Framework

and design for planning uses of information in the NHS

Problems and Progress in Medical Care

ESSAYS IN CURRENT RESEARCH

TENTH SERIES

A framework for planning hospital services

M. S. BUTTS and J. R. ASHFORD

Planning local health services

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Priorities for prevention: a discussion paper

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Foreword

The essays in this book while concerned with the production and use of information for planning and shaping health services—very much matters of the moment—have roots deep in the history of Trust interests.

Thus even before the publication of the results of the Norwich and Northampton case-load studies (1), which spotlighted the issue of the various numbers of hospital beds likely to be required in planning for the NHS, the Trust had been concerned in an earlier venture with experiments (2) in the development of information fundamental to the planning of a system of services to provide medical care for defined populations.

Indeed the developing literature of the results of health services research in which the Trust has had a share (3) indicates the increasing sophistication needed for dealing with the complex issues which have to be taken into consideration in sound planning policies. At the same time they show how this poses a need for a species of general staff thinking at policy-making levels, which has to take account of the complementary problems of education and training to enable individuals to develop their talents to fulfil public policies. Above all they also indicate the activity in the provinces by way of local experiments and developments and are a reminder of the capacities which exist there and of which Government policies should take some account if the optimum is to be gained from the energies and skills of the many people far from the centre of affairs in London but whose morale and effectiveness partly depends on their sympathetic appreciation of policies handed down from some

eminence less holy than Mount Sinai. Yet if there is a cohesive policy on the part of the DHSS in the widest planning sense to show that as much as possible has been delegated and use has been made of such talents as are available in the development of over-all concepts embracing the collection of raw data, its conversion into information for management and the training of management in numerate skills, it is not too evident in the event. On the contrary it not infrequently seems there is at the centre little appreciation of the real requirements of a responsive service and little consideration being given to how to go about meeting these with a fully comprehensive and integrated policy to give reality to devolution with all that it implies. Indeed there seems to be a case for a special look at this facet of health services analogous to that carried out by the Central Policy Review Staff on relations between central and local government (4).

The accent now on planning (5), particularly from the period dating from just before the NHS reforms of 1974, has put a premium on numeracy in the skills of health service managers. It is also a fair guess that in the current phase of restricted finance, if managers and decision-takers are not going to be content to resign themselves to holding a completely defensive line, but instead will be required to look at the whole range of strategic issues at national, regional, and area level, involved in restricted resources and to develop tactical moves to rationalize services to achieve the optimum from such resources as are made available to them, an increased premium will be called for. The need for the kind of framework and mechanisms for action and operation as indicated in the first three of the contributions to this volume, and which require a numerate literacy, the quality of which with others in the provinces (6) Professor Ashford (7) has sought to advance by research as well as in the training of information officers at the University of Exeter (8) will then become even more strikingly evident.

Nor is this true only in the narrow sense of health authorities *qua* institutions providing services. Dr Stone's essay explores more fully the issues in *Prevention and Health: Everybody's Business* (9), but indicates above all the indivisibility of curative and preventive medicine (or personal and population medicine) in the modern state,

in which public policies for health are pervasive realities affecting education as well as professional attitudes and operational systems, in areas well beyond that of the NHS. Yet public policy has to recognize that ultimate success will depend on the effective mobilization of local talents.

It is hoped in a later complementary volume now in the press to point this up more acutely and discuss some of the implications in terms of public policy, including relevant management and educational issues.

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A framework for planning hospital services

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A framework for planning hospital services

Summary. The planning of hospital services is one of the major tasks facing the reorganized NHS. The approach advocated in this paper involves two distinct stages. First, the planner is required to define the terms of reference of the planning exercise by specifying the population served, the *per capita* need, and the efficiency of the services provided. Secondly, a procedure is established whereby these key measures may be translated into a requirement for hospital beds and other in-patient and out-patient resources. The sources of objective quantitative information which may assist the planner in the choice of realistic planning objectives are identified and methods of presenting these data in a convenient form are described. The approach is illustrated by an example from one health services district. It is shown that the results of the planning exercise depend very critically upon the basic assumptions and may differ widely from plans based upon norms for bed provision. The application of these ideas to produce a logical and coherent procedure for resource allocation within a region is described.

Introduction

Within the NHS the need for a systematic planning procedure is now generally accepted and following reorganization in 1974 the planning of services on a coherent and comprehensive basis has become possible for the first time. A planning system (1) has been introduced and is currently being put to the test of practical application at all levels of management. Initial reactions to the proposed system are mixed, but it is becoming clear that there are many uncertainties about the precise way in which the process should operate. Difficulties exist

both at the conceptual level and also in terms of specific issues such as the identification of sources of information and the choice of procedures whereby this information may be manipulated to produce plans. The general aims of the planning process have been discussed elsewhere (2). The object of this paper is to establish a framework which can be used to assist in the planning of local health services. Our approach consists essentially of two stages. In the first place, the planner is asked to make certain broad assumptions about the way in which specific parts of the health services will work at some future date. Secondly, the consequences of these assumptions are explored to produce forecasts of resource requirements on the basis of existing data.

In order to provide a specific focus for our proposed procedures, we have considered in detail the problem of forecasting the requirement for hospital in-patient and out-patient services in a particular health services area. This is a single-district area which lies in a fairly densely populated industrial part of the north of England.

Virtually all the information used in this study was already available to the local health services and, although the manipulation of extensive data sets was involved, the amount of additional data collection required was minimal. The procedures described in this paper can be readily extended to other districts within the same region and form a logical basis for resource allocation within the region.

Principles of planning

We assume that the aim of the NHS is to meet the needs of populations for medical care. In the present state of knowledge it is not possible to specify the precise needs of an individual of given personal characteristics or how these needs might best be met. Nevertheless, it is clear on general grounds that, however defined, need will vary within a population and that, on average, there are likely to be significant differences between males and females and in terms of age. Because of the difficulties of definition, it is necessary to consider surrogate measures of need, and the concepts of the demand for care and the usage of services are important in this context. The relationship between need, demand, and usage has been discussed elsewhere (2). However, it must be emphasized that both demand and usage are likely to be conditioned by the availability and accessibility of services as well as by need, as indicated in Fig. 1. For most of the

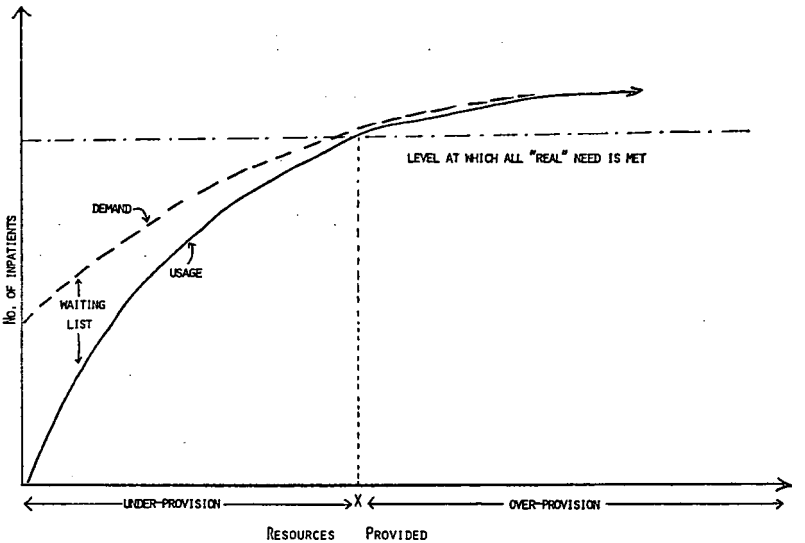


Figure 1. Demand and usage in terms of resource provision.

services currently provided, an increase in resources would probably result in both an increased demand for care and also an increased usage of services. The only generally available indicators of need are the 'norms' for bed provision, which are arbitrary figures usually expressed on a *per capita* basis and applying to very heterogeneous groups of patients. Norms were never intended to do more than to give a general indication of need and by their nature can take no account of special local circumstances. In order to plan effectively for any particular service situation, more detailed and specific measures are required.

In so far as the planner must be concerned with meeting the needs of populations, the size and structure of the population to be served is of primary importance. In the first place, a decision must be made as to whether the particular services being planned are to be reserved exclusively for the residents of a particular geographical area or whether they are to be made available on a more general basis. The first alternative implies that the district concerned is to be self-sufficient and the corresponding population is the **resident** population. Information about the resident population is available at ten-year intervals as a result of the national censuses, the most recent of which took place in 1971. The calculation of estimates of the future population is based upon the census data, together with more recent information about birth- and death-rates. These data are used in conjunction with a theory concerning family structure and trends in

fertility and mortality to produce *population projections*. This process is the responsibility of central government and projections are prepared by the Office of Population Censuses and Surveys (OPCS) for health services districts, areas, and regions. Evidence during the past two decades suggests that these forecasts may be subject to very substantial errors, particularly in respect of events more than ten years ahead of the last available census. The main complicating factors are unforeseen changes in birth-rate and the absence of any reliable data concerning migration.

In heavily populated parts of the country, there are substantial flows of patients across health services boundaries and the population served does not coincide with the resident population. In this case, the services must be provided for a **catchment** population, whose composition and location reflects ease of access to services as well as place of residence. The only data about catchment populations is that derived from Hospital Activity Analysis (HAA), which inevitably refers to past usage of services rather than to future demand or need. If the planner expects to influence the catchment population, either by varying the provision of resources in the particular district and in the neighbouring districts or by artificial restrictions of service, there will be corresponding alterations in the size and composition of the population served which must be taken into account.

Assuming that the relevant population has been specified, the next logical step in the planning process is to identify the total need, by multiplying the *per capita* need by the size of the population served, making due allowance if possible for any differences between sections of the population. If no specific steps are to be taken to alter the catchment population or the geographical distribution of resources provided and if the system had spare capacity in the past, trends in demand at the institutions concerned may be taken as a guide to the need for resources in the future. This situation may well apply in the short term, but over a longer period changes are more likely to take place which will affect both the catchment population and the distribution of resources. The problems of forecasting demand and some possible solutions have been discussed in detail elsewhere (2). In this paper we make the underlying assumption that catchment populations may change and forecasts of demand must therefore be constructed as the product of population size and *per capita* need.

The prediction of future need for specific services presents an exacting task. If demand and need during the recent past can be

equated, extrapolation of past demand rates, expressed either as admissions *per capita* or bed-days *per capita* in relation to in-patient services, may be satisfactory. However, there remains the problem of deciding whether the assumption of equivalence of need and demand can be justified and, if so, whether extrapolation is a reasonable method of forecasting. In many (if not most) specialties, there are difficulties in deciding upon precise levels of current need on an age/sex specific basis and there is also the further complication of projection into the future. Judgement by experts in the field is required, supplemented where necessary by objective evidence about recent trends. For example, the assumption that there will be no significant change in demand or usage when expressed on an age/sex specific basis may provide a useful reference point. A second plausible hypothesis is that recent trends in demand or usage can be extrapolated, either for a whole population or in age/sex specific terms.

The third major item of information required for the planning process is the efficiency of the service, expressed in terms of the resources required for an average case. Again, there are no absolute standards, but the choice of assumptions about the future situation may be guided by current performance. The main resource for hospital in-patient care is the bed, and length of stay and bed occupancy are widely used measures of efficiency. When setting planning targets, two distinct approaches may be helpful. First, current standards of performance in terms of these and related measures in the given district may be examined. Secondly, the variation of corresponding indicators of efficiency for the same specialty between different districts within the same region can provide a useful yardstick of performance. In terms of efficiency also, experience of local conditions and prospects is likely to be the most useful guide. However, current performance in the district or the 'best' current performance amongst the various districts within the region may both provide useful reference standards.

For a given set of assumptions about the population, the *per capita* need for resources and the efficiency with which these resources will be used, estimates of resource requirements at future dates can be calculated. Because of the uncertainties about each of the main parameters of the situation, it is essential for the planner to explore the consequences of different sets of assumptions. In this way, recognition is given to the fundamental uncertainties about the course of future events and what may be termed the 'robustness' of

plans to variations in the basic assumptions can be exposed. The longer the time horizon, the greater the uncertainty of the planning process. It follows that the preparation of plans is an activity which must be updated continuously as new information becomes available.

Populations

In the reorganized NHS, the responsibilities of particular districts and areas are defined on a geographical basis. In general, all services and institutions located within a given area form part of the corresponding organizational unit. However, it does not necessarily follow that such services and institutions will be used solely and exclusively by patients who live within that particular geographical area. Some patients are treated in districts or areas other than the one in which they live. An example of the extent of such cross-boundary transfers is given in Table 1, which shows for two large specialties the proportion of spells of in-patient care for patients living within the boundaries of the chosen area which took place at hospitals located in that area. These results are based upon an analysis of HAA data for the whole region. Since the area lies in the central part of the region, it has been assumed that the proportion of the resident population treated elsewhere is negligible. This would not necessarily be true for areas situated on the boundary of the region; in such cases, an analysis of the corresponding data for any adjacent region(s) where patients resident in the area might be treated would also be required. Reference to Table 1 shows that about three-quarters of the spells of in-patient care in general surgery and about four-fifths in general

Table 1. *Percentage of spells of in-patient care for residents of the chosen area provided in the area*

AGE-GROUP (YEARS)	SPECIALTY			
	General surgery		General medicine	
	Males	*Females*	*Males*	*Females*
0–4	56	63	0	0
5–14	74	79	88	100
15–44	78	75	78	82
45–64	72	73	77	76
65 and over	85	76	81	83
Total	75	74	78	81

Source. HAA records for region.

medicine were provided in the area. Within the same specialty the proportions of in-patient spells treated in the area vary in terms of age and sex. There is no corresponding source of information concerning the delivery of out-patient care, but the assumption that the pattern of in-patient transfers in a given specialty also applies to out-patients is probably adequate for most purposes.

The OPCS provides forecasts of the size and age/sex structure of the populations living within health services districts and areas. Such populations are served partly by the district concerned and partly by other districts. Analysis of in-patient spells in terms of district of residence and district providing care then enables the extent of the contribution of any given district to the care of patients living in any other district to be identified. Suppose that District A accounts for 70 per cent of the in-patient spells for patients resident in that district, for 25 per cent of the in-patient spells for patients resident in District B, and for 20 per cent of in-patient spells for patients resident in District C. The **over-all catchment** population of District A is the population for which services are provided and consists of 70 per cent of the resident population of District A, 25 per cent of the resident population of District B, and 20 per cent of the resident population of District C. If the sizes of the resident populations are (in thousands) 200, 160, and 250 respectively, the over-all catchment population of District A is $(0{\cdot}7 \times 200)+(0{\cdot}25 \times 160)+(0{\cdot}2 \times 250) = 140+40+50 = 230{,}000$. A procedure of this kind may be applied to calculate the over-all catchment population for each specialty in the given district. Since the extent of the cross-boundary transfers can vary with the age and sex of the patient, the procedure should be carried out separately for males and females in each age-group. The various components of the catchment population can then be added together to obtain the **age/sex specific catchment** population for the particular specialty.

The over-all and age/sex specific catchment populations (calculated using the grouping of Table 1) for the chosen area in 1974 are shown in Table 2. This table must perforce exclude the obstetrics, GP maternity, mental handicap, and convalescent categories, for which no HAA records are available. However, for obstetrics, GP maternity, and mental handicap estimates have been made of the catchment population by assuming that regional and area demand rates are equal. The demand in the area as recorded on the SH3 returns was then expressed as a proportion of the demand in the

Table 2. *In-patient catchment populations by specialty, 1974.*

Specialty	Catchment population (1,000s) *Over-all*	*Age/sex specific*
General medicine	237	245
Paediatrics	49*	44
Chest diseases	467	415
Dermatology	137	119
Physical medicine/rehabilitation	485†	478
Geriatrics	30‡	31‡
ENT T & A	181	124
ENT other	168	164
Surgery	241	240
Traumatic and orthopaedic	218	208
Ophthalmology	150	129
Thoracic surgery	19	13
Dental surgery	133	140
Gynaecology	91§	90
Special care baby unit	13	13
Obstetrics ‖	116§	—
GP maternity ‖	130§	—
Mental handicap ‖	148	—
Infectious diseases	0	0
Neurology	0	0
Cardiology	0	0
Venereal diseases	0	0
Rheumatology	0	0
Units for younger disabled	0	0
Radiotherapy	0	0
Urology	0	0
Plastic surgery	0	0
Orthodontics	0	0
Neurosurgery	0	0
Psychiatric children	0	0
Mental illness	0	0
Adolescent psychiatry	0	0
IH dialysis	0	0
GP other, GP dental	0	0
Convalescent	0	0

Note. Resident population is 240,000 of whom 64,000 are below 15 years of age.

* Based upon 0–14-year age-group only.

† Based upon males aged 15–64 in certain districts where only males are treated.

‡ Based upon the over 64-year age-group (although patients less than 65 years of age are treated).

§ Based upon females only.

‖ Estimated from demand rates (Table 3) since no HAA data recorded.

Source. HAA records for the region.

region and the catchment population for the area was calculated as the corresponding proportion of the resident population of the region. Furthermore, no treatment is provided in the area for the infectious diseases, mental illness, child psychiatry, IH dialysis, GP dental, GP other, neurology, cardiology, venereal diseases, rheumatology, units for the younger disabled, radiotherapy, urology, plastic surgery, orthodontics, and neurosurgery specialties. Although the resident population is 247,000, the catchment populations for the most part differ very widely from this figure. For example, the catchment populations for chest diseases and physical medicine and rehabilitation are more than 400,000. Clearly, the chosen area provides these services for other districts. There are also substantial differences between the over-all and age/sex specific catchment populations for many specialties. Certain specialties, such as paediatrics and gynaecology, serve particular sections of the population and the calculation of the corresponding catchment populations has been confined to these specific groups. In summary, these results confirm that catchment populations can differ very widely from resident populations. As far as the catchment populations are concerned, the age/sex specific results may differ substantially from the over-all results and should therefore be preferred in spite of the greater degree of complication involved in the calculation.

Need

The usage of hospital in-patient services reflects both the size and structure of the population served and also the frequency with which patients of given characteristics are admitted to hospital. For planning purposes, it is important to emphasize the distinction between the need for care, the demand for care, and the usage of services. No direct evidence exists about the need for hospital in-patient care by particular populations or about the way such need will vary as time passes. The demand for care is made up of the usage of services and the waiting-list. On general grounds, demand can be regarded as a reflection both of need and also of the availability of services. As the services accessible to a population are enhanced, the demand for these services is also likely to rise until at some level of provision the law of diminishing returns will start to apply. Existing data suggest that in some specialties, such as chest diseases, paediatrics, and maternity, this situation has already been reached. At this stage, part of

the usage of services may not correspond to 'real' need. The position is illustrated in Fig. 1, which shows that for the provision of resources beyond a certain limit waiting-lists will disappear and demand and usage will coincide. At this level, there is likely to be some over-provision of resources. In few specialties, however, is the situation static; in general, the range of effective care will extend year by year and the level, X, at which resources can be said to be over-provided is likely to change as time passes.

Ideally, the planner should attempt to meet the need of the population with which he is concerned, need being assessed in the context of the standards of care prevailing at the time at which the plan is to apply. Given present knowledge, this is an impossible task and it is necessary to employ other methods which, although less satisfactory on theoretical grounds, make use of available information. Such information inevitably refers to usage or to unmet demand and the basic unit has been taken as the in-patient spell. Two main sources of data about the past situation exist. The first is the SH3 return, which shows for each institution and specialty the number of in-patients treated during each calendar year and the number of cases on the in-patient waiting-list at the end of the year. Returns are available for many years and the six years 1969–74 have been chosen as the basis for future projections. The second source of data is HAA, which provides information about usage of (as opposed to the demand for) services in each institution and specialty in terms of the personal characteristics of the patient. Usage rates may vary with age and sex as illustrated in Fig. 2, which refers to the use of the general medicine specialty by residents of the chosen area. These results were calculated by expressing the number of in-patient spells for the given age-group and sex as a proportion of the corresponding (in terms of age-group and sex) resident population. Most specialties which cater for a wide range of ages and both sexes show a similar pattern, with usage rates tending to increase with increasing age and differing between males and females of the same age. Ideally, therefore, the calculation of usage and (by implication) rates of demand and need should be carried out on an age/sex specific basis.

Given a series of demand or usage rates which applied at various times in the past, the next problem for the planner is to use these results to forecast demand rates in the future. A long series of annual data is available from the SH3 returns. On the other hand, the available HAA records cover only a period of two to three years and this

Figure 2. In-patient spells in general medicine specialty, chosen area 1974. Rate per 1,000 resident population.

source of information cannot therefore be used at present to obtain reliable predictions. For this reason, forecasts of future demand were made on the basis of the SH3 returns and the results for the five years 1969–74 were used. Forecasts were obtained by extrapolation on a linear basis for all specialties in which the available data exhibited a linear trend. The only exception was the physical medicine/rehabilitation specialty, for which a quadratic curve was fitted.

In view of the possibility that the past demand rates in the chosen area might have been affected by changing local factors, it was decided to base the forecasts upon the average proportionate changes in demand rates over the whole region, on the grounds that any local aberrations would probably be 'averaged out' over this larger area. The corresponding catchment population was taken as the total resident population of the region. Forecasts were then calculated of the demand rates in the various specialties for 1981, 1986, and 1991 by multiplying the proportionate change in the region by the 1974 figure for the chosen area. The results obtained are summarized in Table 3, which shows in addition the demand rates in the region in 1974. The age/sex specific usage rates based upon HAA and the demand rates based upon the SH3 returns for the chosen area for 1974 have also been calculated, on the basis of the 1974 catchment population.

Table 3. *Current and projected demand rates for area over-all catchment population. Number of in-patient spells per 1,000 population per year.*

SPECIALTY	CURRENT (1974)			REGIONAL PROJECTIONS (SH3)								
		Chosen area		1981			1986			1991		
	Region (*SH3*)	*HAA**	*SH3*	*Estimate*	*Standard error*	*% change*	*Estimate*	*Standard error*	*% change*	*Estimate*	*Standard error*	*% change*
General medicine	11·4	12·3	12·0	15·4	0·9	36	18·2	1·3	60	20·9	1·7	84
Paediatrics†	15·9	19·0	19·2	19·8	1·7	24	22·4	2·5	41	25·1	3·4	57
Chest diseases	1·8	1·6	1·6	1·9	0·1	8	2·0	0·2	12	2·1	0·2	16
Dermatology	0·4	0·4	0·4	0·3	0·1	−17	0·3	0·1	−29	0·2	0·1	−44
Physical medicine/ rehabilitation‡	0·2	0·2	0·2	0·2	na	−9	0·2	na	−9	0·2	na	−10
Geriatrics§	27·9	37·0	40·3	36·0	3·9	29	42·0	6·3	50	48·0	8·7	72
General surgery	18·1	18·9	19·4	18·6	1·1	3	18·8	1·6	4	19·1	2·1	5
ENT	5·1	5·9	4·2	5·6	0·7	9	6·2	1·0	20	6·7	1·3	31
Traumatic and orthopaedic	7·2	6·6	6·7	9·2	0·6	28	10·6	1·0	47	12·0	1·3	66
Ophthalmology	2·0	2·3	2·2	2·1	0·2	4	2·1	0·3	7	2·2	0·4	11
Thoracic surgery	0·6			0·7	0·1	16	0·8	0·2	26	0·8	0·3	38
Dental surgery	1·0	0·9	1·0	1·6	0·0	72	2·1	0·0	122	2·6	0·0	173
Gynaecology‖	15·7	14·9	14·3	16·7	1·3	6	17·3	1·9	10	17·8	2·6	13
SCBU¶	22·8	17·2	17·5	36·8	1·0	61	46·9	1·5	105	57·0	2·0	150
GP maternity‖	6·3	na	6·3**	4·8	0·3	−24	3·7	0·4	−41	2·7	0·6	−57
Obstetrics‖	23·2	na	23·2**	25·6	1·9	10	27·4	2·8	18	29·3	3·8	26
Mental handicap	0·5	na	0·5**	0·5	0·1	0	0·6	0·1	20	0·7	0·2	40

* Usage rate, age/sex specific catchment population.
† Based on population aged 0–14.
‡ Based on empirical fit.
§ Based on population aged 65 years or over.
‖ Based on females.
¶ Based on population aged 0–4.
** Catchment population calculated to make district and region demand rates equal (Table 2).

