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computer

LONG-TERM PLANNING FOR HEALTH CARE OF THE ELDERLY^a

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^a A videofilm report of the Meeting is available as a complement to the present text.

Note

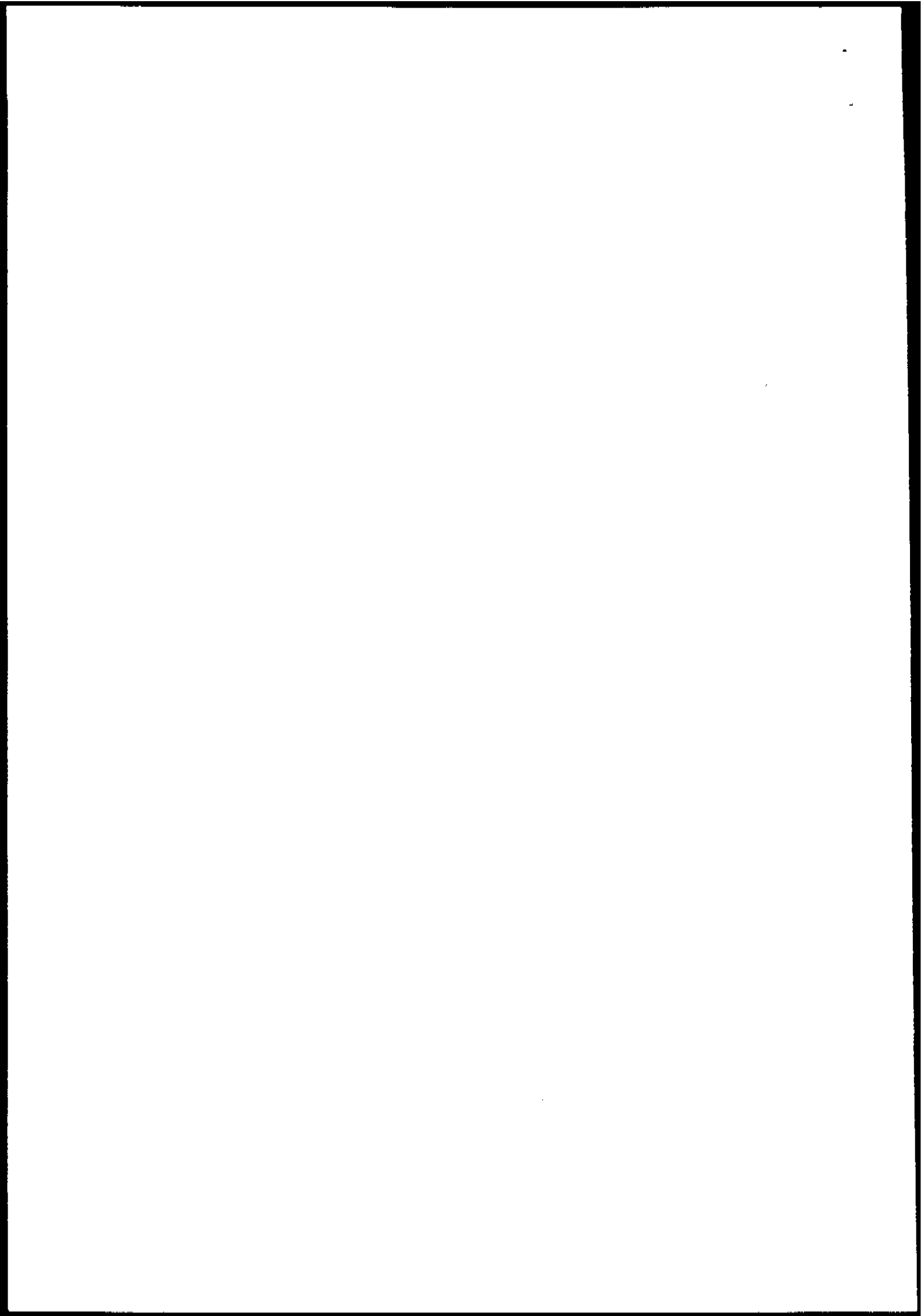
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The views expressed are those of participants in the Workshop and do not necessarily reflect the policy of the World Health Organization.

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^a World Health statistics Quarterly, 37 (1984) pp. 271-280. Special issue on projecting health trends.



1. Introduction

The World Health Organization approach to health planning^a - basically a comprehensive, long-term and strategic planning approach - can be applied to specific problem areas such as the care of the elderly.

The focus of national health plans is now on a long-term horizon, the year 2000, by which date the number of elderly persons will have grown faster than any other population group. Long-term planning for health of the elderly must therefore begin now, utilizing the best available data, techniques and tools.

In 1982, the World Health Organization commissioned the development of a computer-assisted planning model (CAP). The model, developed by Johns Hopkins University School of Public Health, displays implications for the health sector of projected demographic trends in the elderly population by the year 2000.

These displays permit government health officials, health professionals and administrators, elderly persons and other interested groups to grasp quickly the dimension and implications of the aging of the population. The CAP model illustrates how future-oriented analysis of the health problems of the elderly can provide a basis for rational planning.

Initial application of the CAP model has been in the Canadian provinces, Norway and the United States of America (Annex 1) and, over the period 1984-1987, the World Health Organization has undertaken to support such policy analysis and planning in 16 countries. A meeting was therefore held in Oslo, Norway, which was attended by participants from countries which have indicated interest in the computer-assisted planning project. The participants were asked to make suggestions for the further refinement of CAP, based on their national experiences, the aim being to have a generalized computer-assisted planning programme for care of the elderly which can be utilized with minimum difficulty in those countries which are interested in doing so at local, regional and/or national level.

2. Further developments in computer-assisted planning

2.1 Objective

The Computer Assisted Planning (CAP) project is at a critical stage of development^b. Since the objective of the meeting was to seek advice of participants regarding future development of CAP, the following questions were raised:

- What can be done to improve CAP, both regarding presentation and content?
- Is CAP a useful tool for getting people involved in attainment of planning goals?
- Does it facilitate participative planning?
- Does it encourage alternatives and innovations?
- Does it permit monitoring target attainment?
- Does it encourage us to be cost efficient?
- Does it improve our performance as managers, planners, communicators, and teachers?

The goal of the project is to have 16 countries using CAP by 1987.

2.2 Context scenarios

In the Netherlands, long-term planning interest is in developing "context scenarios" for changes in the health system by the year 2000. The Netherlands has established a steering committee to investigate selected aspects of the health system. This steering committee oversees the work of four committees including a committee on aging. A research group is assisting the committee on aging which will report preliminary results by July 1984.

The major task of this committee is to examine autonomous changes in health of the elderly and to develop context scenarios based on these autonomous changes. These autonomous changes include, for example, breakthroughs in prevention, treatment or rehabilitation, especially in chronic

^a Managerial Process for National Health Development, Guiding Principles, World Health Organization, Geneva, 1981, "Health for All" Series, No. 5.

^b see Health Planning for the Elderly, Report of a WHO International Workshop, Budapest, 8-12 November 1982, World Health Organization, 1983 (document IRP/HEE 115).

conditions affecting the health of the elderly. Other autonomous changes to be explored include a changing economic situation such as various levels of economic growth and changing resource and utilization patterns, for example, reduction in nursing home capacity. Implications of these autonomous changes by the year 2000 on the health system of the elderly will be modelled. Regional scenarios will also be developed. It was suggested that CAP could be useful in this effort by demonstrating context scenarios based on the changes, and presenting results in colour graphic displays.

2.3 Policy simulation

In the United Kingdom, a 1981 document entitled "Care in Action" proposed a major shift in health policy. This policy will emphasize primary health care, home and community-based care of the frail elderly. Several major policy issues are raised by this new emphasis, such as:

- How can manpower be shifted to support care at home?
- Can patients be returned and maintained in a home setting by means of a hospital admissions policy which guarantees prompt hospital admission of an elderly person upon the recommendation of the general practitioner?
- How do budgetary restrictions on social services affect National Health Service expenditures?
- What mix of long-term care services is most effective in improving health and social outcomes for the elderly?
- What are the needs of the elderly and how are they met?

It was felt that microcomputers could be helpful in analysing some of these policy issues.

Iceland has similar interest in policy simulation using CAP. Health policy officials and planners in Iceland are ready to apply CAP in Iceland, in mid 1984, because of recently-established legislation on the integration of social and health services. This has a "sunset" provision and the legislation will need to be renewed in the light of actual practice. Policy issues of interest to Iceland are:

- How the newly established Construction Fund should be allocated among alternative forms of institutional care?
- What are the operating cost implications of investment in different forms of institutional care?
- Which forms of institutional care are most effective in meeting needs of the elderly?
- How can Iceland achieve greater equality in the distribution of resources?
- How to meet the needs of the elderly, for example, for home help services in small communities?

By facilitating long-term planning, CAP could be useful in obtaining answers to these questions.

The CAP tool has been helpful in Norway in analysing alternatives and in developing scenarios for new strategies for caring for the elderly. Norwegian health officials are concerned about a projected decline in the elderly between the years 2005 and 2020. It is important to analyse the cost of alternative mixes of institutions and home-based services to meet the needs of the elderly over this time period. The Norwegian National Institute of Gerontology is interested in the projection of nursing home requirements under alternative scenarios. Norwegian health planners should like to extend the CAP tool to county medical officers and chief hospital administrators. To do so, they suggested that CAP be rewritten to increase its ease of use and to make it more flexible in analysing alternatives.

2.4 Model development

The representative of the International Institute of Applied Systems Analysis (IIASA) indicated that a newly developed research plan covers demographic methodological research, research on socioeconomic consequences of aging, and research on medical and health aspects of aging. Issues of high priority to IIASA include analysing the mix of support that would come from families, private savings, public pensions. The intersectoral aspects of CAP are of particular interest in this context. Another major thrust of research of IIASA will be investigation of the

interrelationships between morbidity and mortality. In the CAP model mortality is assumed to be exogenous. It was suggested that CAP might be modified as a result of the research of IIASA. The IIASA research group will also focus on the determinants of productive life expectancy, or disability-free life expectancy. It was suggested that CAP might also take these approaches.

2.5 Special purpose versus commercially available software

The participant from Sweden stressed the importance of special purpose software such as CAP. He noted that commercial software is a closed package and cannot be modified by users. He felt CAP was useful because it permitted users to modify the software package itself to meet their unique needs. It could also be easy to understand and use, and avoids the complexity of a commercial software package. He suggested that WHO could best serve the Member States by supporting the future development of packages such as CAP and making these available to all interested persons.

2.6 Users consortium

The participant from Sweden also stressed the need for communication among users of computer-assisted planning software. A Users Consortium would be helpful in promoting exchange of information among users and providing a mechanism for exchange of modules and procedures.

3. Recommendations

3.1 Nordic CAP cooperative network

It was suggested that a Nordic CAP cooperative network be established including: Finland, Denmark, Iceland, Norway and Sweden to facilitate CAP in the Nordic countries. One way for doing this might be through NOMECSO. NOMECSO currently makes medical statistical reports available to Nordic countries and recently has begun to collect statistics on health of the elderly in Nordic countries.

Sweden has developed a QUEST software package for epidemiological investigations in developing countries and this is one example of a cooperative effort between countries in developing "health-specific" microcomputer software.

3.2 Further development of CAP

Participants stressed the need for further development of CAP. This will include informational material including a user manual, data entry manual, information on projection assumptions. Modifications should be made to make it even more user friendly. Users should be able to interact easily with the data base and to change data and assumptions as in spread-sheet programmes (Annex 2). The software package should be extended to the IBM-PC and IBM compatible microcomputers. The CAP programme should be rewritten with separable modules which are carefully documented. CAP should be made easier to manipulate and should have a user friendly system with error messages and comment statements. The new version of CAP should follow the spread sheet format so that users can make changes easily and quickly. It should ideally involve stages which can be easily learned and used by key top health officials with a minimum of instructions, and followed with stages of increasing complexity available for more selected groups of technical health planners.

3.3 Learning modules

The representatives recommended that WHO support the development of learning modules and tutorial discs to accompany the CAP software package. This would make it possible for a wide range of health officials and health planners quickly to grasp CAP and apply it to their own situation.

3.4 User consortium

It was recommended that WHO establish a user consortium to share information among groups using microcomputers in health planning. This user consortium will be useful to share information and computer software packages and applications among all users.

3.5 International Association of Gerontology 1985 Meeting

It was recommended that a new version of CAP be presented at the 12-17 July 1985 meeting at the International Association of Gerontology to take place in New York. This should give potential users throughout the world an opportunity to see CAP in action and obtain additional information on its usefulness for their countries. It was recommended that the context scenarios research conducted in the Netherlands should also be presented at the 1985 meeting.

Annex 1

**COMPUTER ASSISTED PLANNING:
APPLICATION TO HEALTH OF THE ELDERLY
BY THE YEAR 2000**

Karen Davis*

Introduction

Health implications of the greying of nations

Policy officials and health planners face a major challenge from the growing size of the elderly population between now and the year 2000. Recent articles (1-5) highlight the implications of this changing demographic composition of the population for the health sector. The number of people with chronic conditions will rise, utilization of health services, especially hospital and institutional long-term care facilities, will increase markedly, and expenditures to provide adequate care for the elderly will soar.

The facts regarding future demographic trends and their impact on the epidemiology of disease and health care utilization were highlighted in 1982, in documentation prepared for the United Nations World Assembly on Aging (6). In connection with this Assembly, the Member States of the World Health Organization (WHO) requested the Director-General to help countries anticipate changing age structures and to develop long-term plans that will help sustain the growing number of the elderly, in independence and dignity, within their own homes (7).

Policy makers, unfortunately, have few tools to assist them in selecting strategies for dealing with the health implications of an aging population. The task they face is how to alter current policies in such a way as to ensure that the elderly may live out their lives with dignity at a cost that is affordable to society. It seems likely that achieving this goal will require most countries to alter past practices and design new approaches for promoting the health of the elderly and providing health care.

Provision of microcomputer software packages to WHO Member States

To promote long-term planning for health of the elderly by the year 2000 a Computer Assisted Planning Software package (CAP) was developed for WHO Member States by researchers at the Johns Hopkins School of Hygiene and Public Health. The principal objective in developing this package was to tap microcomputer technology and provide health officials and planners with an inexpensive and easy-to-use tool, which can give a pictorial representation of major strategic issues in health policy analysis.

It was felt that leaders in the health field could themselves use this new tool to consider emerging trends and analyze alternative scenarios for future action. The device is interactive, in that users can select relevant questions and generate answers immediately.

The CAP package provides vivid colour graphic displays of the implications for the health sector of projected demographic trends in the elderly population. Projection models forecast the impact of the aging of the population on the

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**PLANIFICATION ASSISTÉE PAR ORDINATEUR:
APPLICATION À LA PROTECTION SANITAIRE
DES PERSONNES ÂGÉES D'ICI L'AN 2000**

Karen Davis*

Introduction

Conséquences sanitaires du vieillissement des nations

Les responsables politiques et les planificateurs de l'action de santé affrontent aujourd'hui un défi de taille puisque le nombre des personnes âgées ne va cesser de croître d'ici l'an 2000. Des articles récents (1-5) font ressortir les conséquences de cette évolution démographique pour le secteur de la santé. Le nombre de malades chroniques va augmenter, les services de santé, en particulier les hôpitaux et les institutions de soins à long terme, vont être de plus en plus utilisés, et il va y avoir explosion des coûts si l'on veut assurer des soins de qualité aux personnes âgées.

Les faits quant aux futures tendances démographiques et leur retentissement sur l'épidémiologie des maladies et l'utilisation des soins de santé ont été soulignés en 1982 dans la documentation préparée pour l'Assemblée mondiale des Nations Unies sur le Vieillessement (6). A l'occasion de cette assemblée, les Etats Membres de l'Organisation mondiale de la Santé ont prié le Directeur général d'aider les pays à prévoir l'évolution de la structure démographique et à dresser des plans à long terme afin de pouvoir laisser vivre chez elles dans l'indépendance et la dignité, les personnes âgées de plus en plus nombreuses (7).

