

# **Oxford textbook of public health**

VOLUME 3

## **Investigative methods in public health**

Edited by

Walter W. Holland, Roger Detels, and

George Knox

with the assistance of

Ellie Breeze



一九八七年八月廿二日

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Edited by

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## Preface

It is not an easy task to follow in the footsteps of such a renowned editor as Bill 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. Through knowledge of historical aspects of the subject we may gain an understanding of what it is possible to achieve now and in the future. Volume 2 of this textbook is concerned with the process of public health promotion. Volume 3 with the investigative methods used in public health, and finally Volume 4 with a description of the specific applications of public health methods of controlling disease processes, and, with tackling the problems of disease in specific client groups.

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.

London  
January, 1985

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

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The original 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 practice. On accepting the 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 the 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 companion textbook concentrating specifically on 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.

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# Abbreviations

|        |   |            |   |
|--------|---|------------|---|
| ABS    | Chromosome abnormalities  | DES        | Diethylstilbesterol   |
| ADAMHA | Alcohol, Drug Abuse, and Mental Health Administration                   | DHA        | District Health Authority   |
| ADE    | Antibody-dependent enhancement  | DHC        | District Health Council   |
| ADM    | Assistant Deputy Minister   | DHEW       | Department of Health, Education, and Welfare                      |
| ADR    | Adverse drug reaction   | DHHS       | Department of Health and Human Services                           |
| AFP    | Alpha-fetoprotein   | DHSS       | Department of Health and Social Security                          |
| AHA    | Area Health Authority   | DIIMI      | Deutsches Institut für Medizinische Dokumentation und Information |
| AIDS   | Acquired immune deficiency syndrome                                     | DMT        | District Medical Team   |
| ALI    | Annual limit on intake  | DNA        | Deoxyribonucleic acid   |
| ALT    | Alanine aminotransferase  | DOD        | Department of Defence   |
| AMA    | American Medical Association  | DRG        | Division of Research Grants, National Institutes of Health        |
| AMO    | Area medical officer  | DSRU       | Drug Surveillance Research Unit, Southampton University           |
| ARAMIS | American Rheumatology Association Medical Information System            | EB virus   | Epstein-Barr virus  |
| ARP    | Attributable risk population  | ECHO virus | Enteric cytopathic human orphan virus                             |
| BCG    | Bacillus Calmette-Guérin  | EDTA       | European Dialysis and Transplantation Association                 |
| BEIR   | Committee on Biological Effects of Low Levels of Ionizing Radiation     | ELISA      | Enzyme-linked immunosorbent assay                                 |
| BL     | Blood lead  | EPA        | Environmental Protection Agency                                   |
| BMA    | British Medical Association   | EPH        | Elderly person's housing  |
| BOND   | Business-Oriented New Development Plan                                  | ERL        | Emergency reference level   |
| BSI    | British Standards Institute   | FDA        | Food and Drug Administration                                      |
| CAT    | Computerized axial tomography   | FEP        | Free erythrocyte protoporphyrin                                   |
| CCPDS  | Centralized Cancer Patient Data System                                  | FES        | Food Expenditure Survey   |
| CDC    | Centers for Disease Control   | FEV        | Forced expiratory volume in one second                            |
| CDSC   | Communicable Disease Surveillance Centre                                | FPC        | Family Practitioner Committee                                     |
| CF     | Complement fixation   | FVC        | Forced vital capacity   |
| CHAD   | Community Syndrome of Hypertension, Atherosclerosis, and Diabetes Study | GHS        | General Household Survey  |
| CHD    | Coronary heart disease  | GMENAC     | Graduate Medical Education National Advisory Committee            |
| CI     | Confidence interval   | GNP        | Gross National Product  |
| CMV    | Cytomegalovirus   | GP         | General Practitioner  |
| CNS    | Central nervous system  | GRO        | General Registers Office  |
| COHb   | Carboxyhaemoglobin  | GSD        | Genetically significant dose                                      |
| CPI    | Consumer Price Index  | HAA        | Hospital Activity Analysis  |
| CPM    | Critical path method  | Hb         | Haemoglobin   |
| CSD    | Committee on Safety of Drugs  | HCFA       | Health Care Financing Administration                              |
| CSM    | Committee on Safety of Medicines  | HDFP       | Hypertension Detection and Follow-up Program                      |
| CSO    | Chief Scientist Organization  | HDS        | Hospital Discharge Service  |
| CUPE   | Canadian Union of Public Employees                                      | HES        | Health Examination Survey   |
| DAC    | Derived air concentration   |            |   |
| DAWN   | Drug Abuse Warning Network  |            |   |
| DDST   | Denver Developmental Screening Test                                     |            |   |