Comparison of the regional and area demand rates for 1974 shows substantial differences for paediatrics and geriatrics, but reasonable agreement in most other specialties. The two methods of calculation of the area rates for 1974 are generally in good agreement. The forecasts for all specialties except dermatology, physical medicine/rehabilitation and GP maternity involve the assumption that demand rates will increase with time. The extent of the predicted changes reflects the movement in the demand rates in the region observed between 1969 and 1974. It will be noted that the projected increase between 1974 and 1991 is as high as 84 per cent for general medicine, in comparison with only 5 per cent for general surgery. The calculated standard errors of the forecasts increase in size as the gap between the date of the forecast and the date of the last available SH3 returns widens. However, it cannot be emphasized too strongly that both the estimates and their standard errors are valid only to the extent that the assumed form of trend (usually linear) upon which the forecast is based will continue to apply.

Efficiency of in-patient services

For a given population and demand rate, the resulting in-patient bed requirement will depend upon two main factors, length of stay and bed occupancy. Within a specialty, the length of stay, like the demand rate, will vary with the age and sex of the patient. On the basis of the HAA records for the region for 1974, the number of beds in general medicine occupied by patients resident in the chosen area was calculated for males and females in various age-groups. Assuming that there are 365 available days in the year and given the size of the resident population of the particular sex and age-group, the bed usage by the particular group can be found. The results obtained are illustrated in Fig. 3, which shows that the *per capita* bed usage in this specialty increases very steeply with increasing age from about 35 years. These figures can be regarded as the product of usage rate and length of stay, each of which when taken separately shows the same general pattern. It is interesting that the *per capita* bed requirement at 65 years of age in males is more than ten times as high as in the under 34-year age-groups, a result which further emphasizes the high degree of variation of resource utilization in terms of age.

Length of stay is a parameter which is determined largely by clinical considerations and by the characteristics of the patient. However,

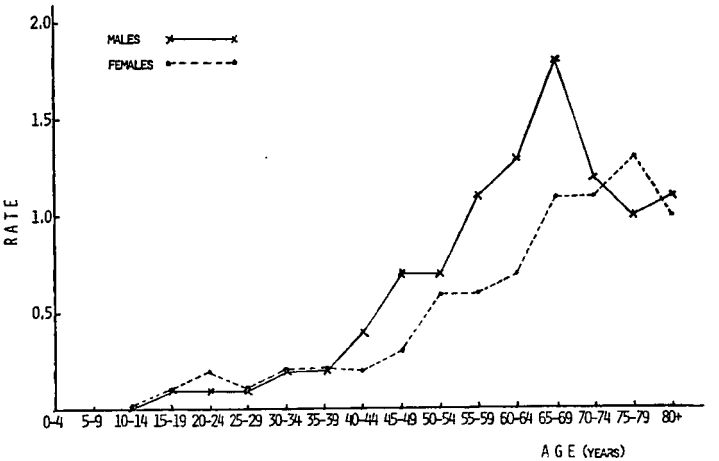


Figure 3. Occupied beds in general medicine specialty, chosen area 1974. Number of beds required per 1,000 resident population.

bed occupancy reflects the interval between the departure of one patient and the arrival of his successor and is an indicator of administrative efficiency also. When setting planning targets, assumptions must be made about both length of stay and bed occupancy: it is clear that both quantities may differ from specialty to specialty and that the former may depend upon case-mix as well as other factors. There are no generally accepted absolute standards in the NHS, although international comparisons suggest that length of stay for a given condition can be substantially shorter and bed occupancy can be substantially higher than is normally the case in England and Wales. Against this background, an analysis of current performance provides a measure which may be useful for the purposes of planning.

Table 4 shows the average length of stay in the various specialties in the eighteen districts in the region as revealed by the SH3 returns for 1974 and Table 5 shows the corresponding bed occupancies. In addition to the results for the various districts (including the chosen area), these tables also show the averages for the whole region. A salient feature of these results is the wide variation between districts. For example, the average length of stay in the general medicine specialty varies from 6·8 to 27·7 days, with a mean of 10·5 days. In some cases, certain of the extreme results are so discrepant that the existence of different conventions for the classification of cases by

Table 4. *Average lengths of stay (days) in 1974 by specialty and district from SH3 returns.*

Specialty	District																		
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*	*M*	*N*	*Chosen area*	*O*	*P*	*Q*	*Regional average*
General medicine	11·1	6·8*	9·0	13·3	27·2	7·7	12·8	13·3	8·4	12·8	9·4	8·5	14·0	9·7	10·5	11·0	9·7	12·4	10·5
Paediatrics	–	5·6	5·8	5·2	8·2	3·0	5·9	8·6	6·0	8·2	9·9	5·9	8·5	7·8	5·1*	7·3	7·5	–	6·7
Chest diseases	–	13·6	31·2	–	28·8	–	24·7	20·3	19·3	–	–	–	–	32·5	40·0	–	7·8	22·6	24·0*
Dermatology	–	18·7	30·0	24·8	–	–	–	21·7	24·7	15·6	26·6	–	16·8	10·1*	17·9	16·2	11·9	20·7	21·9
Physical medicine/ rehabilitation	–	–	17·4	–	–	28·9	–	–	33·7*	–	–	44·8	–	–	49·0	–	–	–	37·1
Geriatrics	141	167	411	104	102	331	109	102	77	85	89	174	143	121	85	72*	77	81	103·4
General surgery	9·4	6·7	8·7	6·3	7·0	8·0	7·6	8·8	8·2	8·4	7·6	7·6	8·7	8·8	8·6	8·5	7·0	7·2	7·9
ENT	3·5	4·1	4·3	4·6	–	3·0	2·9	4·3	5·2	3·2	–	5·6	3·1*	4·5	3·5	–	4·4	4·9	4·2
Traumatic and orthopaedic	12·2	16·3	10·9	13·1	2·0	9·9*	11·3	20·3	15·8	16·0	14·8	17·1	10·2	21·5	13·8	20·5	14·0	20·1	14·8
Ophthalmology	–	16·0	9·8	–	4·4	12·7	8·6	11·4	10·6	8·8	–	9·0	6·7	6·8	10·2	–	5·8	–	9·0*
Thoracic surgery	–	–	–	–	15·4	–	–	–	15·2	–	17·5	10·4*	–	–	10·4	14·6	15·6	9·8	14·2
Dental surgery	–	2·3	1·4	–	2·2	2·7	2·2	2·0	1·9	–	2·5	2·4	2·6	3·2	2·2*	3·1	3·1	2·3	2·4
Gynaecology	5·4	5·5	–	4·1	4·6	5·0	6·0	7·0	6·5	4·8	5·3*	5·8	6·5	6·4	5·7	6·6	6·3	5·7	5·7
SCBU	12·0	12·8	–	10·9	–	17·8	8·0	5·9	13·4	9·8	10·7	6·9	12·9	7·6	12·3	13·8	8·0*	7·5	10·0
Obstetrics	5·5	6·6	5·2	6·6	–	6·9	6·2	8·2	6·2	4·3	6·7	5·0	9·1	9·6	5·6*	7·9	7·0	7·0	6·8
GP maternity	4·9	5·5	4·3	5·8	4·3	3·7	5·5	6·5	4·1	–	–	–	4·8	4·9	4·8*	4·2	–	4·8	5·0
Pre-convalescent	93·5	12·8	24·8	–	12·1	7·8	13·8	–	14·5	–	8·1	23·7	15·5	69·9	16·5	–	–	–	17·9
Mental handicap	–	1,058	1,010	–	1,651	–	2,233	482	318	–	390	1,719	–	1,191	48*	1,541	–	1,079	791

* Value chosen as 'best possible' estimate.

Table 5. *Average bed occupancies (percentage) in 1974 by specialty and district from SH3 returns.*

Specialty	District																		
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*	*M*	*N*	*Chosen area*	*O*	*P*	*Q*	*Regional average*
General medicine	83	80	84	81	81	95	75	82	78	78	79	83	88	89*	85	79	98	83	84
Paediatrics	–	58	74	88	69	34	63	76	57	62	59	67	67	91*	47	40	79	–	65
Chest diseases	–	57	67	–	60	–	65	66	72*	–	–	–	–	61	66	–	100	68	65
Dermatology	–	66	63	61	–	–	–	59	63	38	77*	–	68	56	54	100	108	88	69
Physical medicine/ rehabilitation	–	–	100	–	–	49	–	–	81	–	–	19	–	–	80*	–	–	–	68
Geriatrics	97	97	99*	91	90	96	97	95	92	95	97	97	94	95	87	81	80	87	92
General surgery	67	77	78	77	57	78	69	69	79	82	78	79	67	76	79	82	88*	75	76
ENT	58	51	55	100	–	46	29	41	51	47	–	66	46	84	24	–	60	70*	56
Traumatic and orthopaedic	74	76	68	79	15	98	90	78	72	82	58	94	82	86	76	92*	97	77	80
Ophthalmology	–	67	71	–	18	68	67	68	79*	73	–	70	47	59	52	–	55	–	64
Thoracic surgery	–	–	–	–	60	–	–	–	84	–	73	100	–	–	2	60	97	69*	62
Dental surgery	–	56	35	–	30	33	27	21	26	–	28	73	45	77	41	83	93*	30	45
Gynaecology	63	82	–	72	42	68	69	63	73	74	80*	65	59	81	67	79	68	50	69
SCBU	62	57	–	67	–	73	43	61	64	53	62	38	64	89	54	84*	100	64	64
Obstetrics	72	56	47	69	–	67	61	71	62	52	69	47	65	75*	44	64	73	54	63
GP maternity	36	40	41	46	48	35	33	45	38	–	–	–	49	80*	43	12	–	21	40
Pre-convalescent	91	71	66	–	58	42	54	–	62	–	65	81	64	60	55	–	–	–	65
Mental handicap	–	89	89	–	94	–	97	91	86	–	98	77	–	96	21*	90	–	88	90

* Value chosen as 'best possible' estimate.

specialty must be suspected. For each specialty the pattern of results has been assessed and one value has been selected as providing an estimate of the 'best reasonable' target for planning purposes. This best reasonable estimate is not necessarily the shortest length of stay or the highest bed occupancy, but has been chosen as a measure which, on the basis of the results obtained in 1974, is a feasible target for the chosen area in the future. For the most part, the best reasonable estimate corresponds to a shorter length of stay or a higher bed occupancy than prevailed in the chosen area or the region as a whole in 1974. Both the 1974 data and the best reasonable estimates show a tendency for high bed occupancies to be associated with long average lengths of stay and vice versa.

Forecasts of bed requirements

NORMATIVE METHOD

Within the NHS the most widely used method of assessing bed requirements is based upon 'norms' for resource provision. Such norms apply to beds in particular specialties and represent an authoritative view of what is needed per unit of population served. For the most part, the norms for bed provision are figures originally promulgated by the DHSS and possibly modified to take account of general local circumstances. Norms are generally expressed as beds required per thousand population and thus tacitly involve assumptions about both need and efficiency. However, the norms are essentially arbitrary figures and no attempt is made to define the corresponding usage rates, average lengths of stay or occupancy rates. In so far as they give equal weight to groups of patients whose requirements are clearly very heterogeneous (for example, the norm for maternity beds refers to males and females of all ages), it is clear that norms cannot be regarded as giving any precise indication of need. Furthermore, in the absence of information about catchment populations, they are generally applied to resident populations. In this way, the often wide discrepancies between resident and catchment populations are not taken into account. The resulting bed requirements can only apply to the hypothetical situation in which all districts are self-sufficient.

Given an estimate of the population, the calculation of the bed requirement is a simple matter of multiplying by the corresponding norm. The bed requirements based upon the estimated resident populations in 1981, 1986, and 1991 were calculated for each specialty (3)

Table 6. *Projected bed requirements. All specialties. Comparison of scenarios.*

Demand	Efficiency	1981		1986		1991	
		Resident population	*Catchment population**	*Resident population*	*Catchment population**	*Resident population*	*Catchment population**
Current	Current	1,114	1,136	1,162	1,171	1,217	1,206
Current	'Best'	720	736	753	759	787	782
Projected	Current	1,273	1,313	1,481	1,494	1,695	1,689
Projected	'Best'	847	863	991	998	1,149	1,131
'Normative' method†		1,319	—	1,371	—	1,435	

Beds allocated (1974), 1,110. Beds available (1974), 1,083.

* Based upon 1974 catchment area.

† Excluding mental illness and younger chronic sick for comparison since no beds were attributed to these specialties in 1974 in the chosen area.

and a summary for all specialties except mental illness and the younger chronic sick appears in Table 6. There are substantial discrepancies between the normative requirement for 1974 and the corresponding numbers of beds allocated or available in certain specialties. For some of these, such as general medicine, the difference reflects the fact that the catchment population for rehabilitation is much wider than the area (see Table 2). The population forecasts show a small rate of increase with time and the corresponding estimates for 1981, 1986, and 1991 exhibit a similar trend.

SPECIFIC SCENARIOS

For any given set of assumptions concerning population, need, and efficiency, an estimate can be calculated of the future bed requirement. Population can be expressed in terms of the numbers of persons for whom the service is to be provided, subdivided in terms of sex and age-group. Need can be expressed in terms of age/sex specific *per capita* admission rates, which can be coupled with age/sex specific average lengths of stay to produce age/sex specific *per capita* (occupied) bed requirements, in terms of bed-stays, per year. Since age/sex specific projections of usage are not yet available, we use the projected (proportional) change in demand to modify current age/sex specific *per capita* bed requirements. To examine the implications of a change in the length of stay, we multiply the per capita bed requirement by the ratio of the assumed length of stay to the 1974 length of stay. In order to calculate the (actual) bed requirement, we divide the (occupied) bed requirement by the bed occupancy (expressed as a

ratio), to obtain an estimate of the number of bed-days per year needed. These calculations are performed for each age/sex group within each specialty separately and the actual bed requirement is obtained by aggregating the separate results. Finally, the total number of bed days needed per year is divided by the number of available days in the year (in our calculations, this is taken as 365) to obtain an estimate of the bed requirement in the specialty.

Thus the planner must be prepared to make specific assumptions about population, need, and efficiency. Using the current jargon, this process is called 'choosing a scenario'. For the purposes of planning to meet future requirements, there can of course be no guarantee that any particular scenario will in the event prove to be correct. However, on the basis of the method of calculation it is clear that different scenarios will in general lead to different estimates of the bed requirement. Faced with this situation, the prudent planner will wish to explore the effects of several different scenarios on the outcome, in order to assess the relative importance of each of the components.

The range of plausible scenarios is very wide and for the purposes of this paper consideration has been limited to just eight possibilities. In terms of population, consideration has been given to two alternatives, the resident population and the population of the current (1974) age/sex specific catchment area. Official policy is that districts should aim for self-sufficiency in most specialties, but in heavily populated parts of the country it is unlikely that this aim will ever be achieved and some intermediate position may be thought to be more realistic. In terms of need, two alternatives have been considered. First, is the current (1974) age/sex specific demand and usage rates as determined from the HAA records. This clearly ignores both the possibility of any changes in the future and involves the explicit assumption that current levels of usage can be equated with current need. As an alternative, the projected percentage changes in the rate of demand for care as revealed by the SH3 returns for 1969–74 (see Table 3) based upon the whole region have been applied to the 1974 demand and usage rates for the chosen area. This implies that the trend in the area will be the same as the trend in the region as a whole in each specialty and that the area will experience the same proportionate change as the region. The third main factor is efficiency and again two alternatives have been considered. In the first place, it is assumed that the current (1974) lengths of stay and occupancy rates in the area will continue to apply in the future. The second assumption is

that the 'best possible' result derived from an analysis of the current position in the region as a whole will apply, as indicated in Table 4. In comparison with the current position in the area, this implies that in most specialties substantial improvements are possible.

Projected bed requirements have been calculated for each of the eight possible combinations of assumptions for the years 1981, 1986, and 1991 for each specialty (3) and the results are summarized in Table 6. The only element in the projections corresponding to the current age/sex specific usage rates and current bed occupancies which varies with time is the population, based upon the OPCS projections. According to this scenario, there will be a small but fairly steady increase in the bed requirement in most specialties. The differences between the resident and catchment population projections reflect the current position and in particular the large variation between the catchment populations of different specialties within the area. The projections for the scenario in which the demand rate follows the projections based upon the regional SH3 data, whilst lengths of stay and bed occupancy remain at the levels prevailing in 1974, reflect changes both in the population and the demand rates and in general show a much higher rate of growth with time. Comparison of the scenarios based upon the 'best possible' efficiencies with those based upon current efficiency levels shows that the effect of the assumed improvement is to reduce greatly the bed requirement in most specialties.

The total bed requirements for the various scenarios summarized in Table 6 emphasize the savings which would result if the levels of efficiency could be raised to the 'best possible' levels currently prevailing in the region. The assumption that the demand and/or usage rates will continue to change according to the pattern of the past five years also produces a marked increase in the projected numbers of beds required. The 'normative' projections are substantially higher than those based upon the 'best possible' efficiency. If this level of efficiency can be achieved, the numbers of beds currently available are likely to be adequate to meet the future needs of the area up to 1991.

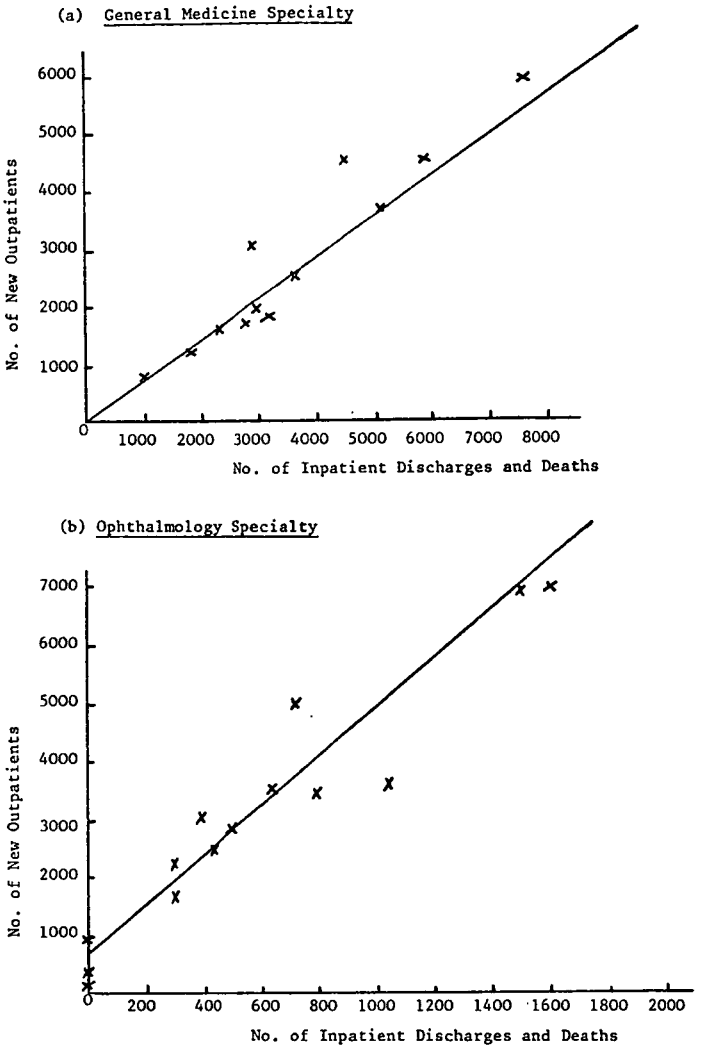
The relation between in-patient and out-patient care

In most specialties, in-patient and out-patient care are closely linked. Many in-patient admissions are preceded by one or more out-patient consultations: after a spell as an in-patient, follow-up care is often

provided in the out-patient clinic. For these reasons, it is natural to expect that levels of in-patient and out-patient activity will be related. The SH3 returns provide quantitative information about various aspects of the in-patient and out-patient services provided by each specialty in every NHS hospital or clinic. Because out-patient clinics may be separated physically from the hospitals at which in-patient services are provided the aggregation of activities in a given specialty over all the hospitals of a health care district is required in order to obtain a realistic picture of the relation between the levels of in-patient and out-patient activity. For certain specialties, two or more districts may share common facilities and the corresponding SH3 returns for each such district must then be taken together.

An analysis was carried out of the relation between the number of new out-patients[1] and various items relating to in-patient activity (including the numbers of in-patient discharges, of available beds, of day cases, and the size of the waiting-list) in the various specialties represented in each district amongst the eighteen districts belonging to a regional health authority. The data chosen for study were the SH3 returns for 1974; the corresponding results for 1975 were also available, but because of the distortions resulting from industrial disputes during that year, were regarded as potentially misleading. When the number of new out-patients was expressed as a linear function of the in-patient data, the only variable found to be significant in the majority of specialties was the number of in-patients. The exceptions were accident and emergency, VD, and orthodontics, in all of which out-patient activities predominated. The in-patient spell was selected as the basic unit for planning in-patient services and this result indicates that the number of new out-patients may be expressed directly in the same terms. An example of the relation between the numbers of new out-patients and of in-patient discharges is given in Fig. 4(a) which refers to general medicine. It will be noted that the points representing the various districts lie approximately upon a straight line passing through the origin. This implies that the number of new out-patients in a given district is a constant multiple of the number of in-patients. A slightly different pattern which was found in a minority of specialties is illustrated in Fig. 4(b) which refers to the ophthalmology specialty. In this case, the points lie on a straight line which does not pass through the origin.

1. For this purpose, a 'new' out-patient is a patient making his first visit to the particular clinic in relation to a given episode of illness.



NOTE: Each point corresponds to a District within the Region.

Figure 4. Relation between the numbers of new out-patients and in-patient discharges, 1974. Each point corresponds to a district within the region.

For specialties which are not represented in each district (sub-regional and other smaller specialties), the SH3 returns for the whole region were taken together for each successive year between 1969 and 1974 (inclusive) and a regression line was fitted to these annual data. This process is inherently less satisfactory than the analysis of the results in the various districts for a particular year, because of changes in definitions and boundaries. However, since the resources involved are relatively small, any distortions of the relationship between the numbers of new out-patients and in-patients are believed to be minimal.