Malheureusement, les décideurs n'ont que bien peu d'outils qui puissent les aider à choisir entre les diverses stratégies possibles face aux conséquences sanitaires du vieillissement de la population. Ce qu'il leur faut trouver, ce sont des moyens d'infléchir les politiques actuelles de façon que les personnes âgées puissent vivre jusqu'au bout dans la dignité, à un coût abordable pour la société. Pour y parvenir, il est vraisemblable que la plupart des pays devront s'écarter des pratiques suivies jusqu'ici et concevoir des approches nouvelles de la protection sanitaire des personnes âgées et des prestations de soins.

Fourniture de produits logiciels pour micro-ordinateur aux Etats Membres de l'OMS

Pour faciliter la planification à long terme de l'action sanitaire en faveur des personnes âgées d'ici l'an 2000, des chercheurs de la Johns Hopkins School of Hygiene and Public Health ont mis au point, pour les Etats Membres de l'OMS, un logiciel pour la planification assistée par ordinateur (PAO). Leur objectif essentiel était d'exploiter la technique des micro-ordinateurs et de donner aux responsables et planificateurs de la santé un outil peu coûteux et facile à utiliser qui puisse fournir une représentation visuelle des principaux axes stratégiques pour l'analyse des politiques de santé.

Il est apparu que les responsables de la santé pouvaient se servir de cet outil nouveau pour envisager les tendances qui se font jour et analyser diverses possibilités de scénarios pour l'avenir. Il s'agit d'un dispositif interactif dans le sens que les utilisateurs peuvent choisir les questions pertinentes et obtenir immédiatement des réponses.

Le logiciel PAO fournit de bonnes présentations graphiques en couleur des conséquences qu'auront pour le secteur de la santé les tendances démographiques prévues en ce qui concerne les personnes âgées. Des modèles de pro-

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health system. Policy analyses and simulations demonstrate the cost and impact of alternative strategies for caring for the elderly over time.

The software package was first developed for the United States of America and then adapted, for actual planning purposes, in the Canadian province of Manitoba and in Norway.

The package comprises a program disc, which generates a choice of coloured graphic displays plus a data disc containing a store of comprehensive data, for use with a transportable microcomputer.

The data disc for the United States is drawn from over 200 different data sources and contains information on demographic characteristics of the population, socio-economic status, the economy, labour force participation, social security, housing, social services, health status, health resources, health utilization, long-term care, mental health care and health expenditures. The Manitoba data disc provides rich data on long-term care services for the elderly within the provincial health plan. Data on the Norwegian disc are disaggregated at the county level to make inter-county comparisons possible.

Development of the Computer-Assisted Planning package

The CAP package was developed specifically for the International Workshop on Health Planning for the Elderly, convened by WHO in Budapest in 1982. The workshop participants reported that the CAP model "encourages the formulation of quantitative predictions of trends under current practices contrasted with changes that would flow from better target attainment" (8). This is a concept which the Organization's Member States in the European Region are putting into practice. Within a common health policy for attaining the goal of health for all by the year 2000, a set of quantified targets has been developed as a tool for individual countries to allow them to monitor their progress towards the health-for-all goal (9).

Methodology

The CAP package is based upon a demographic model of the age and sex distribution of the population over time. Standard projections for future years are based on official government estimates of the prospective population by age and sex cohort. This includes official assumptions regarding net immigration, fertility rates and mortality rates. However, the CAP model permits alternative mortality rate assumptions. In the case of the United States alternative projections are available for mortality rate assumptions such as future declines in overall mortality twice that of the official forecast, one-half the rate of the official forecast, or no change in the mortality rate.

The standard projection is to the year 2000, in keeping with the overall WHO theme of health for all by the year 2000. However, projections are available at 5-year intervals beginning in 1985, and continuing beyond 2000, depending upon the availability of official forecast data and the usefulness of longer-range projections. For example, Norwegian data are projected at 5-year intervals to 2025, and United States data are projected at 5-year intervals to 2030. Canadian projection data are based on census years from 1981 to 2001, in 5-year intervals.

Projections of the impact of aging on the health system incorporate several methodologies. In those areas for

jections prévoient l'impact du vieillissement de la population sur le système de santé. Des analyses et des simulations de lignes d'action font apparaître le coût et l'impact dans le temps de diverses stratégies possibles pour la protection sanitaire des personnes âgées.

Le logiciel, tout d'abord mis au point pour les États-Unis d'Amérique, a ensuite été adapté aux besoins de la planification dans la province canadienne du Manitoba et en Norvège.

Le logiciel comprend un disque de programme, qui produit une série d'affichages graphiques en couleur, plus un disque de données contenant une mémoire de données exhaustives, à utiliser sur micro-ordinateur portable.

Le disque de données pour les États-Unis, établi à partir de plus de 200 sources de données différentes, contient des renseignements sur les caractéristiques démographiques de la population, la situation socio-économique, l'économie, la participation de la population active, la sécurité sociale, le logement, les services sociaux, la situation sanitaire, les ressources en santé, l'utilisation des moyens sanitaires, les soins à long terme, les soins de santé mentale et les dépenses de santé. Le disque de données du Manitoba fournit de très intéressantes données sur les services de soins à long terme pour personnes âgées dans le cadre du plan provincial d'action sanitaire. Les données du disque norvégien sont dissociées au niveau comté de façon à permettre des comparaisons intercomtés.

Mise au point du logiciel pour la planification assistée par ordinateur

Le logiciel PAO a été spécifiquement mis au point pour un atelier international sur la planification sanitaire intéressant les personnes âgées réuni par l'OMS à Budapest en 1982. Les participants à l'atelier ont fait observer que le modèle PAO encourageait la formulation de prévisions quantitatives des tendances compte tenu des pratiques actuelles comparées aux changements qui résulteraient d'une meilleure réalisation des objectifs (8). Tel est le concept que les États Membres de la Région européenne sont en train de mettre en pratique. Dans le cadre d'une ligne d'action sanitaire commune visant à instaurer la santé pour tous d'ici l'an 2000, on a mis au point un jeu de buts quantifiés pour aider les pays à suivre les progrès réalisés en vue de la santé pour tous (9).

Méthodologie

Le logiciel PAO repose sur un modèle démographique de la distribution de la population par âge et par sexe dans le temps. Les projections types pour les années à venir sont fondées sur les estimations officielles de la population prospective par cohortes d'âge et de sexe, qui comprennent les hypothèses officielles concernant l'immigration nette ainsi que les taux de fécondité et de mortalité. Toutefois, le modèle PAO autorise d'autres hypothèses pour les taux de mortalité. Dans le cas des États-Unis, il existe différentes projections pour les hypothèses relatives aux taux de mortalité, par exemple, diminution de la mortalité générale double de ce qui est prévu officiellement ou inférieure de moitié, ou bien pas de changement.

La projection type est établie jusqu'en l'an 2000, conformément au mot d'ordre de l'OMS la santé pour tous d'ici l'an 2000, mais on dispose de projections à intervalle de 5 ans à compter de 1985 et au-delà de l'an 2000, dans la mesure où des prévisions officielles sont disponibles et où des projections à plus long terme sont utiles. Ainsi, les données norvégiennes sont projetées à intervalle de 5 ans jusqu'en l'an 2025 et les données des États-Unis jusqu'en l'an 2030. Les données des projections canadiennes ont pour base les années de recensement entre 1981 et l'an 2001, à intervalle de 5 ans.

Les projections de l'impact du vieillissement sur le système de santé intègrent plusieurs méthodologies. Dans les

which extensive studies have already been conducted, results of those studies are incorporated in the model. For example, projections of future physician supply in the United States are based upon a governmental study by the Graduate Medical Education National Advisory Committee (GMENAC) (10).

In the absence of specific studies, projections are most commonly based on past experience or trends. In the case of expenditures, econometric estimates of historical experience yield a prediction regarding future annual rates of increase in expenditures (adjusted for inflation). These constant dollar annual growth rates are then applied to yield future forecasts of per capita health expenditures by age group and type of health service.

Forecasts of morbidity levels in the population are most frequently based on the assumption that prevalence rates by age and sex cohort will stay constant over time. This is a controversial assumption. Gruenberg (11) and Kramer (12), for example, argue that the seriously disabled or chronically ill are now living longer and that the prevalence rate of disabling and chronic conditions will increase over time. Manton (13), on the other hand, argues that there is no evidence that the average health status of the elderly has declined in recent years, despite a very dramatic decline in mortality rates in the same group. In the absence of convincing evidence on this controversy, the prevalence of disability or functional limitation per person of a given age and sex cohort is assumed to be constant over time. The total level of disabling conditions in the population in future years is determined therefore by the growth of population cohorts. These assumptions can be readily modified in the CAP model if evidence is obtained of superior predictive assumptions for some or all conditions.

Given the rudimentary state of development of projection methodologies, projections, especially those looking far into the future, must be viewed cautiously. Technological advances could markedly alter these forecasts. Fertility rates could continue to decline markedly or could increase dramatically, greatly affecting the size of the work force supporting the elderly population. Immigration could take up some of the slack created by a declining younger population in industrialized countries.

Most importantly, projections assume that current policies will remain unchanged. One of the major purposes of the CAP model, however, is to simulate how alternative policies could affect the future course of the health system. If alternative policies are adopted, the situation projected need not occur. Thus, postponing retirement, redefining "old age", promoting healthier life styles, or shifting resources toward primary care could all change the future course set forth in the model.

Policy analyses and simulations

The CAP package permits policy analyses and simulations of alternative strategies for affecting future trends. The versatility of the model and the easily comprehensible graphic displays encourage the broad involvement of many individuals and groups in policy analysis and planning. The displays permit health professionals, government officials and concerned citizens to grasp quickly the dimensions and implications of the aging of the population.

Government officials can see how changing the financing structure for health programmes will affect budgets over

domains où des études approfondies ont déjà été faites, les résultats sont incorporés au modèle. Ainsi, les projections concernant les futurs effectifs de médecins aux Etats-Unis s'inspirent d'une étude gouvernementale faite par le Graduate Medical Education National Advisory Committee (GMENAC) (10).

En l'absence d'études spécifiques, les projections d'avenir reposent le plus souvent sur l'expérience ou les tendances passées. Dans le cas des dépenses, des estimations économétriques de l'expérience passée fournissent une prévision des futurs taux annuels d'augmentation des dépenses (ajustées en fonction de l'inflation). Ces taux de croissance annuels en dollars constants servent ensuite à donner des prévisions des dépenses de santé par habitant selon les groupes d'âge et les types de prestations.

Les prévisions des taux de morbidité dans la population reposent le plus souvent sur l'hypothèse selon laquelle les taux de prévalence par cohorte d'âge et de sexe resteront constants dans le temps — hypothèse d'ailleurs controversée. Gruenberg (11) et Kramer (12), par exemple, affirment que les personnes gravement handicapées ou atteintes de maladies chroniques vivent aujourd'hui plus longtemps et que le taux de prévalence des maladies incapacitantes et chroniques augmentera avec les années. Selon Manton (13), en revanche, rien n'indique que l'état de santé moyen des personnes âgées se soit dégradé ces dernières années, bien que leur espérance de vie ait considérablement augmenté. Faute d'éléments convaincants, on suppose que la prévalence de l'incapacité ou de la limitation fonctionnelle par personne dans une cohorte d'âge et de sexe donnée est constante dans le temps. Dans les années à venir, le niveau total des maladies incapacitantes dans la population sera donc déterminé par la croissance des cohortes de population. On peut facilement modifier ces hypothèses dans le modèle PAO si l'on a des faits qui sous-tendent des hypothèses prédictives supérieures pour l'une ou l'autre maladie.

Etant donné le niveau rudimentaire de développement des méthodologies de projection, les projections d'avenir, en particulier à très longue échéance, doivent être vues avec prudence car le progrès technique pourrait bien les modifier considérablement. Il se pourrait que les taux de fécondité continuent de diminuer fortement ou bien qu'ils augmentent de façon spectaculaire, ce qui modifierait très nettement l'effectif de la population active qui entretient les personnes âgées. L'immigration pourrait redresser en partie la situation provoquée par le déclin de la population jeune dans les pays industrialisés.

Chose essentielle, les projections supposent que les politiques actuelles ne vont pas changer. Or, l'un des principaux objectifs du modèle PAO est de simuler la façon dont d'autres politiques peuvent infléchir l'orientation future du système de santé. Si l'on adopte d'autres politiques, la situation projetée ne surviendra pas nécessairement. Aussi le relèvement de l'âge de la retraite, la redéfinition de « la vieillesse », la promotion de modes de vie plus sains ou la réaffectation des ressources vers les soins primaires sont-ils autant de mesures qui pourraient modifier l'orientation future inscrite dans le modèle.

Analyses et simulations de lignes d'action

Le logiciel PAO permet de procéder à des analyses de lignes d'action et des simulations de différentes stratégies possibles qui viendraient infléchir les tendances futures. Grâce à la versatilité du modèle et aux affichages graphiques faciles à comprendre, de nombreux individus et groupes sont encouragés à participer à l'analyse et à la planification des lignes d'action. Les affichages permettent à des professionnels de la santé, des hauts fonctionnaires et des citoyens concernés de saisir aisément la dimension et les conséquences du vieillissement de la population.

Les hauts fonctionnaires peuvent se rendre compte de la manière dont l'évolution de la structure de financement des

future periods. Trade-offs between prevention, biomedical research, health services or non-health services can be explored. Epidemiologists can examine health trends under alternative mortality rate or morbidity assumptions. Health planners can estimate the need for physicians, or for hospital or nursing home beds given demographic changes in the population.

One of the principal advantages of the microcomputer is its ability to perform many arithmetic operations quickly. Thus, one important policy application of the CAP package is to calculate requirements for health personnel and facilities as a function of the changing size and demographic mix of the population. While these calculations can be made laboriously by hand or with a calculator, and can be performed with ease on large scale computers, the microcomputer has distinct advantages. Since the only cost is the initial purchase price, numerous alternatives can be estimated quickly and cheaply.

This application is quite straightforward. The model includes counts of the population by age and sex at 5-year intervals into the future. Utilization of health services by type for each age and sex group is entered into the baseline data. For example, the elderly may average 6 visits annually to physicians on an ambulatory basis. The CAP package then projects total physician visits of the elderly at 5-year intervals into the future, assuming current rates of utilization of services continue. The required number of physicians to meet this need in future years can be estimated, based upon current productivity rates (i.e. the number of visits each physician provides in a given year) or upon alternative assumptions regarding changes in productivity over time. These projected requirements can then be compared with projections in available supply. The model can disaggregate utilization by 5-year age intervals (e.g. under age 5, ages 5-9, 10-14, etc., 65-69, 70-74, 75-84 and 85+). Thus, estimates of future requirements can pick up shifts in the composition of the elderly population, e.g. an increasing proportion of the very old. This method can be applied to different types of health personnel, health facilities or health personnel by type of facility. Estimates can be made of the requirement for primary care physicians, physicians by specialty, nurses, allied health professionals, community hospital beds, long-term care hospital beds, nursing home beds, nurses in long-term care facilities, etc. that would provide current levels of care for the elderly in the year 2000, taking into account the increasing number of elderly people and the rapid increase in the very old.

More sophisticated planning can also be incorporated in the CAP software. For example, assumptions could be made that the average length of the work week will shorten over time, reducing the productivity of physician or other health personnel (defined as units of care provided on an annual basis per health care provider). Similarly, it can be assumed that future requirements for care will increase more or less proportionately than the growth in the population by age and sex cohort. For example, in the United States hospitalization rates of the elderly have been increasing, and at an especially rapid rate for those aged 85 and over. An assumption of future increases in rates of hospitalization based upon historical trends can easily be incorporated.