|                  |   |        |  |
|------------------|---|--------|--|
| HI               | Haemagglutination inhibition                                    | NHLBI  | National Heart, Lung, and Blood Institute                                  |
| HIPE             | Hospital In-patient Enquiry                                     | NHS    | National Health Service  |
| HPF              | High powered field  | NHSCR  | National Health Service Central Register                                   |
| HRA              | Health Resources Administration                                 | NIDA   | National Institute of Drug Abuse   |
| HRSA             | Health Resources and Services Administration                    | NIH    | National Institutes of Health  |
| HSA              | Health Services Administration                                  | NIL    | Noise immission level  |
| HSC              | Health and Safety Committee                                     | NINCDS | National Institute of Neurological and Communicative Disorders and Strokes |
| ICAS             | International Computer Access Service                           | NIOSH  | National Institute of Occupational Safety and Health                       |
| ICD              | International Classification of Diseases                        | NLM    | National Library of Medicine   |
| ICHPCC           | International Classification of Health Problems in Primary Care | NMCUES | National Medical Care Utilization and Expenditure Survey                   |
| ICRP             | International Commission on Radiological Protection             | NMFI   | National Master Facility Inventory   |
| IEA              | International Epidemiological Association                       | NNHS   | National Nursing Home Survey   |
| IEC              | International Electronics Commission                            | NRPB   | National Radiological Protection Board                                     |
| IFAT             | Indirect fluorescent antibody test                              | NSAI   | Non-steroidal anti-inflammatory agent                                      |
| IHCE             | Institute for Health Care Evaluation                            | NSF    | National Science Foundation  |
| IM               | Infectious mononucleosis  | NSU    | Non-specific urethritis  |
| INH              | Isoniazid   | OC     | Oral contraceptive   |
| IPS              | International Passenger Survey                                  | OECD   | Organization for Economic Co-operation and Development                     |
| IQ               | Intelligence quotient   | OHA    | Ontario Hospital Association   |
| ISO              | International Standards Office                                  | OHIP   | Ontario Health Insurance Plan  |
| JICST            | Japanese Information Center of Science and Technology           | OPCS   | Office of Population Censuses and Surveys                                  |
| LD <sub>50</sub> | Median lethal dose  | OR     | Odds ratio   |
| LET              | Linear energy transfer  | OSHA   | Occupational Safety and Health Association                                 |
| MBA              | Master of Business Administration                               | PAH    | Polynuclear aromatic hydrocarbons  |
| MHE              | Mental Health Enquiry   | PAHO   | Pan American Health Organization   |
| MI               | Myocardial infarction   | PAN    | Peroxyacetylnitrate  |
| MOEH             | Medical Officer of Environmental Health                         | PARP   | Population attributable risk proportion                                    |
| MOH              | Medical Officer of Health                                       | PC     | Canadian Progressive Conservative Party                                    |
| MPH              | Master of Public Health   | PCB    | Polychlorinated biphenyl   |
| MRC              | Medical Research Council  | PEFR   | Peak expiratory flow rate  |
| MS               | Mean square   | PEM    | Prescription event monitoring  |
| MYR              | Man years at risk   | PERT   | Program evaluation and review technique                                    |
| NAMCS            | National Ambulatory Care Survey                                 | PHLS   | Public Health Laboratory Service   |
| NANB             | Non-A, Non-B hepatitis virus                                    | PHS    | Public Health Service  |
| NAS              | National Academy of Science                                     | PID    | Pelvic inflammatory disease  |
| NCHCT            | National Center for Health Care Technology                      | PMS    | Post-marketing surveillance  |
| NCHS             | National Center for Health Statistics                           | PPA    | Prescription Pricing Authority   |
| NCI              | National Cancer Institute                                       | PRNT   | Plaque reduction neutralization test                                       |
| NCP              | National Cancer Programme                                       | PSRO   | Professional Standards Review Organization                                 |
| NDP              | Canadian New Democratic Party                                   | RADS   | Retrospective assessment of drug safety                                    |
| NEISS            | National Electronic Injuries Survey                             | RAWP   | Resource Allocation Working Party  |
| NGU              | Non-gonococcal urethritis                                       | RCGP   | Royal College of General Practitioners                                     |
| NHANES           | National Health and Nutritional Examination Survey              | RCP    | Royal College of Practitioners   |
| NHBPERP          | National High Blood Pressure Education Research Program         | RCT    | Randomized controlled trial  |
| NHDS             | National Hospital Discharge Survey                              | RHA    | Regional Health Authority  |
| NHI              | National Heart Institute  | RLF    | Retrolental fibroplasia  |
| NHIS             | National Health Interview Survey                                | RMS    | Root mean squares  |
|                  |   | RNA    | Ribonucleic acid   |
|                  |   | RR     | Relative risk  |