A regression line was fitted to the data for each specialty as described above. If the estimate of the constant term in the fitted relationship did not differ significantly from zero, the regression was recalculated, subject to the assumption that the line must pass through the origin; this implies that the number of new out-patients is directly proportional to the number of in-patients. The results obtained are summarized in Table 7, which shows the estimates of the slope and (where appropriate) the constant term of the regression relationship, together with their respective standard errors. As might be expected on general grounds, there are considerable variations in the relationship from one specialty to another. In every case, however, the slope of the fitted regression line was significantly different from zero. All the regression coefficients except that for mental illness are positive. This indicates that as the number of in-patients increases, so also does the number of new out-patients. For mental illness, the opposite trend is present. For this specialty, out-patient care may be a substitute for in-patient care, an observation which is consistent with current clinical practice.

For those specialties for which an analysis of the variations between districts in 1974 was possible, the calculations were repeated on the basis of the SH3 data for 1972 and 1973. Although some boundary changes took place following the reorganization of the NHS in 1974, the results for the three successive years show no evidence of any systematic temporal trend in the estimated coefficients. This suggests that the relationships between the numbers of new out-patients and in-patients are stable and we have therefore adopted the 1974 results as the basis for our calculations of out-patient loads.

Given that the current balance of usage between in-patient and out-patient services will continue to apply in the future, this analysis

Table 7. *Fitted regression relationships between the numbers of new out-patients and the numbers of in-patients.*

Specialty			Constant term		Regression coefficient (slope)	
			Estimate	*Standard error*	*Estimate*	*Standard error*
General medicine	(1)	(2)	0	—	0·735	0·019
Paediatrics	(1)	(2)	0	—	0·634	0·027
Chest diseases		(2)	0	—	3·174	0·134
Dermatology		(2)	0	—	15·605	0·460
Neurology	(1)		590	182	0·851	0·232
Cardiology		(2)	0	—	1·126	0·079
Physical medicine/ rehabilitation		(2) (4)	0	—	6·069	0·889
Rheumatology		(2)	0	—	5·229	1·026
Geriatrics		(2)	0	—	0·137	0·011
General surgery	(1)	(2)	0	—	0·902	0·030
ENT	(1)	(2)	0	—	2·300	0·120
Trauma and orthopaedic	(1)	(2)	0	—	3·348	0·155
Ophthalmology	(1)		681	347	4·119	0·434
Radiotherapy	(1)		506	169	0·514	0·104
Urology	(3)		—	—	—	—
Plastic surgery			1,343	429	1·050	0·201
Thoracic surgery		(2)	0	—	0·432	0·024
Dental surgery	(1)	(2)	0	—	2·461	0·157
Neurosurgery		(2)	0	—	0·450	0·022
Gynaecology	(1)	(2)	0	—	1·032	0·029
Obstetrics	(1)	(2)	0	—	1·050	0·040
SCBU		(2)	0	—	0·129	0·012
Mental handicap		(2)	0	—	0·136	0·018
Mental illness			1,844	2,608	−0·344	0·174
Adolescent psychiatry		(3)	—	—	—	—
GP maternity		(2)	0	—	0·377	0·031
OSU		(2)	0	—	2·867	0·321

(1) Based on district analysis of 1974 SH3 data.
(2) Assumed to pass through the origin.
(3) Insufficient data.
(4) Uncertainty in recorded data.

suggests that for nearly all specialties the future numbers of new out-patients can be expressed in terms of the corresponding numbers of in-patients. We have suggested that in the planning of in-patient care, the calculation of forecasts of the numbers of in-patient spells must involve certain assumptions about the definition of the population to be served and the age/sex specific rates of usage of the particular specialty. By the same token, two alternative assumptions about populations (projected future resident population or projected future population of current catchment area) and two alternative assumptions about usage (current rate or predicted future usage rate) were considered. Forecasts of the numbers of new out-patients were calculated as the sum of the number of new out-patients in 1974 and the product of the estimated regression coefficient (see Table 7) based upon the pattern of care in 1974 and the difference between the estimated numbers of in-patients in the year in question and in 1974.

Forecasts of out-patient requirements

Given a projection of the number of new out-patients, the next stage in the planning process is to calculate the associated resource requirement. Out-patient consultations are carried out during the course of clinic sessions. Each such session involves the attendance of a number of out-patients, some of whom can be classified as 'new' out-patients. It follows that the requirement for out-patient sessions can be expressed as the ratio of the number of new out-patients to the average number of new out-patients per session. Thus, it is necessary to make some assumption about the number of new out-patients per session and an analysis of previous experience in the specialty provides the most useful indicator of the prevailing methods of practice.

An analysis has been carried out of the data for the region as a whole for each successive year from 1969 to 1975 for the various specialties (4). As expected, systematic differences were found between the specialties, which reflect variations in both the balance of in-patient and out-patient care and also in the average time taken for a consultation. In the great majority of specialties, the numbers of new out-patients per session were lower in 1975 than in previous years. This reflects the industrial disputes which took place during that year. Over the previous six years, there were no consistent trends.

Similar analyses were carried out for individual districts within the region. Variations in practice between districts were in general substantially greater than variations over time in a given specialty. In general, the numbers of new out-patients per session in the chosen area were lower than in the region as a whole, but the results for the chosen area showed no consistent trends from year to year, apart from certain anomalies in 1975.

In the associated analysis of in-patient resource requirements, two levels of resource usage were considered, based respectively upon the 1974 practice in the chosen area and a 'best possible' estimate derived from an analysis of the performance of the various districts in the region in 1974. In the context of out-patient planning, we have also examined two possible levels of efficiency. The first of these is the number of new out-patients per session in the chosen area during 1974, which represents current standards. The alternative is the 1974 regional average if this is greater than the corresponding figure for the area. In specialties for which this is not the case, the 1974 figure for the area has been taken. These two levels of efficiency have been chosen for the purposes of illustration only and other assumptions may be appropriate.

The number of new out-patients per clinic is determined by the average number of out-patient consultations per episode of illness (the re-attendance rate) and by the total number of consultations per clinic. The latter quantity itself reflects the time allocated to each patient and the total duration of the clinic. All these parameters are determined by clinical and administrative practice and may be varied as a matter of deliberate policy. Analysis of the existing variations in re-attendance rates and the total number of patients per clinic amongst the various districts within the region suggests that in some specialties there is a 'trade-off' between the total number of out-patient consultations for an episode and the average duration of each consultation. Some clinicians prefer to see their patients on more occasions but for shorter periods than others. If the number of new out-patients per session is fixed, the re-attendance rate and the total number of patients per session may be adjusted to conform to any desired pattern of clinical practice.

Having estimated the number of new out-patients and given an assumption about the number of new out-patients per session, the calculation of the resource requirement in terms of the number of out-patient sessions is a matter of simple arithmetic. As in the

planning of in-patient services, we have considered eight plausible scenarios, corresponding to all combinations of assumptions about population (future resident or future population of current catchment area), about out-patient demand rate (based upon 1974 age/sex specific in-patient demand or projected future in-patient demand) and about efficiency (based upon the current performance in the area or upon projections derived from the current performance for the region). The outcomes of these various scenarios for the various specialties were calculated (4) and a summary for all specialties is given in Table 8.

Reference to Table 8 shows that for all scenarios the demand will increase as time passes. At any given date, there are wide variations between the different scenarios. The highest projections correspond to the scenarios for which the in-patient demand is based upon projections from past data, which indicate considerable growth in some specialties (see Table 4). Given that there were in 1974 some 4,671 out-patient sessions, the majority of the scenarios call for substantial increases in the provision of out-patient care over the period of the projections. An increase in the numbers of new out-patients per session would ameliorate the position to some extent. The results for

Table 8. *Projected numbers of out-patient sessions. All specialties. Comparison of scenarios.*

In-patient demand	New out-patients per session	1981 *Resident population*	1981 *Catchment population*	1986 *Resident population*	1986 *Catchment population*	1991 *Resident population*	1991 *Catchment population*
Current	Current	4,907	4,806	5,099	4,943	5,319	5,100
Current	Projected	(1) 4,093 (4,176)	3,790 (4,260)	4,226 (4,312)	3,865 (4,343)	4,369 (4,461)	3,967 (4,456)
Projected	Current	5,762	5,659	6,652	6,464	7,626	7,285
Projected	Projected	(1) 4,669 (4,748)	4,305 (4,736)	5,234 (5,318)	4,770 (5,210)	5,844 (5,936)	5,253 (5,704)

There were 4,671 sessions in 1974.

(1) Figures in brackets include sessions for SCBU and physical medicine/rehabilitation for which there are no sessions currently.

the individual specialties in general reflect the over-all trends and for any given scenario enable the detailed consequences of changes in the pattern of in-patient care to be identified.

This framework must perforce exclude orthodontics, VD, and accident and emergency specialties which are predominantly out-patient specialties, and urology and adolescent psychiatry for which sufficient data were not available for analysis. Of these specialties, the first three were present in the chosen area (representing 5 per cent of the total sessions currently in the area). Accident and emergency by definition does not have any planned sessions, and facilities required may be assessed by considering the population to be planned for, and by analysing the current distribution of presentations. Orthodontic and VD facilities could be assessed from new out-patient rates *per capita* applied to future populations, but a special survey would be required to assess the correct catchment population in the denominator; trends in these two specialties would be difficult to assess for this reason. The urology and adolescent psychiatry specialties being small, are possibly governed more by policy decisions than by statistical considerations. However, in the absence of sufficient regional data for these specialties, the analysis of national data along the lines described provides the only alternative.

Planning and resource allocation in a region

The approach put forward in this essay enables a planning scenario —a set of assumptions about the future pattern of health care—to be translated into a requirement for resources such as hospital beds or out-patient clinic sessions. The consequences of a given scenario may be expressed equally appropriately in financial terms, since all physical resources carry with them either capital or revenue consequences. Indeed, the major constraint upon the development of the NHS in the immediate future is likely to be financial rather than physical. It follows that the allocation of financial resources must be an integral part of any coherent planning process. It is through the planning process that any re-allocation of resources should take place.

A prime function of regional health authorities is to control the distribution of resources between areas and districts within the region. This can best be achieved by harmonizing the planning scenarios for each constituent district. For example, the region may ensure that the populations planned for by contiguous districts are

consistent, that standard levels of efficiency are adopted or that resource usage rates are equalized over a defined period of time. In this way, proposals will be co-ordinated and the rates of change in levels of service will be limited to acceptable levels. The allocation of capital and revenue funds is an integral part of such systematic planning. Capital is necessary to provide new resources and revenue to enable these resources to operate.

The DHSS is currently promoting both a comprehensive planning system and a radical reassessment of the distribution of health care resources between different geographical areas. The Resource Allocation Working Party (RAWP) was appointed in 1975 to:

> . . . review the arrangements for distributing NHS capital and revenue to RHAs, AHAs, and Districts respectively with a view to establishing a method of securing, as soon as practicable, a pattern of distribution responsive objectively, equitably and efficiently to relative need. . . .

Their report (5) has met with mixed reactions. On the one hand, the RAWP proposals have been welcomed for their noble aims, but on the other the specific methods used to attain these aims have been severely criticized. The recommended method of allocating revenue is to weight the resident population structure by condition-specific usage rates and by standardized mortality rates (SMRs). Compensation is then allowed for cross-boundary flows. This forms a proportionate basis for dividing the total funds available, whether from national level to region, or from region to areas and districts. At the national level, this method can be criticized on several grounds. First, dividing the total revenue in the manner described implicitly assumes that the cost per bed-day is constant irrespective of specialty, or of the age or sex of the patient. There is abundant evidence that significant differences exist in the relative costs of different specialties. Furthermore, on general grounds it is reasonable to suppose that the *per diem* cost of in-patient care varies with age, since older patients tend to stay longer, but on average have a lower daily 'treatment cost', and therefore a lower over-all average daily cost than for younger relatively short-stay patients. It is unlikely that there are no variations between regions in the distribution of care between specialties or in the age distribution of bed-days occupied in each specialty, in which case the absence of differential cost weighting must be regarded as an important limitation. Secondly, it is assumed that condition-specific SMRs reflect morbidity, whereas they are likely to be biased towards morbidity for which effective treatment is

not available. Resource allocation should surely reflect treatable morbidity. In the third place, the resource allocation activity is regarded as entirely separate from the planning activity, a dichotomy which must inevitably be removed.

The RAWP report advocates the adoption of similar methods for the allocation of revenue from the region to its areas and districts. At the regional level, the method is subject to additional objections of a more specific and exacting nature. First, to base detailed calculations on resident populations and then to compensate for cross-boundary flows may not be appropriate sub-regionally, since the extent of inter-district flows may be very substantial and the technique of costing these flows appears to result from an imperfect analysis (6). Secondly, the statistical variation associated with the smaller numbers of condition-specific deaths at sub-regional levels may produce estimates which are not robust in successive years. Insufficient past data exists to use weighted averages over successive years. In addition, analysis has shown that at sub-regional levels two conditions account for the bulk of deaths, and these conditions reflect the natural processes of ageing upon which the health services can have little effect. This casts more doubt upon the use of SMRs as a proxy for morbidity and need. Thirdly, the variability of successive estimates of population data produced by the Office of Population Censuses and Surveys may introduce a further degree of instability. These points are by no means an exhaustive critique of the RAWP proposals, but considered with the more general objections outlined, there is sufficient substance to suggest that even if the method promulgated is applicable nationally it may be inappropriate for resource allocation within a region.

An alternative method for allocating revenue may be developed on the assumption that meaningful plans have been produced along the lines set out in this essay. Although the method will be described in relation to a region allocating to eighteen districts, in principle it could be employed nationally if systematic, coherent, and consistent plans were to be produced by all regions. Two sources of routine data are required: the annual SH3 and Hospital Cost (HCR) returns. Since this is a 'resource-based' method, the use of population data is an unnecessary intermediate step. This alternative method embodies implicitly the assumptions used to produce resource plans.

A technique has been developed based upon simple statistical procedures to estimate the costs of individual specialties from these data

sources (7). One outcome from this technique is the derivation of the average costs within the region per available bed and per out-patient by specialty, and these figures are presented in Table 9. (The term 'cost' is used here synonymously with annual revenue expenditure.) The values in general correspond to expectation, based upon 1973/4 price levels. These figures form the basis of allocating revenue to institutional resources and exclude the teaching cost which was separately estimated and can be applied to appropriate institutions. The use of the total number of out-patients as a basis for allocating out-patient expenditure is intuitively less obvious than the use of available beds for the in-patient component. The number of out-patients was chosen in preference to the number of out-patient sessions since not all sessions are of uniform duration, and the accident and emergency specialty has no designated sessions, but is the largest single provider of out-patient care. The number of available beds was chosen in preference to the number of occupied beds since, while the latter is probably a better measure of patient care, the former was thought to be a better reflection of a dominant majority of other cost components such as staffing levels, heating, lighting, and other overheads.

The SH3 data allow for the compilation of a table of in-patient resources (available beds by specialty) by district. Detailed planning considerations may have changed this inventory for the next allocation period. Similarly, a table of the number of out-patients treated by specialty and district can be compiled and an anticipated output of the planning system will be a statement of how these numbers will change over the next year. If past planning has been on a just and sensible basis, these levels should reflect implicit detail about the extent of patient flows, the age/sex utilization of services by the population, and possibly morbidity differences between different geographical areas. Although this may be a point of contention, the proposed planning cycle should allow for the incorporation of these factors into the future deployment of resources using the framework described.

The figures in the inventories which are used in this exercise are actual values, which are then multiplied by the appropriate costs in Table 9 to produce estimates of notional revenue by district and specialty for in-patient and out-patient resources. These estimates can then be expressed as percentages of the total notional sum (Table 10) to form the basis of the regional allocation of money to area/district. One option is to decide at regional level the separate amounts

Table 9. *Costs per available bed and per out-patient by specialty (1973/4 prices).*

Specialty	*Cost/available bed year* (£)	*Cost/ out-patient* (£)
General medicine	2,941	5
Paediatrics	3,009	4
Infectious diseases	3,361	–
Chest diseases	2,792	4
Dermatology	2,972	4
Neurology	3,234	4
Cardiology	4,061	4
Physical medicine/rehabilitation	1,599	5
VD	3,101	4
Rheumatology	2,918	4
Geriatrics	2,170	5
Younger disabled	2,211	–
General surgery	4,838	4
ENT	4,973	4
Trauma and orthopaedic	4,557	4
Ophthalmology	4,507	4
Radiotherapy	5,363	6
Urology	6,121	4
Plastic surgery	4,715	4
Thoracic surgery	5,872	3
Dental surgery	4,810	4
Neurosurgery	5,070	4
Gynaecology	4,711	3
Obstetrics	3,904	3
SCBU	3,989	4
Child psychiatry	2,313	4
Mental handicap	1,688	3
Mental illness	1,964	4
Adolescent psychiatry	1,939	5
GP maternity	3,430	4
GP other	2,112	4
GP dental	1,973	4
Pre-convalescent	1,889	–
Convalescent	1,691	–
Staff wards	2,153	–
OSU	2,263	4
Unclassified	2,203	–
Accident and emergency	–	3

Table 10. *Percentage of regional institutional revenue allocated to districts.*

District	*In-patient revenue* (%)	*Out-patient revenue* (%)	*District*	*In-patient revenue* (%)	*Out-patient revenue* (%)
1	5·94	3·22	11	6·85	3·90
2	5·05	5·05	12	7·04	10·79
3	6·73	7·64	13	3·15	3·87
4	4·95	2·47	14	5·62	5·16
5	4·04	1·60	15	4·14	4·94
6	5·91	9·95	16	4·46	3·09
7	5·45	4·80	17	4·33	16·10
8	8·52	5·31	18	9·70	3·80
9	6·50	4·85	Region	100·00	100·00
10	1·62	3·29			

for in-patient and out-patient revenue for distribution; alternatively, it is possible to weight the two percentages, aggregate them for each district and then distribute a single sum of money. The RAWP report suggests relative weights of 84·6 and 15·4 per cent for in-patient and out-patient revenue respectively (and this institutional revenue element accounts for about 87 per cent of the total revenue to be distributed). Inspection of Table 10 reveals some disparity between the two revenue components. This is consistent with past planning actions since conscious decisions have been taken in particular instances to centralize the provision of certain out-patient care at specific institutions for sharing between adjacent districts.

Given institutional plans for the next year, it is proposed first that the costs per available bed year and per out-patient by specialty should be calculated from the most recent SH3 and HCR data as described in (7) and, secondly, that the expected 'notional' revenue based upon the average cost estimates and the planned pattern of services should be computed. These notional revenue estimates may then be expressed as percentages of the regional total to allow the actual subdivision of the region's allocation. In principle, this procedure is similar to the RAWP proposals except that SMRs are rejected as being dubious indicators of needs and that planned local utilization rates are used implicitly in preference to national rates to reflect local needs resulting from local population structure and morbidity. The calculations are more direct, are based upon routine regional data, and are intended to link coherently with planning

assumptions. Allocations based upon this method would not give extra money to institutional specialties currently costing more than the average. Other investigations have failed to account for the observed variations in costs between districts and have demonstrated that any 'economies of scale' which might exist are not being exploited currently (8). It is envisaged that a district or area will have in practice, a range of institutions between the extremes of high and low unit costs and that the use of the average is neither punitive nor over-generous. It is for local management to seek out the inefficiencies and, although the proposed method does not isolate such cases, it does not pay for them either. The method of allocation is not in this sense incremental and thus represents an escape from the 'last year's budget plus x per cent' system which has characterized public sector resource allocation in this country for so many years.

Comment

The procedures described in this paper are intended to provide a framework within which the planning process can operate in a logical and coherent way. The results obtained are determined by the assumptions about key factors such as population, demand rate, and efficiency. Such assumptions relate to conditions and events in the future and must inevitably be subject to an element of uncertainty. The local planning team is probably in the best position to decide which assumptions are most realistic and most consistent with local conditions and policies. Nevertheless, the system can produce a more rational resource allocation only if the assumptions adopted by different districts, areas, and regions are mutually consistent. It follows that the selection of planning scenarios should be regarded as one of the main tasks of the planners. For a given scenario, calculation of estimates of future bed requirements is then merely a matter of arithmetic, albeit based upon extensive and complex sets of data such as the SH3 and HAA returns.

There is no doubt that planning based upon projections of resident populations and norms for resource provision is superficially attractive, in that no analysis of past data is called for and the calculations required are relatively simple and straightforward. However, in so far as the normative method makes no allowance for factors such as the extent of the population served or the variations in demand and usage within the population, we consider that the results obtained

should be regarded as no more than a very general guide, to be supplemented by more relevant and detailed procedures which reflect the local situation. The results described in this paper show that the normative method can produce very different estimates of future bed requirements than the more realistic alternative procedures.

In practice, the operation of the planning procedures described in this paper calls for access to extensive data concerning past usage and past performance of particular parts of the local health service. Most of the necessary information is available at the regional level in computer-accessible form and standard programs exist for use on the particular RHA computer to produce the necessary analyses. It follows that the RHA is well-placed to provide such data and analyses on a service basis to local areas and districts as required. In so far as the setting of targets for demand rates, length of stay, and bed occupancy can best be done by reference to data for the whole region, such an arrangement would be preferable to planning procedures based solely upon local data. In the case of districts situated on the periphery of the region, access to HAA data for adjacent regions would also be needed, in order to define catchment populations and the extent of cross-boundary transfers of patients.

All the main quantities used in the calculation of requirements are estimates which must be subject to revision and updating as time passes and new information becomes available. This remark applies as much to the forecasts of resident populations as to the usage of health services. For this reason, the preparation of plans should be a process which is repeated at regular intervals. Furthermore, at any given stage, the planner should be prepared to consider several scenarios. For both reasons, the use of computer-based methods for carrying out the necessary calculations offers important practical advantages.

As in most planning processes, the ultimate controlling factor is the availability of finance. All plans should be costed in both capital and revenue terms and the planning scenario may need to be adjusted in order to conform to the financial constraints. It is unfortunate that the standard NHS cost returns are seldom of value in producing estimates of the unit costs for units which are useful in the planning context. In our own analyses we have derived estimates of specialty-related costs by indirect methods involving the linkage of patient-related statistics from the SH3 returns to the standard hospital cost data. We believe that this type of exercise is essential for effective

management of the hospital service and that the production of case-related cost data should form part of the manager's standard armoury of statistical information. Such data is of value not only for the purposes of monitoring and control, but also as an essential basis for resource allocation. Whilst the questions raised by the RAWP recommendations are unlikely to be answered with authority for many years, if at all, we suggest that the approach described in this essay does represent a practical alternative, which has the advantage of recognizing the inevitable link between planning and resource allocation.

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Planning local health services

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Planning local health services

Summary. The reorganization of the NHS has offered, for the first time, the opportunity to plan the development of the health care system on a comprehensive and rational basis. This essay is concerned with the general aims and specific objectives of planning in this context. The basic concepts of the demand and the need for health care are compared. The nature and limitations of the available sources of information are considered and methods by which these data may be used for forecasting and setting targets for effectiveness and efficiency are described. The essay concludes with a discussion of some problems which prevent the best use being made of information for planning purposes within the NHS.

Introduction

Planning has been described as a process of preparing a set of decisions for action in the future (1). A planning process of some kind must precede the development of any organization. The NHS is no exception to this rule and there is no doubt that over the first twenty-five years of its existence the NHS has been developed to provide an effective and comprehensive system of health care. It is also clear that the major changes which took place were not the result of the operation of any coherent or systematic planning system. The processes which were applied have been described as 'muddling through' by a sympathetic commentator from the United States and as 'disjointed incrementalism' (2) by a senior civil servant closely involved with the NHS during this period. To the extent that a policy of 'to whom that hath shall be given' was followed, the historical inequalities present at the inception of the NHS were perpetuated (3). The

lack of co-ordination between different services resulting from an inappropriate management structure presented a further obstacle to rational change.

