



3679

EUR/ICP/HST 128  
4106r  
ENGLISH ONLY  
UNEDITED

MORBIDITY AND MORTALITY MODELS TO FACILITATE THE APPLICATION  
OF AVAILABLE EPIDEMIOLOGICAL DATA

Report on a WHO Working Group

Bratislava  
14-17 November 1989

1990

EUR/HFA target 35

All rights in this document are reserved by the WHO Regional Office for Europe. The document may nevertheless be freely reviewed, abstracted, reproduced or translated, but not for sale or for use in conjunction with commercial purposes. Any views expressed by named authors are solely the responsibility of those authors.

Alle Rechte an diesem Dokument liegen beim WHO-Regionalbüro für Europa. Das Dokument darf jedoch außer zu Verkaufszwecken oder in anderem kommerziellen Zusammenhang ohne vorherige Genehmigung rezensiert, in Auszügen gebracht, vervielfältigt oder übersetzt werden. Die in dem Dokument zum Ausdruck gebrachten Ansichten geben ausschließlich die Meinung der namentlich angeführten Autoren wieder.

Tous les droits relatifs à ce document sont réservés par le Bureau régional de l'OMS pour l'Europe. Il peut cependant être commenté, résumé, reproduit ou traduit sans autorisation, pour autant qu'il ne s'agisse pas d'un usage lié directement ou indirectement à des fins commerciales. Les vues exprimées par des auteurs nommément désignés n'engagent que la responsabilité de ces derniers.

Европейское региональное бюро ВОЗ оставляет за собой все права, связанные с настоящим документом. Тем не менее его можно свободно рецензировать, реферировать, воспроизводить или переводить. Не разрешается лишь продажа документа, либо иное его использование в коммерческих целях. Всю ответственность за любые взгляды, выраженные в подписанных авторами статьях, несут сами авторы.

## TARGET 35

### Health information systems

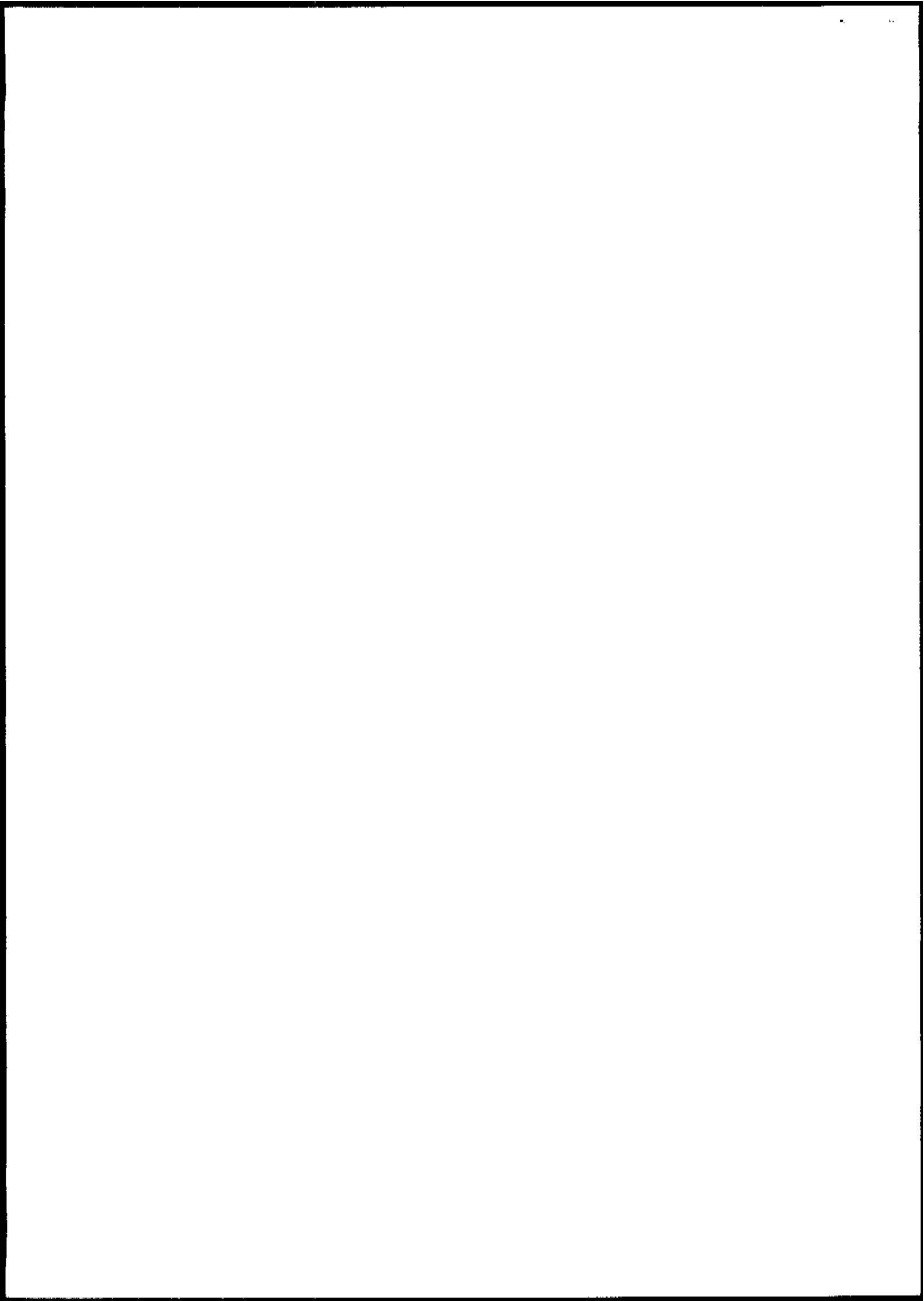
Before 1990, Member States should have health information systems capable of supporting their national strategies for health for all.