The principal advance in health planning, however, has been to move beyond rather straightforward projections of requirements for health services based upon the assumption of continuing to meet current levels of provision of

programmes de santé affectera à l'avenir les budgets. Des échanges peuvent être envisagés entre prévention, recherche biomédicale, services de santé ou services ne s'occupant pas de la santé. Les épidémiologistes peuvent examiner les tendances sanitaires en fonction de différents taux de mortalité ou différentes hypothèses quant à la morbidité. Les planificateurs sanitaires, eux, peuvent évaluer les besoins en médecins, en lits d'hôpitaux ou en lits d'institutions de soins, compte tenu de certains changements démographiques.

L'un des principaux avantages du micro-ordinateur est de pouvoir faire rapidement de nombreuses opérations arithmétiques. Ainsi, une application importante du logiciel PAO est de calculer les besoins en personnel et en installations de santé en fonction de l'évolution des effectifs de population et de sa composition démographique. Faits à la main ou avec une calculatrice, ces calculs sont laborieux; ils peuvent être faits sans peine sur un gros ordinateur mais le micro-ordinateur présente de très nets avantages. Le seul coût étant le prix d'achat initial, on peut évaluer rapidement et à peu de frais de nombreuses possibilités.

Cette application est tout à fait simple. Le modèle comprend un décompte de la population par âge et par sexe tous les 5 ans; l'utilisation des services de santé par type, pour chaque groupe d'âge et chaque sexe, est introduite dans les données de base. Par exemple, les personnes âgées consultent en moyenne 6 fois par an un médecin sur une base ambulatoire. Le logiciel PAO projette alors sur l'avenir les visites totales effectuées auprès des médecins par les personnes âgées à intervalle de 5 ans, en supposant que les taux actuels d'utilisation des services se maintiennent. On peut évaluer le nombre de médecins nécessaires pour répondre à cette demande à l'avenir, sur la base des taux actuels de productivité (c'est-à-dire le nombre de visites assurées une année donnée par chaque médecin) ou bien d'autres hypothèses quant aux changements de productivité dans le temps. Ces besoins projetés peuvent ensuite être comparés avec les projections de l'offre disponible. Le modèle peut dissocier l'utilisation par intervalles d'âge de 5 ans (par exemple, moins de 5 ans, 5-9 ans, 10-14 ans, etc., 65-69 ans, 70-74 ans, 75-84 et plus de 85 ans). Les estimations des besoins futurs peuvent donc tenir compte de modifications dans la composition de la population des personnes âgées, par exemple augmentation de la proportion des grands vieillards. Cette méthode peut s'appliquer à différents types de personnels de santé, d'installations de santé ou aux personnels de santé en fonction du type d'installation. On peut évaluer les besoins en médecins des soins de santé primaires, en médecins par spécialité, en infirmiers, en professionnels apparentés à la santé, en lits d'hôpitaux communautaires, en lits d'hôpitaux pour malades chroniques, en lits d'institutions de soins, en infirmiers pour les services de soins à long terme, etc., assurant les niveaux actuels de soins aux personnes âgées en l'an 2000, compte tenu du nombre croissant des personnes âgées et de l'augmentation rapide du nombre des grands vieillards.

On peut également introduire une planification plus élaborée dans le logiciel PAO. Ainsi, on peut supposer que la durée moyenne de la semaine de travail va diminuer avec le temps, d'où une réduction de la productivité des médecins ou d'autres agents de santé (productivité définie en fonction des unités de soins fournies annuellement par prestataire). On peut de même supposer que les besoins en soins vont proportionnellement augmenter plus — ou moins — que la croissance de la population par cohorte d'âge et de sexe. Par exemple, les taux d'hospitalisation de personnes âgées ont augmenté aux États-Unis à un rythme particulièrement rapide pour les personnes de 85 ans et plus. L'hypothèse d'une augmentation future des taux d'hospitalisation fondée sur les tendances passées peut facilement être introduite.

Mais le progrès essentiel en matière de planification sanitaire a été de dépasser le stade de projections relativement simples des besoins en services de santé fondées sur l'hypothèse d'un maintien des niveaux actuels de prestations

health services per person. The new emphasis is upon setting specific objectives for the health sector, developing broad strategies or programming to meet these objectives, translating these strategies into detailed programming, training the personnel required to carry out these objectives, evaluating the effectiveness of efforts in meeting initial objectives, and feeding this information back into an ongoing process of goal formulation and broad programming development.

This is the essence of the approach of WHO, represented by the Managerial Process for National Health Development (14). It requires a much more sophisticated approach toward planning—one which emphasizes that policy makers should have alternative choices for achieving objectives. Rather than following a rote strategy of assuming that health needs must be met in the future in the same way in which they are met at present or have been met in the past (i.e. "more of the same"), the decision maker recognizes that new approaches can be tried. Fixed numbers of specialist physicians or nursing home beds do not need to be generated in the future to provide care at the same rate as in the past. Rather, home help services may substitute for nursing home bed care. Primary health care providers, including physicians and other primary care personnel, can substitute for specialists. Investment in biomedical research or greater emphasis upon prevention in younger age groups can reduce the prevalence rates of chronic conditions among the old or lessen their severity. An intersectoral approach that invests in housing, nutrition or income maintenance may be an effective way of meeting some health needs.

It is this broader approach to planning—one which emphasizes alternative strategies for meeting objectives—that is the major challenge facing decision makers today. For it is now becoming abundantly clear that few, if any, countries can afford to continue the policies of the past. Rather, alternatives must be sought to meet the nation's health objectives more economically.

The CAP package has been developed to assist WHO Member States with this type of policy analysis and simulation. It permits users to enter alternative assumptions about future rates of change in resource development as a direct consequence of policy decisions, and contrast outcomes under these alternative assumptions. Experience in using the package in Norway, the Canadian province of Manitoba and the United States is described below.

Application in Norway

The CAP model has been applied to health policy problems in Norway, which has already developed a national health plan for the year 2000 and recognized the need to develop specific strategies for achieving the objectives set forth in that plan. The latter is concerned with wide variations in health resources and utilization of health services in different geographical areas and aims to achieve a better distribution of health resources. A peak in the number of elderly near the year 2000, with a subsequent decline followed by a sharp increase by the year 2020 represents a particular challenge to health planners. Officials in the health administration felt that use of a relatively inexpensive microcomputer could be of considerable practical assistance in solving these problems.

Norwegian Census Bureau official forecasts predict a substantial growth of the elderly population by the year 2000. However, in the early part of the twenty-first century, the number of elderly persons aged 70 and over will decline for a few decades before increasing again sharply. To

de services de santé par individu. On s'intéresse aujourd'hui à la fixation d'objectifs précis pour le secteur de la santé, à l'élaboration de vastes stratégies ou d'une programmation axée sur ces objectifs, à l'application de ces stratégies à une programmation détaillée, à la formation des agents nécessaires pour y parvenir, à l'évaluation de l'efficacité des actions, compte tenu des objectifs initiaux, et à la rétroinformation dans un processus continu de formulation des objectifs et de programmation générale.

Telle est, pour l'essentiel, l'approche de l'OMS concrétisée par le processus gestionnaire pour le développement sanitaire national (14). Elle demande une vision beaucoup plus élaborée de la planification, soulignant le fait que les décideurs ont différentes possibilités de choix pour parvenir aux objectifs. Plutôt que de supposer automatiquement que les besoins sanitaires devront être satisfaits à l'avenir de la même façon qu'ils le sont aujourd'hui, ou qu'ils l'ont été dans le passé (c'est-à-dire qu'il faut «un peu plus de la même chose»), le décideur reconnaît que de nouvelles approches peuvent être mises à l'essai. Il n'est pas nécessaire de produire à l'avenir certains effectifs précis de médecins spécialisés ou de lits d'institution pour assurer des prestations au même rythme que dans le passé. Bien au contraire, les services d'aide à domicile peuvent se substituer aux soins hospitaliers en institution. Les agents des soins de santé primaires, y compris médecins et autres personnels, peuvent se substituer aux spécialistes. L'investissement dans la recherche biomédicale ou l'insistance sur la prévention parmi les jeunes peut contribuer à réduire les taux de prévalence des maladies chroniques parmi les personnes âgées ou en atténuer la gravité. Une approche intersectorielle supposant des investissements dans le logement, la nutrition ou le maintien du revenu peut être un bon moyen de répondre à certains besoins sanitaires.

C'est précisément cette approche plus large de la planification — une approche qui souligne les différentes stratégies possibles pour parvenir aux objectifs — qui est aujourd'hui le défi majeur pour les décideurs. Il est en effet clair qu'il n'y a guère — sinon pas — de pays qui peuvent se permettre de poursuivre les politiques suivies dans le passé. Il faut rechercher d'autres moyens de parvenir aux objectifs sanitaires nationaux de façon plus économique.

Le logiciel PAO mis au point par l'Université Johns Hopkins a pour but d'aider les Etats Membres de l'OMS à faire ce type d'analyse et de simulation. Il permet aux utilisateurs d'introduire diverses hypothèses quant à l'évolution du développement des ressources résultant directement des décisions politiques et de comparer les résultats en fonction des différentes hypothèses. L'expérience de l'utilisation de ce logiciel en Norvège, dans la province canadienne du Manitoba et aux Etats-Unis fait l'objet des paragraphes qui suivent.

Application en Norvège

Le modèle PAO a été appliqué aux problèmes de politique de santé en Norvège, pays qui a déjà dressé un plan national d'action sanitaire pour l'an 2000 et reconnu la nécessité de définir des stratégies pour parvenir aux objectifs énoncés dans ce plan. Préoccupée par l'énorme variation des ressources sanitaires et de l'utilisation des services de santé selon les zones géographiques, la Norvège souhaite mieux répartir les ressources en santé. Un nombre maximal de personnes âgées vers l'an 2000, suivi d'une chute puis d'une rapide augmentation vers l'an 2020 — tel est le défi pour les planificateurs de la santé. Les responsables de l'administration de la santé avaient estimé qu'il serait extrêmement utile d'avoir recours à un micro-ordinateur relativement peu coûteux pour résoudre ces problèmes.

Les prévisions officielles du Bureau norvégien du recensement prévoient une croissance substantielle de la population âgée d'ici l'an 2000. Cependant, au début du vingt-et-unième siècle, le nombre des personnes de plus de 70 ans chutera pendant quelques décennies pour augmenter

accommodate the increase in the number of elderly persons between now and the year 2000, Norway could follow several strategies such as building additional nursing homes or other long-term care facilities or placing heavier emphasis upon home help services to enable more of the elderly to live at home. Given the projected dip in the number of elderly people, a heavy reliance upon a strategy of building more facilities may lead to serious excess capacity problems after the turn of the century. The GAP model enables planners to estimate the relative costs of an institutional versus a home-help strategy, taking into account the excess capacity of future years.

Those involved in the planning process use the CAP package to project home nursing services, assuming that a higher proportion of the needs of the elderly are met through this alternative, and that the projected service utilization is translated into personnel requirements, manpower training needs for nurses, home help aides and other personnel required to pursue a non-institutional long-term care policy for the elderly.

Another health problem facing the Norwegian health system is the doubling of full-time physicians expected between 1979 and 2000. Overall, the number of people per physician is projected to drop from 500 to 250 over this period, if past trends continue. Norwegian health officials are concerned that this expansion of supply will lead to under-utilized physicians and that services of marginal or no benefit will be expanded. The Norwegian health plan calls for a marked curtailment in this projected expansion in supply, and a major shift toward primary care physicians. Charts generated by the CAP software package show the gap between supply projected under the plan and under the assumption of the continuation of past trends. The magnitude of the task of achieving plan goals is clearly delineated and can be used as a baseline against which to monitor the effectiveness of policies such as curtailing medical school enrolment.

Norway has a particular concern with the geographical distribution of resources. Its 4 million people live over a large land mass. Some areas are well supplied with health personnel and facilities; others are relatively less well served.

To assist in developing a policy that would lead to a greater equalization of resources throughout the country, the CAP software package includes a geographical comparison analysis. The user selects 1 of the 19 Norwegian counties as a reference county. Charts are then generated which illustrate various aspects of the health sector in the reference county with the comparable aspect for Norway as a whole and for the county with the lowest and highest value for that aspect. The data base includes demographic characteristics of the population, health status, health resources, health utilization and health expenditures.

Resources are also unevenly distributed. Oslo has about 250 people per physician, compared with almost 750 in Nord-Trøndelag. Both areas are expected to experience a halving of this ratio by the year 2000. Oslo has the highest health expenditures per capita, more than twice the level of Akershus.

The Norwegian government instituted a new method for the distribution of central funds for hospital services a few years ago. Hospital funding is now distributed to counties on a block grant formula. The formula is based on age distribution of the population, mortality rates, disability and geographic isolation. The current block grant formula and a proposed alternative formula were simulated with the CAP

ensuite fortement. Pour faire face à la croissance du nombre des personnes âgées d'ici l'an 2000, la Norvège pourrait adopter plusieurs stratégies : construire de nouvelles institutions de soins ou d'autres installations de soins à long terme, ou bien mettre l'accent sur les services d'aide à domicile qui permettraient à un plus grand nombre de personnes âgées de rester chez elles. Étant donné la chute prévue du nombre de personnes âgées, la décision de construire un plus grand nombre d'installations pourrait conduire à de graves problèmes de surcapacité après le tournant du siècle. Le modèle PAO permet aux planificateurs d'évaluer les coûts relatifs des différentes stratégies (institution ou aide à domicile), compte tenu de la surcapacité dans les années à venir.

Tous ceux qui participent à la planification utilisent le logiciel PAO pour établir des projections des services de soins à domicile, en supposant qu'une plus grande partie des besoins des personnes âgées sera ainsi satisfaite ; l'utilisation projetée des services est traduite en besoins en matière de personnel et de formation d'infirmiers/infirmières, d'auxiliaires à domicile et autres agents requis pour mener une politique de soins non institutionnels à long terme aux personnes âgées.

On prévoit qu'en l'an 2000 il y aura 2 fois plus de médecins travaillant à plein temps qu'en 1979 ; cela constitue un autre problème que doit affronter le système de santé norvégien. D'une façon générale, si les tendances passées se maintiennent, la proportion médecin/habitants passera de 1 pour 500 à 1 pour 250 entre 1979 et 2000. Les responsables norvégiens de la santé craignent que cette expansion de l'offre entraîne une sous-utilisation des médecins et un développement de prestations d'intérêt marginal, sinon nul. Le plan norvégien d'action sanitaire demande une réduction marquée de cette expansion de l'offre et une réorientation vers les médecins assurant des soins de santé primaires. Les tableaux produits par le logiciel PAO révèlent l'hiatus entre l'offre projetée dans le plan et l'offre projetée compte tenu de l'hypothèse d'un maintien des tendances passées. L'ampleur de la tâche que constitue la réalisation des objectifs du plan est clairement délimitée et peut servir de base pour suivre l'efficacité de lignes d'action telles que la réduction du nombre des inscriptions dans les écoles de médecine.

La Norvège se préoccupe tout particulièrement de la distribution géographique des ressources. Ses 4 millions d'habitants se répartissent sur un vaste territoire et certaines régions sont bien dotées en personnel et en installations de santé tandis que d'autres le sont relativement moins bien.

Pour aider à définir une politique de répartition plus égale des ressources à travers le pays, le logiciel PAO inclut une analyse par comparaison géographique. L'utilisateur choisit comme référence l'un des 19 comtés norvégiens. Des tableaux sont ensuite produits qui illustrent divers aspects sanitaires dans le comté en question, avec l'aspect comparable pour l'ensemble de la Norvège et pour le comté présentant à cet égard la valeur la plus basse et la valeur la plus élevée. La base de données comprend les caractéristiques démographiques de la population, la situation sanitaire, les ressources en santé, l'utilisation des services de santé et les dépenses de santé.

Les ressources sont elles aussi inégalement réparties. Oslo compte environ 1 médecin pour 250 habitants, alors qu'il y a un médecin pour près de 750 habitants dans le Nord-Trøndelag. Ce taux devrait diminuer de moitié dans les 2 régions d'ici l'an 2000. C'est à Oslo qu'on enregistre les dépenses de santé les plus élevées par habitant, plus du double du niveau de l'Akershus.