Reorganization was expected to produce a solution to these problems and a formal planning system was introduced to provide an element of 'comprehensive rationality' (2) into the situation. However, the benefits of reorganization have been slow to appear. Both amongst the general public and amongst members of the professions working in the front line of medical care, the reaction has been one of disappointment or worse. The new management teams have been presented with problems of great complexity and have been reluctant to take firm action until they have 'played themselves in'. At the same time the service has been exposed to pressures which were not anticipated and whose adverse effects are likely to persist for many years. Practical experience has revealed deficiencies in both the intellectual rationale and the practical details of the reorganization. The guide to planning which is currently on trial within the NHS (4) provides a framework and defines a procedure, but gives little useful insight into the 'how' or the 'why' of the planning process.

Against this background it is important that tangible and clearly perceptible benefits of reorganization should be realized as quickly as possible and it is in the general field of planning that such benefits are most likely to emerge. In the prevailing circumstances of increasing pressure on public expenditure, realistic planning must be concerned largely with the reallocation of existing resources and with marginal changes and developments. Decisions must reflect knowledge and information which already exists and is immediately accessible. Such evidence may be imperfect, but there is no time for the introduction and validation of new information systems. The methods used to digest the data relevant to planning must be simple both in conception and application, since the expertise necessary to apply more sophisticated procedures is very thinly spread. The decisions themselves must have an impact within a time-scale of at most five years and preferably much sooner. This is not to say that the NHS is not without long-term problems, but unless the short-term difficulties are overcome first the service may not survive to meet them.

In any environment the perception of problems and the derivation of solutions to these problems depends very much upon the vantage point of the observer. Much of the impetus for the reorganization of

the NHS has come from central government. An underlying thread which runs through most of the advice emanating from this source is the tacit assumption that the resources available for health care are likely to grow steadily from year to year. Unfortunately, the situation at the periphery of the health care system is now very different. The party is indeed over, and not only in local government. A view of the future as a succession of crises of varying severity and occurring at irregular intervals is probably much closer to the new realities. In these circumstances the planning process becomes even more important, although the basic rationale must be very different. In the face of unpredictable attacks by economic storms, effective planning must be capable of reacting to changes in the rules of the game as they occur. Flexibility and adaptability must be the keynote and a ponderous system involving a succession of national, regional, and area hierarchies is likely to be of limited assistance in helping the local managers react to changing circumstances. This essay is concerned with the planning of local health services on the basis of self-knowledge and self-help, a process which must supplement, and in the prevailing climate often override, more formal and hierarchical procedures.

Why plan?

The success of any organization can best be judged in terms of the extent to which the objectives of the organization are achieved. It follows that the setting of objectives must be the first step in the planning process. The definition of objectives for a comprehensive health care system is a complex matter, although at a superficial level there is general agreement about what is required. The following quotations from the official planning guide (4) represent the consensus view:

> The purpose of going through these steps (i.e. planning) in the NHS is to relate services as closely as possible to **people's needs** by the best use of the available resources.
>
> . . . planning must be responsive to . . . the **needs of people.**
>
> Objective setting will require consideration of **needs, demands** and **resources.**

On this basis it is clear that the prime objective of the NHS is to meet need.

The next logical step is therefore to consider the nature of need. The planning document again provides some fascinating quotations:

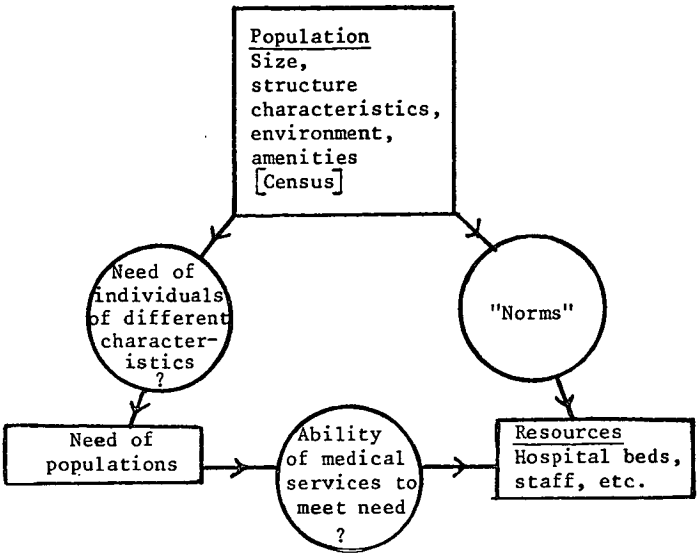

Figure 1. Information about need.

. . . all **real** problems and **needs** of **people**, regardless of the presence or absence of **public pressure.**

. . . planning must be flexible enough to meet the **changing patterns of need.**

Health care planning . . . meet a **wide variety of needs.**

Even although they lack clarity of definition, these quotations provide some insight into aspects of need. Thus, it is clear that need is something which applies to people (although it may not receive public recognition), may occur in many forms, has a changing pattern and apparently has two states, 'real' and 'unreal'. The objective must be to meet 'real need', although for practical purposes exhortations of this kind are totally inadequate as a basis for planning, either centrally for a comprehensive national health service or at the local level.

Notwithstanding the conceptual difficulties, it is helpful to take the process one stage further and to assume that need can be defined. The process of meeting need is illustrated in Fig. 1. The starting point of the exercise is the provision of care for a defined population. In the context of the NHS this will often be the population living in a given geographical area, although in densely populated parts of the country the position will be complicated by cross-boundary flows of patients.

However defined, need will vary from one member of the population to another: for example, the need of a young man for health care will not be the same as that of an elderly woman. Many personal characteristics may be involved, but on general grounds it is clear that age and sex are likely to be important. Given the size and structure of the population and a picture of the varying needs of different classes of individual it is in theory possible by a simple process of aggregation to determine the total need of the population. This defines the target for the planner. However, a further logical process is involved in order to determine the extent to which the defined need is capable of being met. It must be recognized that not all types of need can be satisfied, given the existing state of medical knowledge. Cochrane (6) has pointed out that many accepted medical procedures are ineffective in meeting the needs they are intended to fill and has argued that in this situation the application of such procedures is wasteful of scarce resources. When effective procedures do exist, experience suggests that many types of need can be met in a variety of ways: alternative programmes of care involving different sets of resources are often available. The balance between domiciliary and institutional care for many conditions is a familiar example. The task of the planner is to allocate resources to needs in such a way as to optimize some aspect of the process, within the limits imposed by availability of resources and constraints on their use. For example, it may be decided to satisfy a need in the way which leads to the least possible cost to the NHS. As a result, the resources required to meet the defined need can be identified.

Specific objectives for the planner

In any particular context it is often either impossible or impractical to attempt to satisfy the need of a population for health care in its full variety and range. All that can be done with the finite resources normally available is to satisfy part of the need, but not the whole. The extent to which this can be achieved will normally depend upon the resources applied for the purpose. The position may be summarized in a simple way by means of an 'input–output' diagram as illustrated in Fig. 2. This diagram represents the relation between the input of resources, measured in terms of money, human and physical facilities and the output, measured in terms of meeting need, for a particular sector of a health care system. The curve labelled '(a)'

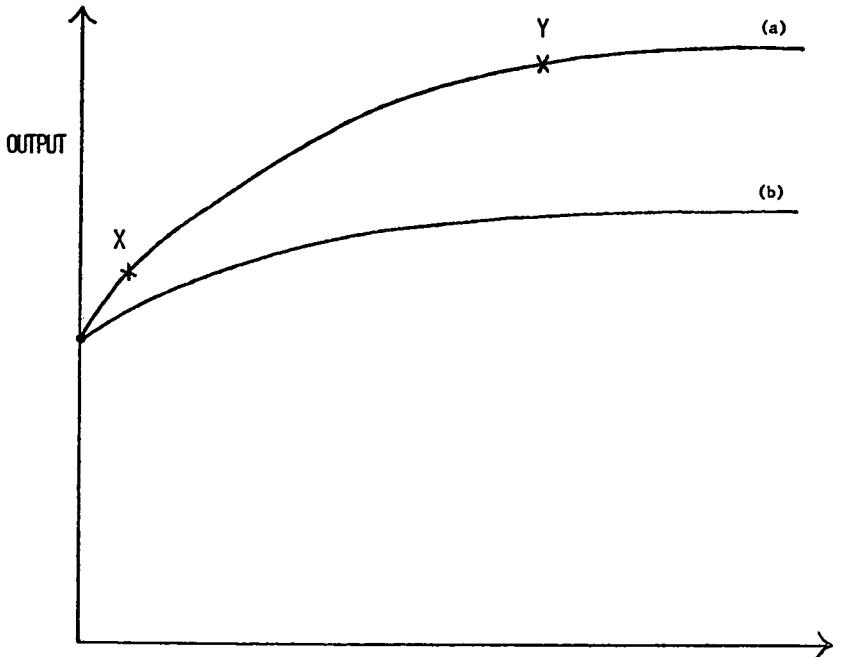

Figure 2. Input–output diagram.

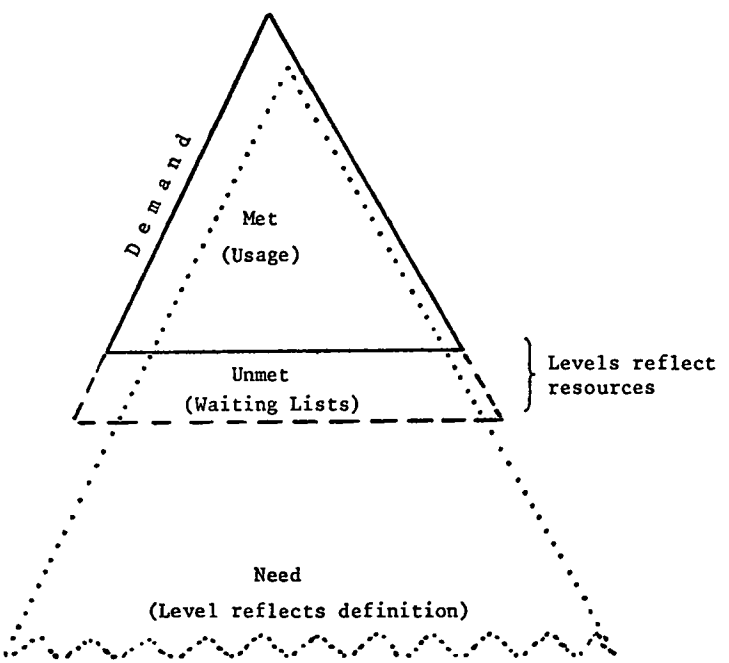

Figure 3. The 'iceberg' model.

represents a typical pattern. As the input of resources increases from zero, the output of met need increases sharply. The starting point of the output curve is taken as greater than zero, to take account of the contribution of factors such as family help outside the medical care system. As input increases further the rate of increase of output becomes progressively smaller as the 'law of diminishing returns' takes effect, so much so that large increments of input at the upper end of the scale produce little return in terms of output. By way of contrast, the curve labelled '(b)' in Fig. 2 represents an ineffective programme of care which produces little return however large the input of resources. In this discussion of Fig. 2 it is assumed that the balance of resources applied at any level of input is such as to produce the greatest possible level of output. Sub-optimal resource allocation would tend to reduce the output corresponding to a given level of input.

The application of this type of process in the practical situation is obstructed by the absence of essential and fundamental information, not only about the need of individuals but also about the ability of the medical services to meet this need. The only way in which further progress can be made is by attempting to 'short-circuit' the path from the population to the resources by the introduction of 'norms' for resource provision. Typically, norms are expressed in terms of resources required per head and cover the main classes of health care. In the absence of fundamental information about need, the setting of norms must inevitably be an arbitrary process and the results obtained can do no more than provide some guidance as to relative levels of need in different populations. This uncertainty is recognized to some extent by the fact that norms tend to give equal weight to individuals of very different characteristics (and therefore needs). Although norms do provide some pointers for the planner, they must be supplemented by more detailed and relevant information.

In order to make further progress it is necessary to consider the provision of health care in terms of other concepts, including 'demand' and 'usage', which are more tangible and more easily defined. The relation between demand, usage, and need is illustrated in terms of the familiar 'iceberg' model in Fig. 3. The need of a population for health care is represented by an iceberg: moving from the apex to the bottom of the iceberg involves a progression along a spectrum of need, from classes which are clear-cut and generally recognized towards the more nebulous and ill-defined areas about which there is

little agreement. The base of the iceberg does indeed coincide with the bottom of a 'bottomless pit', which has become the preoccupation of many recent commentators. There is no doubt that the concept of a finite burden of need as promoted by the founders of the NHS involves a fundamental fallacy. The modern health service planner must be aware of the impossibility of plumbing such depths and must be prepared to limit his goals in the light of the available resources.

The demand for health care may be divided into two classes: met and unmet. Demand which is met corresponds to usage and is an objective entity which is capable of precise measurement. Unmet demand represents requests for care which are not satisfied. In a free and universal health service such as the NHS, unmet demand is manifested in waiting-lists for hospital care. The significance of such waiting-lists should, however, be interpreted with great care; general experience of human behaviour suggests that demand will appear only if there is a reasonable chance of that demand being satisfied. If this is not the case substitutes will be sought: in the context of the NHS these will include self-medication and 'private' care. The NHS system of care is centred on the family doctor and much of the demand for care by patients does in fact reflect expert advice. For this reason it is likely that there is a substantial overlap between demand and the upper part of the iceberg of need. However, there is no doubt that some of the existing demand does not correspond to need, as indicated in Fig. 3. Such demand might be said to reflect the 'unreal' need hinted at in the NHS guide to planning. The depth of the iceberg covered by demand, both met and unmet, depends not only upon the size and nature of the resources available, but also upon the extent to which these resources match the need.

On this basis it is clear that although the ultimate goal of the planner is to meet need, because of the difficulties of definition this is simply not a practical policy. The objectives of the planning process may be considered in three stages. First, it is necessary to plan to meet the demand for care, subject to the caveat that some form of 'queueing' by patients for certain services is probably inevitable. Records of usage of services and of waiting-lists for care are available to provide a guide to the forecasting of demand. Furthermore, to the extent that demand corresponds to the views of the population and of their professional advisers as to what constitutes real need, this is consistent with the fundamental aim of the NHS.

Given that demand can be met, the next stage in the planning process is to consider possible ways in which resources can be re-allocated in order to obtain the greatest possible level of efficiency. The guide to planning refers to this point on numerous occasions and the following quotation is a typical comment:

> Proposals should **review** the use of **existing** resources and propose improvement by **redeployment** wherever appropriate.
> Defining strategy (requires) consideration of **alternative routes** to goals.
> A **selection** of options should then be made.
> Plans should deal with **all critical resources**.
> **Revenue** and **manpower** should be treated as resources in their own right.

We take the argument somewhat further than this and consider the specific objective of meeting demand in a manner which in some sense is the best amongst the available choices. This optimization process calls for data about the resource implications and costs of existing programmes of care, as well as for estimates of the corresponding quantities for the range of feasible alternatives. Such information is not generally available. Assuming that some improvement is possible (and the author's experience suggests that a minimum revenue saving of at least 20 per cent can often be achieved [5]), the planner is able to identify resources available for alternative uses. In a climate of financial retrenchment, to earmark such potential savings provides the first line of defence for the local health services in the face of any cuts in real resources imposed from higher levels of the managerial hierarchy. In happier times, such savings might be employed to augment any increase in resources designed to improve the local services.

The third stage in the planning process is to consider how any additional resources may be applied to satisfy needs not being met by existing services. In practice, such decisions will depend very much upon the nature of the local situation and upon the types of resource released by the second stage in the planning process. In theory, the planner should consider for each main sector of health care the corresponding input–output curve as illustrated in Fig. 2. The problem is one of determining priorities between different sectors, an exercise which is both inherently difficult to place on a logical basis and, having come to a decision, even more difficult to justify to interested parties, both lay and professional. If the curve is of form (a), the priority to be assigned to the particular sector should reflect

the position that has been reached. Thus a local service which has reached the position *X* is still on the steep part of the curve: a small increase in input can be expected to result in a relatively large increase in output. A higher priority would be appropriate than in the case of position *Y*, on the flatter part of the curve, since even a large addition to resources at this level can produce only a small 'pay-off'.

In principle, the planning process must involve a review of all aspects of health care in the light of the prevailing constraints. In practice, such scrutiny will tend to be concentrated upon new developments, which until they are implemented cannot generate the special interests and resistance to change which tend to apply to well-established services. Because of the long lead times involved in the provision of both human and physical resources in health care, developments which cannot make use of existing staff and buildings are likely to be at a great disadvantage. Further constraints upon planning decisions include policies determined at higher levels of management, professional attitudes, and public opinion, as manifested in the community health councils or elsewhere. If there was ever any doubt that each of these interests has the power of veto, recent experience should serve to remove any uncertainty in this respect.

Forecasting demand

We have suggested that the first concern of the planner must be to meet demand. This involves a process of forecasting the size and nature of the demand and the ability of the health services to cope with the forecast demand at some future time. Throughout the ages foretelling the course of future events has been a universal human preoccupation. A wide range of methods is available and examples of unsuccessful forecasts are manifest at every hand. The basic uncertainty of the process must be acknowledged. However, in the field of health care experience suggests that, unless there are obvious changes in the prevailing circumstances, present and past demand is a good guide to demand in the future. For this reason, it is suggested that information about the past should form the basis for forecasts of future demand. Such information need not be specific to any particular population and it is adequate as a first step to consider trends in the demand for particular services in order to forecast the future demand for those services.

Table 1(*a*). *Information about resources and their use. Community services.*

Resource	*Source*	*Nature*	*Usage*	*Efficiency*	*Effectiveness*
General medical practice	FPC	Location Organization	List size* Special payments	–	–
Community nursing	AHA	Numbers in grades	–	–	–
General dental practice	FPC & DEB	Location Organization	Items of service	na	Conservation/† extraction
Pharmaceutical	FPC & PPA	Location	Items of service	na	–
Ophthalmic	FPC	Location	Items of service	na	–

* Can be related to defined populations. † Not generally accessible.

Table 1(*b*). *Information about resources and their use.*

Resource	*Source*	*Nature*	*Usage*	*Efficiency*	*Effectiveness*
Hospital	SH3	Location No. of beds by spec.	No. of I/P by spec.	Occupancy TI LOS	–
		No. of O/P clinics by spec.	No. of new and old O/P by spec.	Ratio, new/old O/P No. O/P per clinic	–
			No. of day-cases by spec.	–	–
	Cost accounts	Revenue by institution, department	–	Not related to spec., or diagnosis or case	–
	Staff returns (eg SBH2)	Nos by grade	–		–
Hospital (in-patient only)	HAA (most acute spec) MHA (mental illness)	Record for each I/P spell	Specialty diagnosis LOS Operation, by age, sex, residence*	LOS by diagnosis, operation	Outcome by diagnosis, operation, age

* Can be related to populations.

In the reorganized NHS the district is the level of organization responsible for the delivery of medical care and a policy of self-sufficiency within the district has been advocated. For this reason, it is appropriate to consider demand for particular services on a district basis. We have seen that demand has two components, met (or usage) and unmet. The sources of information about the usage of particular resources are summarized in Tables 1(*a*) and 1(*b*), which refer respectively to community-based and hospital services. In terms of community services, information about the usage of resources is very sparse, particularly at the critical level of general practice, which acts as a filter for the demand for hospital care. Apart from list size and payment for special items of service, no information is generally available about the usage of the general practitioner service by particular classes of the population. In contrast, for general dental practitioners and ophthalmologists, who are remunerated by item-of-service, a detailed record exists of all work carried out under the aegis of the NHS. This information is accumulated for the purposes of calculating individual payment, but can also be used for planning purposes (7). The position as regards the hospital services is better, but by no means completely satisfactory. The most convenient summary of the usage of hospital services is the SH3 return, which is completed in a standard form for each NHS hospital and clinic. The SH3 returns are prepared quarterly for local management and are summarized annually for central government. They show for each specialty the numbers of beds available, the bed occupancy, turnover interval, and average length of stay, together with the numbers of 'new' and 'old' out-patients and the numbers of out-patient clinics. Also available are the hospital cost accounts and staffing returns, but these are not co-ordinated with each other or with the SH3 returns and are not presented in terms of the services rendered to patients. Information is also available for most acute specialties from Hospital Activity Analysis, which involves a record of each spell of in-patient stay. The Mental Health Enquiry is capable of serving a similar function in respect of psychiatric hospitals (8), but is normally regarded as a return for the use of central government only.

Information about unmet demand is more sparse, as indicated in Table 2. The SH3 returns show the length of the waiting-lists for in-patient care at the end of the period to which they refer. They do not, however, show the distribution of the period spent on the waiting-list, which for the less urgent cases may be much longer than

Table 2. *Gynaecology specialty. Indicators of efficiency for in-patients in a region.*

	In-patients				Out-patients	
District (1974)	*Occupancy* (%)	*Average length of stay (days)*	*Turnover per annum*	*Turnover interval (days)*	*Re-attendance rate*	*No. of patients per session*
A	62·9	5·4	42·6	3·2	2·4	18·5
B	81·1	5·5	54·4	1·2	3·0	31·3
C	72·1	4·1	63·7	1·6	3·6	35·4
D	42·3	4·6	33·7	6·3	2·8	24·2
E	67·6	5·0	49·1	2·4	2·5	31·4
F	69·1	6·0	42·3	2·7	3·3	25·3
G	63·2	7·0	32·8	4·1	2·5	22·1
H	73·0	6·5	40·9	2·4	3·7	51·9
I	74·0	4·8	56·6	1·7	4·2	39·1
J	80·3	5·3	55·3	1·3	2·2	34·4
K	64·5	5·8	40·4	3·2	4·1	81·5
L	58·9	6·5	32·9	4·6	3·0	24·8
M	80·6	6·4	46·2	1·5	4·5	41·6
N	67·2	5·7	43·3	2·8	3·8	28·1
O	79·2	6·6	43·6	1·7	3·7	27·1
P	68·0	6·3	39·4	3·0	3·2	77·7
Q	50·0	5·7	32·1	5·7	3·5	37·7
ENGLAND						
1974	71·2	5·7	45·4	2·3	2·9	22·4
1973	71·1	5·8	44·7	2·4	2·8	22·0
1972	74·8	6·0	45·5	2·0	2·8	22·7
1971	76·4	6·2	44·6	1·9	2·8	23·2
1970	78·4	6·5	43·9	1·8	2·8	23·0

Source. SH3 returns.

a simple average would suggest. Nor does the SH3 give any information about the waiting-list for out-patient appointments, which to some extent regulate the in-patient waiting-lists. A further indicator is activity in the 'private sector', although this reflects ability and willingness to pay as much as demand. Apart from general dental practice and ophthalmic services, this private activity is believed to be concentrated in the field of hospital care, but except for specific 'services', such as abortion, little quantitative information is collected.