#### Index:

MORBIDITY  
MORTALITY  
MODELS, THEORETICAL  
EPIDEMIOLOGY  
HEALTH PLANNING

## CONTENTS

	<u>Page</u>
1. Introduction . . . . .	1
2. Review of existing models . . . . .	2
3. Comparison of models, including the ability to serve for the health planning process . . . . .	8
4. Availability of the epidemiological background data for risk modelling . . . . .	8
5. Concept of generalized risk function . . . . .	9
6. Present and future modelling activities in the participating centres . . . . .	9
7. Main conclusions and recommendations . . . . .	12
 Annex 1 Population data used for the modelling and/or available in the participating centres . . . . .	 13
Annex 2 List of working papers . . . . .	15
Annex 3 List of participants . . . . .	16



## 1. Introduction

The essential role of epidemiology and the need for greater use of existing epidemiological data for the formulation and preparation of national health policies have been emphasized by the World Health Assembly and other WHO forums for many years. Even in the case of an important problem like the prevention of major noncommunicable diseases, the gap between existing epidemiological knowledge and its application is significant. Existing data on widely recognized risk factors and their contribution to mortality and morbidity are not being fully applied in practice. This is partly due to the absence of relevant models and other instruments which could help transform existing raw epidemiological data into a form easily applicable in practice.

The Working Group on Morbidity and Mortality Models to Facilitate the Use of Available Epidemiological Data, was organized by the WHO Regional Office for Europe, in close collaboration with the Division of Noncommunicable Diseases of WHO headquarters and the Medical Bionics Research Institute in Bratislava.

The meeting was opened by Professor R. Dzurik, Medical Bionics Research Institute, Bratislava, who welcomed the participants to Bratislava and the Medical Bionics Research Institute.

Dr E. Chigan, Director of the Noncommunicable Diseases Division of WHO headquarters, responded to the greeting and opened the meeting. Dr Martin Rusnak was elected Chairman and Dr Max Woodbury, Rapporteur.

The general purposes of the meeting were:

1. to review existing risk models and related problems in mortality and morbidity analysis;
2. to discuss the experiences and problems in the practical use of existing models;
3. to assess the availability of epidemiological background data for risk modelling and the concept of generalized risk functions;
4. to discuss the possibilities to modify the existing models, incorporating the generalized risk functions;
5. To discuss the future activities in the field of morbidity and mortality modelling.

In addition, four models developed by the Medical Bionics Research Institute, IIASA Population Division, Erasmus University, Rotterdam, and by the Institute of Control Sciences, Moscow, were available on the PC for demonstration.

## 2. Review of existing models

2.1 The general approaches developed for the modelling of the health care system and carried out at IIASA were presented by Dr Rusnak. In his paper several attempts to model noncommunicable disease prevalence based on both systems and statistical models of various degrees of biological and mathematical complexity are discussed. Reviews of previous efforts in modelling utilisation of health services arising as outcomes of disease prevalence were also included. These included models of health manpower generated by health demands and mediated by particular health service organisational considerations; resource allocation models based on both conflicting health service needs and on geographical distribution. Mention was made of resource allocation models successfully tested in the United Kingdom and Czechoslovakia.

