disadvantaged Illsley demonstrates the way the social scientist approaches a public health problem.

This volume should give the reader some idea of the vast scope of public health, the range of fields and problems for which public health has a major contribution to make, and the multidisciplinary nature of much of the work. It attempts to review how we can approach and develop a methodology for the investigation, prevention, and control of the major public health problems in our society at this time.

The development of public health policy is dependent upon a series of scientific methods, and we do not attempt in this book to cover all the methods and their applications. However, it is to be hoped that those examples that have been chosen will illustrate to the reader the way in which particular problems can be approached. Each chapter includes a comprehensive list of further reading which should equip the reader with the means of obtaining a deeper knowledge should he or she wish to pursue any theme further.

This is the first of what we hope will be many editions. As each chapter was submitted to the editors we have attempted to identify gaps and areas of overlap. There is no doubt, however, that some remain. It is only through feedback from readers that we will be able to adapt, modify, and improve further editions. If the book is successful it will be entirely due to the effort of the contributors who undertook with great patience a tremendous amount of work. They were bombarded with instructions, advice, reminders, and modifications and we would like to express our thanks and extend our apologies to all of them. Our gratitude also goes to our secretaries and assistants who coped so admirably with the enormous task of compiling this work. We hope that it will be widely read by all those concerned with the formulation and execution of public health policy and that it will provide a suitable framework for devising approaches to some of the problems challenging public health today.

W.W.H.
R.D.
G.K.

Contributors

Eva Alberman

Professor of Clinical Epidemiology, The London and St Bartholomew's Hospital Medical College, Turner Street, London E1 2AD, England.

John A.D. Anderson, MA, MD, DPH, FFCM, FRCGP

Professor of Community Medicine, University of London, United Medical and Dental Schools of Guy's and St Thomas' Hospitals, Guy's Campus, and Honorary Consultant Rehabilitation and Occupational Medicine, Guy's Hospital, London SE1 9RT, England.

Elizabeth M. Badley, DPhil, MSc

Deputy Director, Arthritis and Rheumatism Council Epidemiology Research Unit, University of Manchester Medical School, England.

Dean Baker, MD

Assistant Professor of Public Health, School of Public Health, Division of Epidemiology, CHS 71-269, University of California, Los Angeles, CA 90024, USA.

Ian A. Baker, MB, BS, MRCP, MSc(Soc. Med.)

Specialist in Community Medicine, Bristol and Weston Health Authority, Mannlife House, 10 Marlborough Street, Bristol BS1 3NP, England.

John S. Bryden, MSc, MBChB, FFCM, MBChS

Senior Epidemiologist, Institute of Neurological Sciences, Glasgow G51 4TF, Scotland.

Sabri Challah, MA, MB, BChir

Lecturer, Department of Community Medicine, St Thomas's Hospital Medical School, United Medical and Dental Schools, London SE1 7EH, England.

J.R.T. Colley, MD, BSc, FFCM

Professor of Community Medicine and Director, MRC National Survey of Health and Development, University of Bristol, Department of Epidemiology and Community Medicine, Canynge Hall, Whiteladies Road, Bristol BS8 2PR, England.

J. Mark Elwood, DSc, MD, SM, FRCP(C), DCH, MFCM

Professor and Head, Department of Community Health, University of Nottingham, Queen's Medical Centre, Nottingham NG7 2UH, England.

Bruce L. Evatt, MD

Director, Division of Host Factors, Center of Infectious Diseases, Centers for Disease Control (United States Public Health Service), Atlanta, GA 30333, USA.

John R. Froines, PhD

Associate Professor of Public Health, School of Public Health, Division of Environmental and Occupational Health Science, CHS 56-071, University of California, Los Angeles, CA 90024, USA.

Tom Fryers, MB, ChB, DRCOG, DPH, MD, PhD, FFCM

Specialist in Community Medicine, North West Regional Health Authority, Director, Psychiatric and Mental Handicap Registers, Salford, and Senior Lecturer in Community Medicine, Department of Community Medicine, University of Manchester Stopford Building, Oxford Road, Manchester M13 9PT, England.

N.S. Galbraith, MB, FRCP, FFCM, DPH

Director, Communicable Disease Surveillance Centre, London and Honorary Senior Lecturer in Community Medicine, London School of Hygiene and Tropical Medicine, London WC1, England.

John C. Greene, DMD, MPD

Dean, School of Dentistry, University of California, San Francisco, CA 94143, USA.

Clark W. Heath, Jr., MD

Professor of Community Health, Department of Community Health, Emory University School of Medicine, 1518 Clifton Road, NE, Atlanta, GA 30322, USA.

Basil S. Hetzel, MD

Chief, Division of Human Nutrition, Commonwealth Scientific and Industrial Research Organisation, Kintore Avenue, Adelaide, SA 5000, Australia.

Raymond Illsley, PhD

Professor of Medical Sociology, University of Aberdeen, and, until recently, Director, MRC Sociology Research Unit, Westburn Road, Aberdeen AB9 2ZE, Scotland.

Bryan Jennett, MD, FRCS

Professor of Neurosurgery, Institute of Neurological Sciences, University of Glasgow, Glasgow G51 4TF, Scotland.

Robert L. Kane, MD

Professor, UCLA School of Medicine and UCLA School of Public Health, and Senior Researcher, The Rand Corporation, 1700 Main Street, Santa Monica, CA 90406, USA.