On this basis it is clear that standardized information is available from the SH3 about the demand for hospital care in particular specialties. The way in which such information may be used for the

preparation of a forecast of the number of cases in the future is illustrated in Fig. 4(*a*). This figure shows the demand for in-patient care in three specialties, paediatrics, radiotherapy, and GP maternity, over the period 1969–74. None of these specialties has a waiting-list and the demand is reflected by the number of cases treated. For each specialty all the cases treated at hospitals within the district have been taken together. It will be noted that the vertical scale of the graph is not uniform. A logarithmic scale has been chosen in order to ensure that the trends in each specialty follow a straight line. This pattern corresponds to a uniform **rate** of change of demand: if there had been a uniform **absolute** change, the data would follow a straight-line relationship when plotted on a uniform scale.

Given this pattern of past data, the planner is faced with the problem of predicting future trends. In the absence of any information to the contrary, it seems reasonable to extrapolate the linear relationship into the future and to 'read off' estimates of future demand from the graph. The simplest method of extrapolation is by eye and often this will be sufficiently accurate for the purpose. However, there exist a wide variety of more mathematical procedures designed to optimize various features of the process of prediction, subject to given assumptions about the form of the underlying trend (9). In any particular situation it is often impossible to be specific about the properties of the process about which the forecast is to be made. No general rule can therefore be postulated about the best procedure on theoretical grounds. However, practical experience suggests that a weighted moving average is often effective in preparing forecasts of demand for health care. Of course, if the planner suspects that there will be a change in the general circumstances he should take account of this information in preparing his projection, rather than merely extrapolate past trends in an uncritical way. The position regarding GP maternity care provides a good insight into the kind of decision processes which might be involved. Thus in this particular district the number of cases has fallen by almost one-half over the five-year period between 1969 and 1974. The planner would need to consider very carefully whether he should anticipate a further fall by one-half over the next five years. Alternatively, he might decide that demand is likely to remain at the 1974 level, or even that the deferment of the family-building process will not continue indefinitely and that an increase in the birth-rate, and thus in the demand for GP maternity care, is due to show a sharp increase. It must be emphasized that

there is no way of being sure of what will happen in the future. All that can be said is that substantial swings upwards or downwards are possible and that the health services must be prepared to respond to changes in a flexible way as they occur. A second major uncertainty which faces the planner is whether (and, if so, when) to react to changing demand by a radical reorganization and/or rationalization of the service, which in this case might involve the concentration of all maternity care in consultant units. The position as regards maternity services in all parts of the country is one of gross over-provision of resources, the level of which has shown little (and perhaps much too little) reaction to the changing birth-rate and methods of care.

For many specialties, and particularly those with significant waiting-lists, the situation is more complicated. Fig. 4(*b*) shows an example relating to general surgery. In this context, demand is calculated as the sum of the number of cases treated and the number on the waiting-list for in-patient care at the end of the year. This is only an approximation to the true situation in respect of the unmet component of demand. Thus the length of the waiting-list for out-patient care (for which figures are not generally available) may determine the length of the waiting-list for in-patient care. Furthermore, the length of both waiting-lists may be expected to reflect the availability of service, which is embodied in the expected waiting-time. Thus, if it is believed that the patient may have to join a long queue, alternative (although perhaps less desirable) programmes of care may be chosen. In this particular example, the pattern of service was radically changed in 1972 by the introduction of day-care, so that during the latter part of the period under review the service available exceeded the number of new cases, the length of the waiting-list being reduced. It will be noted that in this case the demand has been plotted on a uniform scale, there being no evidence that a logarithmic (or any other non-uniform scale) would be more helpful. In this example it would be unrealistic to plan to eliminate the waiting-list immediately, since if this were done removal of the only barrier to service would be expected to result in an unpredictable drift in the case-mix. A more realistic aim would be to reduce the waiting-list in a series of planned steps and at each stage to review the effect upon the nature of the demand.

For some specialties, such as geriatrics, the hospital provides an alternative to other forms of care either within or outside the health

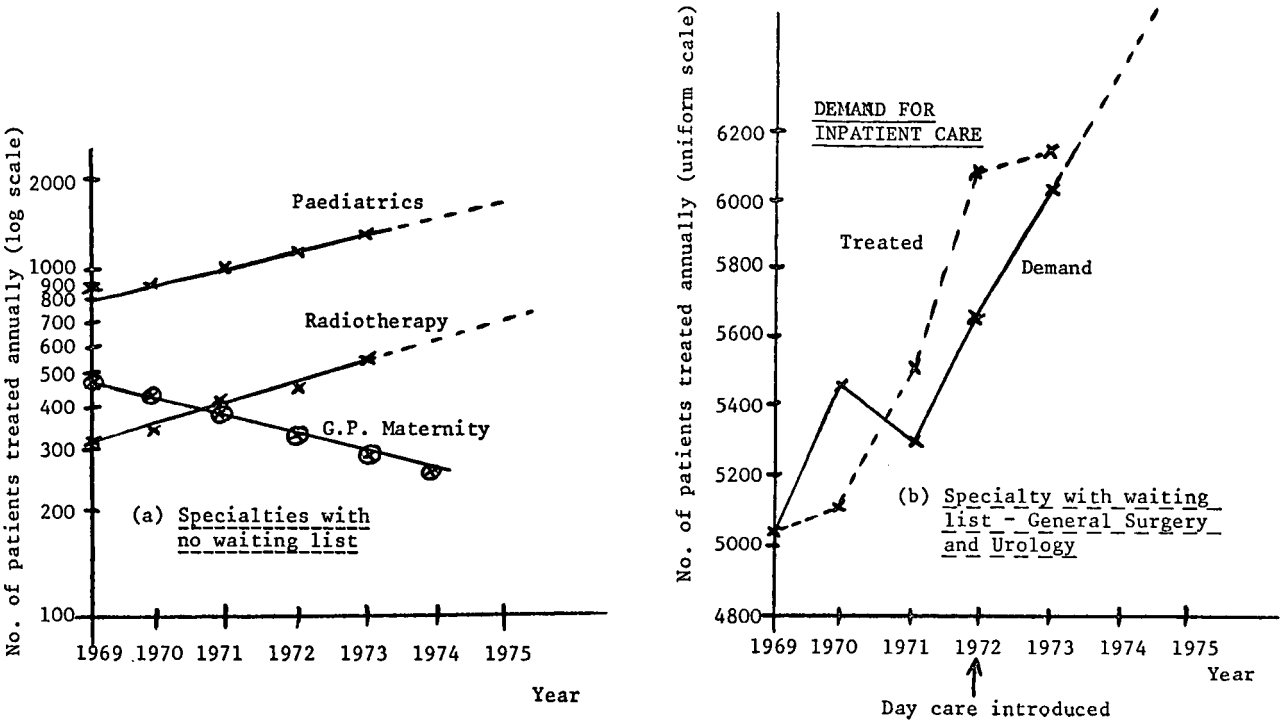

Figure 4. Demand for in-patient care.

services. In these cases supply and demand are closely linked, particularly if the hospital constitutes only a small proportion of the total capacity of the system. To the extent that usage of the particular service may be expected to expand to conform to any realistic increase in the supply of care, planning in terms of past hospital experience is unrealistic. A more logical approach is to attempt to measure the size of the total reservoir of potential patients and to decide upon the proportion for whom each particular alternative form of care is to be made available. This approach cannot be conducted solely on the basis of the usage of particular medical and social services and must involve the review of a specific population of patients. In this sense, need, rather than demand, is the explicit consideration.

As in the case of in-patient services, the demand for out-patient care may be assessed in terms of the trends revealed by the SH3 returns. In this way, it is possible to consider the usage of the out-patient service in terms of the numbers of 'new' patients, defined as patients making their first out-patient attendance for the particular condition. Information is also available about the total number of patients dealt with by the particular specialty. However, it is not possible to determine the length of the out-patient waiting-list on the basis of data routinely collected. Since in some specialties this waiting-list is the primary means by which control is exercised on the demand for in-patient care, this factor may be important.

All forecasts are liable to be in error. Mathematical techniques for forecasting allow due account to be taken of the effects of errors due to random fluctuations in the observations. For this reason, forecasts are often expressed not only in terms of average or expected levels but also as bounds within which the future values will lie with a defined probability. A confidence level of 95 per cent is often adopted and the upper and lower bounds corresponding to this level are calculated. However, any statistical procedure of this type must rest on the assumption that the rules which govern future events are the same as have applied in the past. Unfortunately this is no longer a reasonable assumption in the context of the NHS: industrial disputes, ideological conflict, and uncertainties about public finance are tending to introduce completely new factors into the situation. For this reason, it is essential that the forecasts should be kept under continuous review. The SH3 returns which form the main basis for the analysis of demand are available at quarterly intervals and forecasts should be re-calculated as each new set of data becomes available. This

frequency of data analysis is more exacting than the recommended annual planning cycle. However, there is no *a priori* reason why a planning cycle of exactly one year should be appropriate in a situation so far removed from the primitive agricultural background from which the conventional annual budgetary process was derived. A year is too short a period to deal with processes having a lead time of several years which are characteristic of much health care planning, and too long to provide a basis for the 'fire brigade' types of decision which are so characteristic of the present climate.

In order to cope with the requirement for frequent recalculation of forecasts it is essential that simple and standardized procedures should be applied to the analysis of the basic data. The format of the SH3 return is particularly suitable for the application of computer methods and a set of standard programs which have proved to be very effective for the preparation of forecasts and other purposes are described below.

Planning the use of resources

In essence the planner must be concerned with the provision of resources of the appropriate quantity and type and with the way in which these resources are used. Emphasis must therefore be given to both the effectiveness and the efficiency of the services that are provided. In the context of health care, neither concept is clearly defined and the available information, direct and indirect, about each leaves much to be desired.

The fundamental test of the effectiveness of care is the outcome to the patient, as revealed by the extent to which the goals of the relevant programme of care have been fulfilled. In the context of most aspects of health care, the difficulties of definition are manifest. Even assuming that satisfactory measures of outcome are available, there are no absolute standards of performance, and assessment must be on a relative basis. This means that comparable information must be collected in all parts of the health care system. The only reliable information about outcome available in standardized form for the population resident in particular geographical areas is mortality. However, since only a small minority of episodes of illness are terminated by death, mortality data are of very limited application. Furthermore, most mortality occurs in old age and reflects the cumulative effect of a variety of personal and environmental factors

extending over many years. These arguments also apply to perinatal and neonatal deaths to a limited extent, but mortality rates in populations do provide a useful yardstick for measuring the effectiveness of maternity care (10).

A second source of information about outcome to the patient may be derived from HAA statistics. Although the system provides no direct information about serial records of hospital admissions, computer-based methods of record linkage may be applied to bring together successive admissions for the same patient with a high degree of accuracy. Current research by the author and his collaborators suggest that if HAA records are available on a regional basis over a period of about five years, a useful indicator of the effectiveness of certain specific procedures can be obtained (11). On the other hand, data about certificated sickness absence derived from National Insurance statistics are of doubtful validity for this purpose, in view of the possible influence of the nature of local employment and of prevailing social attitudes. Nor is it possible to rely upon the reactions of the consumers of health care, as manifested by the community health councils (CHCs) or elsewhere. In the absence of any specific mechanisms for co-ordinating the activities of CHCs and for providing a range of standardized information about local health services, such comments must be essentially subjective.

Indirect information about effectiveness may be derived from 'process' studies of health care. Such studies involve a description of the delivery of care in terms of the facilities available and the way in which such facilities are used. For example, operating theatres may be classified in terms of technical standards. Antenatal care may be classified in terms of the frequency and nature of contacts with the health services during pregnancy. Inevitably such analyses call for the consideration of detailed information about particular resources and the use of these resources by populations, which is seldom available on a general basis.

The quality of the information available about the efficiency of health care delivery is equally unsatisfactory. Ideally, the most relevant indicator of efficiency is resource utilization per unit of outcome, or failing this, resource utilization per unit of service or, failing this, resource utilization per case for a given programme of care. Because of the lack of co-ordination between data about patients and data about resources, existing data systems are not adequate to provide any of these measures of performance. The only

generally available substitute is resource utilization per case for a given specialty, the available units of resource utilization being hospital beds (for in-patients) and out-patient attendances (for out-patients). Both types of information may be derived from SH3 returns. In addition, the HAA system can provide information about bed utilization in terms of specific diagnoses or operations and the Mental Health Enquiry is capable of filling a similar role for psychiatric hospitals. No absolute standards of performance exist for any of these measures of efficiency. The only available basis of comparison is the corresponding data for the same service over a period of time or for similar services in other parts of the country.

For in-patient services the SH3 returns are concerned solely with the usage of hospital beds, which are certainly a key resource, but by no means the only factor which must be taken into account in planning. Indicators of the efficiency of the usage of beds may be calculated in terms of bed occupancy, average length of stay, annual turnover, and turnover interval. For out-patients, the re-attendance rate and the average number of patients per clinic can be calculated.

In order to set appropriate planning targets, it is helpful to review performance data for several different geographical areas and also possibly for several years in the immediate past. An example of this process is given in Table 2, which refers to the performance of the gynaecology specialty in seventeen districts within a region for a single calendar year (1974). As far as occupancy is concerned, the results in the various districts vary from 42·3 to 81·1 per cent, a very wide range. Annual turnover varies from 32·1 to 63·7 and turnover interval from 1·2 to 6·3 days. In contrast, the average length of stay varies less widely, the extremes being 4·1 and 6·6 days. On this basis the planner must derive realistic targets for future services. As far as occupancy is concerned, rates in excess of 80 per cent were recorded in three districts and a target of about 80 per cent would be realistic in an environment in which there is pressure on resources. Examination of turnover intervals reveals figures of 1·5 days or less for three districts also. In contrast to occupancy and turnover interval, which reflect pressure on resources and administrative efficiency, length of stay is a parameter determined largely by clinical considerations. Thus, although averages of 5·0 days or below were recorded in four districts, the planner may well reject the notion of curtailing clinical decisions by resource constraints. A target of 6·5 days for average

length of stay would accommodate virtually all the 1974 patterns. Taken in conjunction with the target turnover interval of 1·5 days, an average case would 'block' a bed for a total of 8 days. This bed would be occupied for a proportion of 6·5/8 or 81 per cent of the time. If the forecast of the number of cases per annum is n, the number of bed-days required is $8n$ per annum and the number of beds is $8n/365$. Similar procedures may be applied in other specialties to determine the number of beds required to meet the forecast demand. These forecasts can then be compared with the numbers of beds available in particular institutions and any over-provision of resources or potential bottlenecks can be identified.

As far as the out-patient data are concerned, districts *K* and *P* have relatively high numbers of patients per session. These happen to be teaching districts and the organization and staffing of their clinics is more generous than in the remainder of the region. The re-attendance rates reflect clinical decisions as well as pressure on resources. In the non-teaching districts, re-attendance rates tend to increase with the numbers of patients per session, which suggests that there is a 'trade-off' between the length of consultation and the number of times a patient is seen. When planning the number of out-patient sessions, both factors are important. The number of sessions required is equal to the product of the number of new cases and ratio of the re-attendance rate to the number of patients per session. The average value of this ratio is about 0·1 and hence, for the non-teaching districts, the number of sessions required is one-tenth of the forecast number of patients. Individual clinicians would then be in a position to decide upon the appropriate balance between re-attendances and the length of the consultation.

Table 2 also shows the corresponding data from the SH3 returns for the whole of England, excluding teaching hospitals. This provides a reference standard both for the individual districts and for the planning targets. In general, planning targets should be reasonably consistent with the national average, although consideration should be given to recent trends in the national data and to specific local factors. On the basis of the trends in average length of stay shown in Table 2, the suggested planning target of 6·5 days is sufficiently large to accommodate any justifiable variations in clinical practice in the future. The national data for out-patient clinics show little change from year to year and the ratio of patients per session to attendance rates is slightly lower than for the region.

Analyses of this type may be carried out on the basis of the SH3 returns for each specialty and targets for efficiency, as measured in terms of these simple indices, can be derived. These can then be combined with estimates of demand or of need to determine the levels and distribution of resources required at various dates in the future. The same process also serves to identify units and districts where the use of resources is anomalous and thus provides a basis for monitoring past performance as well as for planning for the future.

Having determined the number of cases expected in each specialty, the question arises as to whether the existing allocation of resources to specialties is the best that might be devised. For the planner of health care in a district it may be that some rearrangement of specialties between the different institutions would be desirable. What constitutes 'best' in these circumstances is arguable, but for the purposes of tactical decisions we suppose that, subject to agreed limits concerning the quality of care and the accessibility of services to patients, the objective should be that of running the service at the least possible cost. The problem is presented in symbolic form in Table 3, in terms

Table 3. *Optimal resource allocation within a district. Matrix of resources and institutions.*

Specialty	Institution										Total no. of cases
	I_1	I_2	.	.	.	I_j	.	.	.	I_l	
S_1	r_{11}	r_{12}	.	.	.	r_{1j}	.	.	.	r_{1l}	r_1
S_2	r_{21}	r_{22}	.	.	.	r_{2j}	.	.	.	r_{2l}	r_2
.	.	.				.				.	.
.	.	.				.				.	.
.	.	.				.				.	.
S_i	r_{i1}	r_{i2}	.	.	.	r_{ij}	.	.	.	r_{il}	r_i
.	.	.				.				.	.
.	.	.				.				.	.
.	.	.				.				.	.
S_k	r_{k1}	r_{k2}	.	.	.	r_{kj}	.	.	.	r_{kl}	r_k
Total no. of cases	$r_{.1}$	$r_{.2}$	.	.	.	$r_{.j}$	.	.	.	$r_{.l}$	n
Total bed-days	T_1	T_2	.	.	.	T_j	.	.	.	T_l	T
Total theatre hours	O_1	O_2	.	.	.	O_j	.	.	.	O_l	O
Total labour ward hours	L_1	L_2	.	.	.	L_j	.	.	.	L_l	L
Etc.											

of a matrix defined by the specialties and the institutions within the district. We suppose that there are l institutions in the district (in practice l may be as high as 50) at which care might be provided, labelled $I_1, I_2, \ldots, I_l$ and that there are k specialties, labelled $S_1, S_2, \ldots, S_k$. The number of patients of a particular kind (usually it will be adequate to consider in-patients and day-cases only) treated by the i^{th} specialty at the j^{th} institution is denoted r_{ij}. The problem for the planner is to determine the best set of values for r_{ij}.

There will never, in practice, be a completely free choice. The allocation will be restricted by a number of constraints. In the first place the total number of patients in each specialty must be equal to the forecast, so that the row totals, $r_1, r_2, \ldots, r_k$, are fixed. Secondly, there is an upper limit to the amount of care that can be provided for a given specialty in a particular institution, which can be assessed in terms of the maximum number of bed-days available. Suppose that the average number of bed-days (represented by the sum of the average length of stay and the turnover interval) for the i^{th} specialty at the j^{th} institution is denoted d_{ij}. The total number allocated to specialty S_i at institution I_j is then the product $r_{ij}d_{ij}$. The total number of bed-days required in I_j is then the sum of the bed-days in each specialty and may be denoted T_j.

Both upper and lower limits can be set for T_j, depending respectively upon the maximum capacity and the minimum viable level of activity. A similar approach may be applied to other critical resources, including for example, operating theatre hours and labour wards. In order to make the necessary calculations, a forecast of the quantity of the particular resource per average case in each specialty is required. Upper and lower limits can then be set for each institution. For example, at an institution, I_j, with no operating theatre, $O_j = 0$.

In general there will be other considerations which will constrain the allocation of cases to institutions. For example, if the district contains a single, well-equipped general hospital, as a matter of policy certain specialties must be located at that hospital and nowhere else. If the specialty S_i is one of those concerned, all the entries r_{ij} in the i^{th} row of Table 3 will be zero except in the position corresponding to the district general hospital. By the same token, certain institutions may lack facilities which are essential for particular specialties. This means that all entries for these specialties in the column relating to that institution in Table 3 will be zero. If the district covers a large

geographical area, it may be decided that certain institutions (such as community hospitals) should serve only part of the whole. In order to cope with this requirement, all relevant specialties should be subdivided on a geographical basis, each part being considered as a separate row in the resource allocation table. If it is decided that a specialty can only be practised at a single institution, this can also be included as a further constraint.

Having completed the analysis of constraints, it will normally be found that some (if not most) of the entries in the table are predetermined, being fixed to be zero or the forecast total number of cases for the corresponding specialty. The problem is then to choose the remaining values of r_{ij} in such a way as to achieve minimum cost without violating any of the remaining constraints. This is a simple mathematical programming problem. The first aim is to determine whether a feasible solution exists; in other words, to see whether the resources are adequate to cope with the forecast numbers of cases. This can be done without the need to calculate the average costs per case of each specialty at each institution. By allocating arbitrary unit 'costs' to each entry in the table, standard computer programs can be used, to identify both the 'bottlenecks' and also the resources where some 'slack' exists. If no feasible solution can be found, the problem can be re-analysed to mimic a range of hypothetical situations in which further 'dummy' resources are introduced, in order to produce a solution compatible with the forecasts. In this way the effect of particular hypothetical changes in the total resources available to the system can be explored.

Given that sufficient capacity exists (or can be provided) within the system, the next step is to estimate the revenue costs associated with the care of an average case in each specialty in each institution. This is a less formidable problem than would appear at first sight, since only those entries for which the number of patients, r_{ij}, can be varied need to be considered. A value of zero cost can be assigned to all entries for which the number of cases is completely determined by the constraints of the situation. The estimation of costs presents a problem in applied economics which is conceptually simple but may be difficult in practice because of the lack of financial information. In principle, the costs of running an institution may be considered as the sum of a 'fixed' element for the institution itself, a further 'fixed' element for each specialty providing care in the institution, and the 'variable' costs for each specialty, which will depend upon

the number of cases and the average cost per case at the level of activity which is envisaged. Experience suggests that existing NHS accounts, supplemented by local advice and data concerning the past case-mix, staffing policies, and other factors, enable reasonably good approximations to both the fixed and the variable costs to be calculated.

Given the cost structure, the application of mathematical programming techniques is required to determine the allocation of specialties between institutions which leads to the smallest possible revenue costs. Standard computer programs are available for this purpose, although in some situations there will be little freedom of manoeuvre and the range of possible solutions is small enough to permit the exploration of the situation by simple manual methods. Whatever the degree of complication, the preparation of a formal resource allocation table and the specification of the limitations imposed by various constraints should form a fundamental part of the planning process.

Planning to meet need

As an essential complement to the study of demand, an analysis of need should also be carried out. The starting-point for such a study is to identify the population to be served and to forecast changes in the composition and structure of that population. A policy statement has been made to the effect that each district should be self-sufficient in all the specialties for which there is a significant demand for care. However, given the existing distribution of resources, it will be many years before this objective can be achieved. In the meantime, the planner must make a deliberate decision about the nature of the population with which he is concerned. Two obvious alternatives are the population living in the given geographical area—the 'resident' population—and the population currently using institutions located within the geographical area—the 'current catchment' population. In a few locations, the two populations will be coincident for most specialties, but, in general, 'cross-boundary' transfers will occur. When calculations are made on the basis of resources per person, the results obtained using the two definitions may be very different (see [12], Table 4). In situations of this kind, the planner may be concerned with an intermediate situation in which the district will have made some progress towards self-sufficiency, but is still some years away from achieving this target. In this case it is what may be termed

the 'forecast catchment' population which is of primary interest and concentrating upon the existing catchment population or the resident population may be misleading.