A series of recommendations mentioned the needs to consider the following conditions needed to assure appropriate application of models developed:

- 1) the identification of potential users of the model and the assurance of their willingness to utilise the models;
- 2) the availability of the models to potential users in "user friendly" form;
- 3) the availability of data from various sources for model development and application;
- 4) conditions for dissemination of the models and their outputs;
- 5) training courses and facilities for familiarization with modelling principles and practice.

2.2 Compartment model-multistate systems offer significant advantages for epidemiological models in chronic disease studies. Rusnak and colleagues presented an analysis of lung cancer morbidity and mortality using a general model (DIAL). DIAL can serve as the basis for many studies of this kind. A number of system models have been completed and can be used as applications, such as the one for lung cancer presented here.

A key point in the determination of the statistics of compartmental systems is the fact that compartment parameters determine the probability distribution of variables for individuals within the compartment as well as transition from one to another compartment.

Since compartment models act over time the introduction of new cohorts must be dealt with. In survival models they are not considered, but in simulating the future rate of lung cancer events in populations, new cohorts must be introduced for each clock cycle or time period. In addition, the model must be started. The model as presented includes provision for scenarios of preventive actions (interventions).

Other elements of the DIAL computer programme relate to the necessity for a proper output and the specific matrix operation carried out. Thus the preparation of the lung cancer model required the building of files specifying the states of the model, the state variables of the compartments, the transition rates, and the initial occupancies of the compartments.

Results of the simulation runs were carried out to the year 2003 for Czechoslovakia using data from a recent smoking survey. Lung cancer incidence and prevalence data were also available. The population data were official figures. Transition rates between the compartments were based on recent studies.

The authors presented tables of a baseline run (without scenarios of intervention) to be compared with the results of a scenario in which the transition to smoker from non-smoker were zeroed out.

The results of the calculation indicated that projections of the assumed change are not so simple as might be supposed, possibly due to initial occupancy assumptions and the resulting initial transitions. The second important point is that early concerns about simulation responses to minor changes were not justified and that the relationship in the seemingly simple model are complex and surprising.

The authors presented the completed LCA designed model to forecast mortality and morbidity of lung cancer. The philosophy of the model is identical with the one using the general DIAL modelling tool. The LCA model has been designed with the aim of easy usage. The user interface is based on windows and pop-up menus requiring minimal skills in computer interaction.

2.3 The compartment model for diabetic population projection, by Dr F. Hauser and Dr M. Andel was presented. Diabetes is said to increase the hazard coefficient of risk variables for other diseases. Consequently, an increase of diabetes prevalence will have implications of increasing mortality and adverse effects on population health. The proportion of diabetics is increasing for unknown reasons in many places throughout the world and is very high in some populations such as in Mauritius and among the Pima Amerindio in Arizona. It is thus important to plan for the effects of increases. The objective in this paper was to project incidence, prevalence and mortality of the disease, specifically to project incidence and mortality to deduce prevalence and the mortality burden.

The diabetes sub-population derives from MULTISPOM population projections which are used as exogenous variables to provide the pool of persons at risk for diabetes using a multicompartiment system with rates set by external variables, when appropriate. Two main sub-populations of diabetics are recognised and the flow through the 3 compartments over age and from the non-diabetic compartment to the two diabetic compartments are governed by rate coefficients which are sex and age-specific as are the mortality and incidence coefficients.

Transit rates between sub-populations are age-sex-specific incidences and mortalities. All-cause mortality of the general population is from official statistics, while incidences were obtained by indirect standardisation of the German Democratic Republic health statistics data adjusted for differences in diabetes type classification. Diabetic mortality rates are from Danish and US longitudinal studies. Fertilities were estimated by expert opinion. Risk factors are not yet included. Most information is on obesity and a suitable risk function expressing the influence of Type II (NIDDM) incidence is sought.

Diseases not leading directly to death should be modelled on an epidemiological basis by morbidity models (diabetes, hypertension, cholelithiasis, cataract, etc). Morbidity models also allow further elaboration of consequences for health services need and for problems of disability and quality of life. Research in this direction should be recommended.

Attention should be paid to mortality risk factors as well as to incidence risk factors. Typically the latter factors are specific for both Type I and Type II diabetes while the former factors are the same for all diabetics and for non-diabetics (although they are different from CVD mortality risk factors).

The cognitive function of modelling should be promoted in the field of morbidity and mortality models. This implies the creation of models incorporating as much current knowledge of etiology as possible. This approach can, among other things, direct the orientation of future epidemiological studies and shape their design to efficiently test the proposed hypotheses.