Le Gouvernement norvégien a institué, il y a quelques années, une nouvelle méthode de répartition des crédits centraux destinés aux services hospitaliers. Les fonds hospitaliers sont maintenant alloués aux comtés selon une formule de subvention globale fondée sur la distribution par âge de la population, les taux de mortalité, les incapacités et l'isolement géographique. La formule actuelle et une autre

software package (Fig. 1). This simulation indicates that the per capita allocation would be greatest for Finnmark, in large part because of the very high mortality rate in this county and its extreme geographic isolation, in comparison with Østfold (which would have the lowest weighting), Sør-Trøndelag (the reference county) and the country as a whole.

Application in Manitoba

The Canadian province of Manitoba routinely uses the CPA as a tool in projecting health and social services needs for its elderly population. There is a greater range of long-term care services for the elderly in Manitoba than other Canadian provinces. Evaluations of the effectiveness and efficiency of this expanded coverage have been conducted. There is also an ongoing longitudinal survey of a sample of elderly to monitor changes in health status and use of services by the elderly over time. Manitoba is thus particularly suitable for demonstrating the application of the CAP model package.

Like Norway, Manitoba is concerned about regional disparities in resources. While personal care homes (i.e. nursing home care) are covered under the provincial health plan, limitations on resources generate waiting lists for admission to homes. The CAP software package is used to monitor trends in waiting lists for Winnipeg and for rural areas of the province.

From a professional evaluation of the provincial long-term care coverage, estimates indicate that almost 50% of the elderly currently receiving care at home would require care in a nursing home or hospital if home care were not provided. Considerable savings are estimated from a policy of provision of home care, relative to cost under optimal care patterns in the absence of home care. Estimated savings from expanding care services at home can also be illustrated using the CAP package.

Application in the United States of America

The CAP package for the United States has a comprehensive, easily accessible data base and is designed to encourage health officials and planners to view the health problems of the elderly in an intersectoral framework, looking at sectors important to health such as social security, housing and social services.

The United States has a large post-World War II "baby boom" which will reach ages 35 to 60 by the year 2000. The growth in the size of the elderly population will be felt in the early part of the twenty-first century as this group reaches retirement age.

Growth in the elderly population is spurred by very marked reductions in death rates of the elderly in the last 15 years. As shown in Fig. 2, heart diseases death rates for the elderly have dropped markedly and are expected to continue to decline by the year 2000. Cerebrovascular death rates of the elderly have also plummeted in the last 15 years.

While this success is remarkable, it implies that the United States will face an increasing strain on its health services in future years. The number of elderly living at home with some restriction in their activities of daily living will increase—mainly because of the rapid growth in the number of elderly aged 85 and over.

formule actuellement proposée ont fait l'objet d'une simulation avec le logiciel PAQ (Fig. 1). Elle indique que c'est au Finnmark que l'allocation de crédits par habitant serait la plus élevée, essentiellement à cause des taux très élevés de mortalité dans ce comté et de son extrême isolement géographique par rapport à Østfold (qui aurait le coefficient de pondération le plus faible), au Sud-Trøndelag (comté de référence) et à l'ensemble du pays.

Application au Manitoba

La province canadienne du Manitoba utilise systématiquement le PAQ pour projeter les besoins en services sanitaires et sociaux destinés aux personnes âgées au Manitoba, où la gamme de services de soins à long terme pour personnes âgées est plus vaste que dans d'autres provinces du pays. On a ainsi évalué l'efficacité et le rendement de cette couverture élargie et fait une enquête longitudinale dans un échantillon de personnes âgées afin de suivre dans le temps l'évolution de la situation sanitaire et de l'utilisation des services par ce groupe d'âge. Ces activités se prêtent particulièrement à la démonstration des applications du logiciel PAQ.

Tout comme la Norvège, le Manitoba se préoccupe des disparités régionales dans les ressources. Si les institutions de soins sont prévues dans le plan sanitaire provincial, des contraintes financières sont à l'origine de listes d'attente pour l'admission dans ces institutions. Le logiciel PAQ permet de surveiller les tendances des listes d'attente pour Winnipeg et pour les zones rurales du Manitoba.

D'après une évaluation professionnelle de la couverture provinciale en soins à long terme, des estimations indiquent que près de 50% des personnes âgées qui reçoivent actuellement des soins à domicile auraient besoin de soins en institution ou en hôpital si elles ne recevaient pas de soins chez elles. On estime qu'une politique de soins à domicile peut entraîner de très importantes économies par rapport à des soins optimaux en l'absence de soins à domicile. On peut également avec le logiciel PAQ évaluer les économies résultant d'un développement de ces services.

Application aux Etats-Unis d'Amérique

Le logiciel PAQ pour les Etats-Unis, qui comprend une base de données exhaustive et d'accès facile, a pour but d'encourager les responsables et planificateurs de la santé à envisager les problèmes de santé des personnes âgées dans un cadre intersectoriel, en tenant compte d'aspects importants pour la santé tels que sécurité sociale, logement et services sociaux.

Les Etats-Unis ont connu, après la Deuxième Guerre mondiale, une « explosion démographique » et ceux qui sont nés à ce moment-là atteindront 35-60 ans d'ici l'an 2000. La croissance du nombre des personnes âgées touchera les Etats-Unis au début du vingt-et-unième siècle à mesure que ce groupe arrivera à l'âge de la retraite.

La très nette réduction des taux de mortalité parmi les personnes âgées au cours des 15 dernières années explique entre autres l'augmentation de leur nombre. Comme le montre la fig. 2, les taux de mortalité par cardiopathies, parmi les personnes âgées, ont considérablement diminué et devraient continuer à le faire d'ici l'an 2000. Parallèlement, les taux de mortalité par maladies cérébro-vasculaires chez les personnes âgées ont très fortement régressé ces 15 dernières années.

S'il s'agit là d'un remarquable succès, il aura pour conséquence d'imposer à l'avenir un fardeau de plus en plus lourd aux services de santé des Etats-Unis. Le nombre des personnes âgées vivant chez elles, tout en étant quelque peu limitées dans leurs activités quotidiennes, va s'accroître — en grande partie à cause de l'augmentation rapide du nombre de personnes de 85 ans et plus.

The growing number of elderly people with chronic and limiting health problems will cause a major shift in hospital care. The United States has been experiencing a major growth in hospital admissions by the elderly, while admission rates for those under age 65 have changed very little in recent years. If these trends continue, the CAP model projects that the proportion of hospital days accounted for by the elderly will increase from 38% to 58% by the year 2000.

The aging of the United States population is likely to increase the cost of its already costly health care system: the proportion of the gross national product devoted to health care in the United States is projected by the CAP model to increase from 9.8% in 1981 to almost 15% by the year 2000.

This creates a particular problem because health care for the elderly is financed through a Federal Government programme, Medicare, while care for other population groups is largely financed through voluntary employer health insurance plans. Thus, the rapid expansion in health expenditures on the elderly means a rapid expansion in public expenditures — at a time when the Federal Government is experiencing large budget deficits and the trust fund financing Medicare hospital care is projected to be depleted by the end of the 1980s.

Finding solutions to "rescuing" the Medicare trust fund is a major policy dilemma facing the United States. At a recent conference sponsored by the United States Congress the CAP model was used to simulate the impact on the Medicare trust fund of replacement of the current premium by an income-related premium tax administered through the federal personal income tax system (15). With this expanded revenue source and tighter cost containment measures for hospitals and physicians, it is projected that the trust fund can be brought into balance throughout the planning period (now until 1995). Alternative approaches, such as greater sharing in the cost of health bills by the elderly, and other tax increases have also been simulated by the CAP model.

Conclusion

These examples from Norway, Manitoba and the United States, illustrate the wide variety of uses of the CAP software package in health planning. It is useful for preparing comprehensive baseline data on the current situation:

- illustrating targets or goals, and the gap between current trends and the selected targets over time;
- monitoring progress toward goals;
- estimating the implications of changing demographic structure or economic conditions on health services utilization and resource requirements;
- simulating alternative strategies for achieving policy goals;
- comparing the disparity in resource allocation across geographic areas, or population groups;
- stimulating fruitful policy discussions by dramatically illustrating the dimensions of the problem, its future trend if past policies are continued, and by projecting the impact of alternative approaches.

While CAP software packages have to date been taken up by developed countries, the technology is simple and available at a cost which developing countries can afford.

L'accroissement du nombre des personnes âgées atteintes de maladies chroniques ou de troubles restreignant leur activité va entraîner une réorientation importante des soins hospitaliers. Les Etats-Unis ont enregistré une forte augmentation des hospitalisations de personnes âgées, alors que les taux d'hospitalisation des moins de 65 ans ont très peu changé ces dernières années. Si ces tendances se maintiennent, le modèle PAO prévoit que la proportion des journées d'hôpital pour les personnes âgées passera de 38% à 58% d'ici l'an 2000.

Le vieillissement de la population américaine risque d'accroître le coût d'un système de soins de santé déjà dispendieux: le modèle PAO prévoit que la part du produit national brut consacrée aux soins de santé passera de 9.8% en 1981 à près de 15% d'ici l'an 2000.

Ceci pose un problème particulier car les soins aux personnes âgées sont financés par un programme du Gouvernement fédéral, le *Medicare*, alors que les soins destinés à d'autres groupes de population sont en grande partie financés par des plans volontaires d'assurance-maladie des employeurs. Aussi le développement rapide des dépenses de santé consacrées aux personnes âgées signifie-t-il une expansion rapide des dépenses publiques — alors même que le Gouvernement fédéral connaît un important déficit budgétaire et que l'on prévoit d'ici la fin des années 80 un épuisement du fonds fiduciaire qui finance les soins hospitaliers du programme *Medicare*.

Trouver des solutions pour «sauver» le fonds fiduciaire *Medicare* est un enjeu politique majeur pour le pays. Lors d'une récente conférence parrainée par le Congrès des Etats-Unis, le modèle PAO a été utilisé pour simuler l'impact qu'aurait sur le fonds fiduciaire le remplacement de la prime actuelle par un impôt-prime lié au revenu qui serait géré par le système d'impôt sur le revenu des particuliers (15). En élargissant ainsi les sources de revenus et en maîtrisant mieux les coûts de l'activité des hôpitaux et des médecins, on prévoit de rétablir l'équilibre du fonds fiduciaire pour toute la période de planification (actuellement jusqu'en 1995). D'autres possibilités, par exemple prise en charge par les personnes âgées d'une part plus importante des frais de santé, ainsi que d'autres augmentations d'impôts ont également fait l'objet de simulations avec le modèle PAO.

Conclusion

Ces exemples en provenance de la Norvège, du Manitoba et des Etats-Unis illustrent les multiples usages qui peuvent être faits du logiciel PAO pour la planification sanitaire à long terme. Il permet de préparer des données de base exhaustives sur la situation actuelle:

- illustrant les buts ou objectifs et faisant apparaître le décalage entre les tendances actuelles et les objectifs sélectionnés dans le temps;
- suivant les progrès réalisés;
- évaluant les répercussions d'une évolution de la structure démographique ou de la situation économique sur l'utilisation des services de santé et les besoins en ressources;
- simulant différentes stratégies possibles pour la réalisation des objectifs;
- comparant l'affectation des ressources entre zones géographiques ou groupes de population pour faire ressortir les disparités;
- contribuant au débat sur les grandes orientations en illustrant spectaculairement l'ampleur du problème et son évolution si l'on continue d'agir comme par le passé et en projetant l'impact de différentes possibilités d'action.

Si jusqu'à présent ce sont les pays développés qui ont adopté les logiciels PAO, la technique est toutefois simple et d'un coût abordable pour les pays en développement.

Data input can be a combination of actual data and "best guesses" based on expert opinion. Yet the format permits rapid revision of baseline data as better estimates become available. The CAP model can readily be extended to analyses of maternal and child health, for example, and need not be restricted to health concerns of the elderly. Similarly, it can be extended to environmental health concerns, mental health concerns, accident prevention, etc.

CAP is a tool. Its usefulness depends upon the involvement and active participation of planning officials in the design of policy analyses and simulation of real importance. It is hoped that the brief overview provided here will stimulate further interest in tapping the substantial benefits to be derived from the rapid growth of computer technology in recent years, and in applying them to improve the health status of all peoples by the year 2000.

Les entrées de données peuvent associer les éléments factuels et «les suppositions optimales» fondées sur l'avis d'experts. Néanmoins, le format permet de revoir rapidement les données de base à mesure que l'on dispose de meilleures estimations. Le modèle PAO peut ainsi être élargi à des analyses en santé maternelle et infantile puisqu'il ne se limite pas aux problèmes de santé des personnes âgées. On peut également l'appliquer aux problèmes d'hygiène du milieu, de santé mentale, de prévention des accidents, etc.

La planification assistée par ordinateur est un outil. Son utilité dépend de l'engagement et de la participation active des responsables de la planification à la conception d'analyses et de simulations des grandes orientations d'importance réelle. Nous espérons que le bref aperçu présenté ici incitera les personnes intéressées à mieux exploiter les remarquables possibilités de la révolution informatique de ces dernières années afin de l'appliquer à l'instauration de la santé pour tous les peuples d'ici l'an 2000.

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FIG. 1
HOSPITAL FUNDING: CURRENT AND ALTERNATIVE WEIGHTS FOR FORMULA FOR BLOCK GRANTS; NORWAY AND SELECTED COUNTIES, 1983-2000
FINANCEMENT DES HÔPITAUX: COEFFICIENTS DE PONDÉRATION ACTUELS ET PROPOSÉS POUR LA FORMULE DE SUBVENTION GLOBALE, NORVÈGE ET TROIS COMTÉS, 1983-2000

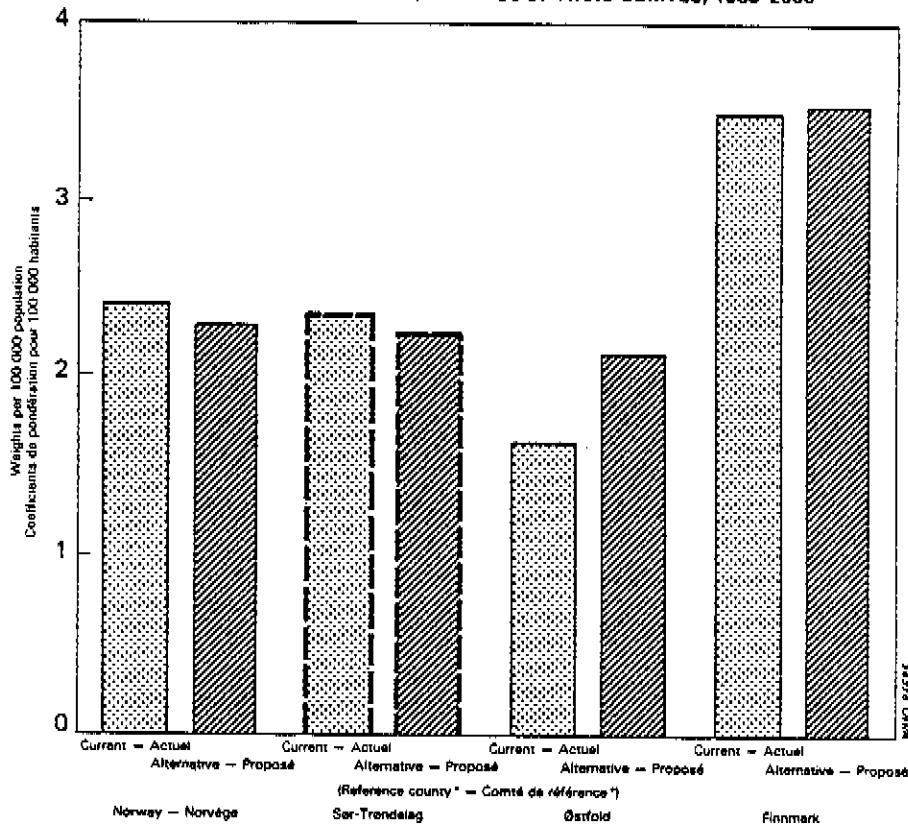
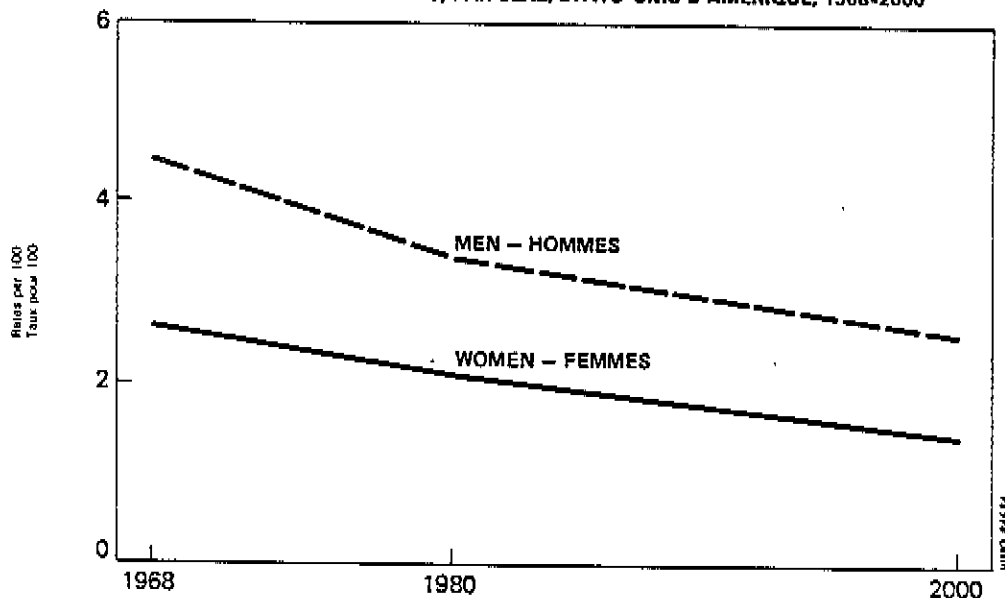