Having decided upon the appropriate population for the particular purpose, the next step is to calculate a forecast of the population size and structure. In the United Kingdom, firm information is available about the population living in particular geographical areas as a result of the decennial censuses, the most recent of which took place in 1971. There are no comprehensive and continuously updated lists of persons classified in terms of place of residence, as are available in the more highly regulated countries. After a delay to allow for data processing and analysis, which is measured in years rather than months, the Office of Population Censuses and Surveys (OPCS) issues statements about the population of particular geographical areas. These have been shown to be accurate and provide the only direct measurements available. Unfortunately the latest available census data refer to events which took place between two and twelve years previously, whereas the planner is often concerned with the position perhaps five or ten years ahead. Forecasts are therefore required and these must clearly use the last available census data as a basis. The OPCS has developed procedures for this purpose, the results of which are referred to as 'population projections'. This terminology is significant and points to the difficulties of forecasting in this context. The history of population forecasting in this country is not encouraging. For example, successive OPCS forecasts of the *total* population of England and Wales in 1985 vary from 46 million (1955) and 56 million (1965) to 50 million (1973). The problems of forecasting the population of a small geographical area, such as a district or area, are much greater, since it is necessary to take account of internal migration as well as births, deaths, immigration, and emigration. A retrospective analysis of the projections prepared by OPCS for the health services districts will be very revealing when the results of the 1981 census become available. However, it is probably reasonable to expect that projections of population numbers in a particular district more than ten years ahead of the census on which they are based may be in error by at least 10 per cent. For particular subgroups of the population, such as women of child-bearing age, the inaccuracies may be even greater.

In spite of these reservations, the OPCS provide projections for health services administrative areas which are revised at intervals of

about two years to take account of recent changes in the birth- and death-rates and these are the most readily accessible forecasts. However, it should be borne in mind that there are two further population registers which are subject either to continuous or periodic revision. The first of these is the list of patients registered with general practitioners, which is maintained by the local family practitioner committee (FPC) and forms the basis for the payment of capitation fees. Such lists are widely believed to be inflated by delays in removing the names of patients who die or move away from the area, which tends to more than balance the under-registration of transients and new arrivals. Inclusion of a patient on such a list is merely a reflection of the location of the doctor in terms of FPC districts, rather than of the patient's own place of residence. Despite these difficulties, comparison of the population registered at the time of the census with the census returns enables a 'correction factor' to be derived, which can then be applied to the future changes in the list of patients. The second potential source of population data are the electoral registers, which cover all persons over the age of 18 years and are never more than eighteen months out of date. In this case also the list does not include the whole resident population (in spite of the associated legal sanctions) but a 'correction factor' can again be derived by comparison of the electoral registers current at the time of the most recent census with the census returns. At the present time the use of supplementary information of this kind is not well established, but studies by the author and his co-workers suggest that useful information can result. Health service planners should be aware that planning of services for populations is a widespread activity within the public sector of the economy. In particular, local authorities have a close interest in these problems and make extensive use of forecasting methods based upon housing stock, which, although superficially attractive, are potentially misleading at times when employment patterns and the private housing market are disturbed.

When catchment populations are considered, it is clear that reference must be made to information about the usage by populations resident in particular geographical areas of particular health services facilities. The only generally available source of information is the HAA return, which is classified in terms of place of residence of the patient. In general, HAA covers in-patients only and is confined to acute specialties. The pattern of usage of services may be different for out-patients or for other specialties. Indeed, even among

Table 4. *Analysis of cross-boundary traffic. General medicine specialty, in-patients, 1974.*

Use of services by resident population of District D			Use of services in District D		
District of treatment	*No.*	*%*	*District of reference*	*No.*	*%*
A	64	2	A	1	0
B	56	2	B	164	5
C	29	1	C	371	12
D	2,423	79	D	2,422	82
E	144	5	E	12	0
F	120	4	F	3	0
G	204	7	G	6	0
All others in region	9	0	All others in region	2	0
Outside region	—*	—	Outside region	15	0
Total	3,049	100	Total	2,996	100

* Believed to be negligible.

the acute specialties the catchment areas for the institutions located within a district may vary widely. This means that in the study of current catchment areas, detailed analysis is required. Average figures may be misleading when applied to a particular specialty. In particular, the catchment areas of services for the mentally ill and mentally handicapped may differ very considerably from those for other specialties.

Two main types of analysis are required in the study of traffic across district boundaries. First, is an analysis centred upon the use of services by the resident population. This calls for a scrutiny of HAA records for all institutions which may provide services for the population concerned. Table 4 gives an example of an analysis for the general medicine specialty. The district concerned lies towards the geographical centre of the region in which it is situated and is in no sense a place which might attract holidaymakers or casual visitors. An analysis was carried out of all the HAA records for the region and it is considered that virtually all of the institutions used by this population were covered. The second type of analysis involves a classification of services provided by the institutions situated within the district. Reference to Table 4 shows that just under 80 per cent of the in-patients resident in the district were also treated in the district. In contrast, just over 80 per cent of the treatments provided by the

district applied to residents of the district. In this case, the cross-border traffic is virtually in balance, but the volume of the inward and outward transfers is substantial. The number of cases coming from outside the region was very small. It is also thought that the number of patients resident in the district who were treated outside the region is negligible, but an analysis of HAA records for all regions would provide definite confirmation. The figures in the last column of Table 4 indicate the extent to which services in the district were used by patients resident in various districts within the region. For each district, the number of such transfers may be expressed as a proportion of the total number of cases from the resident population. If this ratio is multiplied by the size of the appropriate resident population, and the result is summed over all such districts (including the one in which the services are situated), the catchment population can be calculated. This must involve an analysis on at least a region-wide basis. The data given in Table 4 are not adequate for this purpose, although the contribution to the current catchment population from the district is 82 per cent of the resident population.

In addition to traffic between districts, the catchment areas of particular institutions within a given district are also important. Table 5 shows the results of an analysis (covering all acute specialties) based upon the HAA returns for each of the institutions in a particular district. The border areas of this district are thinly populated (or correspond to the coastline) and it is known that only a very small proportion of the resident population are treated elsewhere. In this analysis, the place of residence of the patients has been classified in terms of the county borough, urban, or rural districts into which the area was divided prior to local government reorganization. Each cell in Table 5 includes three figures: the entry at the top left-hand side shows the number of cases, the entry at the bottom is the proportion of cases resident in the particular locality, and the entry on the right-hand side is the proportion of cases dealt with at the institution. Thus, reference to the upper left-hand cell of the table shows that some 3,414 patients resident in the county borough were treated in the district general hospital (Site 1), representing 46 per cent of all patients from the county borough and 36 per cent of the patients treated at that hospital. It will be noted that some 22 per cent of all patients treated lived outside the district. In this case there are no significant compensating transfers and this represents a real inflation of population as a result of the presence of large numbers of

Table 5. *Analysis of catchment areas within a district. All acute specialties, 1973.*

Hospital	Locality of Residence					
	CB	UD1	RD1	...	Outside District	Total (of 19 Localities)
DGH (Site 1)	3414 / 36 / 46	719 / 7 / 30	458 / 5 / 48		2479 / 26 / 42	9594 / 100 / 36
DGH (Site 2)	2097 / 41 / 28	333 / 6 / 14	170 / 3 / 18		913 / 18 / 16	5131 / 100 / 19
Orthopaedic	316 / 18 / 4	88 / 5 / 4	37 / 2 / 4		941 / 52 / 16	1793 / 100 / 7
Eye Hospital	326 / 25 / 4	98 / 7 / 4	45 / 3 / 5		415 / 32 / 7	1311 / 100 / 5
. . .						
Community 1	32 / 3 / 0	934 / 82 / 40	38 / 3 / 4		37 / 3 / 1	1144 / 100 / 4
Total (of 22 hospitals)	7395 / 28 / 100	2360 / 9 / 100	959 / 4 / 100		5866 / 22 / 100	26456 / 100 / 100

holidaymakers in the district in the summer. Such patients come from all parts of the British Isles, as well as from overseas, and in the circumstances the definition of a specific catchment population is impossible. However, on the basis of meeting need, a substantial allowance for temporary residents is required.

The HAA records also permit a more detailed analysis of the likely effect of demographic changes upon the need for resources. For example, the question can be posed as to what changes in resource provision would be required to take account of future changes in the size and structure of the population, on the assumption that current patterns of usage of services are maintained. An example is given in Table 6, which refers to the general medicine specialty in a district in which cross-boundary flows of patients are virtually in balance. An analysis was carried out of HAA data for 1974 in terms of age and sex and the results are summarized in the upper four rows of the table. The population data are OPCS projections based upon the 1971 census; the discharges and average lengths of stay for the various sub-groups are derived directly from the HAA

Table 6. *Forecast of future usage of a specialty by resident populations in a district.*

SEX	Males						Females						Total
Age-group (years)	0–4	5–14	15–44	45–64	65–74	75+	0–4	5–14	15–44	45–64	65–74	75+	*All**
Population, 1974†	11·3	21·7	49·4	29·2	7·9	2·9	10·7	20·8	48·5	29·7	9·9	5·8	247·8
No. of discharges, 1974	0·0	10·0	365·0	847·0	355·0	71·0	0·0	26·0	452·0	504·0	279·0	131·0	3040·0 (2,931)
Average length of stay, 1974 (days)	–	7·3	7·6	11·4	12·4	13·9	–	4·1	6·1	11·5	14·4	15·9	10·7 (10·5)
Beds required, 1974	0·0	0·2	7·6	26·4	12·1	2·7	0·0	0·3	7·5	15·9	11·0	5·7	89·5 (84·5)
Discharges per 1,000 resident population, 1974	0·0	0·5	7·4	29·0	44·9	24·5	0·0	1·2	9·3	17·0	28·2	22·6	12·3
Beds per 1,000 resident population, 1974	0·0	0·01	0·15	0·90	1·53	0·93	0·0	0·01	0·15	0·54	1·11	0·98	0·36
Population, 1984	11·7	22·1	56·7	27·7	9·1	3·7	11·1	21·1	55·7	28·1	11·4	7·2	265·6
Discharges, 1984	0·0	11·0	419·6	803·3	408·6	90·6	0·0	25·3	518·0	477·7	321·5	162·7	3238·3
Beds required, 1984	0·0	0·2	8·5	24·9	13·9	3·4	0·0	0·2	8·4	15·2	12·7	7·1	94·5

* The numbers in brackets are the corresponding data from the SH3 returns for 1974.
† Thousands.

records for the whole region for patients resident in the district. The figures for beds required are obtained as the ratio of the number of bed-days allocated to the sub-group, divided by 365. The fifth and sixth rows of the table show rates derived from the upper rows. The results show that up to the age of 75 years, the admission rate, the average length of stay, and the bed requirement, increase very sharply with increasing age. The general pattern is similar for males and females, but the usage rates are substantially higher for males than for females in the 45–74-year age-groups. These rates are then applied to the OPCS forecasts of the population size and structure and the resulting forecasts of numbers of cases and bed requirements are shown in the last two rows of the table. In comparison with 1974, the 1984 forecasts indicate a modest increase in both the number of cases and the bed requirement. Similar calculations could, of course, have been carried out under different assumptions about the discharge and bed requirement rates. Indeed, it might be reasonable to extrapolate from recent data, obtained by a similar analysis of the HAA returns for each successive year. The last column of the table shows the corresponding results for numbers of cases, numbers of occupied beds and average length of stay from the SH3 returns for hospitals in the district. In spite of the difference in the populations, agreement is very good, reflecting the balance between the flows of patients in this specialty into and out of the district.

A study of the kind described above is no more than a substitute for a systematic analysis of need. Although an attempt is made to take account of demographic changes, the assumption is made that the need of individuals and the way in which such need is to be met can be represented by current patterns of care or by forecasts based upon current patterns. In other words, the approach embodies the implicit notion of preserving present standards or of following through the consequences of recent trends. The only viable alternative to this approach is the application of norms for resource provision. The derivation of such norms is an arbitrary process which represents a compromise between subjective and objective expert opinion and a view of what is practicable in a particular set of circumstances. The uncertain nature of this process is reflected in the great generality with which norms are usually expressed. For example, norms for the provision of maternity care are based upon the size of the total population of males and females of all ages, regardless of the likelihood or even possibility of giving birth; norms for

Table 7. *Comparison of population structure in a district with the national average, 1976.*

Age-group (years)	District			England and Wales	
	*No.**		%	%	
0–14	59		21	23	
15–64	168		59	63	
65–74	28	59	10	9	14
75 or more	31		11	5	
Total	286		100	100	
Females					
15–44	50		18	22	

* Thousands

geriatric care are based upon the total population over the age of 65 years, regardless of the strong relationship between age and need within this group. If populations are generally homogeneous in structure within small geographical areas (such as health service districts) this approach would be satisfactory, but this is far from the case in practice. Table 7 compares the projected population structure of a particular district with the national average for 1976. In this district the proportion in the over-64-year age-group is expected to be almost 50 per cent higher than the national average, and the proportion in the over-74-year age-group is more than twice as high. In view of the relatively high usage of the services of most specialties by older people, these results suggest that whatever the implicit standards on which national norms were based, the 'real need' of the district will be under-estimated by their application in an unthinking way. Unfortunately, however, the national planners give no guidance as to how much compensation is called for, although an analysis of local recent usage of services on the lines described in Table 6 would be helpful. In contrast, the proportion of women of child-bearing age is below the national average, which suggests that the normative provision for maternity care might be over-generous. In this context, however, it is the actual number of births (rather than the number of women who might give birth) which is of primary importance.

A key stage in the planning process is to compare the resources available with the forecast demand and with the 'need' as determined by norms. Table 8 gives an example for one particular district of forecasts for 1976 based upon the methods described in this essay.

Table 8. *Comparison of demand and normative need with resources available for hospital beds in a health care district.*

Specialty	*Norm beds/1,000 population*	*Beds needed 1976*	*Forecast demand 1976*	*Beds available 1974*
Acute*	2·5	713	874	948
Special care baby unit	0·125	36	25	31
Younger chronic sick	0·1	29	—‡	30
Maternity	0·45	128	97	102
Geriatrics	10†	586	254	470
Psychogeriatrics	2·5†	146	—‡	1,572§
Mental illness	0·5	143	—‡	
Mental handicap	0·65	185	—‡	1,575§

* Excludes sub-regional specialties.
† Rate per 1,000 population over 65 years of age.
‡ No valid forecast available.
§ Currently serves larger catchment area than district.

It will be noted that no forecasts were made of the demand in certain specialties, due to uncertainties associated with changing patterns of care. The discrepancies between the three sets of resource figures are considerable and detailed consideration of each apparent anomaly is required. However, it is clear that there was, in 1974, a surplus of beds in the district and steps are being taken to reconcile the demand with the resources available. In the experience of the author, this kind of position is by no means atypical and the universally accepted picture of the NHS as a system fighting on all fronts against a shortage of resources of every kind is very misleading. Many of the current problems of the NHS can be resolved by a reallocation of existing resources and for the immediate future the main problem is that of spending limited revenue funds wisely.

Comment

By any standards, a modern health care system is a complex undertaking. Although it is often necessary to consider in detail the component sub-systems, it cannot be emphasized too strongly that the whole is greater than the sum of the parts. Different sub-systems interact in complex ways and changes in any one sub-system may affect other sub-systems, and often have consequences that are difficult to anticipate. Thus, when planning a comprehensive set of services it is essential that proposals for different sectors or different

institutions should be properly co-ordinated. This is essentially a problem of systems design. The planner must be prepared to take an over-all view of the whole system, as well as to probe in great detail at particular parts. In the context of the reorganized NHS at the district level, this is clearly the responsibility of the district management team, who must ensure that the proposals of the various health care planning teams are compatible and complementary.

Although the existing data about the need, demand, usage, effectiveness, and efficiency of care leaves much to be desired both in content and accuracy, it is an unfortunate but characteristic feature of the NHS that the best use is seldom made of the information which is available. This situation may be attributed to three main factors. First, there is little general awareness of how such information might be used to improve the management of the service. It has been argued by critics of the NHS that the pattern of development of the service since it was established has consisted largely of involuntary reactions to a series of unforeseen problems and stimuli. Following reorganization, the time has come to take a more positive stance and to anticipate and take specific steps to meet difficulties and problems before they arise. Secondly, the data which are collected are not made accessible to the potential users, in an appropriate form and without undue delay. In the third place, the skills necessary to manipulate and interpret such data are not available at the appropriate levels of management. There is still some doubt about precisely what levels are in fact appropriate in the reorganized NHS. In a single district area, or in an area containing just two districts, the area might be the lowest level requiring this kind of expertise, but in areas containing three or more districts, help is probably required by the district also.

Effective planning is possible only if the circumstances under which future decisions will be made can be forecast with reasonable accuracy. This is most certainly not the case for long-term planning of health services in this country (or indeed, anywhere). Over a time period of ten years, estimates of the size and structure of populations may be in considerable error, whilst the pace of development of medical care and of the consequent demands upon resources may change in a fundamental way. Furthermore, systems such as the NHS are subject to all the vagaries of the economic climate. On the other hand, the provision of key resources in health care is subject to very substantial lead times. This paradox can only be resolved if the

preparation of plans incorporates a wide range of assumptions about the future position, and is an activity which is kept under continuous review as new and more recent information becomes available. Large and complex capital investments should be avoided and emphasis should be given to developments which are capable of modification in the future if the need arises.

The question of local access to local data is very important. At the present time, many statistical returns are prepared at the local level and are then transmitted to the higher tiers of management for data processing and analysis. With some notable exceptions this process is characterized by inordinate delays, which affect data processed nationally, such as census returns and vital statistics, as well as data produced on a regional basis. In some cases there is little appreciation of the fact that such information might be of great value at various levels of management within the NHS. For example, the Psychiatric In-patient Enquiry is capable of producing information about lengths of stay, lengths of spells outside hospital, and readmission rates in different sections of the population, which could provide a reliable basis for monitoring the performance of the mental illness services. A quick solution to these problems is unlikely. Effective management in this key area is required and in view of the difficulties which have affected many computing activities within the public sector in this country over many years, it is possible that commercial data-processing services offer the only viable solution. Ideally, data collected locally should be processed rapidly in computer-readable form and made available for local analysis. As far as the author is concerned, the use of academic computing facilities to process data immediately after collection is proving to be very cost-effective, but this type of solution can only be applied on a very limited scale.

Experience with HAA and other NHS data systems has shown that the production of standard and stereotyped analyses for distribution on a general basis is likely to be a sterile and unproductive exercise. It is essential that the local managers should pose their own particular questions and that they should be able to call upon the necessary expert support from within their own resources. An expert in information processing should work closely with every district management team, and should have direct access to all relevant local data. Staff with the required skills are available, but are in great demand throughout the economy and are unlikely to enter the health

services in sufficient numbers unless an adequate career structure is apparent. At the present time this is far from the case and there is little evidence that central government regards this form of manpower planning as a serious problem.

Finally, the current crisis within the NHS may well provide a unique opportunity for bringing services more closely into line with the current needs of the population. The recent history of the NHS has not been characterized by a rapid response to changing circumstances; maternity services have continued to be provided at a level which takes little account of the prolonged and substantial fall in birth-rates; facilities for the care of patients suffering from chest diseases have continued to be made available on a scale which takes little account of the massive fall in the demand for care; services have continued to be maintained in the centres of the large cities, although there has been a general movement of the population to distant suburbs. The imperative need to balance the books at a time of acute shortage of finance is enabling (if not forcing) changes to take place which, however desirable on rational grounds, would have been unthinkable even in the recent past. This opportunity offers a unique challenge to the planner to put the health care system into a position in which the greatest benefits can be derived from any new resources which may be made available in the future.

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An information service for planning and managing a National Health Service district

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An information service for planning and managing a National Health Service district

Introduction

Management information has been a subject of interest in the NHS for some years. Since the reorganization in 1974 its provision and use has changed from an enthusiasm to a necessity with the introduction of the planning cycle and greater emphasis on efficient management resulting from the worsening national economic situation. At the operational level planning involves teams of doctors, nurses, and other professional staff actively engaged in patient care. The size of operational units has increased by the amalgamation of former health authorities into districts. These planning teams and the managers of the health care and support services require the assistance of information and planning staff for the effective performance of their new responsibilities. Beyond assigning specific planning responsibilities to chief officers and through them to their staffs there is little detailed guidance on how to organize for this activity and much has been left to local decision.

This article describes the arrangements introduced in the Exeter Health Care District to provide a planning support service and gives an account of some work it has done. The intention is to show how a multidisciplinary approach is being developed. The authors, all administrators, recognize that they may have emphasized the administrative role in a process which depends on the contribution of several professions. It is hoped that the three examples of joint action described later in the article will correct any such impression.

Designing a district information service

Exeter Health Care District covers the eastern quarter of Devon, spreading some 60 miles from east to west and 30 miles north to south: Exeter, situated in the middle, is the natural centre of communications. Rather more than a third of the district population of 280,000 live in Exeter, a similar proportion to the east of the City, and the remainder to the west. It is a population in which the elderly comprise 20 per cent (the national average is 13 per cent) and it is expected that their number and proportion will increase at least until the end of the century. Traditionally, Exeter has provided hospital care for Devon beyond the present district boundaries, and in 1975 13 per cent of the in-patient treatments in the general hospitals were for residents of the two neighbouring districts, Torbay and North Devon. In addition, Exeter provides care for the mentally ill for its own population and the Torbay and North Devon districts and a service for the mentally handicapped covering the whole of Devon area and part of the neighbouring areas, Somerset and Cornwall. The large number of hospitals (more than 30 housing 4,000 beds), a budget of £25 million (1976/7) and 7,000 staff on the payroll, are a measure of this concentration of service in one locality. The district, formed in 1974, is an amalgamation of services formerly managed by five independent authorities whose management policies and styles differed considerably.

Major tasks presented by the district include: shaping services in response to the health care needs of the population; the amalgamation and streamlining of the services of the former separate management organizations; and managing the dispersal of the centralized mental illness and mental handicap services to the districts they serve. For all these tasks the District Management Team (DMT) recognized that management information would be a top priority and it was decided to identify from each of the main disciplines staff with special responsibilities for the planning and information function. It was also agreed that these staff drawn from community medicine, nursing, finance, and administration would collaborate and assist each other and as far as possible be freed of any routine responsibilities. This stems from a view that day-to-day problems of operational services inevitably erode the time available for planning. The team of staff (known as the Information Group) would support the

many planning teams at work in the district collecting and presenting information as requested.

Gradually, the Information Group has assembled: the district community physician (DCP) has freed himself from the routine management of community services to concentrate on planning; the district nursing officer (DNO) has allocated a senior nursing officer and the district finance officer (DFO) and district administrator (DA) have allotted staff to the information function. The advantages of collaboration are shown in the work already done. The Information Group has a wide variety of knowledge and experience and together form a considerable resource able to tackle large and complex tasks. During 1977 the district organization will for the first time be brought together in one building which will be beneficial to the development of the Information Group.

The administrative contribution to the Information Group

The DA has a staff of seven administrators (excluding clerks and secretaries) working at the district office and they are in two divisions each headed by an administrator next in line to the DA. One division deals with all operational matters and the other is concerned solely with information and planning (IPD). Of the four staff currently employed in this division three had no previous specialist experience in the work and the fourth is a statistician and has a postgraduate degree in health service information. Together they run what is known as the Information Room which houses a library of published reports and the main data files. It is a centre of information available to all staff in the district and the Community Health Council. Although the IPD is not subject to the day-to-day problems and distractions of operational management its work is geared to district priorities and timetables. The formation of the IPD is an indication of the importance attached to the function since before 1974 there were no administrative staff engaged whole-time in this activity. Among the five former authorities comprising the district there were 58 administrative posts, amalgamation enabled this number to be reduced by 5 and the IPD was formed from within this smaller establishment. The savings arose largely by the reduction of separate headquarters offices and not at the expense of administrative staff working at unit level.