2.4. Some methodological problems of the simulation of epidemiological problems were presented by Dr M. Kotva. His paper inspects the simulation of the epidemiological process in a way very different from the rest of the papers of the working group. From the author's point of view, most, if not all of the models for epidemiological simulation are described as not validated. The author focuses on the motion of systems, i.e. the changes in and of a system over time. To validate a simulation model several tests must be applied, the first one being the faithfulness of the simulation model to past observations, i.e. we must be able to forecast past values from prior initial conditions. Additional tests include seeking for implications of the simulation in aspects not used in setting up the hypothesis on which the simulation is based and verifying their truth (or falsity). These experiments can extend thought experiments in process of cognition. The difficulty is making realistic tests of the composite hypotheses set up for epidemiological simulation, particularly in chronic disease, prompts the questions:

(1) is it suitable to use unverified simulation models in the study of such diseases?

(2) will it be possible to advance the verification of the simulation hypotheses?

The author's answer to the first question is that such models may be used if their use is accompanied by a proper statement of their not-validated status. His answer to the second question is yes, even if for the time being the only way is to use such models for prognostication. Only the availability of comprehensive data on the status and trends on the health of the population can improve the possibility to verify simulation models. This implies the need for building appropriate information systems at the primary health care level.

2.5 Dr R. Capocaccia presented the approach which allows to estimate the cause-specific disease incidence on populations where only cause-specific mortality and survival data are available. An application of both a simple direct calculation and a maximum likelihood estimate were presented for cancer mortality in the Italian population.

The results of a model application to female breast cancer were discussed. The possibility of using the model to project incidence levels was also considered.

These techniques were seen by the working group of significance for modelling of morbidity in those situations when only cause-specific mortality and survival data are available to the modeller.

2.6 Dr M. Heliövaara presented a report on coronary risk factors as predictors of work disability and mortality. This longitudinal study, linked baseline risk factor measurements with follow-up work disability and mortality data from health insurance records over a 10-16 year period in a sample of 41 889 males and females from 25 to 64 years at entry. Various cardiovascular risk factors were estimated as predictors of total mortality, cardiovascular mortality and work disability using population attributable risk fractions for cigarette smoking, systolic and diastolic blood pressure, total cholesterol and body mass index. Age, sex and disability and disease differentials were found in the predictive power of the risk factors. While smoking and blood pressure were seen as powerful predictors of CVD and work disability, cholesterol was of limited predictive value for non-CVD mortality or work disability. Body mass index was an important predictor of work disability in women due to osteoarthritis. It was thus seen that different diseases or functional end-points were differently predicted by common risk factors for cardiovascular diseases and that this should be taken into account when considering a "generalized" morbidity or mortality function.

2.7 Mr J.E. Dowd presented an example of a model developed by Woodbury, Manton, Stallard and Dowd which modelled cause-specific mortality risk in males as a function of male risk factor mean levels which were modelled to change over time according to a linear autoregressive process which contained an error term representing diffusion of the auto and cross-regression effects. The dynamic equation was subject to mortality selection from all causes. The age and cause-specific mortality function was quadratic in the risk factor levels and was multiplied by an age-related Gompertz function which modelled the cause-specific hazard to national cause-specific mortality changes with age.

The risk factor dynamics were initially determined from the 20-year Framingham male follow-up information while the mortality quadratic hazards were modelled from data from Framingham, the Finnish Seven Countries and Kaunas male mortality data for cardiovascular diseases, cancers and residual diseases. The risk was projected to a cohort between 30 and 100 years of age, by means of multiple cause survival functions. It was demonstrated how this model could be adjusted to the situation from another country (Mauritius) by using risk factor levels and their variances from a 1987 Mauritius survey and the appropriate Gompertz adjustments to the mortality hazards computed from Mauritius national cause-specific data. The model generated predictions of man-years of life lost or gained, and indirect costs due to loss of life due to risk factor levels. These measures were adjusted to Mauritius population structure and per capita gross national product.

2.8 Dr L. Gunning-Schepers reported on PREVENT, a model which estimates the health benefits of prevention on risk factor prevalence in a population. In addition to using known epidemiologic measures of effect, several added elements allow population-based changes, trends and impacts to be measured in a more relevant and realistic way for health planning purposes. These events include:

(a) a time dimension over which risk factor exposure develops changes and impact on mortality from one or more diseases. Latent periods before risk factor exposure impact on mortality and lag times before risk factor reductions achieve maximum effect are included;

(b) a multi-factorial representation of risk factor-disease interaction where one risk may influence the mortality of many diseases, and a single disease may be influenced by many risk factors;

(c) a dynamic population background where demographic changes in the population covering the projection period are considered and intervention changes are measured against the mortality levels brought about by already established trends in the prevalence of risk factor values for the cohort in that population as measured by current and past risk factor levels and changes.