FIG. 2
TRENDS AND PROJECTIONS OF MORTALITY FROM HEART DISEASES (ICD-9 Codes 390-456) AT AGES 76-79 YEARS, BY SEX, UNITED STATES OF AMERICA, 1968-2000
TENDANCES ET PROJECTIONS DE LA MORTALITÉ PAR CARDIOPATHIES (Codes 390-456 de la CIM-9) DANS LE GROUPE D'ÂGE 75-79 ANS, PAR SEXE, ETATS-UNIS D'AMÉRIQUE, 1968-2000



Annex 2

THE PERSONAL COMPUTER IN HEALTH MANAGEMENT

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SUMMARY

The role of personal computers in health management is discussed. More particularly, ways in which the health manager can himself use a personal computer to gain insight into existing data are presented and discussed. The concept of a spreadsheet is explained. Some examples of the use of personal computers in health planning are shown.

INTRODUCTION

Gaining access to the traditional computer, and knowing how to use it, used to be beyond the ken of most people outside of the computer science community. Although many in the health sciences have gone to the effort of learning how to use computers, maintaining computing skills was difficult and meant effectively wearing two hats - health scientist and computer scientist. Also, in developing countries especially, when it came to allocation of computer resources, health scientists were usually given a rather low priority. In short, information tools were not designed for nor particularly accessible to those in the health field.

The tremendous (and still accelerating) development of micro-electronics is opening up computing to persons who did not have (or did not want) access to it heretofore. This is only part of the story, however, since raw computing power is not useful in itself. To harness this power and allow the non-computer professional to apply it directly in his or her own field requires a new type of software. This software is fundamentally different from traditional computer software in three ways:

1. It is easy to use;
2. It is inexpensive;
3. It allows problems to be expressed in users' terms.

This new concept in computer usage is truly "popular computing", and that is what is happening all around us right now.

Software exists today which most people can use, and more software is appearing every day which will allow virtually everyone to use computers for their own purposes. With these new tools we are being provided with exciting and powerful ways of interacting with information and molding it to our needs, in ways that we could only dream about in the recent past.

APPLICATIONS IN HEALTH MANAGEMENT

Managers everywhere need access to information and ways of understanding its implications, and health managers are no exception. There are already available quite a number of powerful software tools with which to examine and manipulate information. More sophisticated, and even easier to use software is coming along at a fast clip. With such tools, the decision-making, target setting, monitoring and evaluation tasks of the health manager will be based on a more intimate familiarity and in-depth understanding of the available information.

This paper discusses just one of these software tools, one which exists now, and can be used now by the health manager. The state-of-the-art in popular, currently available personal computer software is an electronic spreadsheet program called LOTUS 1-2-3. We shall see how a personal computer can help to manipulate and investigate information, and to play "what if?" in programme planning, monitoring and evaluation.

It needs to be stressed at this point that a basic disadvantage of the print media is that the reader will not be able to actually experience first hand how this works in practice. This paper is trying to describe the dynamic process whereby it is now possible for the health manager to manipulate his own data by himself. It is not just to show that graphs can somehow be produced.

SPREADSHEETS

Firstly, we need to look at the general features of spreadsheet software. The overall concept is very simple, yet very powerful. It was first introduced about five years ago in a program called VISICALC. This is one of those concepts that, once you've seen it you wonder, "Why didn't I think of that?". A spreadsheet has the following characteristics (refer to Figure 1):

1. The spreadsheet itself is a large matrix of cells (like pigeonholes);
2. The computer screen is a window into the entire spreadsheet (which is much larger than the screen);
3. One of three things can go in any cell: text, numbers or formulas - cells are from 1 to 72 characters wide;
4. Any calculations are automatically updated across all cells;
5. Copy/move makes replication and manipulation easy.

ORGANIZATION OF TABULAR INFORMATION

An example of what we can do with a spreadsheet is given in Figure 2. (Note that the TOTALS row and the columns under the BOTH heading are formulas.) Everyone needs to keep data around in tabular form, so here's a way to do it neatly. Clean, updated copies are always available without retyping. The data may have originally come from the mainframe, another personal computer or it could have been keyed in by hand (this was keyed in in about 10 minutes).

Another advantage of keeping data like this is that it is readily available for inclusion into reports or other word processing documents, (re)typing errors are eliminated. Even more to the point of this discussion, the manager can look at his data - not just in tabular form as you see here, but with graphics. The following two figures are easily generated from the table.

Figure 3 shows how the population is distributed among age groups, while Figure 4 shows the distribution of deaths in the population. While this is no surprise, the important point is that any data can be quickly and easily depicted graphically, and graphs help understanding. Using this technique would make it easy to compare the situation among counties or economic groups within a country.

In examining the mortality curve for males (Figure 4) we note a hump in the adolescent age groups. This phenomenon can be examined in more detail by zooming in on these age groups. Figure 5 shows deaths among males and females in the 5-39 year age range. The numbers above the curve are ratios of male to female deaths.

We have now seen how a spreadsheet can allow the health manager to investigate data more effectively, in ways which were not possible before. Continue to bear in mind that this a dynamic process which allows the health manager to examine health data himself both in overview and in detail.

LIFE TABLES

Anyone who has labored over life table calculations will readily appreciate how the personal computer can calculate (and recalculate) the actual life table. Now we are going to look at some spreadsheets which deal with life tables.

Closer examination of the cells in Figure 6 reveals how the formulas work. Consider cell D7 (at the intersection of column D and row 7) where we see the formula "+B7/C7". This means to divide the current value of cell B7 by the current value of cell C7 and place the result here (i.e., in cell D7). We note that cell B7 will contain the number of deaths in males aged 5-9, and C7 the population of 5-9 year old males. Thus, D7 will be the mortality rate of males aged 5-9.

These formulas were not typed in. Only one row was required to be typed, the rest of the rows were simply duplicated down the sheet for the other age groups. All cell references are adjusted automatically by the spreadsheet program. Following the previous example, "+B7/C7" becomes "+B8/C8" when copied down a row. The real meaning is to divide the cell two to the left by the cell one to the left and place the result here.

Note that the table in Figure 6 is a generalized life table. It becomes specific to a country or any geographic or economic subgroup when death and population figures for the population of interest are inserted.

The final table is shown in Figure 7, after merging in the Norwegian male and female demographic data from the table where we keep it (recall Figure 2). All calculations were carried out automatically in about three seconds.

And, of course we always have the possibility of some more graphs - it always helps to "see" the data. Let's begin by looking at some standard graphs we all know. The four graphs in Figures 8,9,10,11 were immediately available based on the values in the spreadsheet. If different data were put in, the same graphs could be instantly produced based on that new data, too.

To be sure, at one time someone had to specify the graphs by indicating to the spreadsheet the type of graph required, which cells should be included, and what the titles should be. In total, each graph was specified in approximately 5 minutes.

With graphs such as these the health manager can begin to formulate answers to such questions as:

- o How many pregnant women will there be in 10 years?
- o How many school age children will there be in 10 years?
- o How many paediatric beds will be needed in 10 years?
- o How many productive years will be lost to various illnesses?
- o How many vaccinations will be required?
- o How many incapacitated geriatric patients will need to be taken care of?

Also, based on life table spreadsheets like this one, the health manager can begin to examine in more depth the possible impact of various hypothetical health actions or programmes on:

- o mortality rates (qx)
- o survivorship (lx)
- o life expectancy (ex)
- o total years lived (Tx)

We can see how this might work by setting up some hypotheses and examining their effect on the above indicators.

Hypothesis 1: "What if" we were able to offset or postpone mortality among males aged 40 and older to the rate of men 5 years younger?

Hypothesis 2: "What if" we were able to reduce mortality among males aged 40 and older by 10%?

Hypothesis 3: "What if" we were able to reduce the mortality among males under 30 by 40%?

The four graphs in Figures 12,13,14,15 examine the impact of hypotheses 1 and 2 on mortality, survivorship, life expectancy and total person years lived. Hypothesis 3 is considered in Figure 16, where we can see that a reduction in mortality among adolescent males would have little overall impact on person years lived.

Cause of Death

Health management needs to be ever conscious of the chief causes of mortality among the population so that the important ones can be targeted, and time and resources not be wasted on others. In the spreadsheet of Figure 17 we can examine the three most important causes of death, by sex and age, and develop a feeling for their relative importance.

Figure 18 shows graphically the three major causes of death for each age group as contained in the spreadsheet. It is obvious at a glance that any efforts to reduce mortality must take into consideration ischaemic heart disease (shown on the graph as IHD), malignant neoplasms (MNP) and cerebrovascular disease (CBD).

Fig. 2

Demographic Information - NORWAY - 1981 data

| Age x | ** MALES ** | | ** FEMALES ** | | ** BOTH ** | |
|----------|-------------|---------|---------------|---------|------------|---------|
| | Dx | Px | Dx | Px | Dx | Px |
| 0 | 221 | 25,975 | 161 | 24,894 | 382 | 50,869 |
| 1-4 | 53 | 105,898 | 46 | 100,570 | 99 | 206,468 |
| 5-9 | 47 | 154,268 | 26 | 147,773 | 73 | 302,041 |
| 10-14 | 49 | 170,480 | 24 | 161,855 | 73 | 332,335 |
| 15-19 | 145 | 163,838 | 52 | 155,252 | 197 | 319,090 |
| 20-24 | 181 | 158,067 | 52 | 150,976 | 233 | 309,043 |
| 25-29 | 149 | 157,088 | 42 | 149,646 | 191 | 306,734 |
| 30-34 | 160 | 161,213 | 69 | 150,618 | 229 | 311,831 |
| 35-39 | 214 | 141,097 | 105 | 133,033 | 319 | 274,130 |
| 40-44 | 251 | 105,525 | 137 | 102,590 | 388 | 208,115 |
| 45-49 | 401 | 96,723 | 208 | 95,245 | 609 | 191,968 |
| 50-54 | 758 | 105,289 | 343 | 105,063 | 1,101 | 210,352 |
| 55-59 | 1,340 | 115,371 | 631 | 118,587 | 1,979 | 233,958 |
| 60-64 | 2,049 | 110,227 | 963 | 120,079 | 3,012 | 230,306 |
| 65-69 | 2,792 | 93,313 | 1,491 | 107,560 | 4,283 | 200,873 |
| 70-74 | 3,521 | 72,955 | 2,230 | 93,126 | 5,751 | 166,081 |
| 75-79 | 3,649 | 48,765 | 3,242 | 73,192 | 6,891 | 121,957 |
| 80-84 | 3,385 | 28,198 | 3,938 | 47,969 | 7,323 | 76,167 |
| 85+ | 3,445 | 16,262 | 5,315 | 31,122 | 8,760 | 47,384 |

Key:

Dx = Number of deaths in age group
Px = Median population in age group

Sources:

- STATISTISK ARBOK 1983 (Central Bureau of Statistics of Norway)
- World Health Statistics Annual - 1983