|      |   |         |  |
|------|---|---------|--|
| SAQC | Statistical Analysis and Quality Control Center   | STD     | Sexually transmitted disease   |
| SAS  | Statistical Analysis System                       | TRIMIS  | TriService Medical Information System                                  |
| SBP  | Systolic blood pressure                           | TSP     | Total suspended particulates   |
| sd   | Standard deviation                                | UHDDS   | Uniform Hospital Discharge Data Set                                    |
| se   | Standard error                                    | UNSCEAR | United Nations Scientific Committee on the Effects of Atomic Radiation |
| SEER | Surveillance, Epidemiology and End Result Program | UTI     | Urinary tract infection  |
| SMON | Subacute myelo-optic neuropathy                   | VA      | Veterans Administration  |
| SMR  | Standardized mortality ratio                      | WHO     | World Health Organization  |

# Introduction

George Knox

## THE NATURE OF PUBLIC HEALTH INVESTIGATION

Analogies between investigations of the health of individuals, and of populations, have many times been drawn. As in clinical medicine, a public health practitioner can become involved in such investigations through the demands of an acute episode (for example, an epidemic of food poisoning) or through attention having been drawn to a more insidious or chronic problem (for example, a high case fatality from breast cancer, or a rise in perinatal mortality among mature infants). Alternatively, a proactive as opposed to reactive role may be adopted with the public health practitioner seeking out problems on his own initiative. An example might be the potential threat of a declining acceptance rate for pertussis vaccine, or a rising proportion of smokers among pregnant women.

In each case the parallels with normal clinical practice are clear, and they extend to the public health practitioner's subsequent executive behaviour regarding 'investigation' and 'treatment'. Thus, once the problem has been identified, he will undertake a series of goal-directed special enquiries leading to the administrative and planning analogies of diagnosis, prognosis, explanation, advice, and treatment.

These analogies and parallels carry the appeal of a respectable professional image, and conform with the traditions of orthodox professional practice. They are courted at least as much for this reason as for any practical utility. But, although we can continue to accept and even promote them, it may be more valuable in the pragmatic field of public health investigation, to pay more attention to the differences rather than to the similarities between clinical and public health practice.

## TECHNICAL SUPPORT SYSTEMS

The first of the differences between clinical and public health investigation relates to the kinds of technical support system appropriate to each. The great burden of clinical medicine springs from complaints generated by patients who are either already ill or believe themselves to be ill, and the approach expected of the practitioner is therapeutic—that is, curing and caring. In so far as physical treatment is necessary or useful, the practitioner's problem is to modify the internal environment in a manner which will retard or arrest the disease process, or ameliorate its effects. His diagnosis is therefore pathological (including biochemical,

microbiological, and other aspects), and the necessary investigations relate the patient's internal pathological processes. They depend upon the well-developed resources of the clinical investigative departments to be found in any major hospital. The support staff are either medical or laboratory scientists, in turn supported by laboratory technicians, and the whole system serves the unambiguous priority of one professional group.