Intervention results are measured in such life-table based outcome parameters as: total mortality and disease-specific mortality (number and per cent of population), mortality difference, potential years of life gained, actual years of life gained, survival to various ages and expectations of life at birth.

The model runs on MS-DOS microcomputers under an easily understood and used menu system, and can be run by persons having little microcomputer experience. The relative risks used in the model are based on a synthesis of international epidemiological studies, while the "baseline" risk factor prevalences may be added from local experience in a specified format.

Dr L. Gunning-Schepers reported that experience with this model in national health planning exercises in the Netherlands had been useful in determining the degree to which goals and targets set by health planning scenarios could be achieved by various prevention strategies. The programme is now being made available to regional health planners in the Netherlands as a tool for health planning at the local level. A demonstration of the menu driven features of the model was given on a PC.

Two types of issues were raised in the discussion. The first concerned the data used as input in the model: how were the historic prevalence data collected mostly by literature search on relevant epidemiological data and again with a process of piecing together data from different age categories.

The second discussion point mainly centered around the steps necessary to ensure that such models are really used for policy making purposes: the credibility of the data input, the ability to see the logic behind the calculation method (the "correctness" of the model, earlier alluded to by Dr Kotva, but in this case the correctness in the eyes of the potential user who may not have the same mental model of the risk/disease process as the model builder) and finally the user friendliness of the man/computer interface.

2.9 Dr A.A. Holt made an informal presentation of modelling of disease in the Department of Health, London. There was an attempt to model in two areas:

- cervical cancer screening
- smoking.

The models were to cover the effect of screening in the first case and effect of intervention in the second with a view to national policy formulation.

The smoking model has two parts: impact of interventions (e.g. advertising, restrictions, taxes) on a number of smokers and then smoking to mortality or life years losts.

Although the model was not very successful, these points emerge:

- (i) need for subjective input from experts;
- (ii) difficulty in getting data on behaviour and processes in right form (or consistent when several sources are available);
- (iii) complexity of model, meant only trained people could use it;
- (iv) complexity of model made interpretation difficult even if the user was trained.

The cervical cancer model was more successful and endeavours were acceptable to Policy Division. Again the model was more complex than it needed to be - only 3 to 4 basic factors were really relevant.

2.10 Dr A.I. Michalski presented a model developed by him and Dr A. Yashin. The model is based on the assumption of probabilistic transitions between the different states. In this case the mean time which a person stays in "good health" state is the "health life expectancy". The morbidity is the rate of transition from "good health" to "ill" state. This morbidity is a latent morbidity, it differs from registered morbidity in population because it takes into account latent ill persons. The probabilistic relation between cause-specific mortality, total mortality in population and latent morbidity is used for estimating the last. The estimate of latent morbidity is used for the estimation of "good health life expectancy" and disease prevalence in population.

The model equations can be set up to cover a variety of systems, such as that used by Dr Capocaccia to estimate the disease incidence.

A system describing the end stages of cancer morbidity and mortality, which dealt with the latency, problem of unobserved carcinogenesis, was presented and demonstrated on the PC.

3. Comparison of models, including the ability to serve for the health planning process

The models presented may be classified according to the following dimensions:

- (a) mathematical structure;
- (b) data inputs needed for minimum and maximum outputs;
- (c) the epidemiological process modelled, including disease and risk factor interactions, demographic structure;
- (d) the form and content of outputs of the model;
- (e) the class of health planning problems addressed by the model.

While data inputs to some extent are shown in tabular form in Annex 1, a complete multidimensional classification was not attempted. WHO headquarters (Division of Noncommunicable Diseases) agreed to produce a more elaborate classification and circulate it to participants with a detailed commentary on the content and interrelations between dimensions.

It was thought useful to attempt a future comparison of the ability of each process model to address a generic type of health planning scenario constructed to include the range of interests, concerns and expectations that such a model may be confronted with to be considered as a useful tool or adjunct to a planning process. It was suggested that an artificial but reasonably realistic scenario be constructed at the Institute of Public Health and Social Medicine, Erasmus University (Dr L. Gunning-Schepers) and circulated to the workshop participants. Each participant is to prepare a description of how their model will address the scenario, what data resources are needed to produce output which can serve to aid recommendations for appropriate planning action, and to indicate what form the computer output will take and how the output can be used to address questions raised by the scenario. The results could be used for training epidemiologists at pregraduate or postgraduate level in order to find out the kind of data needed to attain answers derived from proposed scenarios.