H. Keen, MD, FRCP

Professor of Human Metabolism, Guy's Hospital Medical School, and Director, Unit for Metabolic Medicine, and Diabetic Clinic Physician, Guy's Hospital, London SE1 9RT, England.

John F. Kurtzke, MD, FACP

Professor and Vice Chairman, Department of Neurology and Professor, Department of Community and Family Medicine, Georgetown University School of Medicine, Washington DC, and Chief Neurology Service and Chief Neuroepidemiology Research Program, Veterans Administration Medical Center, Washington DC and

x List of contributors

- Consultant in Neurology to Surgeon General of the Navy and the USNH Bethesda MD (Rear Admiral, Medical Corps US Naval Reserve).
- M.J.S. Langman, BSc, MD, FRCP**
Professor of Therapeutics and Honorary Consultant Physician, University Hospital Department of Therapeutics, Queens Medical Centre, Nottingham NG7 2UH, England.
- Barry Lewis, MD, PhD, FRCP, FRCPATH**
Professor and Head, Department of Chemical Pathology and Metabolic Disorders, St Thomas's Hospital Medical School, and Honorary Consultant, St Thomas' Hospital, London SE1 7EH, England.
- R.F.A. Logan, BSc, MBChB, MSc, MRCP**
Senior Lecturer in Clinical Epidemiology and Honorary Consultant Physician, University Hospital, Department of Community Medicine, University of Nottingham Medical School, Queen's Medical Centre, Nottingham NG7 2UH, England.
- Richard J. Madeley, MB, BS, MSc, MFCM**
Senior Lecturer, Department of Community Health, University of Nottingham Medical School, Queen's Medical Centre, Nottingham NG7 2UH, England.
- Ken Mullen, MA**
Research Officer, MRC Medical Sociology Unit, Westburn Road, Aberdeen AB9 2ZE, Scotland.
- Robert I. Pfeffer, MD**
Associate Professor, Department of Neurology, University of California, Irvine, CA 92668, USA.
- Leon S. Robertson, PhD**
Research Scientist, Department of Epidemiology and Public Health, Yale University Medical School, 60 College Street, New Haven, CT 06510, USA.
- Geoffrey Rose, DM, DSc, FRCP, FFCM**
Professor of Epidemiology, London School of Hygiene and Tropical Medicine, London and Physician, St Mary's Hospital, London, England.
- Rodolfo Saracci, MD, FACE**
Chief, Unit of Analytical Epidemiology, International Agency for Research on Cancer, 150 Cours Albert Thomas, 69372 Lyon Cedex 08, France.
- Michael Shepherd, MD, FRCP, FRCPsych, DPM**
Professor of Epidemiological Psychiatry, Institute of Psychiatry, University of London, De Crespigny Park, London SE5 8AF, England.
- R.F. Spicer**
Medical Director, London Youth Advisory Centre, 29 Prince of Wales Road, London NW5 3LG, England.
- Anthony J. Wing, MA, MD, FRCP**
Consultant Nephrologist, St Thomas' Hospital, and Chairman, EDTA Registry, St Thomas' Hospital, London SE1 7EH, England.
- Philip H.N. Wood, MB, FRCP, FFCM**
Director, Arthritis and Rheumatism Council Epidemiology Research Unit, and Professor of Community Medicine, University of Manchester and Honorary Specialist in Community Medicine, North Western Regional Health Authority, England.
- Samuel J. Wycoff, DMD, MPH**
Chairman, Department of Dental Public Health, University of California, San Francisco School of Dentistry, San Francisco, CA 94143, USA.

Abbreviations

ACCN	Administrative Co-ordinating Committee on Nutrition	DRO	Disablement Resettlement Officer
ACGIH	American Conference of Governmental Industrial Hygienists	EAD	Entry into active duty
ADL	Activities of daily living	EASD	European Association for the Study of Diabetes
AFP*	Alpha-fetoprotein	EBV	Epstein-Barr virus
AGN	Advisory Group on Nutrition	ECHO virus	Enteric cytopathic human orphan virus
AH	Alkylating hyperostosis	EDTA	European Dialysis and Transplant Association
AHA	Area Health Authority	EEC	European Economic Community
AL	Acute leukaemia	ERC	Employment Rehabilitation Centre
ALS	Amyotrophic lateral sclerosis	ESD	Employment Services Division of the Manpower Services Commission
ANSI	American National Standards Institute	ESRD	End-stage renal failure
APF	Acidulated phosphate fluoride	ESRF	End-stage renal failure
APHA	American Public Health Association	FAO	Food and Agriculture Organization
ARF	Acute renal failure	FAS	Fetal alcohol syndrome
AS	Alkylating spondylitis	FEP	Free erythrocyte protoporphyrin
BCME	bis-chloromethylether	FEV	Forced expiratory volume
BDA	British Diabetic Association	FEV ₁	Forced expiratory volume in one second
BL	Burkitt's lymphoma	FVC	Forced vital capacity
BMG	Benign monoclonal gammopathy	Gaw	Airways conductance
BMI	Body mass index	GDM	Gestational diabetes mellitus
BP	Blood pressure	GHS	General Household Survey
BT	Brain tumour	GNP	Gross national product
CAT	Computer-assisted tomography	GOA	Generalized osteoarthritis
CDH	Congenital dislocation of the hip	GP	General practitioner
CDSC	Communicable Disease Surveillance Centre	G6PD	Glucose-6-phosphate dehydrogenase
CGL	Chronic granulocytic leukaemia	GPMU	General Practitioner Maternity Unit
CHD	Coronary heart disease	HBsAg	Hepatitis B virus antigen
CHO	Cholesterol	HBV	Hepatitis B virus
CLL	Chronic lymphocytic leukaemia	HC	Huntingdon's chorea
CNS	Central nervous system	HD	Hodgkin's disease
CNSLD	Chronic non-specific lung disease	HDFP	Hypertension Detection and Follow up Program
CRF	Chronic renal failure	HDN	Haemolytic disease of the newborn
CSF	Cerebrospinal fluid	HIP	Health Insurance Plan of Greater New York
CSO	Central Office of Statistics	HIPE	Hospital In-patient Enquiry
CV	Closing volume	HLD	Hepatolenticular disease
DBPC	Dibromo-3-chloropropane	IARC	International Agency for Research into Cancer
DD	Disc degeneration	ICD	International Classification of Diseases
DHHS	Department of Health and Human Services	ICIDH	International Classification of Impairments, Disabilities, and Handicaps
DHSS	Department of Health and Social Security	IDD	Iodine deficiency disorder
DISH	Diffuse idiopathic skeletal hypertosis		
DM	Diabetes mellitus		
DMFT	Decayed, missing, and filled permanent teeth		
DNA	Deoxyribonucleic acid		