The technical support systems appropriate to public health investigation are of quite a different nature. They are concerned with processes taking place outside the individual. They include the mechanics of transmission of infectious organisms from one person to another, directly or through intermediate stages, the exposure of people to physical and chemical hazards and the effects of protective procedures; also human responses to social, economic, educational, and work environments, as well as to health education activities. They are concerned in addition with the social and administrative services and processes which bring medical, nursing, and other health services into effective contact with those in need of them.

The investigation of these problems is conducted only in part by doctors and laboratory scientists. The others involved include statisticians, information scientists and computer staff, sociologists, economists, educationists and health educationists, systems analysts, operational research scientists, and management scientists. They also include a range of technical and engineering experts competent in the maintenance of wholesome food, water, and air, and in the protection of the population from the ill effects of noise, radiation, the harmful effects of drugs, inadequate housing, and a wide range of social hazards. The professional identifications of these scientists, engineers, and technicians are not uniquely related to medicine, and many are employed in organizations with indirect or partial responsibilities for health matters. The tight hierarchical structure of the hospitals does not exist and there may be little unified control of staffing, standards, or investment. Joint operations and investigations must be conducted from a basis of professional consensus and agreement, rather than a basis of requisition.

It is an open question whether a dispersed and informally organized investigative resource such as this is more or less effective than a more closely controlled arrangement, and it is not our purpose to discuss this point here. It would however be foolish not to recognize the *de facto* social and

professional differences, as well as the technical differences, between the clinical and public health investigative processes.

### Data acquisition and data analysis

The professional autonomies and specializations described above have led, *inter alia*, to a substantial division between data processing and analysis on the one hand, together with health service management and activity information, and the acquisition of information relating to the health of the population, on the other. These divisions are reflected in the headings and sub-headings which we employ in this volume, and our first section is concerned entirely with information systems. It attempts to display both the complexity of the arrangements which have evolved in different countries, and to describe the interactions between the evolution of this complexity, and the advent and development of computer-based processing. Our second section describes in more detail a range of analytical approaches usually associated with the discipline of epidemiology. Our third section describes or exemplifies the contributions to public health of several other professional disciplines.

In the fourth section we describe field investigations concerned with the control of biological, physical, and chemical hazards. These monitoring and data acquisition processes constitute the traditional materials of public health practice. Although they have perhaps been overshadowed in recent years by the growth of those information and scientific processes which have become necessary for the provision and maintenance of comprehensive health care services, their crucial importance remains. Indeed, as our contributors show, improvements in expected and accepted standards of health, combined with technical developments in monitoring and in the theory and practice of defending people from such exposures, are generating renewed momentum in these fields.

### THE MODEL BASES OF PUBLIC HEALTH

The overwhelming concern of the clinical practitioner with the control of the *milieu interieure* has over the years generated a vast range of pathological models. They provide the chief theoretical basis of clinical practice. In so far as they describe the 'causes' of disease, they do so in the sense of describing the mechanisms by which underlying processes produce the clinical phenomena of illness. In other words, the clinician's concern with cause is in the sense of 'pathogenesis'. Although clinicians will nowadays often rely upon empirically investigated measures of the efficacy of therapies, in the majority of their day-to-day decisions they probably rely chiefly upon this pathological, biochemical, or pharmacological theory which has accumulated over the years. It is for this reason that its study constitutes so large a part of the scientific training of doctors.

By contrast, the public health practitioner is concerned more with causes which *precede* illness, and his concern to control them stems from his traditional prior concern with prevention, rather than with treatment. In so far as he relies

upon a knowledge of causal processes in the pursuit of these aims, he is concerned with cause in the sense of 'aetiology'. He wishes to know what *precedes* the disease, and how the disease itself is determined by interruptable environmental processes. We have to admit, however, that the body of validated theory available to the public health practitioner is no where so detailed and pervasive as that available to the clinician.