4. Availability of epidemiological background data for risk modelling

Dr W. Morgenstern described the data sets of the ERICA study available at the WHO Collaborating Centre at the University of Heidelberg (Federal Republic of Germany). He stated that appropriate sets of data from the centre's archives could be made available to those centres in the Working Group interested in their use for modelling purposes. The characteristics of these data are described in the European Heart Journal (Volume A, Supplement 1, August 1988).

Other data sets, both cross-sectional and longitudinal, were briefly described, among them those of the WHO, MONICA, CINDI, INTERHEALTH studies. A large number of other international longitudinal epidemiological data sets were noted, whose availability to individual investigators was not known. It was decided that WHO headquarters (Division of Noncommunicable Diseases) should prepare a questionnaire to be sent to its Collaborating Centres in

Noncommunicable Diseases, to determine the availability of data sets of specified content which could be useful to modelling activity of the Working Group. An annotated listing will be distributed to the Working Group.

The population data used for modelling and/or available in the participating centres are indicated in Annex 3

## 5. Concept of generalized risk function

Dr R. Prokhorskas introduced the idea of a generalized quadratic risk function for noncommunicable disease which could be used to compute risk of disease in countries where prevalence of a specified set of risk factors was available on an age and sex-specific basis but where no longitudinal studies had been carried out to determine risk factor-risk relationships. This risk function had been studied and discussed in a previous (Working Group on the Assessment of the Relationship between Common Risk Factors and Mortality, Heidelberg, 1989 - EUR/ICP/HST 112).

After detailed discussion of the conditions under which this function could be most validly used and after recognition that potentially there are multiple risk factors for each disease and that a single risk factor may affect more than one disease, the Working Group concluded that:

There is a need for a generalized relative risk function which can be used on an age, sex and cause-specific basis to estimate risk in those populations with generally recognised epidemiologic similarities to that of the donor populations. This risk function may be used with prevalence data on the same set of risk factors from each target country to compute age, sex and cause-specific risk of disease in the target country. Under certain assumptions these cause-specific risk functions may be combined to produce an estimate of mortality risk from all causes. When populations are seen to be epidemiologically heterogeneous, attempts should be made to stratify them into mutually exclusive homogeneous classes where each class has its own donor populations from which parameters are derived for the target populations in the same stratum. Wherever possible, efforts should be made to pool, within each homogeneous stratum, results from studies which have a common set of risk factors to derive more stable estimates of the risk function parameters.

## 6. Present and future modelling activities in the participating centres

### 6.1. Rotterdam

(1) Continued implementation of the PREVENT model for health policy making at the national, regional level for evaluation of the Netherlands' targets and for HFA targets, and at the international level for policy making and for evaluation of intervention projects.

(2) Working on the elaboration of the present model for socio-economic sub-groups.

(3) Development of comprehensive morbidity and disability models. The comprehensive model that is being developed at the Institute of Public Health and Social Medicine, Erasmus University, has the following characteristics:

- (i) Set of disease-specific models of which the main results can be combined in a core model.
- (ii) Use of simulation techniques (comparable to PREVENT Model).
- (iii) Realistic demography, not a theoretical cohort. Possibility of modeling population heterogeneity.
- (iv) Disease part of the model comprises incidence, survival and mortality. The disease process is defined by disease-specific stages which cannot be aggregated over different diseases, and simultaneously by very global health states, which can be aggregated over different diseases.
- (v) Health care utilisation and its costs are specified for the different diagnosis groups and health care sectors.
- (vi) When possible, intervention effects will be modeled, depending on availability of information.
- (vii) Financing by Ministry of Health.
- (viii) Organisation: Three sub-groups of researchers:
  - (a) modeling group (Head: Professor Habbema)
  - (b) epidemiology and effectiveness group (Head: Professor van der Maes)
  - (c) economics group (Head: Professor Rutten, coordination of total project: Professor van der Maes).

## 6.2 London

1. Use of population projections of Health Care usage for health care financing.
2. Health resource allocation models incorporating mortality data (document available).
3. Possibly more modelling work on Health Prevention and Promotion - although the PREVENT model may cover the needs.
4. Population local area maps of morbidity and mortality data from map-linked databases.