IDDM	Insulin-dependent diabetes melitus	PCB	Polychlorinated biphenyl
IFAD	International Fund for Agricultural Development	PCV	Packed cell volume
Ig	Immunoglobulin	PDA	Patent ductus arteriosus
IGT	Impaired glucose tolerance	PEFR	Peak expiratory flow rate
IM	Infectious mononucleosis	PEM	Protein energy malnutrition
IQ	Intelligence quotient	PHLS	Public Health Laboratory Service
ITP	Idiopathic thrombocytopenic purpura	PID	Pelvic inflammatory disease
IUGR	Intra-uterine growth retardation	PK	Pyruvate kinase
JCA	Juvenile chronic arthritis	PMP	Polymalgia rheumatica
LBW	Low birthweight	PNH	Paoxysmal nocturnal haemoglobinuria
LD	Lymphocyte-defined	PRD	Primary renal disease
LSD	Lysergic acid	RA	Rheumatoid arthritis
LYAC	London Youth Advisory Centre	RAW	Airway resistance
MAFF	Ministry of Agriculture, Food, and Fisheries	RCP	Royal College of Physicians
MD	Muscular dystrophy	Rh	Rhesus
MG	Myasthenia gravis	RHD	Rheumatic heart disease
MM	Multiple myeloma	RNA	Ribonucleic acid
MMEF	Maximum expiratory flow rate	SBA	Spina bifida aperta
MND	Motor neuron disease	SDAT	Senile dementia of the Alzheimer type
MOEM	Medical Officer of Environmental Health	SGaw	Specific airways conductance
MRC	Medical Research Council	SHE	Sentinel health events
MRP	Medical removal protection	SHHD	Scottish Home and Health Department
MS	Multiple sclerosis	SLE	Systemic lupus erythematosus
MSC	Manpower Services Commission	SMR	Standardized mortality ratio
MV	Metatarsus varus	SRaw	Specific airways resistance
NAYPCAS	National Association of Young People's Counselling and Advisory Service	SS	Systemic sclerosis
NCEN	National Council on Egg Nutrition	SUA	Serum uric acid
NCHS	National Center for Health Statistics	2,4,5,T	2,4,5-trichlorophenoxyacetic acid
NDDG	National Diabetes Data Group	TCDD	Tetrachlorodibenzodioxin
NFPA	National Fire Protection Association	TCV	Talipes calcaneovalgus
NHL	Non-Hodgkin's lymphoma	TEV	Talipes equinovarus
NHLBI	National Heart, Lung and Blood Institute	TLV	Threshold limit value
NHLI	National Heart and Lung Institute	TOPS	Training Opportunities Scheme
NHS	National Health Service	TSD	Training Services Division of the Manpower Services Commission
NIDDM	Non-insulin dependent diabetes mellitus	TSH	Thyroid stimulating hormone
NIH	National Institutes of Health	UGDP	University Group Diabetes Programme
NIOSH	National Institute for Occupational Safety and Health	UK	United Kingdom
NOHS	National Occupational Hazard Survey	UN	United Nations
NPC	Nasopharyngeal carcinoma	UNDP	United Nations Development Program
NTD	Neural-tube defect	UNICEF	United Nations Children's Fund
OA	Osteoarthritis	UNRRA	United Nations Relief and Rehabilitation Administration
OGTT	Oral glucose tolerance test	UTI	Urinary tract infection
OHE	Office of Health Economics	US	United States
OPCS	Office of Population Censuses and Surveys	UV	Ultraviolet radiation
OSHA	Occupational Safety and Health Authority	VDT	Visual (or video) display terminal
		WHO	World Health Organization