Traditional public health practice was based to a very large extent upon a single causal model. It consisted of an invasive noxious agent—physical, chemical, or biological. Apart from the fact that many of these agents can now be identified, it did not differ in any substantial way from the model represented in the episode of the Gadarene swine. The idea was in the course of time modified by the identification of the noxious agents, and by expunging magical mechanisms of transfer, and more recently by the recognition and development of the notions of non-sufficiency and non-necessity. It was recognized that exposure to tuberculosis and inhalation of tuberculosis bacilli, was not a 'sufficient' cause of developing the disease, and that other events and circumstances combined to determine the outcome. It was also recognized that some disorders may be determined through alternative pathways, so that no *particular* nominated cause always (i.e. necessarily) precedes the disease. In death by firing squad, each bullet may be sufficient, but none individually is necessary! In many aetiological mechanisms it was recognized that the causes were neither necessary nor sufficient, and they were sometimes described as an 'agent-host-environment' interaction in which the causal pathway could best be represented as a network.

### Conceptual evolution

The notion of a causal network of (mainly) non-sufficient and non-necessary causes led to the introduction of 'probabilistic' ideas. The probability of a sequence of necessary events occurring was the product of their individual frequencies, while parallel/alternative causal streams were handled in an additive manner. These ideas had some value, but they were also unfortunately a source of muddle.

The centre of the problem was a confusion between predictive and causal models, and even a lack of appreciation that any specific choice of model was necessary for interpreting measurements of risk or of relative risk. The term 'risk-factor' is still often used without commitment as to whether it represents the strength of a prediction or the strength of a cause. The unfortunate consequence has been a dissociation between the relatively precise idea of 'cause', and the non-committal notions enshrined in 'contributory factor'. Thus, it is not infrequent to hear clinicians, and others concerned with health care at the individual level, deny that low birthweight is a cause of death or handicap, or that dietary patterns are a cause of colon cancer, or that cigarette smoking is a cause of ischaemic heart disease. predisposing factors, yes; but causes, no. And from this denial there follows an attitude of preventive nihilism.

A further limitation of traditional models springs from

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their exclusive relevance to diseases which can be defined in qualitative pathological terms. The starting point of studies depending upon such models is a precise taxonomy. This produced an almost specific diversion of the public health approach away from those disorders which could not be so defined. They include psychiatric illnesses, behavioural deviances, and a wide range of disabilities which were definable more in the nature and degree of the impairment which they inflicted upon their owners (blindness, deafness, dementia, mental retardation, arthritis, back pain) rather than in specific pathological terms.

In the last two or three decades, however, we have seen the beginnings of a conceptual liberation, and an extension of the repertoire of models on which public health investigative approaches are based.

First, although effective epidemiological investigation continues to depend very largely upon effective taxonomies (e.g. the differentiation of senile dementia into atherosclerotic and Alzheimer's dementia), there has been a considerable growth of enquiries based upon quantitative models. An example would be the investigation of intelligence, scholastic attainment, physical growth, and emotional development among pre-school and school-children. Each can be expressed as a quantifiable attribute, with a range extending across the whole population. This frees the investigator from the need to define 'diseased' subclasses. He can, nevertheless, relate performance in these respects to the events and circumstances of pregnancy, of delivery, and of early nutritional, toxic, and infective exposures. He can propose and test the hypothesis that the two might be causally related.

Second, the vague notion of a genetic or familial 'pre-disposition', which was almost devoid of predictive or preventive value, is nowadays being replaced by the development and validation of more specific genetic models. In an earlier section, one contributor describes our improved understanding of immune processes and of their genetic determination (Chapter 3, Volume 1). The study of interactions between such processes, and environmental exposures of different kinds, is now one of the fastest growing points of medical science.

Third, the processes of disease diffusion are being quantified. The mathematical modelling of epidemic processes, is becoming progressively and usefully connected with the problems of real life. This is especially so in the fields of planning vaccination programmes, and predicting the consequences of alternative vaccination policies. Predicting the long-term consequences of chronic exposures to noxious agents with long and variable latent intervals, producing their effects in competition with other causes of illness and death, is also proving susceptible to the newer mathematical and computer simulation approaches.

Fourth, increasing application of the experimental approach, and in particular the technique of the randomized controlled trial, has sharpened up the notion of 'cause' wherever it has been applied. A cause, in this context, is anything which can be manipulated to alter the subsequent prevalence or incidence of a disease, or its consequential effects, or which might modify subsequent physiological or

social performance. Thus, cigarette smoking can be seen quite starkly as a cause of perinatal death, so soon as it is demonstrated that mean birth weight and perinatal mortality rate, can be altered through specific health educational methods, or through specific social policy decisions (e.g. taxation).