5. There are several models in use at local level in the NHS:
  - Balance of care (for elderly)
  - Performance Indicators
  - AIDS Service Planning
  - Decision Support for Districts (Health Care Purchasing)
6. In each case user intervention is allowed in terms of data, parameters and factors to be included/excluded. It is important that models are simple, understandable and generally linear. Graphic and tabular results on PC screen by far the best approach. Local databases encouraged, but fall back national data used as default option;
7. Putting models out to use implies a back-up on software, training and ideally interpretation of the first results.

### 6.3 Duke University

1. Multi-state computation of expectations of life in different morbidity, disability and health care states.
2. Use of multi-dimensional disability measures as risk factors in the stochastic process model of disease.
3. Population projections of chronic disease for all UN countries using cross-sectional combinations of cohorts.

### 6.4 Moscow

1. Examine assumptions of population distributions which represent heterogeneity.
2. Develop models with new data sets.
3. Use the probability model for estimation of healthy and active life expectancy.

### 6.5 Prague

1. Use disease incidence and prevalence models to interpret data and to project trends.
2. Create disease models which incorporate etiological and biological models and assess data needs.
3. Apply the morbidity models to assess the need for various levels and kind of health care in the population.

### 6.6 Rome

1. Develop further applications of the present models, including further cause-specific cancer models, CHD models, and extension to other diseases.

2. Make international comparisons.
3. Output model results to health service research problems.
4. Small area research (with Milan University) on disease rate from 600 health service areas in Italy.

#### 6.7 Helsinki

1. Define end-points incidence disability and mortality from chronic diseases along with related risk factors and develop model.
2. Consider precursors and consequences of mental diseases.
3. Further epidemiological research on early retirement and work disability.

#### 6.8 Bratislava

1. Extend models with ERICA data.
2. Extend models to incorporate disability and economic data.
3. Link mortality and morbidity patterns with national and EURO health indicators.
4. Collaborate with IIASA on international mortality patterns using life-table cause-specific mortality distributions with cause eliminations.

#### 7. Main conclusions and recommendations

1. There is a variety of already developed models in morbidity, mortality, health resources and related fields but only a small part of them can be used as a tool in the real health planning process.
2. To bridge the gap in communication between modellers and health planners, attention should be paid to the practical application of the models designed. Efforts should be made to show the usefulness of models in health planning. This would imply the use of either simple models or models in which the logical basis for results and the presentation clearly demonstrates relevance to the planning problem.
3. Each national modelling group should be in contact with their national health policy planning counterparts to explore the means by which contacts can be established and maintained. WHO will attempt at the international level to establish forums by which modellers and health policy planners can meet and discuss the possibilities of joint activities.
4. WHO should continue to expand its activities in the development, classification, evaluation and where possible dissemination of models which are of relevance to health planning process.
5. In the presence of data shortage there is a need for generalized relative risk functions which can be used in populations with generally recognized epidemiological similarities where prevalence of a specific set of risk factors is available but where no large longitudinal studies have been carried out to determine the risk factor - risk relationship.

It was recommended that regular meetings of the Working Group be held and that plans for a meeting in late 1990 be contemplated.

Annex 1

Population data used for the modelling and/or available in the participating centres

Centre	Population Data (Demography)	Projection of Populat.	Risk Factor	Mortality Data - Cause-s specif.	Registers of Disease	Special Clinical and Epid. Studies	Historical Trend Data	Other Specify
			<u>Preval.</u>	<u>Means</u>	<u>Incid.</u>	<u>Survival</u>		
HELSINKI	YES	YES	YES	YES	YES	CANCER AND CROSS-SECT. STUDIES, TIME-TREATS DIS.	BOTH LONGITUDINAL AND CROSS-SECT. STUDIES, TIME-TREATS	YES, FOR SEVERAL DISEAS. AND RISK FUNCTIONS
MOSCOW	YES	YES	YES	YES	YES	LONGITUDINAL DATA	LONGITUDINAL DATA	YES
BRATISLAVA	YES	YES	NO	YES	YES	CANCER JUU, PM, RHEUMAT, DISEAS.	STROKING, IDH	NO
								HEALTH CARE DATA (3EDS) PHYSICIANS... 40 YEARS
PRAQUE	YES	NO	YES	YES	NO	INCIDENCE OF CLIN. COMPLICAT. AND RISK FACTORS COMPLICATIONS	INCIDENCE OF CLIN. COMPLICAT. AND RISK FACTORS COMPLICATIONS	YES
								ALL-CAUSES MORT. FOR HEALTH STATE CATEGORIES