Fig. 3

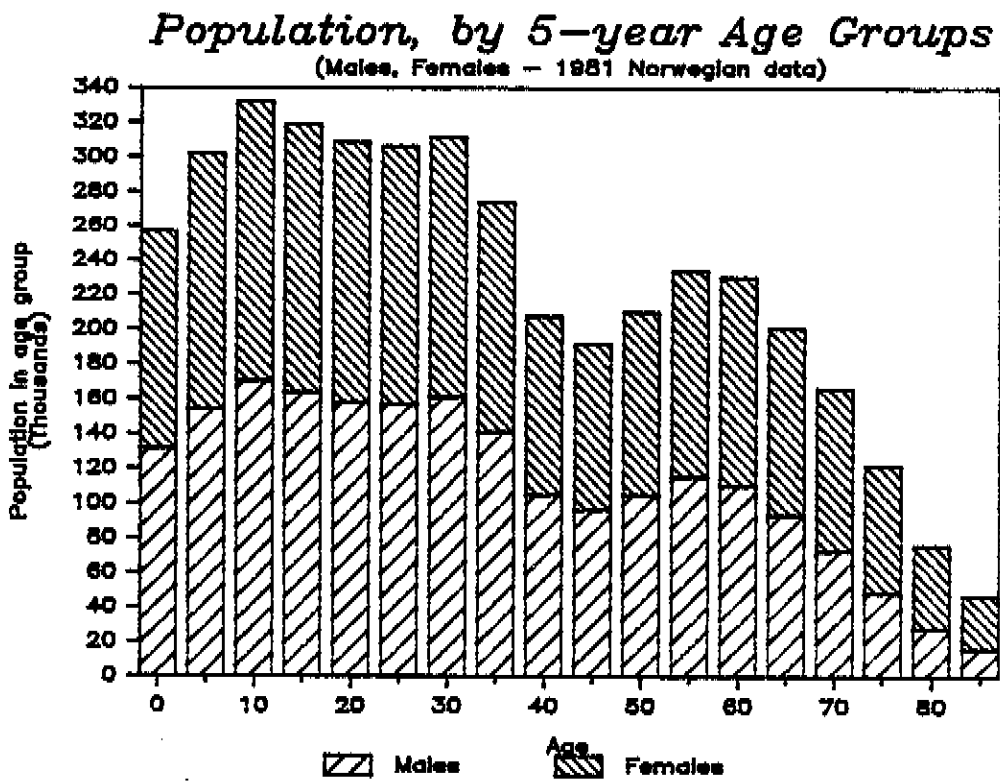


Fig. 4

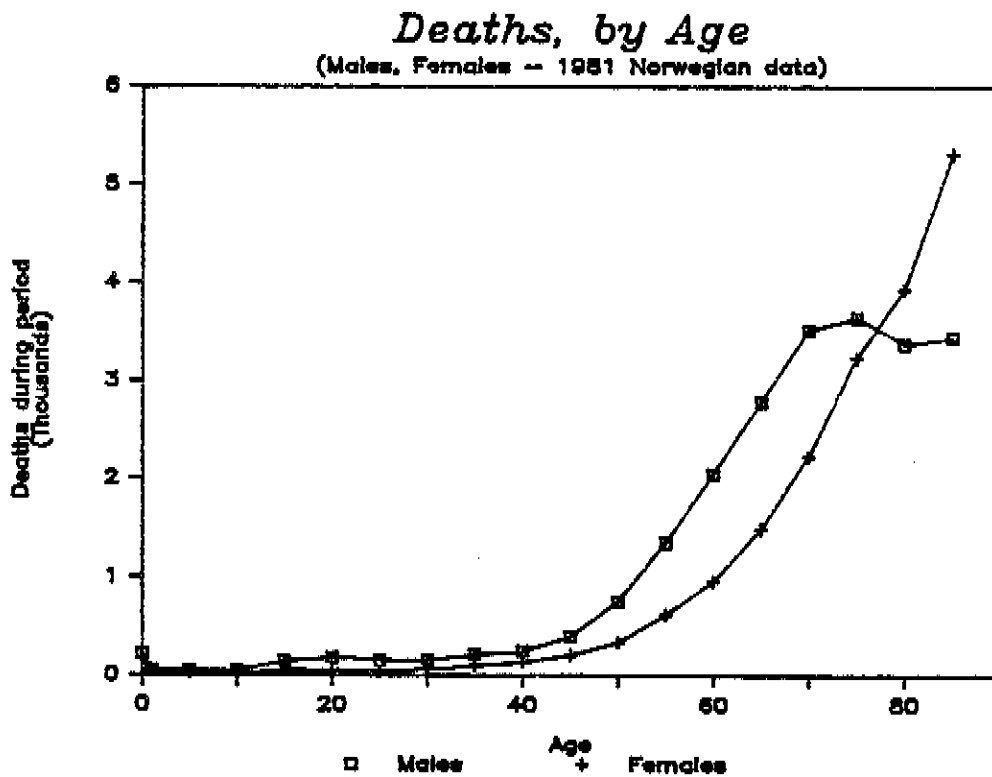


Fig. 5

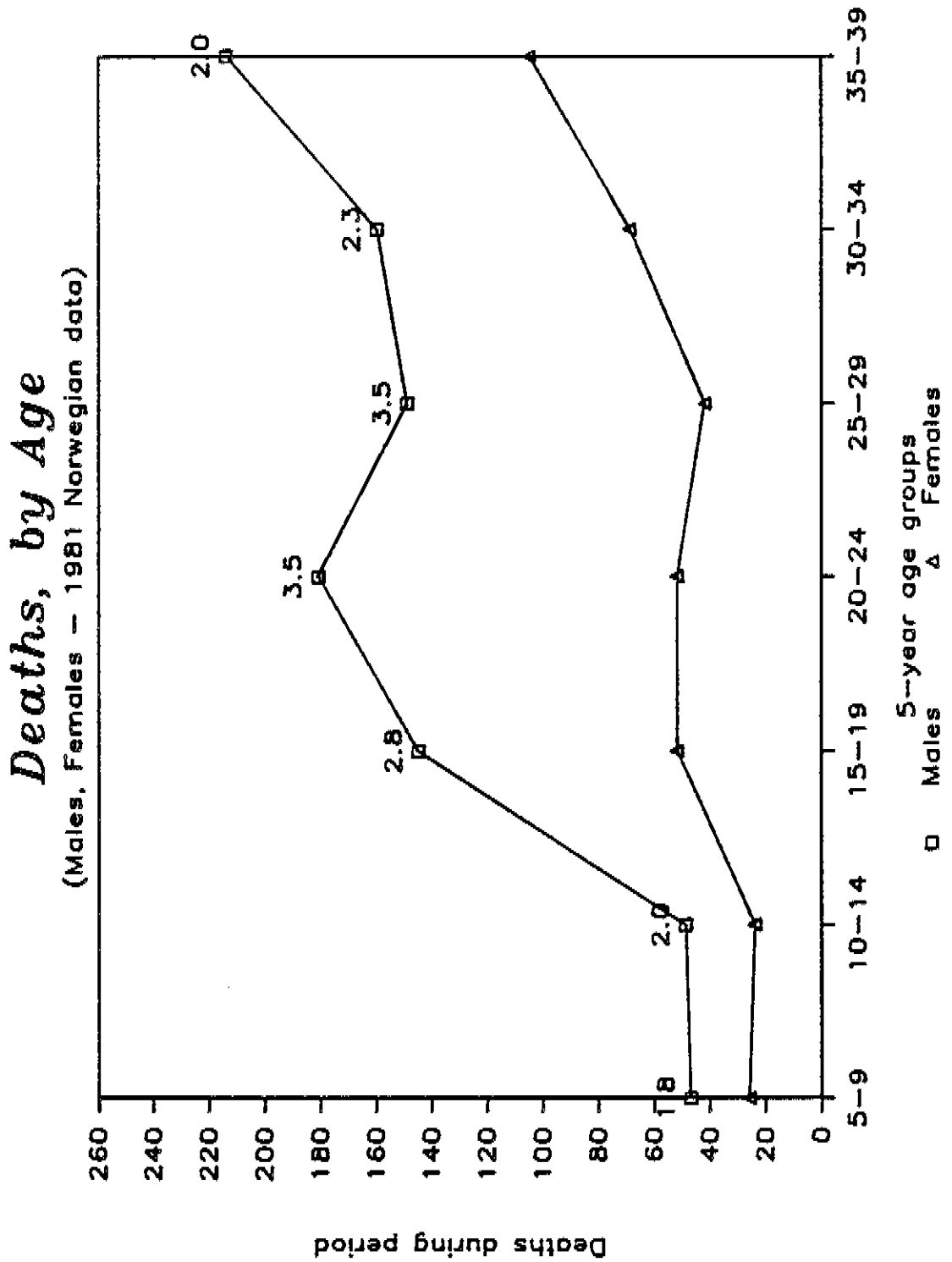


Fig. 6

A1: Life Table - 1981 Norwegian data

READY

| | A | B | C | D | E | F | G | H | I |
|----|----------------------------------|----|----|--------|-----------------|-----------|---------------|---------|--------|
| 1 | Life Table - 1981 Norwegian data | | | | | | | | |
| 2 | ** MALES ** | | | | | | | | |
| 3 | x | Dx | Px | mx | qx | lx | Lx | Tx | ex |
| 4 | ----- | | | | | | | | |
| 5 | 0 | | | | | | | | |
| 6 | 1-4 | | | | | | | | |
| 7 | 5-9 | | | +B7/C7 | 10*D7/(2+5*D7) | +F6-F6+E6 | 5/2*(F7+F8) | +H8+G7 | +H7/F7 |
| 8 | 10-14 | | | +B8/C8 | 10*D8/(2+5*D8) | +F7-F7+E7 | 5/2*(F8+F9) | +H9+G8 | +H8/F8 |
| 9 | 15-19 | | | +B9/C9 | 10*D9/(2+5*D9) | +F8-F8+E8 | 5/2*(F9+F10) | +H10+G9 | +H9/F9 |
| 10 | 20-24 | | | +B10/C | 10*D10/(2+5*D1) | +F9-F9+E9 | 5/2*(F10+F11) | +H11+G1 | +H10/F |
| 11 | 25-29 | | | +B11/C | 10*D11/(2+5*D1) | +F10-F10* | 5/2*(F11+F12) | +H12+G1 | +H11/F |
| 12 | 30-34 | | | +B12/C | 10*D12/(2+5*D1) | +F11-F11* | 5/2*(F12+F13) | +H13+G1 | +H12/F |
| 13 | 35-39 | | | +B13/C | 10*D13/(2+5*D1) | +F12-F12* | 5/2*(F13+F14) | +H14+G1 | +H13/F |
| 14 | 40-44 | | | +B14/C | 10*D14/(2+5*D1) | +F13-F13* | 5/2*(F14+F15) | +H15+G1 | +H14/F |
| 15 | 45-49 | | | +B15/C | 10*D15/(2+5*D1) | +F14-F14* | 5/2*(F15+F16) | +H16+G1 | +H15/F |
| 16 | 50-54 | | | +B16/C | 10*D16/(2+5*D1) | +F15-F15* | 5/2*(F16+F17) | +H17+G1 | +H16/F |
| 17 | 55-59 | | | +B17/C | 10*D17/(2+5*D1) | +F16-F16* | 5/2*(F17+F18) | +H18+G1 | +H17/F |
| 18 | 60-64 | | | +B18/C | 10*D18/(2+5*D1) | +F17-F17* | 5/2*(F18+F19) | +H19+G1 | +H18/F |
| 19 | 65-69 | | | +B19/C | 10*D19/(2+5*D1) | +F18-F18* | 5/2*(F19+F20) | +H20+G1 | +H19/F |
| 20 | 70-74 | | | +B20/C | 10*D20/(2+5*D2) | +F19-F19* | 5/2*(F20+F21) | +H21+G2 | +H20/F |

Fig. 7

Life Table - 1981 Norwegian data

| x | Dx | Px | ** MALES ** | | | | | |
|-------|-------|---------|-------------|--------|---------|---------|-----------|------|
| | | | mx | qx | lx | Lx | Tx | ex |
| 0 | 221 | 25,975 | 0.0085 | 0.0085 | 100,000 | 99,404 | 7,253,818 | 72.5 |
| 1-4 | 53 | 105,898 | 0.0005 | 0.0020 | 99,149 | 396,198 | 7,154,414 | 72.2 |
| 5-9 | 47 | 154,268 | 0.0003 | 0.0015 | 98,950 | 494,375 | 6,758,216 | 68.3 |
| 10-14 | 49 | 170,480 | 0.0003 | 0.0014 | 98,800 | 493,643 | 6,263,842 | 63.4 |
| 15-19 | 145 | 163,838 | 0.0009 | 0.0044 | 98,658 | 492,200 | 5,770,198 | 58.5 |
| 20-24 | 181 | 158,067 | 0.0011 | 0.0057 | 98,222 | 489,709 | 5,277,998 | 53.7 |
| 25-29 | 149 | 157,088 | 0.0009 | 0.0047 | 97,661 | 487,152 | 4,788,290 | 49.0 |
| 30-34 | 160 | 161,213 | 0.0010 | 0.0050 | 97,199 | 484,794 | 4,301,138 | 44.3 |
| 35-39 | 214 | 141,097 | 0.0015 | 0.0076 | 96,718 | 481,764 | 3,816,344 | 39.5 |
| 40-44 | 251 | 105,525 | 0.0024 | 0.0118 | 95,987 | 477,100 | 3,334,580 | 34.7 |
| 45-49 | 401 | 96,723 | 0.0041 | 0.0205 | 94,853 | 469,398 | 2,857,479 | 30.1 |
| 50-54 | 758 | 105,289 | 0.0072 | 0.0354 | 92,907 | 456,320 | 2,388,081 | 25.7 |
| 55-59 | 1,348 | 115,371 | 0.0117 | 0.0568 | 89,621 | 435,389 | 1,931,761 | 21.6 |
| 60-64 | 2,049 | 110,227 | 0.0186 | 0.0888 | 84,534 | 403,901 | 1,496,372 | 17.7 |
| 65-69 | 2,792 | 93,313 | 0.0299 | 0.1392 | 77,026 | 358,328 | 1,092,470 | 14.2 |
| 70-74 | 3,521 | 72,955 | 0.0483 | 0.2153 | 66,305 | 295,830 | 734,142 | 11.1 |
| 75-79 | 3,649 | 48,765 | 0.0748 | 0.3152 | 52,027 | 219,141 | 438,312 | 8.4 |
| 80-84 | 3,385 | 28,198 | 0.1200 | 0.4617 | 35,629 | 137,024 | 219,171 | 6.2 |
| 85+ | 3,445 | 16,262 | 0.2118 | 0.6925 | 19,180 | 82,147 | 82,147 | 4.3 |

Life Table - 1981 Norwegian data

| x | Dx | Px | ** FEMALES ** | | | | | |
|-------|-------|---------|---------------|--------|---------|---------|-----------|------|
| | | | mx | qx | lx | Lx | Tx | ex |
| 0 | 161 | 24,894 | 0.0065 | 0.0065 | 100,000 | 99,546 | 7,887,747 | 78.9 |
| 1-4 | 46 | 100,570 | 0.0005 | 0.0018 | 99,351 | 397,042 | 7,788,202 | 78.4 |
| 5-9 | 26 | 147,773 | 0.0002 | 0.0009 | 99,170 | 495,630 | 7,391,160 | 74.5 |
| 10-14 | 24 | 161,855 | 0.0001 | 0.0007 | 99,082 | 495,228 | 6,895,530 | 69.6 |
| 15-19 | 52 | 155,252 | 0.0003 | 0.0017 | 99,009 | 494,631 | 6,400,302 | 64.6 |
| 20-24 | 52 | 150,976 | 0.0003 | 0.0017 | 98,843 | 493,791 | 5,905,671 | 59.7 |
| 25-29 | 42 | 149,646 | 0.0003 | 0.0014 | 98,673 | 493,020 | 5,411,880 | 54.8 |
| 30-34 | 69 | 150,618 | 0.0005 | 0.0023 | 98,535 | 492,111 | 4,918,860 | 49.9 |
| 35-39 | 105 | 133,033 | 0.0008 | 0.0039 | 98,309 | 490,579 | 4,426,749 | 45.0 |
| 40-44 | 137 | 102,590 | 0.0013 | 0.0067 | 97,922 | 487,982 | 3,936,170 | 40.2 |
| 45-49 | 208 | 95,245 | 0.0022 | 0.0109 | 97,271 | 483,712 | 3,448,188 | 35.4 |
| 50-54 | 343 | 105,063 | 0.0033 | 0.0162 | 96,214 | 477,176 | 2,964,476 | 30.8 |
| 55-59 | 631 | 118,587 | 0.0053 | 0.0263 | 94,656 | 467,069 | 2,487,300 | 26.3 |
| 60-64 | 963 | 120,079 | 0.0080 | 0.0393 | 92,171 | 451,797 | 2,020,231 | 21.9 |
| 65-69 | 1,491 | 107,560 | 0.0139 | 0.0670 | 88,548 | 427,910 | 1,568,434 | 17.7 |
| 70-74 | 2,230 | 93,126 | 0.0239 | 0.1130 | 82,616 | 389,748 | 1,140,524 | 13.8 |
| 75-79 | 3,242 | 73,192 | 0.0443 | 0.1994 | 73,283 | 329,886 | 750,776 | 10.2 |
| 80-84 | 3,938 | 47,969 | 0.0821 | 0.3406 | 58,671 | 243,401 | 420,891 | 7.2 |
| 85+ | 5,315 | 31,122 | 0.1708 | 0.5984 | 38,689 | 177,490 | 177,490 | 4.6 |

Keys

- Dx = Number of deaths in age group, Px = Median population in age group
- mx = Proportion in age group dying during interval
- qx = Probability of dying during period (mortality rate)
- lx = Survivors at age x
- Lx = Total years lived during interval
- Tx = Total years yet to be lived by age group
- ex = Life expectancy for age group

Sources:

- STATISTISK ARBOK 1983 (Central Bureau of Statistics of Norway)
- World Health Statistics Annual - 1983