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Abbreviations

ACCN	Administrative Co-ordinating Committee on Nutrition	DRO	Disablement Resettlement Officer
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BDA	British Diabetic Association	FEV ₁	Forced expiratory volume in one second
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CHO	Cholesterol	HBV	Hepatitis B virus
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CNSLD	Chronic non-specific lung disease	HDFP	Hypertension Detection and Follow up Program
CRF	Chronic renal failure	HDN	Haemolytic disease of the newborn
CSF	Cerebrospinal fluid	HIP	Health Insurance Plan of Greater New York
CSO	Central Office of Statistics	HIPE	Hospital In-patient Enquiry
CV	Closing volume	HLD	Hepatolenticular disease
DBPC	Dibromo-3-chloropropane	IARC	International Agency for Research into Cancer
DD	Disc degeneration	ICD	International Classification of Diseases
DHHS	Department of Health and Human Services	ICIDH	International Classification of Impairments, Disabilities, and Handicaps
DHSS	Department of Health and Social Security	IDD	Iodine deficiency disorder
DISH	Diffuse idiopathic skeletal hypertosis		
DM	Diabetes mellitus		
DMFT	Decayed, missing, and filled permanent teeth		
DNA	Deoxyribonucleic acid		

IDDM	Insulin-dependent diabetes melitus	PCB	Polychlorinated biphenyl
IFAD	International Fund for Agricultural Development	PCV	Packed cell volume
Ig	Immunoglobulin	PDA	Patent ductus arteriosus
IGT	Impaired glucose tolerance	PEFR	Peak expiratory flow rate
IM	Infectious mononucleosis	PEM	Protein energy malnutrition
IQ	Intelligence quotient	PHLS	Public Health Laboratory Service
ITP	Idiopathic thrombocytopenic purpura	PID	Pelvic inflammatory disease
IUGR	Intra-uterine growth retardation	PK	Pyruvate kinase
JCA	Juvenile chronic arthritis	PMP	Polymalgia rheumatica
LBW	Low birthweight	PNH	Paoxysmal nocturnal haemoglobinuria
LD	Lymphocyte-defined	PRD	Primary renal disease
LSD	Lysergic acid	RA	Rheumatoid arthritis
LYAC	London Youth Advisory Centre	RAW	Airway resistance
MAFF	Ministry of Agriculture, Food, and Fisheries	RCP	Royal College of Physicians
MD	Muscular dystrophy	Rh	Rhesus
MG	Myasthenia gravis	RHD	Rheumatic heart disease
MM	Multiple myeloma	RNA	Ribonucleic acid
MMEF	Maximum expiratory flow rate	SBA	Spina bifida aperta
MND	Motor neuron disease	SDAT	Senile dementia of the Alzheimer type
MOEM	Medical Officer of Environmental Health	SGaw	Specific airways conductance
MRC	Medical Research Council	SHE	Sentinel health events
MRP	Medical removal protection	SHHD	Scottish Home and Health Department
MS	Multiple sclerosis	SLE	Systemic lupus erythematosus
MSC	Manpower Services Commission	SMR	Standardized mortality ratio
MV	Metatarsus varus	SRaw	Specific airways resistance
NAYPCAS	National Association of Young People's Counselling and Advisory Service	SS	Systemic sclerosis
NCEN	National Council on Egg Nutrition	SUA	Serum uric acid
NCHS	National Center for Health Statistics	2,4,5,T	2,4,5-trichlorophenoxyacetic acid
NDDG	National Diabetes Data Group	TCDD	Tetrachlorodibenzodioxin
NFPA	National Fire Protection Association	TCV	Talipes calcaneovalgus
NHL	Non-Hodgkin's lymphoma	TEV	Talipes equinovarus
NHLBI	National Heart, Lung and Blood Institute	TLV	Threshold limit value
NHLI	National Heart and Lung Institute	TOPS	Training Opportunities Scheme
NHS	National Health Service	TSD	Training Services Division of the Manpower Services Commission
NIDDM	Non-insulin dependent diabetes mellitus	TSH	Thyroid stimulating hormone
NIH	National Institutes of Health	UGDP	University Group Diabetes Programme
NIOSH	National Institute for Occupational Safety and Health	UK	United Kingdom
NOHS	National Occupational Hazard Survey	UN	United Nations
NPC	Nasopharyngeal carcinoma	UNDP	United Nations Development Program
NTD	Neural-tube defect	UNICEF	United Nations Children's Fund
OA	Osteoarthritis	UNRRA	United Nations Relief and Rehabilitation Administration
OGTT	Oral glucose tolerance test	UTI	Urinary tract infection
OHE	Office of Health Economics	US	United States
OPCS	Office of Population Censuses and Surveys	UV	Ultraviolet radiation
OSHA	Occupational Safety and Health Authority	VDI	Visual (or video) display terminal
		WHO	World Health Organization

Disease processes

1 The application of epidemiological methods in the investigation and control of an acute episode of infection

N. S. Galbraith

INTRODUCTION

The most terrible outbreak of cholera which ever occurred in this Kingdom, is probably that which took place in Broad Street, Golden Square, and the adjoining streets, a few weeks ago. Within two hundred and fifty yards of the spot where Cambridge Street joins Broad Street, there were upwards of five hundred fatal attacks of cholera in ten days (Snow 1855).

In this outbreak of cholera near Golden Square in 1854, John Snow established the method of epidemiological investigation of an acute episode of infection and applied the method to disease control. The purpose of this chapter is to describe this method and its use in the investigation and control of episodes of acute infectious disease and of toxic conditions epidemiologically resembling acute infections. A general account of infectious disease control is given in Volume 2, Chapter 2 and for descriptions of specific infections readers are referred to Mandell *et al.* (1979), Benenson (1980), Christie (1980), Emond *et al.* (1982) and Wilson and Miles (1984).