The role of the Information and Planning Division

The primary object of the IPD is to assist the DCP in the preparation of plans for the health care services. DCPs depend considerably on administrative support and the method adopted in Exeter ensures not only that there is a reasonable number of administrators appropriately graded but that they have a clear priority for this aspect of work. The IPD also undertakes tasks of a management services nature which are commissioned by the DMT, departmental heads, and others.

In addition to these priorities certain rules of thumb have been established for the selection of projects to ensure that the IPD is used effectively. First, priority is given to matters directly connected with health care. Secondly, consideration is given to financial magnitude, for example, preference would be given to a study where 10 per cent of the district budget is involved over one affecting 1 per cent. Thirdly, greater attention is given to projects designed to make better use of existing resources than those calling for an increase in the district budget.

A review of the work carried out by the IPD indicates three broad areas of activity. First, assisting the DCP in the review of health care services which in addition to the compilation of annual plans has involved the preparation of special reports on a number of services: the elderly, maternity, mental handicap, and rehabilitation. Secondly, there is work connected with the use of resources: examining the implications of new developments such as the appointment of consultant medical staff and assessing cases for the allocation of extra resources, for example, requests for increased hospital bed allocations. It has been possible to rationalize the institutional provision in the district and several studies have involved concentrating work in fewer hospitals and clinics. The third area is data preparation principally in the field of patient activity and manpower: improving methods of collection and reliability of statistical returns, preparing analysis as requested, and developing the information available. One example in this last category concerns in-patient and out-patient statistics known as the SH3 returns: this has been computerized and easily comprehended printouts show changes over a period of five years and make comparisons between local statistics and regional and national averages for every clinical specialty. This presentation has been adopted in other parts of the country.

The information routinely produced in the NHS is often dismissed as being too approximate and inaccurate for use in planning but critics seldom suggest alternatives. There is an enormous investment in the preparation of the standard returns and experience indicates in Exeter, as elsewhere, that quality can be improved and use made of the data already available. The high cost and time involved in establishing new information bases is beyond the means of an individual district and has not proved to be necessary. There have been occasional discoveries that much-needed information has been regularly compiled but not known about and also that quite simple techniques suffice to give the knowledge sought. One example of this occurred in 1975 when the four districts of the Devon Area Health Authority were considerably over-spent. Monitoring of staff expenditure was vastly improved by simply counting the names on the payroll giving an adequate guide to changes in the salaries bill well in advance of the expenditure statements. It was also discovered that overtime costs thought not to be available were regularly produced as part of the regional computer salaries and wages service. Elementary discoveries such as this suggest that more can be done with the vast range of data already available in the NHS.

The Division is linked with the Department of Mathematical Statistics and Operational Research at Exeter University with which it is participating in a research project funded by the Nuffield Provincial Hospitals Trust evaluating information services at district and regional levels. There is also close contact with the Institute of Biometry and Community Medicine, and the experimental computer project linking primary and secondary health records, both of which are in Exeter; and the South Western Region's computer bureau. This all helps the district to be alert to the information available and the uses to be made of it.

Having described the structure and operational policies of the information services in Exeter, in the following sections there are accounts of some projects which have been undertaken.

Hawkmoor Hospital: a case-study

Hawkmoor is a former TB sanatorium situated 18 miles from Exeter on the eastern edge of Dartmoor and for many years it has been the centre for thoracic surgery and chest medicine for Exeter, Torbay, and North Devon districts. In common with similar hospitals its

isolation, once a major attribute, had become a disadvantage to the thoracic surgeons and chest physicians who increasingly required the services of a district general hospital for the care of their patients. This had long been recognized and many plans had been prepared to transfer the services into Exeter but without success. It had been hoped to include facilities in the new branch of the district general hospital to be completed in 1974 but the additional expense could not be met. The clinicians at Hawkmoor had found it possible to meet the demands on them with decreasing numbers of beds and in May 1974 they were jointly allocated 124 of the hospital's 234-bed complement. In 1972 the former South Western Regional Hospital Board transferred mentally handicapped patients to 70 of the unused beds at Hawkmoor with the object of reducing overcrowding in the local mental handicap hospitals. More beds were required for this purpose and they were available at Hawkmoor but no action had been taken because it would so radically alter the balance of the hospital, from acute to long-stay. The task was to resolve these linked problems with the constraint that additional capital investment at the district general hospital was not possible.

ANALYSIS OF CLINICAL ACTIVITY

A working party of medical and nursing staff was set up and the IPD assisted them. Their first step was to assess the facilities which could be made available within the district general hospital (which comprises six units in Exeter including the new branch) and to estimate the level of resources required to provide a thoracic surgery and chest medicine service comparable to that at Hawkmoor. The neighbouring districts were also consulted to see whether they could make resources available and the Torbay District was able to accommodate its own chest medicine service thereby reducing the demand on Exeter. A review of bed use within the Exeter District General Hospital showed those specialties with bed allocations which were greater than the number required to maintain current levels of service. Three 20-bedded children's wards, the standard provision for the district, were included in the new branch and the paediatricians were willing to consider releasing one ward for thoracic surgery. This was on the condition that an adequate children's service could be maintained from the remaining 40 beds. The analysis in Fig. 1 helped to establish that this would be possible, similar studies were carried out for general chest medicine, theatre time, and

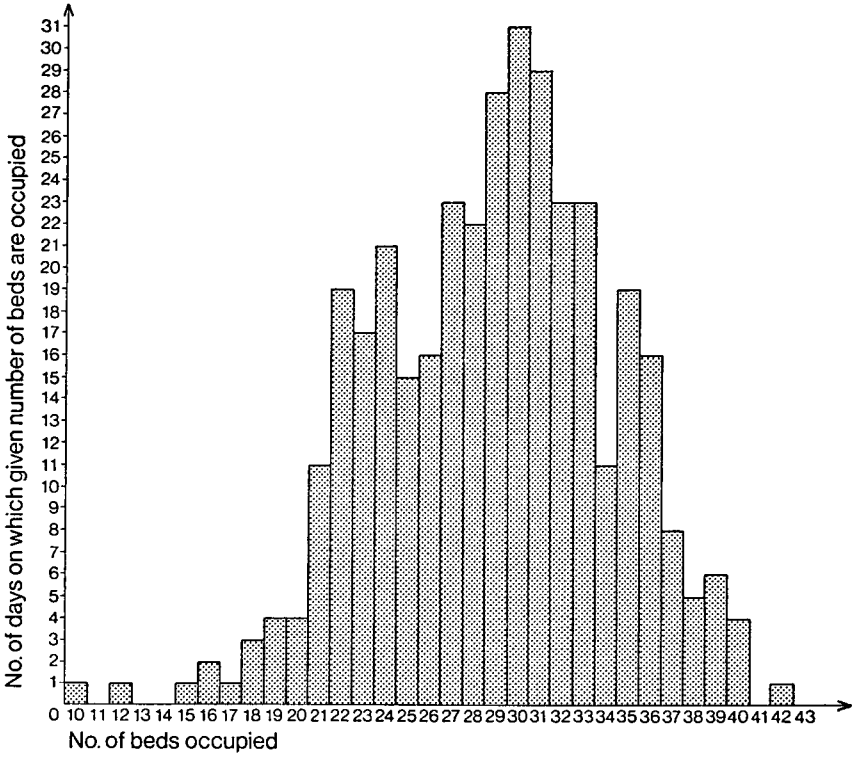

Figure 1. Number of days a given number of beds were occupied by children.

Mean = 28·9 occupied beds.

Includes: Paediatrics, general medicine, general surgery, traumatic surgery.

Excludes: Orthopaedics, ENT, ophthalmology (for which there is separate provision).

out-patient department accommodation; these revealed that it would be possible to accommodate the general chest medicine services.

Table 1 is a summary for five years of thoracic surgery at Hawkmoor. It is compiled from the SH3 hospital return and compares the derived statistics, length of stay, etc., with regional and national averages. Clearly the style of care provided at Hawkmoor could not be transferred to Exeter into the reduced resources available and clinicians wished to see the range of possibilities open to them and whether an adequate service could be provided. Table 2 is an extract from a table which alters variables such as length of stay, turnover

Table 1. *The use of thoracic surgery beds in the Exeter Health Care District compared with the South West Regional Health Authority and England (excluding teaching hospitals).*

	Year				
	1969	*1970*	*1971*	*1972*	*1973*
Discharges and deaths	431	350	371	338	376
Average available beds	46·0	46·0	46·0	46·0	46·0
Average occupied beds	26·1	21·8	23·2	20·7	20·2
Occupancy percentage					
District	56·7	47·4	50·4	45·0	43·9
Region	62·3	61·8	62·5	61·4	60·6
National	69·5	66·1	63·9	64·4	64·9
Average length of stay					
District	22·1	22·7	22·8	22·4	19·6
Region	13·3	12·5	12·2	14·2	13·7
National	16·1	14·7	14·3	14·5	14·1
Turnover per annum					
District	9·4	7·6	8·1	7·3	8·2
Region	17·1	18·1	18·7	15·8	16·2
National	15·7	16·4	16·3	16·3	16·8
Turnover interval					
District	16·9	25·2	22·4	27·3	25·0
Region	8·1	7·7	7·3	8·9	8·9
National	7·1	7·5	8·1	8·0	7·6
Waiting-list	38	25	32	31	31

Source. SH3 hospital return.

Table 2. *Abstract of analysis of bed requirements for thoracic surgery.*

Discharges and deaths	380	380	380	380	380	380	380	380
Average length of stay	23	20	17	16	15	14	13	12
Turnover interval	4	4	4	4	4	4	4	4
Beds required	28·1	25·0	21·9	20·8	19·8	18·7	17·7	16·7
Discharges and deaths	340	340	340	340	340	340	340	340
Average length of stay	23	20	17	16	15	14	13	12
Turnover interval	4	4	4	4	4	4	4	4
Beds required	25·2	22·4	19·6	18·6	17·7	16·8	15·8	14·9

The number of beds required is calculated using the formula:

$$a = b \times (c + d) \div 365$$

where

a is the number of beds required;
b is the annual number of discharges and deaths;
c is the average length of stay;
d is the turnover interval.

interval indicating the effect this has on the work which can be undertaken. It assisted the clinicians in their deliberations by illustrating that 340–80 patients each year could be treated in a ward of 20 beds.

Following the transfer of the chest services from Hawkmoor 60 of the vacated beds were made available for the mentally handicapped. The benefit was twofold: it offered ground-floor accommodation to aging and disabled patients; in turn their places were filled by young adults who had grown up and remained in two children's mental handicap hospitals because there was no other place for them. The IPD was able to help doctors and nurses in this specialty monitor the complex moves and measure the contribution to improved space provisions for patients in the mental handicap hospitals.

THE FINANCIAL TRANSACTION

There were two stages in the reckoning. The first was the net effect on running costs of the transfer of chest services from Hawkmoor. Some contribution had to be made to the Torbay District for the element of chest medicine service being transferred and Hospital Activity Analysis provided useful data about the number of Torbay residents treated as in-patients.

Within the Exeter Health Care District three calculations were necessary; the current cost of providing chest services at Hawkmoor; the new costs of their provision in Exeter; and the funding levels already allocated to the ward, theatre, and out-patient departments in Exeter. Table 3 is a summary but indicates in part 1 that the net effect was a saving of £124,000 per year (1974 prices). The second stage was the cost of transferring the mental handicap service to Hawkmoor, an improvement in the quality increasing the expense of providing the service, and part 2 of Table 3 shows by how much the additional costs of opening two new wards exceeded the savings arising from reducing the numbers of patients in the existing wards. The Devon Area Health Authority could well have decided to stop at the first stage and produce a saving, in the event they accepted the DMT recommendation though it involved an additional allocation of £93,000, albeit a smaller sum than the £124,000 contribution made available by the chest service transaction. The financial result was a saving in excess of 1 per cent of the acute general hospital services budget which was transferred to the mental handicap budget.

Table 3. *Cost statement of moves (summary).*

MOVES	COSTS (£1,000s) *Old location*	*New location*	Net effect *Saving*	*Additional cost*
1. Thoracic surgery, general chest medicine—centralization Hawkmoor ——→ Exeter:				
Thoracic surgery, general chest medicine	221	97	124	—
2. Mental handicap—decrowding Mental handicap ——→ Hawkmoor:				
Sixty patients to Hawkmoor	12	229	—	217
Net additional cost of transferring mental handicap patients to Hawkmoor 1 minus 2				93

The management information prepared jointly by the finance and administrative staffs was essential to the successful realization of this complex redeployment.

REDUCING EXPENDITURE

During the Hawkmoor exercise the DMT was aware that while it had detailed financial knowledge of one part of its budget little was known about the general patterns of expenditure because the control systems of the new area health authority had not been installed. In 1975 it became apparent that the area budget was considerably overspent and emergency action was necessary to bring it back into control. Each of the four DMTs was required to contribute to a reduction of staff totalling 250 and to prepare plans for a reduction of revenue commitment. Exeter's target was £220,000. Reference has already been made to the monitoring arrangements introduced to inform management about the number of staff on the payroll and the expenditure on overtime, both of which were invaluable to the DMT's appreciation of the results of the measures it was introducing. It was decided that the revenue saving proposals should arise from improvements in efficiency and not from the reduction of services to patients. The ability to evaluate proposals was gained only by having staff free from everyday responsibilities to attend to this. The revenue saving proposals made by the DMT achieved the sum required within their self-imposed constraint: one of the schemes

involved the closure of a hospital and the reprovision of its services in a neighbouring unit; others concentrated catering preparation in fewer kitchens. Since that time of crisis the DFO and his staff have introduced a complete system of expenditure control which for Exeter involves some 300 separate budgets.

A LONG-TERM COMPREHENSIVE HOSPITAL PLAN

Hawkmoor had released resources and enabled them to be used for another purpose but no account had been taken of other competing claims and their relative priority or whether redeployment was in the best long-term interests of Devon's health services. This problem was arising in another way as each health care planning team prepared plans for the future. There was no way of evaluating their compatibility with each other and their consistency with a strategic plan, for there was none. Preparation of long-term plans was the next logical step and it was decided to look first at hospital services, not least because they absorb 90 per cent of Exeter's health services budget. It also coincided with the request from the DHSS to give consideration to this (DS 85/75: *Review of Health Services and Resources Planning Tasks for 1976/77*). The job was given to a working party chaired by the DCP and comprising consultants, general practitioners, the DNO, and DA. The IPD was fully engaged for some months gathering information for this study. As a consequence the working party's report makes available a deeper analysis than the simple multiplication of bed norms by population size. It sets out estimates of the changing size, age structure, and geographic distribution of the population. DHSS policy on the complementary roles of district general and community hospitals is described and comparisons made between this and the current work of the hospitals in the district.

Estimates are made of the size of provision by DHSS bed norms and examined in the light of current provision and the use made of hospitals. The impact of the elderly, holidaymakers, and the recently completed M5 motorway are also assessed. The report examines the services to the rest of Devon and the provision which should be made for this and the policy decisions on which it is dependent. It lists all the problems concerning hospitals about which the working party was aware. The document is a basis for a development plan covering the function, distribution, and size of the district's hospitals until the year 2000 and has been used in discussion with local authorities and

the Community Health Council. Arising from these consultations the DMT will prepare a policy for hospital service development which will provide the context in which all proposals for change to any part of the district services can be assessed. Following the completion of this project a similar review of the primary care services has been inaugurated.

Conclusion

These three examples and many others have convinced the Exeter DMT of the good sense of having its own management information staff. The policy has been to regard information as a separate function best unrelated to routine operational duties, identifying from each of the main district departments staff engaged in this activity and encouraging close working relationships in what is called the Information Group. This concept of a multidisciplinary approach to planning support is not fully developed and the occupation of a common office building in 1977 will assist its realization.

The administrative component of the Information Group, the Information and Planning Division, has been formed primarily to support the DCP in his health care planning role, and it affords him the assistance of senior administrative staff. Administrators are wary of specialist activities which so often in the past have proved to be culs-de-sac to promotion prospects. This problem has been avoided by providing the IPD with a management services role and maintaining its link with the main administrative staff. The arrangement meets the service needs of the DCP and also the career requirements of the members of the IPD.

The IPD has employed generalists and specialists, notably a statistician, and experience indicates that both have a contribution to make, the generalist providing working knowledge of the organization which assists the sensible application of the specialists' skills. Whereas a spell of work in information and planning will enhance the career of the general administrator, recruitment of specialists and their career prospects are not so straightforward; it may be that they should move between planning organizations in industry, local government, and similar organizations rather than expect a total career in the NHS. Specialist planners can be usefully employed at the operational level and ways must be found which make it attractive for their involvement.

Critics may question the justification of a large planning staff in one district and in reply three arguments can be advanced. First, the results of the work described above speak for themselves. Secondly, a district the size of Exeter is an organization of sufficient magnitude to warrant its own management information staff. Finally, a comparison with other districts indicates no great difference in the proportion of the budget spent on management staff. The investment in management information arises from a decision to concentrate on this function and allocate resources to it.

Priorities for prevention

A discussion paper

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Priorities for prevention

A discussion paper

Aim and scope of the paper. The foremost aim of this paper is to try to formulate a priority-based strategy of preventive medicine for the community.

A recent consultative document (1) has urged that both the medical profession and the general public think more positively about preventive medicine and its possibilities. Since no specific policy suggestions were forthcoming from that document, there is a need for the debate to move in a more practical direction.

The paper consists of five main sections. The first, by way of introduction, describes the historical background to the recent revival of interest in medical priority-setting, and discusses some theoretical approaches to decision-making. The second outlines the history, nature, objectives, and limitations of preventive medicine, with the emphasis placed heavily on principles rather than detail. The third attempts to make an objective assessment of the current state of the public health. Fourthly, in firmly grasping the nettle, a proposed list of priorities for prevention is incorporated into the discussion relating to the practical application of preventive solutions to our modern health problems. Finally, an attempt is made to place prevention in an organizational setting.

Two major limitations have been imposed, primarily for reasons of space. The first is geographical. The developing world has a very different pattern of mortality and morbidity from that of the West and the conclusions drawn in this paper are inevitably bound by the nature of the data, which are British. Nevertheless, the principles of prevention apply equally throughout the world. Secondly, no attempt has been made to explore in depth the important issue of cost-effectiveness to which the specialist skills of interested economists might be usefully directed in the future.

Introduction

WHY 'PRIORITIES'?

Many observers have commented that the birth of the National Health Service in 1948 marked the beginnings of a new era of British social policy. As a monument to the final demise of *laissez-faire* in health matters, it symbolized a renewed awareness of collective public responsibility towards the needs of the sick, the disabled, and the dependent; and as a piece of social legislation it represented the first major expression of a social philosophy whose origins could be traced back to Plato. For many, the NHS was something more than a gigantic bureaucratic venture into the uncharted realms of nationalized health care. The people of Britain were being offered the prospect of a healthy future where disease would be routed and suffering abolished, all at the Treasury's expense.

Today, a cloud of despondency (some would say realism) has descended on our health policy makers as rising public expectations of health care, coupled with remorselessly escalating costs of buildings, equipment, and manpower have conspired to erode morale and provoke widespread discontent. Most depressing of all, the outcome of this accelerating activity and spending appears to have been negligible, if our health statistics are to be relied upon. The improvement of some indices, including infant, perinatal, and maternal mortality rates, has been accompanied by a disappointing deterioration in others, including mortality from coronary artery disease and lung cancer.

The overt optimism of the Beveridge Report has since given way to a more searchingly critical response to any newly aired proposal concerned with health improvement. Economic adversity has bred a ruthless scepticism of new and potentially costly ideas. Modern health planning has reformulated objectives along more materialistic lines than those of its predecessor. Huge efforts are now ploughed into the overriding and thankless task of minimizing expenditure, excising superfluities, and above all, selecting 'priorities'. This is the background against which the persuasive claims of preventive medicine must be judged.

PRIORITY-SETTING AND THE DECISION-MAKING PROCESS

The selection of priorities depends on a behavioural process of daunting complexity, and has held the attention of social scientists for a number of years.

The term 'priority' requires clarification. It implies both a ranking and the right to preferential treatment of some kind, but it does not indicate either the basis on which the ranking is made or the nature of the preferential treatment (2). The basis on which a rank order is determined depends on criteria which may be related to either 'importance' or 'timeliness'. The former is often believed to take precedence over the latter, yet in reality, expediency often dictates that relatively unimportant activity is undertaken first. Ideally, criteria of both 'importance' and 'timeliness' should contribute to the selection of priorities (see below: 'Applying preventive solutions'). The nature of the preferential treatment that will be given once ranking has been determined may influence the approach to priority-setting. For example, it may involve resource allocation, the reorganization of services, or research activity. In the context of this paper, the priorities will be determined for the purpose of formulating a policy of preventive medicine.

The above account may suggest that priority-setting is essentially a logical exercise. Some decision analysts, indeed, have proposed mathematical models whereby many forms of medical decision-making may be represented or even predicted; by contrast, others have stressed the importance of ethics in decision-making (3).

Aharoni (4) has suggested a basic framework for analysing the various determinants of group decision-making. Although his observations were drawn from the world of business, they seem remarkably apposite to the workings of the health service.

He identified four interrelated categories of influences on the outcome of any decision-making process, namely:

1. The structure of the organization within which decisions are taken.
2. The participants.
3. The interactions between the participants.
4. The available information.

The **structure** of the organization may either facilitate or hinder effective decision-making, and may even dictate the nature and quality of the decision. Individuals within an organization probably

share at least some of its goals and regard the organization as a means of achieving these goals. The potential of this collective commitment will only be realized if the structure of the organization permits its expression.

The **participants**, while sharing certain goals, will diverge on others. Each individual will bring his own attitudes, values, and role perceptions to the group, and these will influence his commitment to future action. Inevitably, self-interest will play its part, to a greater or lesser extent, in the motivation of each participant.

A dynamic **interaction** between individuals within a group will commence on (or before) the first meeting. This may produce striking changes in attitudes as a result of exposure to other individuals holding differing views, or it may lead to the adoption of defensive, rigid postures. A mutual bargaining may give way to compromise or conflict, either of which may ultimately encourage or undermine the possibility of reaching a satisfactory decision.

Finally, all organizations require **information**. Data gathering, however, is usually costly in terms of both finance and effort, and the desired information may not be available. The consequent uncertainty may erode confidence, or it may be used as a smoke-screen for a lack of commitment to action. Conversely, where information is abundant, only those data conforming to previously held beliefs may be consciously or unconsciously selected.

All of these influences are worth bearing in mind when health service decisions are considered. The remainder of this paper will address itself primarily to the use and interpretation of **information** in the determination of priorities.