Centre	Population Data (Demography)	Projection of Populat.	Risk Factor	Mortality Data -Cause Specif.	Registers of Disease	Survival	Special Clinical and Epid. Studies	Historical Trend Data	Other Specify
ROTTERDAM	YES	NO	YES	NO	YES, AND TOTAL MORT.	NO	YES, FOR OTHER RELATIVE RISKS	YES	TIME LAPS ASSOCIAT. WITH RELAT. RISKS
ROME	YES	NO	NO	NO	YES	YES	NO	YES	
LONDON	YES	YES	YES	NO	YES	NO	YES - FOR SPECIFIC STUDIES	YES	
DUKE UNIVERS TTY (US A)	YES	YES ALL UN COUNTRIES	NO	YES	YES	NO	YES LONGITUDINAL	NO	GMP OF ALL UN COUNTRIES
MHD/EURO, ODPENHAGEN	YES	YES	YES	YES	YES	NO	NO	NO	
KAUNAS	YES	NO	YES	YES	YES	CANCER	1. KRIS 2. PROSPECTIVE INTERNATIONAL STUDY ON JUVEN. HYPERT. 3. MONICA	YES	

Annex 2

List of working papers and background material

ICP/HST 128/1	Provisional list of working papers and background material
ICP/HST 128/2 Rev. 1	Scope and purpose
ICP/HST 128/3	Provisional agenda
ICP/HST 128/4	Provisional programme
ICP/HST 128/5 Rev. 1	Provisional list of participants
ICP/HST 128/6	Mortality and morbidity models - M. Rusnak
ICP/HST 128/7	Mortality and morbidity projections: Lung cancer - M. Rusnak, S. Scherbov and B. Cider
ICP/HST 128/8	Prevent, a model to estimate the health benefits of prevention - Louise J. Gunning-Schepers, Jan J. Barendregt, P.J. van der Maas
ICP/HST 128/9	The concept of the generalized risk function - R. Prokhorskas
ICP/HST 128/10	Morbidity models for the analysis of chronic disease mortality - R. Capocaccia
ICP/HST 128/11	Some methodological problems of the simulation of epidemiological problems - M. Kotva
ICP/HST 128/12	Epidemiological data for the diabetic population projection - F. Hauser, M. Andel
ICP/HST 128/13	Coronary risk factors as predictors of work disability and mortality in Finnish adults - M. Heliövaara

Annex 3

LIST OF PARTICIPANTS

TEMPORARY ADVISERS

- Dr Richardo Capocaccia  
Istituto Superiore di Sanita, Laboratory of Epidemiology and  
Biostatistics, Rome, Italy
- Dr Bohus Cider  
Center of Biomedical Cybernetics, Medical Bionics Research Institute,  
Bratislava, Czechoslovakia
- Dr Louise Gunning-Schepers  
Directorate General of Health, Staff Bureau for Policy Development,  
Ministry of Welfare, Health and Cultural Affairs, Rijswijk, Netherlands
- Dr Frantisek Hauser  
Institute of Social Medicine and Organization of Health Services,  
Prague, Czechoslovakia
- Dr Markku Heliövaara  
The Social Insurance Institution, Research Institute for Social  
Security,  
Helsinki, Finland
- Dr Andrew A. Holt  
Director of Operational Research Services, Department of Health and  
Social Security, London, United Kingdom
- Dr Milan Kotva  
Institute of Social Medicine and Organization of Health Services,  
Prague, Czechoslovakia
- Professor P.J. van der Maas  
Department of Public Health and Social Medicine, Erasmus University  
Rotterdam, Rotterdam, Netherlands
- Dr Anatoli Michalski  
Institute of Control Sciences, Moscow, USSR

Dr W. Morgenstern  
Klinikum der Universität Heidelberg, Abteilung Klinische Sozialmedizin,  
Heidelberg, Federal Republic of Germany

Dr Martin Rusnak (Chairman)  
Centre of Biomedical Cybernetics, Medical Bionics Research Institute,  
Bratislava, Czechoslovakia

Dr Sergei Scherbov  
International Institute for Applied System Analysis, Laxenburg, Austria

Professor M. Woodbury (Rapporteur)  
Center for Demographic Studies, Durham, USA

OBSERVER

Dr A. Egnerova  
Postgraduate School of Medicine, Bratislava, Czechoslovakia

Dr A. Zarborskis  
Central Research Laboratory, Medical Institute, Kaunas, Lithuanian SSR,  
USSR

WORLD HEALTH ORGANIZATION

Regional Office for Europe

Dr R. Prokhorskas (Secretary)  
Statistician, Epidemiology and Statistics

Headquarters

Dr E. Chigan  
Director, Noncommunicable Diseases

Mr J.E. Dowd  
Epidemiological and Statistical Methodology