Definitions

An 'acute episode' may comprise a group of cases, a single case, or a carrier of a pathogenic organism. The word 'epidemic' is often used, and is defined as 'the occurrence in a community or a region of cases of an illness clearly in excess of expectancy' (Benenson 1980); however, this word is probably best avoided because it lacks a precise scientific definition and because it is misleading to the public, to whom it suggests the large-scale plagues of the past. 'Outbreak' is an alternative, but this word is best restricted to mean two or more related cases or infections and, therefore, excludes a single case or carrier. In this chapter 'outbreak' is used specifically with this meaning and 'acute episode' is used generally.

Systematic investigation

The investigation of an acute episode of disease requires a systematic approach (Barker and Rose 1976). It comprises seven main activities: (i) 'preliminary enquiry'; (ii) identification of cases; (iii) collection of data; (iv) analysis of data; (v) control; (vi) communication; and (vii) further epidemiological and laboratory studies.

It is not always necessary to follow this sequence; the order will depend on the circumstances of the acute episode under investigation, and often several of them will be undertaken at the same time. In the Golden Square outbreak of cholera, for example, Snow was sufficiently convinced by his preliminary enquiry of the association of the disease with water from the Broad Street pump that he acted immediately to control the episode by requesting the removal of the pump handle. He then followed this with a more detailed investigation to confirm his findings and undertook an incidence study in South London to demonstrate the association of cholera with sewage polluted water. Modern acute disease control remains based on Snow's methods, the main purpose being the early detection of disease, rapid investigation and timely application of control measures to prevent further cases.

Surveillance

The detection of acute episodes of disease in the past relied mainly on the appearance of groups of cases associated in time or place as in the Golden Square cholera outbreak. But with the establishment of universal death registration in the UK in 1837 it became possible to search actively for such case clusters and other variations in the patterns of disease. William Farr, the first compiler of abstracts (medical statistician) at the General Registry Office in London, founded modern surveillance (Langmuir 1976) which has been defined as 'the continued watchfulness over the distribution and trends of incidence through the systematic collection, consolidation and evaluation of morbidity and mortality reports and other relevant data' (Langmuir 1963).

The method of surveillance comprises four main activities.

First, the collection of data, which may either be accomplished by routine reporting or by special surveys designed for surveillance; second, the analysis of these data to produce statistics; third, the interpretation of the statistics to provide information; and fourth, the dissemination of the information to all who require it so that whenever necessary swift action may be taken to investigate and control disease. This method of surveillance has been applied particularly in the field of infectious disease (Galbraith 1982) but the same techniques can be applied also to non-infectious diseases in which the causative agent gives rise to disease within a short period of time. In these conditions, such as acute poisoning and acute drug-induced disease, it may be possible by early detection and investigation to identify and remove the agent and thus prevent further cases, in the same way as in acute infectious disease.

Surveillance of infectious diseases and other acute diseases in large populations, nationally and internationally, has assumed greater importance in recent years because of the increased movement of people, foodstuffs, and materials throughout the world. Indeed, sometimes surveillance is the only means of detecting an outbreak of disease when the victims have travelled during the incubation or latent period from the common place where they acquired the disease to many different destinations, or when the vehicle of the disease is geographically widely distributed. This change in the epidemiology of disease has become increasingly apparent since the late 1950s and has led many countries to establish national surveillance centres. In England and Wales a laboratory associated centre, the Communicable Disease Surveillance Centre, was set up in 1977 (Galbraith and Young 1980), and many of the examples used in the description of the investigation and control of an acute episode of disease which follows are derived from the experience of epidemiologists working from this Centre.

THE PRELIMINARY ENQUIRY

On proceeding to the spot, I found that nearly all the deaths had taken place within a short distance of the pump (Snow 1855).

Thus did John Snow describe the beginning of his preliminary enquiry into the Golden Square outbreak. The purposes of the preliminary enquiry are (i) to confirm that the reported episode of disease exists and there is indeed a problem requiring investigation; (ii) to confirm the diagnosis of the disease; (iii) to formulate tentative hypotheses of the source and of the spread of the disease; and (iv) to initiate immediate control measures if necessary.

Confirming the problem

A reported episode of disease may not be real and may arise for several reasons. The data may be misinterpreted. The reported episode may be due to increased clinical detection of the disease following the introduction of new diagnostic techniques, or because a new treatment has become available and it is therefore more important to recognize the disease, or because a clinician in the area has a special interest in the

condition. New and improved laboratory tests or a special laboratory interest in a disease may also increase detection. False-positive results of special investigations, such as laboratory tests or radiological studies, may present as an outbreak of disease. Changes in population size and structure, and improved reporting procedures can all result in an apparent increase in incidence of disease.

'Legionitis'

The misinterpretation of data by newsmen caused a spurious outbreak of legionnaires' disease – 'legionitis' – amongst British tourists in Spain in March 1981 (Communicable Disease Report 1981). Three deaths in tourists, one of whom had legionnaires' disease, came to the notice of the local press and it was assumed that because they had all stayed at the same hotel, an outbreak of this disease had taken place. The British press and media reacted to reports from their Spanish colleagues with stories on the outbreak under headlines such as 'Virus Kills Tourists', and correspondents vied with each other to obtain new 'angles' on the episode and to interview doctors who were considered to be controlling the outbreak. The public were alarmed and the medical services inundated with enquiries about the 'Benidorm epidemic'. Fortunately, however, the episode came to an end after about four days, when journalists had visited the hotel and discovered for themselves that the three deaths were unrelated and that a problem did not exist. They then realized that 'legionitis' was a disease of communication potentiated by newsmen and not a communicable disease.