A fifth major departure has been in the attention given to the behavioural elements of disease causation. Thus, it is not sufficient to say that smoking causes lung cancer; we have to look for more proximate causes, and to study the causes of smoking. We enter here into the provinces of advertising and commercial economics, of education, and of health education, of peer group pressures, addiction, and so on.

A sixth development has been the increased attention given in recent years to behavioural/environmental interactions determining the pattern of use of health services by sick people. These models are not purely behavioural, and include physical and operational elements. We develop this area below.

### Health services research

The investigation of health services, with the evaluation of their effectiveness, appropriateness, accessibility, resource requirements, costs, and benefits, can be seen as a direct extension of the host-agent-environmental model. In the case of iatrogenic disease, the service is seen as the agent. In the case of effective care or prevention, the service is seen as a modifying environment. The rapid growth of this area of research in recent years sprang from the recognition that the disparity between demand and supply of health care services was universal, and would probably be with us for ever. This would apply whatever the arrangements for the provision of resources, so that a choice of priorities and of alternative deployments would also be needed at the service-provision level, as indeed it is at the clinical level. Scientific investigation was necessary to guide these choices. As it developed, health services research came to demand investigative methods which differed in their technical emphases and organization, from those demanded by more traditional public health approaches.

First, there was an increased emphasis upon large data-acquisition systems, managed on a routine basis, with the aim of monitoring performance in continuing and quantitative terms, rather than necessarily addressed to answering qualitative biological questions.

Second, the design of investigations was more often problem-led, than dictated by the availability of data and of developed technique. More insistently than previously, an accommodation was necessary between operational relevance and timeliness, on the one hand, and scientific elegance on the other. Often, the work was so intimately linked with planning and policy processes, as to trouble the consciences of the scientific investigators. Problem-led is one thing; problem-dominated, to the extent of possibly influencing the results, is another. Epidemiologists have often felt uncomfortable with the notion of 'action research', in which the research process is indissolubly linked with the process of advocating and promoting change, in the manner

formulated originally by Cherns. Sociologists are more familiar with these problems and necessities; but some epidemiologists have declined to be drawn into health services research, in any shape or form.

Third, 'evaluation' was recognized eventually to have at least two quite different meanings. The first depends upon measuring the performance of services which already exist. In the traditional scientific manner, analysis is based upon collected facts. The problem is that facts are grammatically and syntactically located in the past, while planners and policy-makers are concerned with the future. *Their* need is for prediction. So the second necessary type of evaluation relates to proposals for future services. Facts have no relevance in this process unless some kind of extrapolation can be made. Frequently, the extrapolation must be from one place to another, and from one circumstance to another (e.g. scientific enquiry to service application), as well as from one time to another. The construction and use of predictive and extrapolative models is a thoroughly respectable part of the scientific process, but it is not one which had been very much used in traditional public health contexts. Substantial new development was necessary. Furthermore, the theoretical and model building developments necessary for planning purposes, required a joint consideration of social, operational, and biological processes. The combination was novel. As a result, model-based predictive methods are only now beginning to find their proper place.

Fourth, as health services research developed, its threatening nature emerged. It was not simply that it threatened clinical autonomy, as any management-linked process must, but it also threatened traditional views that social policy and management decisions were the sole prerogative of senior people whose status in this respect was acquired through processes other than special training or special skill in population-investigative methods.

For all these reasons, health services research introduced

a new level of social, political, and technical complexity to the investigative processes associated with responsibilities for the public health. We have therefore included within this third volume a short section on applications and problems arising in this field and have tried to develop the notions of 'complexity' and of 'interactivity' as features with which we will have to contend, and whose nature we might as well begin to try to understand.