Fig. 8

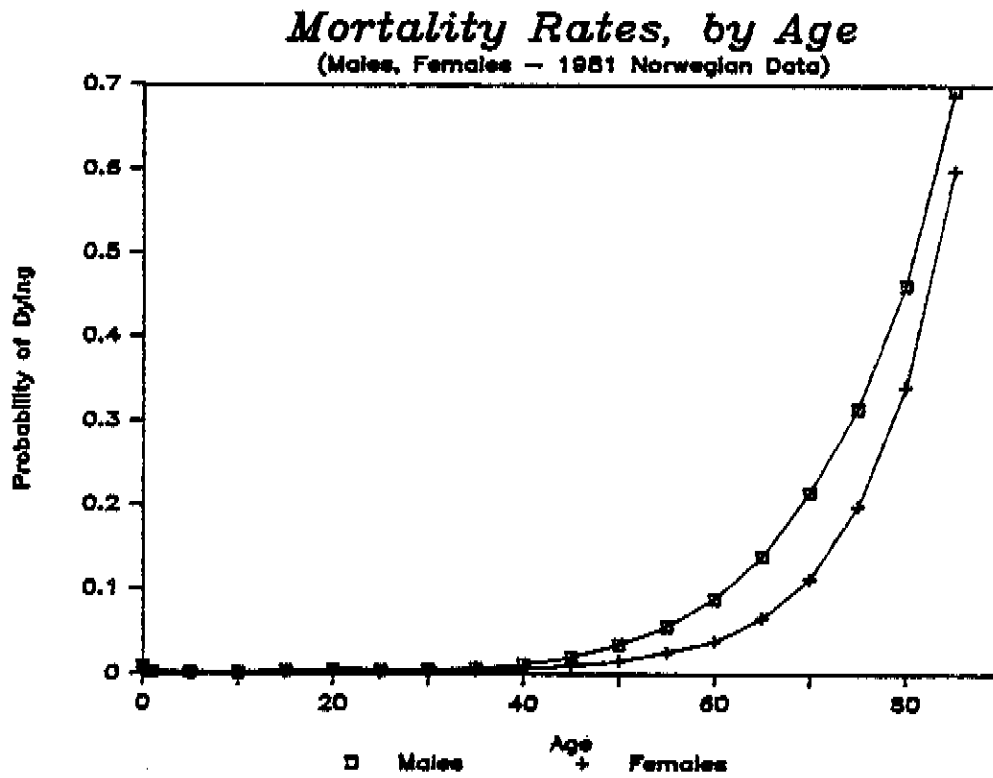


Fig. 9

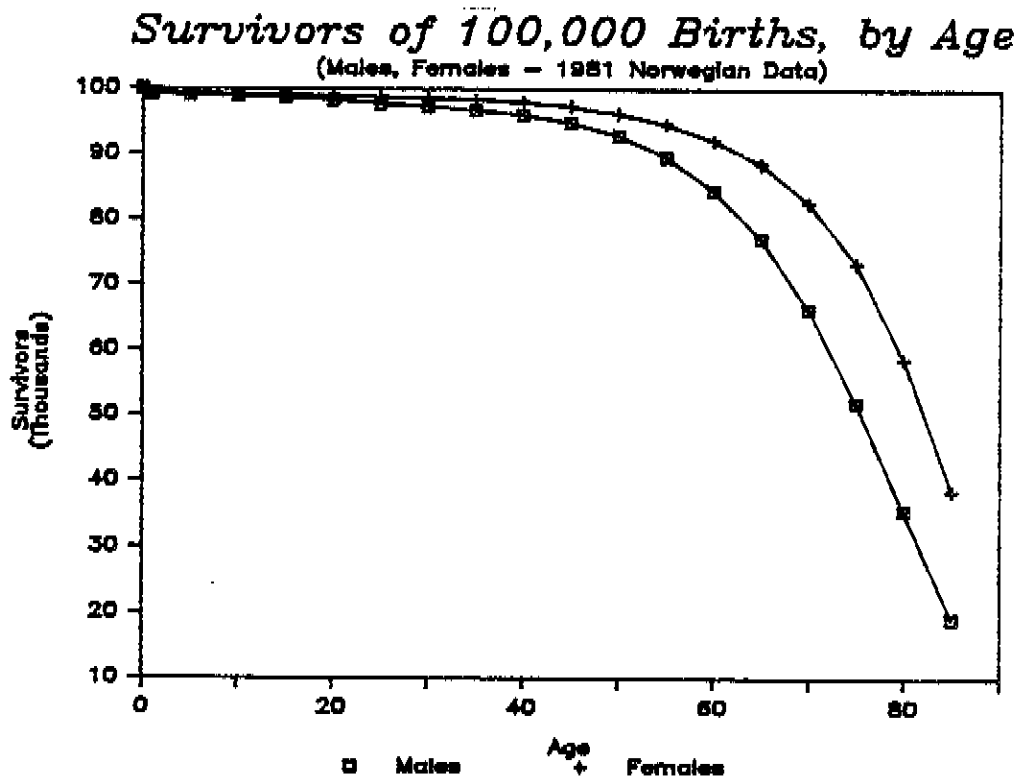


Fig. 10

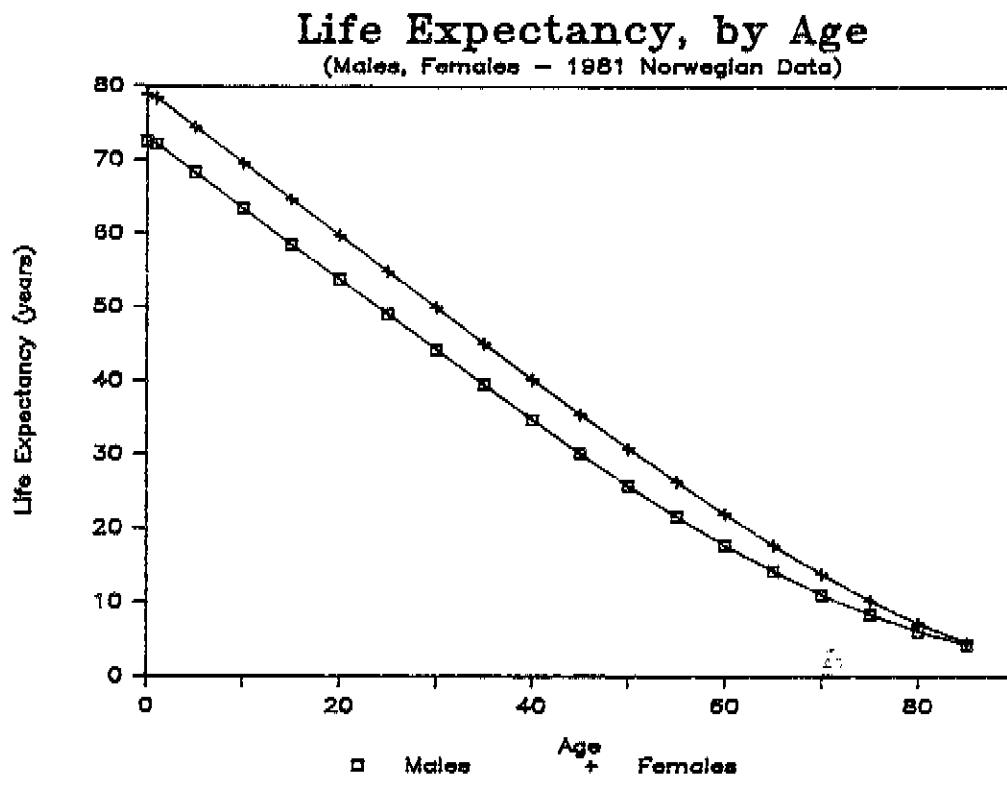


Fig. 11

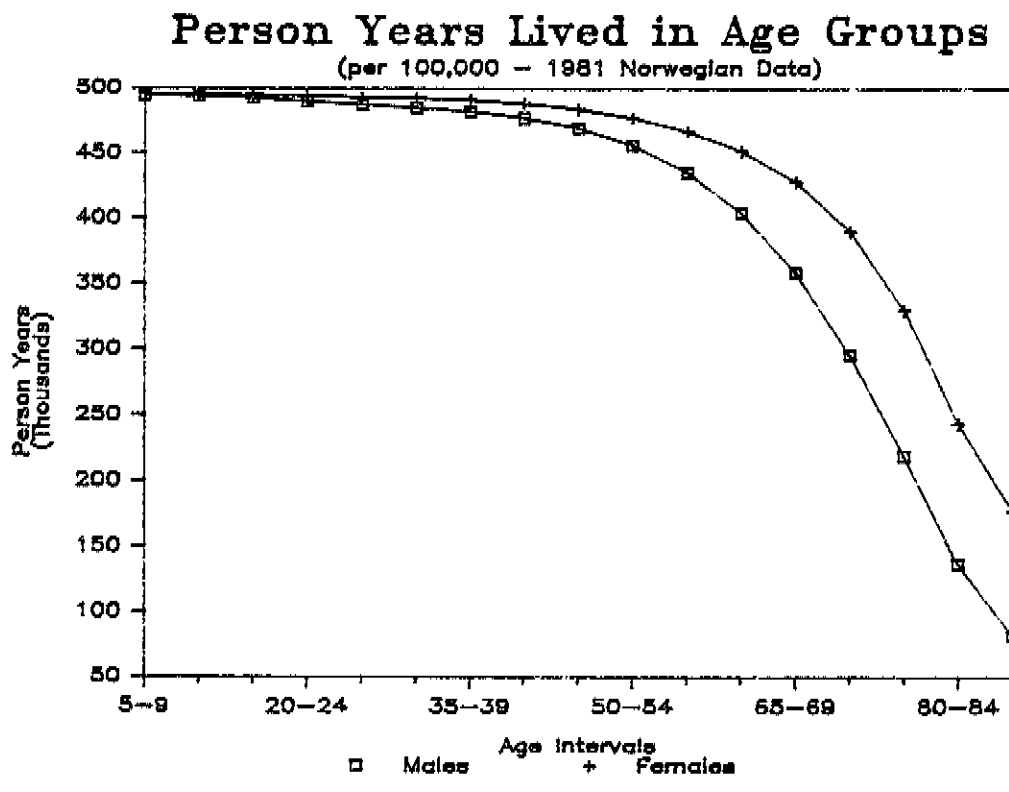


Fig. 12

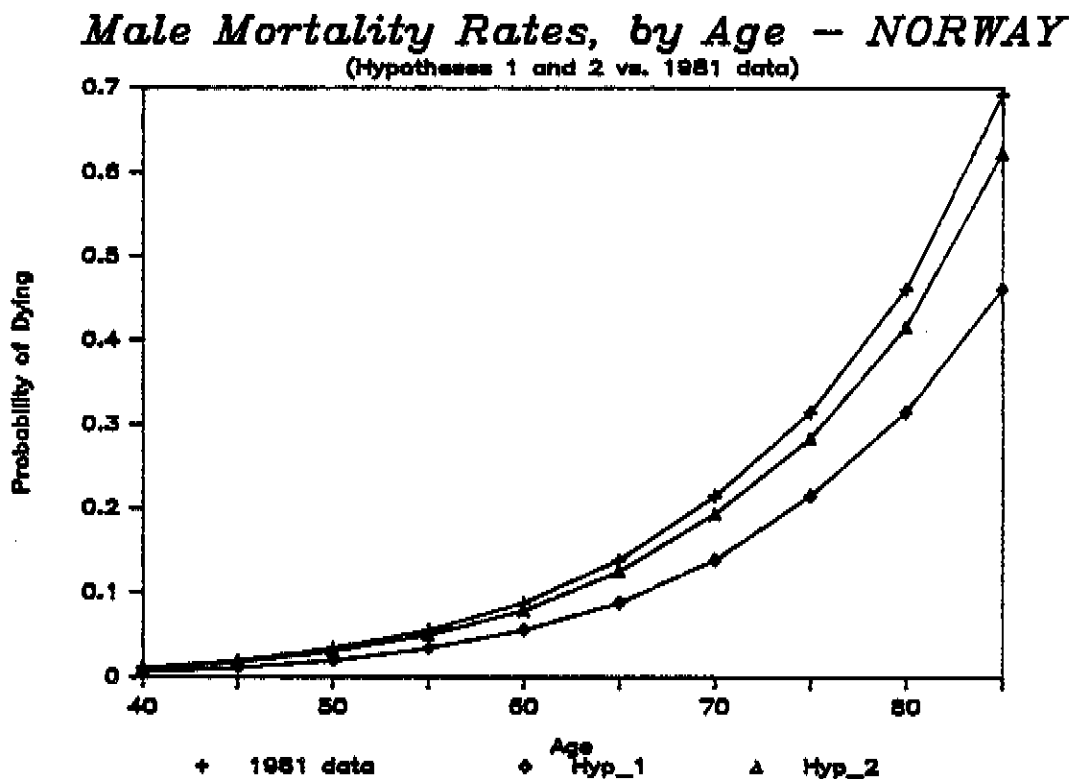


Fig. 13

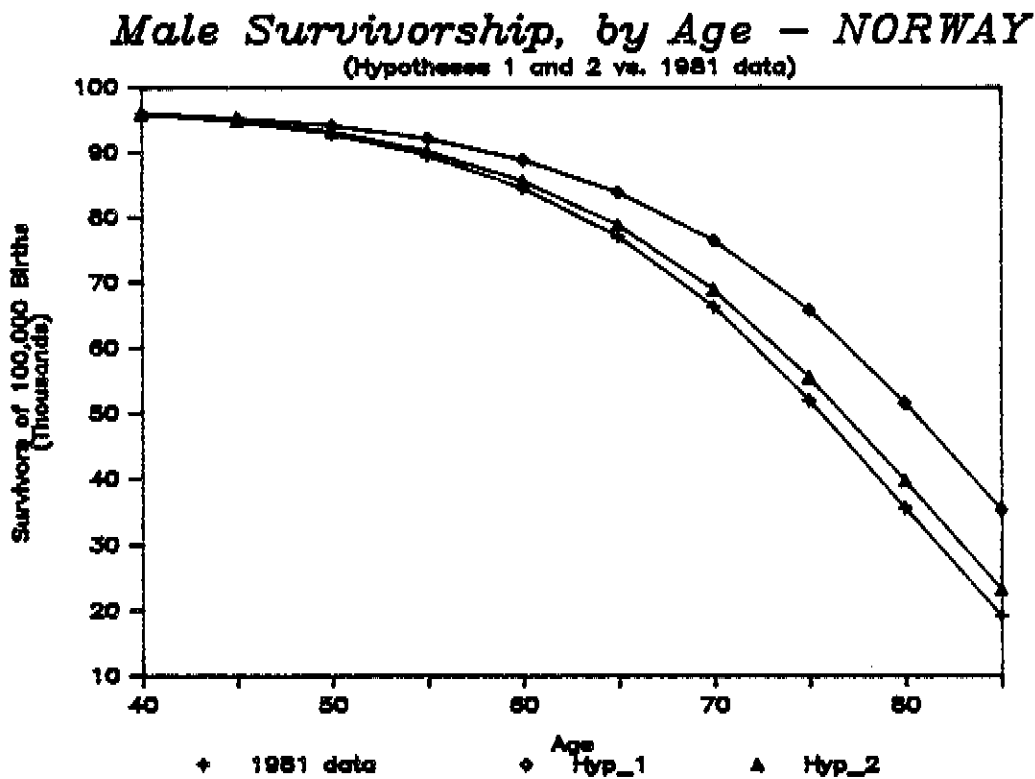


Fig. 14

Male Life Expectancy, by Age - NORWAY
 (Hypotheses 1 and 2 vs. 1981 data)