Pseudobacteraemia

Contaminated blood culture bottles in a hospital in Essex gave rise to another spurious outbreak of disease (Willson *et al.* 1981). Between early 1980 and March/April 1981 positive blood cultures, mainly of *Klebsiella aerogenes*, increased from 0.5 per cent to 6.5 per cent. The preliminary enquiry showed that the laboratory results were incompatible with the clinical findings. Subsequent detailed investigation demonstrated contamination of citrate bottles used for the collection of blood for the determination of the erythrocyte sedimentation rate. The organism probably was spread from these bottles to the blood culture bottles in the nozzle of the syringe, because it was the practice to fill the citrate bottles first after bleeding the patient and then to fill the blood culture bottles from the same syringe.

Meningitis and population change

A study of cases of meningitis admitted to hospital in Motherwell, Scotland, showed a steep rise in the number of cases of aseptic meningitis in the late 1950s, which then continued at about double the level previously experienced (Sharp and Dewar 1973). However, this increase was probably not due to increased incidence but to changes in the population served and to new virological techniques. In 1950 two infectious disease hospitals combined and the catchment population increased; new housing in the area attracted young families and led to a greater proportion of children and young adults in the population, age groups in which aseptic meningitis is common. New virological techniques enabled

the causative viruses to be identified, creating more interest and making possible the distinction of many types of aseptic meningitis from non-paralytic poliomyelitis, under which diagnosis they may have previously been recorded.

Confirming the diagnosis

The clinical diagnosis may often be easily established by the study of several case histories of affected persons. Sometimes a knowledge of previous events in the locality is helpful, for example, the prevalence of disease and immunization uptake. Occasionally a previously unrecognized disease is encountered and then it is necessary to define carefully the new clinical entity for epidemiological study. Laboratory tests are essential to confirm the diagnosis in many infections but epidemiological investigation should usually begin on clinical diagnosis and should not await the laboratory results. In some diseases laboratory tests are the only means of identifying cases and may indeed be the means of bringing to light an outbreak of disease in the first place.

Unrecognized yersiniosis

A continuing outbreak of abdominal pain and diarrhoea in boys in a boarding school in 1980 remained undiagnosed until detailed clinical histories and appropriate laboratory investigations were carried out (Bartlett *et al.* 1983, personal communication). The predominance of abdominal pain and the finding of mesenteric adenitis at laparotomy on one child suggested yersiniosis, and this was subsequently confirmed by isolation of *Yersinia enterocolitica* from affected pupils. Recognition of the disease permitted further epidemiological and laboratory study which indicated person-to-person spread of the infection between the children, probably originally introduced into the school from an animal source on the school farm.

Misdiagnosed food poisoning

An explosive outbreak of 'food poisoning' was reported at an open-air jazz band festival in Nottingham in 1980 (Bebbington *et al.* 1980). The first child collapsed at about 10.30 a.m. and in the following 2.5 hours the local emergency services were overwhelmed by over 400 cases which were

taken to hospital. The initial diagnosis of acute chemical food poisoning was rejected after a study of a few case histories; the main clinical feature was syncope—vomiting and diarrhoea were absent. Subsequent investigation led to the definition of the disease as 'epidemic syncope' associated with the excitement and tension of the festival and the hot, humid weather conditions that were prevailing.

Precise laboratory diagnosis

A geographically widespread outbreak of salmonellosis associated with calf meat in the south of England in 1958, was recognized only by the precise laboratory identification of the pathogen, *Salmonella typhimurium* phage-type 20a (Anderson *et al.* 1961). Cases infected with this organism comprised about 17 per cent of all *S. typhimurium* infections in a population of over 17 million persons. Without this precise laboratory diagnosis the outbreak would not have been recognized, epidemiological study would have been impossible, and the source of the outbreak, a calf-collecting centre, would not have been discovered.

Taking immediate control measures

It is often necessary to take immediate control measures based on the tentative hypotheses of the source and the method of spread of the infection. If the preliminary enquiry suggests a common source outbreak due to food, milk, or water, it may be possible to stop the distribution of the material or to render it safe; samples should always be taken for subsequent laboratory investigation to confirm that the material was indeed contaminated. In serious person-to-person infections, such as diphtheria, hepatitis B, or poliomyelitis, as soon as the diagnosis is suspected it is necessary to identify persons who may have been the source of infection so that they may be isolated if appropriate, and to identify those who may have been exposed to infection so that they can be traced and given protection or treatment by vaccines or chemotherapy.