## TERMINOLOGY

It is necessary finally to comment upon terminology: and even upon spelling. Our contributors work in a variety of different cultures and we thought it inappropriate to pretend otherwise. The meanings of terms used by one, are not necessarily congruent with the meanings used by another. Terms such as efficiency, efficacy, and effectiveness are given different meanings in different working contexts. Operational research in the UK is operations research in the USA. Cohort study does not mean the same thing to one worker as it does to another. Incidence rate in one context is the same as attack rate in another. And so on.

We have tried, editorially, to ensure that meanings are clear within their contexts and there should be little risk of misunderstanding if a little care is taken.

International dictionaries have of course been constructed (J.M. Last, (1983). *A dictionary of epidemiology*) and have made contributions both towards uniformity and clarity, but we felt that in their present stage of evolution their main function was to supply a descriptive exposition of the manner in which terms were actually used, rather than to provide an authoritative statement of the manner in which they *should* be used. This balance will no doubt change as the processes of validation and consensus proceed, but we did not feel that we were yet at this stage.

# Information systems and routine monitoring

## Health information resources

# 1 Health information resources: United States – health and social factors

Nancy D. Pearce

## INTRODUCTION

This chapter reviews health information systems that provide data for routine monitoring of the health of the population of the US. Since it is possible to discuss only a few of the existing systems, the material in this chapter represents a sampling of the total universe of data systems. Several criteria were applied in the selection of the systems to be included. Each system must be: (i) national in coverage, or representative of the situation in the country as a whole; (ii) currently operational, although it may be periodic in its collection of data (e.g. conducted biennially rather than continuously); (iii) operated by either the federal government or the private sector; and (iv) produce primary data rather than a secondary compilation of data from other sources. Systems excluded are those that provide data for specific programmes, with the exception of the Medicare programme statistical system which has been included because it covers virtually the entire population age 65 years and older. Also excluded are those programmes that operate at the state level, provide data only for the state and some or all of its subdivisions, and important and highly useful compendia that contain highlights from a number of primary data sources. Examples of secondary data sources in the health area are the *Statistical Abstract of the United States*, published annually by the Bureau of the Census and *Health, United States*, the annual report to Congress from the Secretary of the Department of Health and Human Services, prepared annually by the National Center for Health Statistics and the National Center for Health Services Research.

To provide a framework for the organization of these diverse data sources, they are presented in three broad groupings: health status, including morbidity and mortality; health care resources and their utilization; and health economics. Placement of individual data sources in these categories is somewhat arbitrary, but every effort was made to ensure that the placement is as logical as possible. For example, while the National Health Interview Survey produces information on both the utilization and financing of health care services its primary purpose is provision of information on morbidity and so it is located in the section on health status.

The relative paucity of information on health care professionals is noteworthy. Numerous *ad hoc* studies have been conducted for several health occupations but they have typically been limited to the membership of a particular national

professional organization and conducted on an irregular basis. Anyone interested in the most current data for any particular health occupation should contact the national professional association.

There are limited sources that meet the criteria for inclusion for health economics data because most health economics studies use secondary data, involve secondary analysis of data from various sources, or are based on 'single-time' studies.

For each data system the material is typically divided into two sections. The first section describes the purpose and scope of the system; the second section provides an overview of the data collection procedures and data items. At the end of each description a reference is given to one or two sources for additional information about each system. The references also frequently identify other data collection programmes of the respective organizations.

## HEALTH STATUS

### National morbidity and mortality reporting systems

#### Purpose and scope

The Centers for Disease Control (CDC) maintain national surveillance programmes for selected diseases, with the co-operation of state and local health departments. Over the years the surveillance systems maintained by these centres have expanded, and emphasis has shifted as certain diseases have lower incidence rates and other diseases have taken on new aspects. The data are used to identify outbreaks of communicable diseases and to monitor trends in those diseases.

In 1878 an act of Congress authorized the collection of morbidity reports by the Public Health Service for use in connection with quarantine measures against pestilential diseases such as cholera, smallpox, plague, and yellow fever. The following year a specific appropriation was made for the collection and publication of reports of notifiable disease, principally from foreign ports; in 1893 an act provided for the collection each week from state and municipal authorities throughout the US. To secure uniformity for the registration of these morbidity statistics Congress enacted a law in 1902 directing the Surgeon General of the Public Health Service to provide forms for the collection, compilation, and publication of such data.