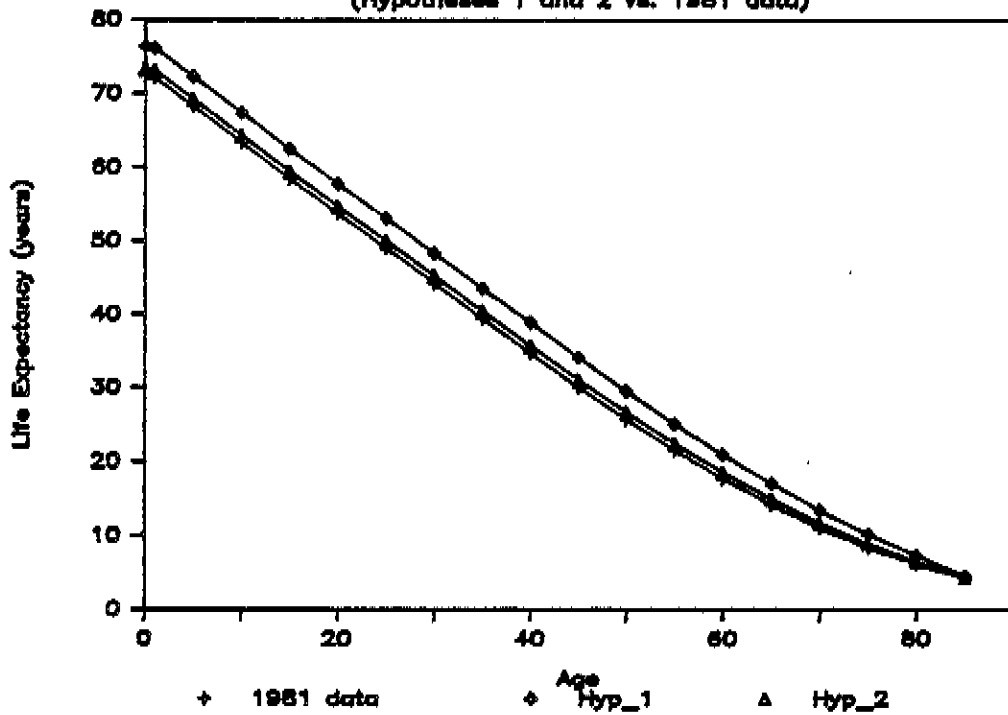


Fig. 15

Person Years Lived in Age Intervals
 (Hypotheses 1&2 vs 1981 data - Norway)

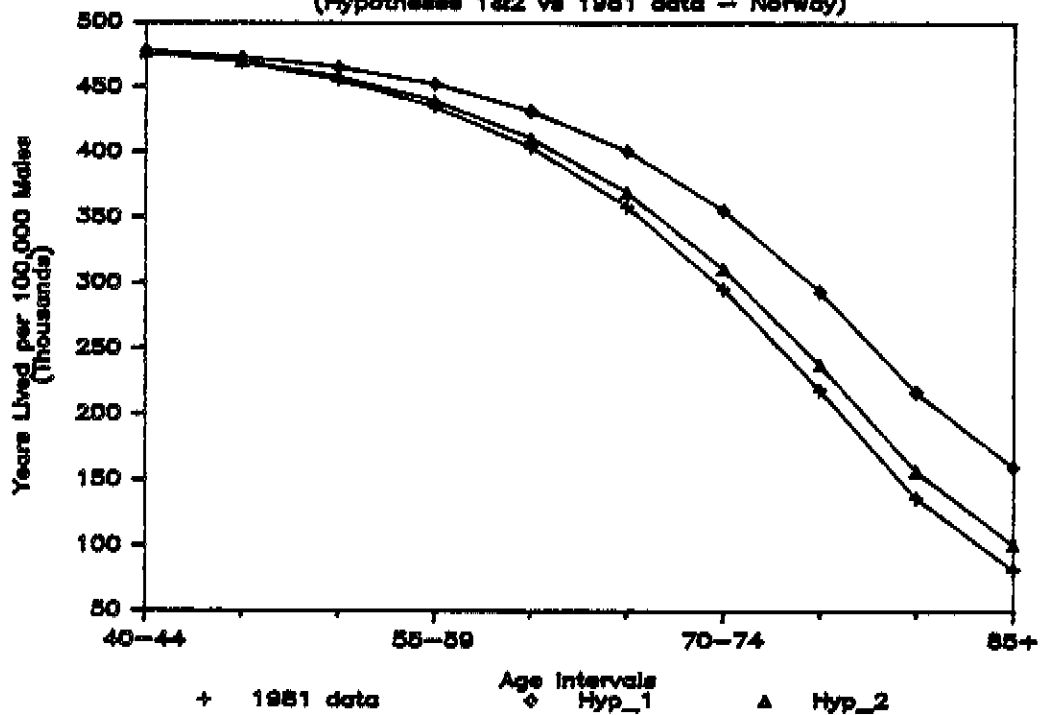


Fig. 16

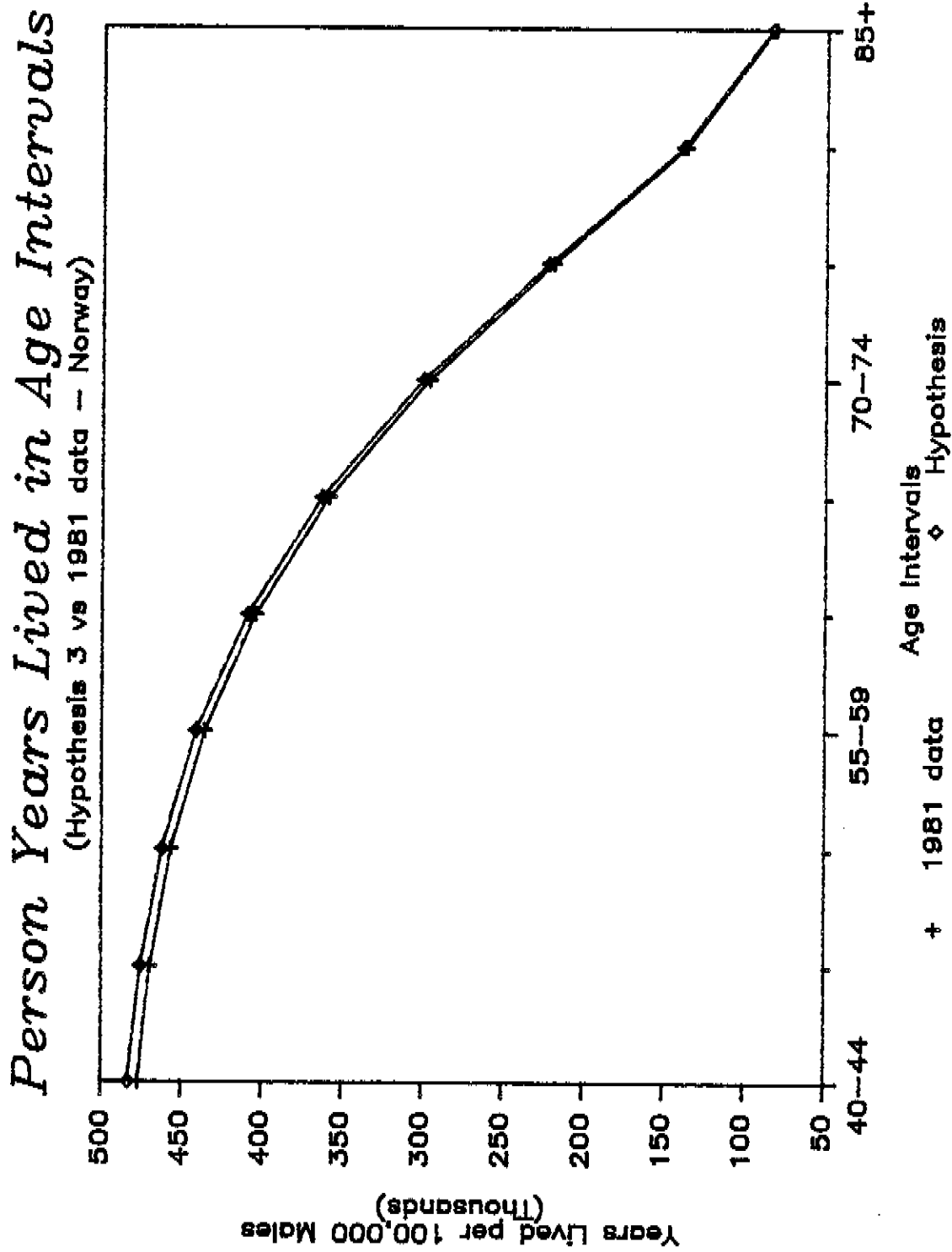


Fig. 17

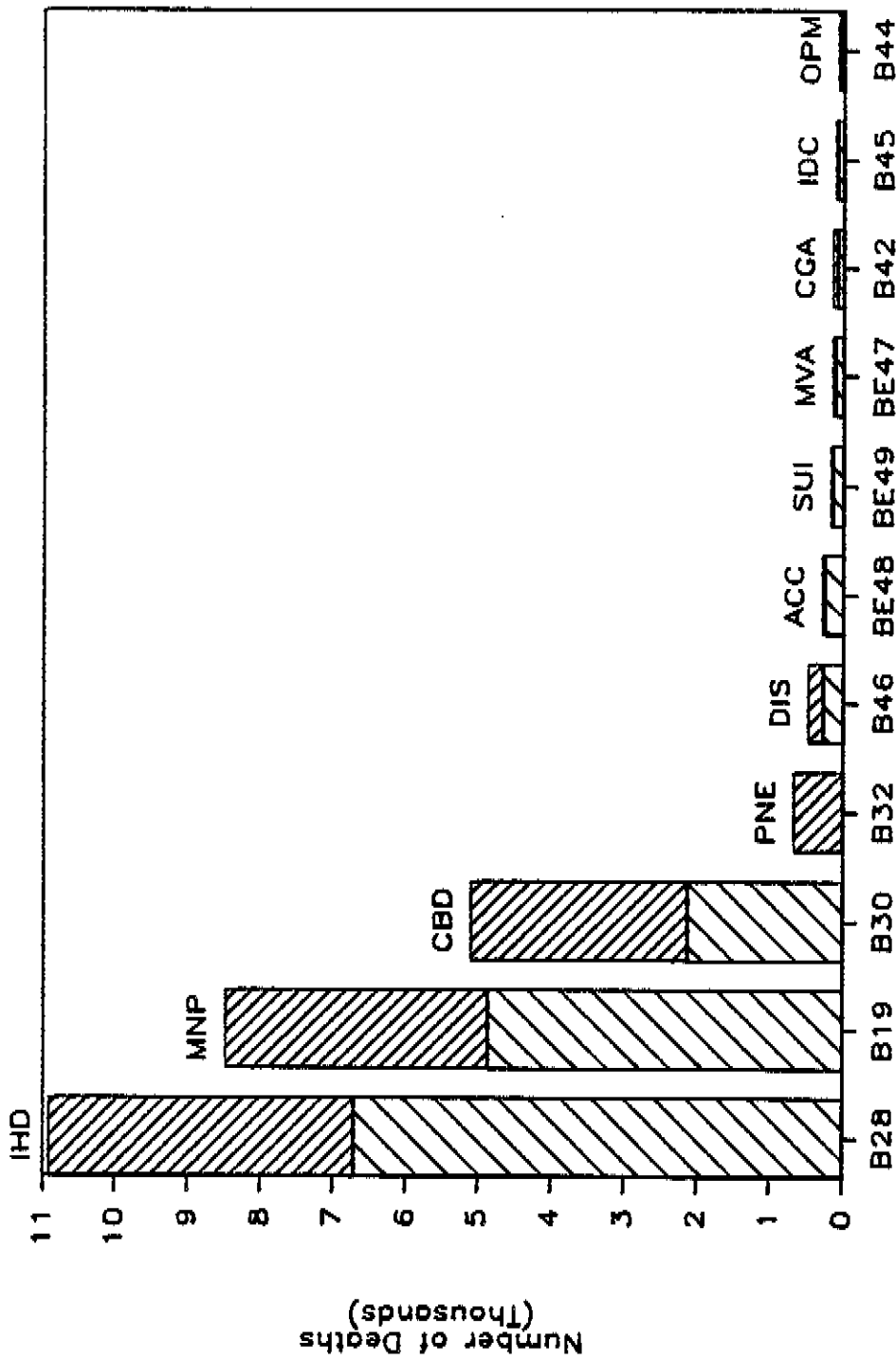
Three most important causes of death by sex and age
NORWAY 1981

| Age Group | Males | | | | | | | Females | | | | | | | | |
|-----------|--------|-----|-----|-------|-------------|------|------|---------|------|------|-----|-------------|------|------|------|-------|
| | Causes | | | | ICD-8 Codes | | | Causes | | | | ICD-8 Codes | | | | |
| | 1 | 2 | 3 | other | 1 | 2 | 3 | other | 1 | 2 | 3 | other | 1 | 2 | 3 | other |
| 0 | 72 | 45 | 34 | 70 | B42 | B44 | B45 | | 58 | 37 | 29 | 37 | B42 | B44 | B45 | |
| 1-4 | 14 | 13 | 7 | 19 | BE48 | B42 | B46 | | 14 | 6 | 6 | 20 | BE48 | B19 | BE47 | |
| 5-9 | 14 | 12 | 9 | 12 | BE47 | BE48 | B19 | | 6 | 6 | 4 | 10 | B19 | BE47 | B42 | |
| 10-14 | 14 | 14 | 9 | 12 | BE47 | BE48 | B19 | | 5 | 4 | 3 | 12 | B42 | B19 | BE47 | |
| 15-19 | 48 | 28 | 19 | 50 | BE47 | BE48 | B19 | | 13 | 9 | 8 | 22 | BE47 | B46 | B19 | |
| 20-24 | 46 | 41 | 39 | 55 | BE49 | BE47 | BE48 | | 11 | 9 | 7 | 25 | B19 | B46 | BE47 | |
| 25-29 | 41 | 31 | 20 | 57 | BE48 | BE49 | B46 | | 13 | 8 | 4 | 17 | B19 | BE49 | BE47 | |
| 30-34 | 42 | 30 | 26 | 62 | BE49 | BE48 | B19 | | 24 | 6 | 5 | 34 | B19 | B46 | BE48 | |
| 35-39 | 50 | 41 | 32 | 91 | BE48 | B19 | BE49 | | 59 | 14 | 7 | 25 | B19 | BE49 | B46 | |
| 40-44 | 56 | 49 | 34 | 112 | B28 | B19 | BE48 | | 68 | 11 | 10 | 48 | B19 | BE49 | BE48 | |
| 45-49 | 109 | 81 | 37 | 174 | B28 | B19 | B46 | | 112 | 21 | 18 | 57 | B19 | B28 | B46 | |
| 50-54 | 265 | 169 | 51 | 273 | B28 | B19 | B45 | | 170 | 37 | 26 | 110 | B19 | B28 | B46 | |
| 55-59 | 534 | 331 | 85 | 398 | B28 | B19 | B46 | | 319 | 90 | 46 | 176 | B19 | B28 | B46 | |
| 60-64 | 770 | 583 | 130 | 566 | B28 | B19 | B46 | | 440 | 175 | 80 | 268 | B19 | B28 | B46 | |
| 65-69 | 1055 | 739 | 194 | 804 | B28 | B19 | B30 | | 506 | 376 | 195 | 414 | B19 | B28 | B30 | |
| 70-74 | 1215 | 905 | 343 | 1058 | B28 | B19 | B30 | | 613 | 602 | 328 | 687 | B19 | B28 | B30 | |
| 75-79 | 1099 | 811 | 493 | 1246 | B28 | B19 | B30 | | 835 | 639 | 583 | 1185 | B28 | B19 | B30 | |
| 80-84 | 868 | 634 | 558 | 1325 | B28 | B19 | B30 | | 903 | 837 | 622 | 1576 | B28 | B30 | B19 | |
| 85+ | 747 | 544 | 465 | 1689 | B28 | B30 | B19 | | 1161 | 1035 | 680 | 2439 | B28 | B30 | B32 | |

| M | F | T | | | |
|------|------|-------|------|-----|-------------------------------------|
| 6718 | 4200 | 10918 | B28 | IHD | Ischaemic heart disease |
| 4871 | 3620 | 8491 | B19 | MNP | Malignant neoplasms |
| 2132 | 2978 | 5110 | B30 | CBD | Cerebrovascular disease |
| 0 | 680 | 680 | B32 | PNE | Pneumonia |
| 279 | 201 | 480 | B46 | DIS | All other diseases |
| 262 | 29 | 291 | BE48 | ACC | All other accidents |
| 151 | 33 | 184 | BE49 | SUI | Suicide |
| 117 | 39 | 156 | BE47 | MVA | Motor vehicle accidents |
| 85 | 67 | 152 | B42 | CGA | Congenital anomalies |
| 85 | 29 | 114 | B45 | IDC | Ill-defined conditions |
| 45 | 37 | 82 | B44 | OPM | Other causes of perinatal mortality |

Fig. 18

Leading Causes of Death - Norway 1981



Causes of Death (ICDB B-list)

Annex 3

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