A contaminated milk supply

An outbreak of 77 cases of *S. heidelberg* infection took place in Cirencester in November 1961 (Knox *et al.* 1963). Pre-

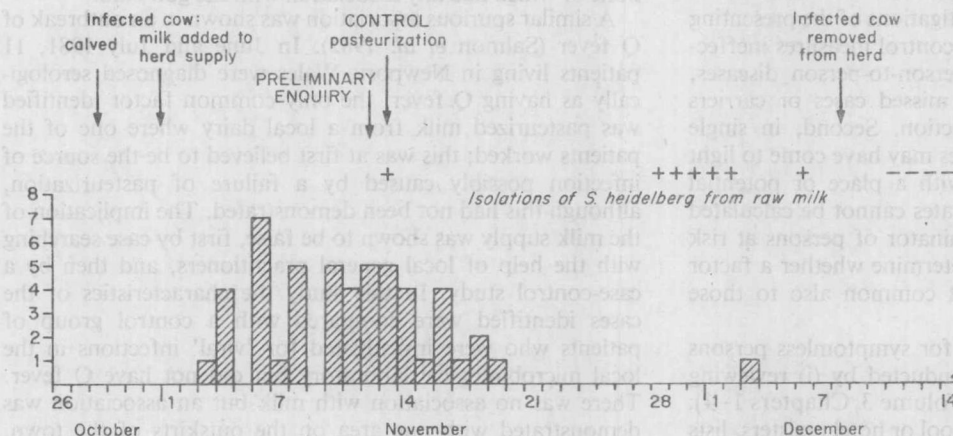


Fig. 1.1. Outbreak control after preliminary enquiry. A milk-borne outbreak of *Salmonella heidelberg* infection. (Adapted from Knox *et al.* (1963).)

liminary enquiry on 13 November of the first few cases reported suggested that raw milk from a local farm was the common factor, and so on the same evening the supply was pasteurized. Subsequent investigation showed that the 77 cases were in 56 households, 53 of which had been supplied with the contaminated milk. The outbreak declined rapidly after pasteurization, only one case being reported more than six days after distribution of the raw milk was stopped (Fig. 1.1).

Anthrax emergency

A single case of pulmonary anthrax was reported in West Ham, London, in 1965 in a 54-year-old man who had died suddenly (Enticknap *et al.* 1968). Immediate preliminary enquiry at his home and workplace revealed no association with animals or animal products except bone charcoal; his job was to empty sacks of coarse granular bone charcoal into a grinding machine to convert it into charcoal powder. The sacks he emptied were second-hand-jute sacks from India and had been previously used to import the dried bones from which the charcoal was made. A tentative hypothesis that these sacks were the vehicle of infection enabled their rapid withdrawal from use, and the protection with penicillin of other operatives at the charcoal-grinding factory who had possibly been exposed to risk. Laboratory investigations confirmed the hypothesis and epidemiological enquiry demonstrated the chain of infection from sun-dried bones in India to the West Ham charcoal factory worker via the contaminated second-hand sacks.

IDENTIFICATION OF CASES

I requested permission, therefore, to take a list, at the General Register Office, of the deaths from cholera, registered during the week ending 2nd September ... (Snow 1855).

The cases first identified in an acute episode of disease often comprise only a small proportion of all the cases in the episode and are unlikely to be a representative sample. Snow appreciated this and asked the Registrar General to provide him with a list of all registered deaths due to cholera in the Golden Square area for study. Investigations of the presenting cases alone may be misleading and control measures ineffective for three reasons. First, in person-to-person diseases, such as diphtheria, there may be missed cases or carriers responsible for spreading the infection. Second, in single source outbreaks the presenting cases may have come to light because of a chance association with a place or potential vehicle of infection. Third, attack rates cannot be calculated because of the absence of a denominator of persons at risk and therefore, it is impossible to determine whether a factor common to the cases, is or is not common also to those apparently at risk but not affected.

The search for additional cases, for symptomless persons and for persons at risk may be conducted by (i) reviewing mortality and morbidity data (see Volume 3, Chapters 1-4); (ii) reviewing lay records such as school or hotel registers, lists

of residents in institutions, payrolls and other occupational records, nominal rolls of travellers, and lists of persons attending functions associated with the episode; (iii) household enquiry; (iv) special appeal in the medical or lay press and through the media; and (v) screening by clinical examination or by laboratory or other tests.

A search for diphtheria contacts

A case of diphtheria was reported in a four-year-old child living in an hotel for homeless families in Hackney, London in 1975 (Chattopadhyay *et al.* 1977). The search for source contacts and persons exposed to risk in London, using hotel and school registers, and local household enquiry, detected 222 children and 60 adults. Clinical examination and nose and throat swabs identified four children with diphtheria, who were siblings of the index case, and two other children who were carriers; they were isolated and treated. The remaining contacts were protected by appropriate immunization and chemotherapy. The family of the index case had resided in Birmingham until moving to Hackney four days before the onset of symptoms; household enquiries and screening of neighbours in Birmingham led to the discovery of two carriers of the same organism who had recently arrived from Bangladesh. They were considered to be the probable source of the outbreak. Without the detailed and painstaking search for cases, carriers and persons exposed to risk, it is unlikely that the outbreak would have been so successfully contained.

Spurious associations in single source outbreaks

In April 1979, four of 58 persons taking part in a golfing tournament in the Midlands developed pneumonia in the week after the event; serological tests confirmed the diagnosis of legionnaires' disease in two of them and were suggestive in a third (Tobin *et al.* 1981). At first, the golf club was considered to be the likely source of infection but later the association with golfing was shown to be spurious by two means. First, detailed case histories showed that all four cases of pneumonia had stayed at the same hotel and of 26 golfers who stayed elsewhere none were affected, a small but statistically significant difference. Second, a search for cases using the hotel register identified a further four cases of pneumonia, none of which had any association with the golf club.

A similar spurious association was shown in an outbreak of Q fever (Salmon *et al.* 1982). In June and July 1981, 11 patients living in Newport, Wales were diagnosed serologically as having Q fever; the only common factor identified was pasteurized milk from a local dairy where one of the patients worked; this was at first believed to be the source of infection possibly caused by a failure of pasteurization, although this had not been demonstrated. The implication of the milk supply was shown to be false, first by case searching with the help of local general practitioners, and then by a case-control study. In this study the characteristics of the cases identified were compared with a control group of patients who were investigated for 'viral' infections in the local microbiological laboratory but did not have Q fever. There was no association with milk but an association was demonstrated with one area on the outskirts of the town,

where infection was thought to have occurred from contaminated straw and dust scattered in the streets from passing farm vehicles.

The need for denominator data

The need for the collection of denominator data from persons apparently exposed to the risk of infection but not affected was demonstrated in an investigation of an outbreak of gastroenteritis in a London office canteen (O'Mahony *et al.* 1983a). Food histories from 142 affected persons and 77 who were not affected enabled the calculation of food-specific attack rates which identified the meal involved and showed an incubation period of 30–36 hours, consistent with a diagnosis of viral gastroenteritis. Furthermore, analysis of the food-specific attack rates implicated fruit juice as the most likely vehicle of infection; this had been prepared by one of the catering staff shortly after the onset of diarrhoea and vomiting and before she reported sick. Laboratory studies were negative, but the epidemiological findings made possible by the collection of denominator data, indicated that the outbreak was probably viral gastroenteritis caused by the sick foodhandler.

COLLECTION OF DATA

With regard to the deaths occurring in the locality belonging to the pump, there were sixty-one instances in which I was informed that the deceased persons used to drink the pump-water from Broad Street . . .

(Snow 1855).

A clear case definition is an essential prerequisite to epidemiological investigations. Having defined the disease, existing records, such as hospital, general practitioner, and laboratory reports and notifications are valuable means of identifying cases, but their use for the collection of data is limited because they rarely quickly provide a sufficiently accurate epidemiological description of the disease to be useful in formulating control measures. In most episodes a special enquiry is necessary, similar to that carried out by John Snow in Broad Street and the surrounding area.

The aim of the enquiry will usually be to collect data from those affected and those at risk but not affected, and will include: name, date of birth or age, sex, address, occupation, recent travel, immunization history, date of onset of symptoms, and a description of the illness and the names and addresses of the medical attendants. Other details will depend on the factors brought to light by the preliminary enquiry, for example, if it is likely that the disease was foodborne then detailed food histories will be required or if a person-to-person spread disease is probable then lists of possible source contacts and persons exposed to risk will be necessary.

The data should be collected on a carefully designed standard form of questionnaire, constructed on the findings of the preliminary enquiry, to ensure accurate and comparable records of all persons included in the enquiry and to facilitate manual analysis or coding for computer analysis (Bennett and Ritchie 1975). Whenever possible the questionnaire should be

tested rapidly in a few cases and in a few unaffected persons apparently exposed to risk; it will be appreciated that in an acute episode of disease there is insufficient time to evaluate fully a questionnaire before use.

Administration of the questionnaire will often be by direct face-to-face interview by a single investigator or a group of investigators previously given guidance on the completion of the form. This structured interview may be followed by informal questioning or an unstructured interview, which is sometimes valuable in detecting hitherto unsuspected factors common to the cases. Interview by telephone may be useful in obtaining data quickly and obviating the need to travel long distances to conduct a house-to-house enquiry. These methods of direct administration of a questionnaire are appropriate when detailed information is required or when the source of infection has not been identified, and are usually limited to a small number of cases. When numbers are large and the enquiry is straightforward a self-administered questionnaire is often more effective, although this is always liable to bias if there are many non-responders (Bennett and Ritchie 1975).

Hepatitis B: a clue from existing records

An outbreak of hepatitis B in Kent in 1978, associated with tattooing, was initially suspected because the first two cases notified as 'infective jaundice' were in young adult males who had been tattooed (Limentani *et al.* 1979). Although the routine notification records thus provided an early clue to the aetiology and spread of the infection, subsequent case searching and epidemiological and laboratory investigations were necessary to confirm the diagnosis and substantiate the association with tattooing. Altogether 34 cases of hepatitis B were identified, 31 of which had been tattooed by the same tattoo artist within six months before onset of symptoms; the other three cases were secondary cases. The first case in the outbreak became jaundiced two weeks after tattooing and was probably infectious during the incubation period and the likely source of the outbreak; spread to subsequent clients in the tattoo parlour probably took place because of defects in hygiene of the tattooing procedure. Local control measures included the provision of a guide to hygienic tattooing to improve hygiene and prevent the spread of blood-borne disease. The outbreak was followed by national advice on hygiene (Noah 1983) and by legislation to improve the methods of tattooing.

Paratyphoid: investigation by direct enquiry

A detailed questionnaire directly administered to a few cases was successful in locating the place of infection of 13 cases of paratyphoid B fever in England in September 1980 (*British Medical Journal* 1981). The 13 cases resided in eight different health districts but were all infected with organisms of the same phage-type, *S. paratyphi B* 3a var 4. This type, unusual in Britain but common in Spain and Portugal, suggested an outbreak in returning holiday-makers. This was confirmed by telephone interviews but subsequent face-to-face interviews were necessary to find the common factor; 12 of the 13 affected persons recalled visiting the same beach bar restaurant in a small village in the Algarve, Portugal within a