The concept of preventive medicine

ORIGINS

The hallowed writings (generically attributed to Hippocrates) of the Alexandrian medical sages contain the earliest formal statement of the preventive philosophy, although the ancient Chinese expected their physicians to keep them healthy as well as to cure their ailments. The Romans prided themselves in their sophisticated feats of sanitary engineering and were conscientious observers of high standards of personal hygiene. The collapse of the Roman Empire led to a return to relatively primitive living conditions in Europe, and it was not until the Rennaissance that interest in public health measures was

revived on a large scale. Ecclesiastical registration of births and deaths in sixteenth-century England marked the beginnings of systematic record-keeping, and in 1662 John Graunt published *Natural and Political Observations mentioned in a Following Index and made upon the Bills of Mortality,* which is recognized as a milestone in the history of data analysis.

The eighteenth century witnessed several important developments in the history of preventive medicine. The spread of plague and smallpox added impetus to the public health movement and Frank's system of police medicine in Germany attracted attention throughout Europe. In 1747, James Lind demonstrated the antiscorbutic effects of citrus fruits, thereby winning many friends, and therefore influence, in the British naval establishment. And Jenner's courageous experiments on the protective effects of vaccination against smallpox in 1796 elevated the status of preventive medicine still further.

The rise of the urban population in the early nineteenth century which accompanied the Industrial Revolution created a public health problem of unprecedented dimensions. Chadwick's vivid account of urban squalor in his report *The Sanitary Condition of the Working Population of Great Britain,* which was published in the wake of the cholera epidemics in 1832, was instrumental to the passing of the Public Health Act of 1848, the first major legislative expression of public concern. In Germany, two unlikely figures were in the forefront of the sanitary reform movement: Virchow, a pathologist, and Pettenhofer, a chemist. The discoveries of Koch and Pasteur added scientific weight to the political demands of the reformers.

The first medical officers of health in Britain were appointed under the terms of the Public Health Act of 1875, which remained in force until 1936. The name of Sir John Simon is inextricably linked with this period, and his colourful personality must have contributed immensely to the effective establishment of a respected system of public health in Britain. Florence Nightingale, despite her stern opposition to the germ theory of disease, was an active proponent of household and hospital hygiene in addition to her many other interests.

A series of legislative measures, from the National Insurance Act of 1911 to the establishment of the National Health Service, dominated the first half of the twentieth century. The therapeutic revolution, heralded by the discovery of chemotherapy, dealt a severe blow to the cause of prevention, and the new institutions of health care were seen primarily as a means of administering treatment. The

expensive failure of this kind of medical technology to deliver the expected health benefits has reawakened interest in preventive medicine which is now called upon to face the challenges of chronic non-communicable disease, cancer, trauma, and mental illness.

DEFINITIONS AND OBJECTIVES

Winslow's definition of public health in 1920 may be applied with equal relevance to preventive medicine, ie 'the science and art of preventing disease, prolonging life, and promoting physical and mental health and efficiency' (5).

The terms 'health' and 'disease' require amplification. Most attempts at defining them become entangled in semantic difficulties, whose resolution often emerges by expressing health and disease in the negative terms of each other. The World Health Organization bravely opted for a positive approach when it proclaimed in 1948 that health was a 'state of complete physical, mental and social well-being, not merely the absence of disease or infirmity' (6).

Winslow's definition, in the context of the WHO's statement, affirms the dual objective of 'preventing disease' and 'promoting health' as complementary, but distinct, facets of the same activity. The difference is one of emphasis, with health promotion aimed at general measures, and disease prevention directed against specific disorders. Of course, in practice, the distinction may be somewhat academic, but it is desirable that these concepts, inasmuch as they are utilized in medical literature, be clarified.

Recently, a third aspect of prevention has received advocacy—the attempt to prevent progression from illness to disablement following the onset of disease.

The objectives of preventive medicine may therefore be stated in the following succinct form:

1. The promotion of positive or optimum health.
2. The prevention of departure from health.
3. The prevention of disabling illness after the onset of disease.

THE NATURAL HISTORY OF DISEASE

The effectiveness of intervention by preventive means cannot be presumed at whatever stage of the disease process action is taken. The evaluation of a preventive measure depends on an understanding of the prognosis for the individual (or a population) if no intervention were undertaken. Nearly half a century ago, Ryle expressed a view

pertinent to this discussion that 'in the department of prognosis there has not only been no general advance, but an actual loss of competence through neglect of the study of what may be called the natural history of disease in man' (7).

The natural history of a disease may be described as a dynamic continuum from the healthy state at one end, progressing through various intermediate stages to the outcome, whether it be recovery, disability, or death. Initially, in the **prepathogenesis period**, the potential host, agent, and environmental factors interact, leading to the **pathogenesis period**, the response of the host to various stimuli and the subsequent course of the disease. Sooner or later, symptoms, physical signs, or abnormalities are detectable, and the **clinical horizon** has been reached.

Each disease has its own distinctive natural history, an understanding of which permits a realistic appraisal of preventive possibilities. For example, once carcinoma of the lung reaches the clinical horizon, no known intervention can halt the inevitable progress of the disease towards death. A knowledge of the prepathogenesis period, where cigarette smoking is the central factor, offers the prospect of an alternative approach to the control of the disease. By contrast, the appropriate treatment of pulmonary tuberculosis which has reached the clinical horizon is usually strikingly effective. The preventive problem posed by those two cases is quite different and is dependent on an appreciation of their natural histories.

An insight into the natural history of a disease offers more than the prospect of intervention at a specific phase of the disease. It may also provide opportunities for taking community-based preventive action at several points, sometimes simultaneously, in the natural history of a disease in the hope of arresting its course at whatever stage it is diagnosed. For most chronic disease, of course, both knowledge and medical technology are far too limited to permit such a multiple assault on a single disease, and tantalizing problems arise in attempting to assess the significance for prevention of aspects of the natural history, particularly when controlled intervention trials have not, for one reason or another, been carried out.

Ischaemic heart disease, for example, may well have its origins in early childhood, possibly in the first few weeks of life. Low birthweight, breast-feeding, and judicious weaning may all 'protect' against the development of coronary artery disease in adult life. Later, cigarette smoking, a high intake of saturated fat, high blood

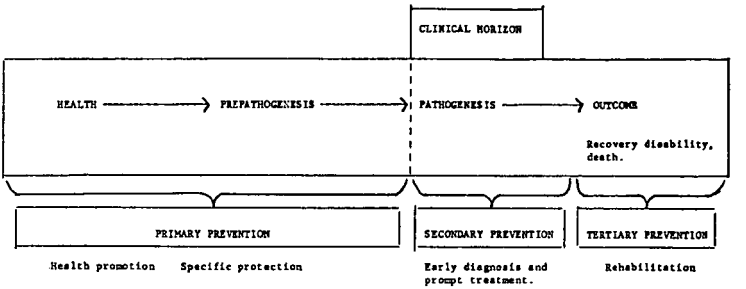

Figure 1. Preventive measures in relation to the natural history of disease.

pressure, lack of exercise, and emotional stress may place an individual 'at risk'. The appearance of symptoms, such as angina pectoris, dyspnoea, or syncope, may lead to the identification of aggravating and potentially reversible factors whose removal might halt the progress of the disease. Acute myocardial infarction itself does not necessarily represent the end of the preventive road. If the individual survives the attack, careful clinical management and adequate rehabilitation may considerably improve his quality of life. And if he succumbs, the medical services have a potentially helpful role in rendering support to bereaved relatives, both psychologically and materially.

LEVELS OF PREVENTION

The following classification, one of many, is particularly useful in that it may be easily related to the natural history of disease (Fig. 1).

PRIMARY PREVENTION relies on measures designed to promote health or to protect the individual against specific disease agents in the environment.

SECONDARY PREVENTION attempts, by early diagnosis and prompt treatment, to arrest disease processes and restore health, or to limit disability likely to ensue in an untreated case.

TERTIARY PREVENTION is concerned with rehabilitating persons in whom irreversible defects and disabilities have occurred.

Primary prevention utilizes knowledge of the prepathogenesis phase of the disease. The aim is to promote health and to ensure specific protection against noxious agents. An understanding of the interrelationship between the host, agent, and environment and the way in which they might be modified to influence the disease process, is essential. Health promotional activities include health education, nutritional programmes, and attention to the residential, occupational,

and recreational environment. Specific protective measures include the use of immunization procedures, the modification of certain personal habits, and protection from environmental hazards.

Secondary prevention attempts to advance the clinical horizon to the point where intervention can effectively alter the course of the disease. Without a knowledge of the pathogenesis, and subsequent outcome of a disease, intervention cannot be evaluated. The arguments surrounding early disease detection by screening are ethical, economic, and scientific, the last often arising out of unwarranted assumptions about the likely progress of the untreated disorder.

Tertiary prevention, in the form of rehabilitation, is undertaken in the later stages of the pathogenesis of disease. Such measures may contribute to the quality of an individual's life in terms of self-respect and usefulness to society as well as, in some cases, to the prolongation of life.

The potential range of preventive measures available is therefore very wide. Their appropriate application depends on a rational selection of priorities, which are determined, in part at least, by the prevailing pattern of illness in a community. The perception of that pattern is the problem to which the following section is addressed.

The assessment of community health

It is a truism that a community's health status should be assessed in advance of attempts to improve it. In other words, diagnosis should precede treatment.

However, the difficulties of making a community diagnosis are legion. The doctor responsible for such a task relies heavily on routinely collected data, a variety of *ad hoc* community surveys, and his own informal grapevine. His impression of the state of the public health is as accurate as his information system will allow.

Before discussing the problems of community health data collection and its interpretation, some general comments will be made on the use of the familiar, yet ill-defined, expression 'medical need', which has an important bearing on the subsequent consideration of the relevance and usefulness of routine data to the health planner.

THE MEASUREMENT OF 'NEED'

Administrators are often exasperated by the stubborn reluctance of doctors to answer coherently the question 'What are the main health

needs of the community?' 'Needs' are usually distinguished from 'demands' on the basis that the former are perceived by doctors, while the latter are said to represent a bottomless pit of lay expectations which can never be fulfilled.

These simplistic concepts arose in response to the patent inability of the health service to function within the limits of the resources allocated to it. By espousing the idea that priorities could be identified according to medical 'importance', decision-makers have sought to evade recriminations and accusations of bias.

The problem is that the definition of illness is far from absolute. The perception of 'disease' is governed as much by social and cultural as by medical influences. Similarly, the selection of 'important' or 'high-priority' health problems is as much a philosophical as a scientific exercise. Changing attitudes to alcoholism, mental illness, and sexual deviancy illustrate the shifting sands of both medical and public opinion, sometimes within the span of a single generation. The boundaries between medical and social pathology, and between normal and abnormal phenomena are seldom static.

A separate, though related, issue concerns the interpretation of data. The estimation of the relative numerical size of a problem is easier than the assessment of its importance as a public health problem since the degree of suffering or disability, not easily quantifiable, imposed on the affected individual must be taken into account. In addition, the ethical dimension of such judgements is inescapable. For example, because of the economic importance of the working population to society, are 'young' deaths worthy of more concern than 'elderly' deaths? And are deaths from congenital abnormalities as undesirable as the prospect of increased survival rates amongst severely handicapped individuals? Alternatively, can priorities be determined by estimating, as Black and Pole have attempted (8), the relative 'burden' of illness on the community and its services? Recurring questions of this nature are seldom resolved by methodological improvements in data collection and analysis.

None of these considerations will greatly ease the burden on the medical planner; however, they emphasize the professional importance of his ethical orientation and the centrality of value judgements in the assessment of health, thereby freeing him from the spurious obligation of identifying so-called 'objective' or 'true' medical 'need'.

THE AVAILABLE DATA: GENERAL CONSIDERATIONS

Routinely collected data relevant to health has been in existence since the pioneering days of William Farr, whose first report for the Registrar General was published in 1839. Since then, a highly complex and sophisticated government sponsored information system has evolved employing a large number of statisticians and civil servants who collect, analyse, and publish a vast quantity of numerical information, some with commentary. The techniques, validity, and uses of routinely collected statistics have been comprehensively reviewed by Alderson (9).

From the medical point of view, the most reliable of all the data collected are those relating to **mortality**. The occurrence of death must be registered by law, and until relatively recently, was regarded as an unambiguous and indisputable event. However, the accuracy of the recording of the cause, as opposed to the fact, of death is more vulnerable to criticism. Certification practices, diagnostic accuracy, and medical fashion are all liable to variation. Fortunately, validation studies have been undertaken and these tend to support the assumption that mortality statistics, in general terms, are fairly reliable guides to the pattern of fatal disease in the community (10).

There are problems peculiar to the measurement of **morbidity**. Community studies have demonstrated that only a proportion of all symptomatic individuals presents to doctors. Moreover, most record-keeping is such that the extraction of relevant information is fraught with difficulties. Case-notes are usually designed to serve a clinical rather than a statistical function. And, as observed earlier, there may be wide differences of opinion over the definition of illness, as opposed to abnormality or social adversity. The duration of illnesses may confuse their identification, since they may be counted at a point in time (point prevalence) or by the number present during a defined period (period prevalence). Alternatively, newly occurring illness may be counted (incidence). In an era of chronic disability and disease, one person may become ill many times within a short period, thereby inflating the count, and attempts have been made to count the number of ill persons, rather than illnesses, to circumvent this difficulty.

The main source of routinely collected morbidity data relates to the hospital service. The Hospital In-Patient Enquiry (HIPE) covers England and Wales and is based on a 10 per cent sample of hospital

deaths and discharges. Its drawbacks are numerous: it is published two years after the data are collected, events rather than people are counted, and it contains no measures of severity. The Hospital Activity Analysis (HAA), more recently instituted, suffers from fewer of the limitations of the HIPE data. It covers all hospital discharges and deaths and is available within a few months of the data collection. Separate analyses are operated for psychiatric hospitals and in Scotland. No routine general practice morbidity data are collected, but a number of surveys have been undertaken including those of Logan *et al.*, Fry, and Morrell *et al.* (11, 12, 13). The General Household Survey, based on interviews with a random sample of householders, is a useful source of information on reported illness and disability, as are the various morbidity studies undertaken periodically by research workers (for example, Davies, Bennett *et al.*, Dunnell and Cartwright, Harris [14, 15, 16, 17]).

Certain diseases and disabilities are notified to local authorities and interested research workers, and these should not be overlooked.

The strictures on the interpretation of statistics, however carefully collected and validated, apply with even greater force to morbidity than to mortality statistics. Such information can guide the planner towards decision-making but cannot substitute for it.

THE HEALTH OF THE NATION

Demography

The total population of England and Wales, based on the mid-year estimate for 1974, is 49·3 million. (Because of the separate system of data collection in Scotland and Northern Ireland, this review has largely confined itself to England and Wales.)

The sex ratio, favouring females over-all, reflects the greater male mortality over the age of 45 years.

Projections of likely population changes depend on assumptions about fertility, mortality, and migration. The first of these is the most difficult to predict. Since 1964, the annual number of live births has declined continuously for obscure reasons. Improved family planning, economic constraints, and a tendency to postpone starting families have all been suggested as possible factors. Over-all mortality rates have been gradually declining over recent years but the decline has been slowing down progressively. Migration rates are not expected to change dramatically over the next few years.

On present assumptions, the population of England and Wales

is expected to grow by 2·9 million by the year 2001. The projected growth is almost confined to the working age-groups with virtually no change in the others.

This projection seems inconsistent with assumptions about our 'ageing' population structure. However, although the predicted female population over 60 years in 2001 is 5·6 million (similar to 1974 figures), the over-75 female population is expected to increase by approximately 30 per cent, while the 60–74 female age-group is expected to decline proportionately.

To summarize, by the year 2001, mortality rates are expected to decline by approximately 25 per cent of present levels, and the total population is expected to increase by 2·9 million, with the increases confined to the working age-groups and very elderly female populations. The projections have implications for the future provision of health and social services. The demand for paediatric and maternity services will probably remain fairly static, while the burden on geriatric institutional and domiciliary services is likely to increase.

Mortality: the over-all picture

The commonest causes of death (in England only) are shown as a percentage of all male and female deaths for 1972 in Table 1. Table 2 illustrates the sex differences in the death-rates, with lung cancer notably prominent amongst men and breast cancer some way behind cancer of the digestive tract in women. The largest increases in mortality rates between 1962 and 1972 occurred for lung cancer and ischaemic heart disease in men, and for lung and breast cancer in women. The increase in pneumonia deaths apparent in both sexes,

Table 1. *The six commonest causes of death in England (1972).*

Cause	*% of total deaths*
*1. Ischaemic heart disease	25·5
2. Cancer (excluding lung)	14·8
3. Cerebrovascular disease	13·8
*4. Pneumonia	7·8
5. Bronchitis	5·0
*6. Lung cancer	5·4
7. Others	28·8
Total	101·1

* Increasing mortality rate since 1962.

Source. On the State of the Public Health (London: HMSO, 1972).

Table 2. *Six commonest causes of death in men and women (Registrar General, England and Wales, 1972).*

Cause	*Rate per 100,000*
Males	
1. Ischaemic heart disease	367
2. Cerebrovascular disease	133·5
3. Carcinoma of lung	108·1
4. Bronchitis	95·2
5. Pneumonia	84·3
6. Carcinoma of digestive tract	73·6
Females	
1. Ischaemic heart disease	254·9
2. Cerebrovascular disease	199·1
3. Pneumonia	100·5
4. Carcinoma of digestive tract	64·1
5. Carcinoma of breast	44·3
6. Bronchitis	31·8

is somewhat surprising. The explanation may lie in either the greater virulence of the infecting organism (bacterial or viral) or in changing diagnostic practice.

The over-all pattern is therefore one of death from three main causes: circulatory disease, respiratory disease, and cancer. Because of the age-structure of the population, the major causes of death in the younger age-group emerge only when age-specific death-rates are examined.

Infant mortality (age 0–1 : Table 3)

As many lives are lost in infancy, especially in the perinatal period, as in the next thirty years of life. The principal causes are prematurity, defective intra-uterine growth, the hazards of birth, congenital malformations, and respiratory disease.

The recording of sudden unexpected death in infancy ('cot death') has increased strikingly in recent years (Fig. 2). The significance of this apparent increase in incidence remains obscure. Medical awareness of the problem has probably heightened over the last few years and this may have influenced certification, or a recent change in the recording procedure may have taken place. About a quarter of cot deaths remain unexplained after necropsy, the remainder being attributable to a variety of treatable causes. An interesting feature is the very much lower cot death-rate in both Holland and Sweden, and it has been suggested that this may reflect a higher standard of social, parental, and medical competence in those countries (18).

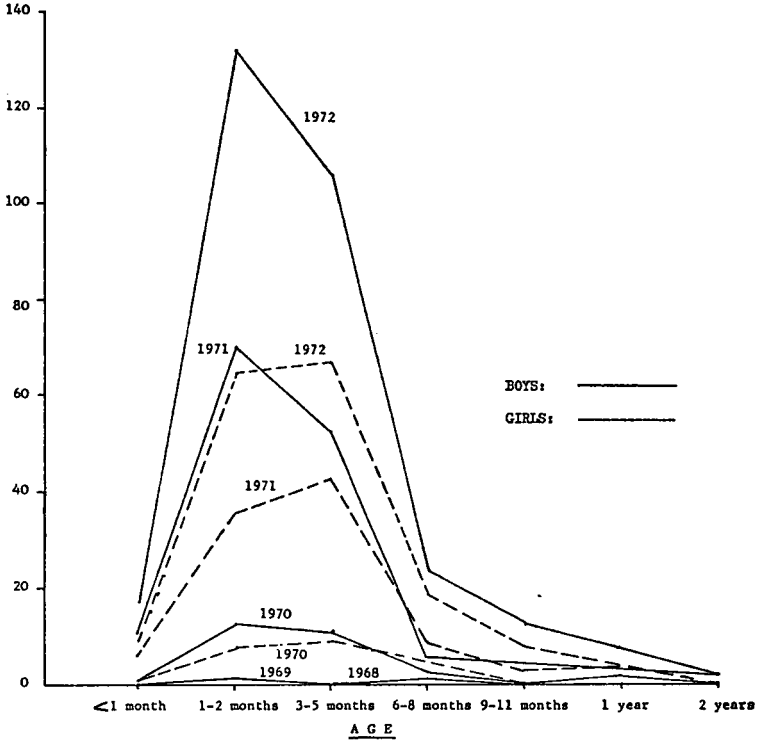

Figure 2. Number of sudden deaths, cause unknown, 1968–72.

Table 3. *Causes of death, infants under 1 year (both sexes, England and Wales, 1972).*

Cause	*No.*	*% total deaths (to one decimal place)*
Birth injury, difficult labour, anoxic and hypoxic conditions	3,337	26·7
Other causes of perinatal mortality	2,294	18·4
Congenital anomalies	2,757	22·1
Respiratory diseases	1,905	15·2
Infective and parasitic diseases	469	3·7
Sudden death, cause unknown ('cot death')	460	3·7
External causes (including accidents)	391	3·1
Deaths from other causes	885	7·1
Total deaths	12,498	100·0

Table 4. *Causes of death, ages 1–4 (England and Wales, 1972).*

Cause	Males				Females			
	No.		*% total deaths*		*No.*		*% total deaths*	
External causes: Motor vehicle accidents	114	357	9·2	28·9	72	249	6·7	23·2
External causes: Others	243		19·7		177		16·5	
Respiratory diseases	223		18·1		205		19·1	
Congenital anomalies	183		14·8		197		18·4	
Malignant diseases	143		11·6		121		11·3	
Infective and parasitic diseases	119		9·6		93		8·7	
Diseases of nervous system (including mental disorders)	101		8·2		99		9·2	
Deaths from other causes	109		8·8		109		10·2	
Total deaths	1,235		100·0		1,073		100·1	

Table 5. *Causes of death, ages 5–14 (England and Wales, 1972).*

Cause	Males				Females			
	No.		*% total deaths*		*No.*		*% total deaths*	
External causes: Motor vehicle accidents	386	693	25·1	45·1	193	278	20·4	29·4
External causes: Others	307		20·0		85		9·0	
Malignant diseases: Leukaemia	120	289	7·8	18·8	84	164	8·9	17·3
Malignant diseases: Others	169		11·0		80		8·4	
Congenital anomalies	117		7·6		121		12·8	
Respiratory diseases	125		8·1		103		10·9	
Diseases of the nervous system (including mental disorders)	111		7·2		74		7·8	
Deaths from other causes	205		13·3		206		21·8	
Total deaths	1,540		100·1		946		100·0	

Table 6. *Causes of death, ages 15–24 (England and Wales, 1972).*

Cause	Males				Females			
	No.		*% total deaths*		*No.*		*% total deaths*	
External causes: Motor vehicle accidents	1,313	2,122	40·5	65·5	363	619	25·2	43·0
External causes: Suicide	222		6·9		99		6·9	
External causes: Others	587		18·1		157		10·9	
Malignant diseases	322		9·9		206		14·3	
Respiratory diseases	187		5·8		116		8·0	
Diseases of nervous system (including mental disorders)	175		5·4		91		6·3	
Diseases of circulatory system	—		—		112		7·8	
Deaths from other causes	433		13·4		297		20·6	
Total deaths	3,239		100·0		1,441		100·0	

Mortality of early childhood (age 1–4: Table 4)
Accidents contribute about a quarter of all deaths in this age-group. More boys than girls die from this cause, and the accidents tend to occur in the home rather than on the roads. Respiratory disease, mainly infection, is the second largest numerical problem, followed by congenital anomalies, malignancy, and infection.

Mortality of later childhood (age 5–14: Table 5)
Forty-five per cent of all male deaths and nearly 30 per cent of all female deaths in this age-group are caused by accidents, the majority involving motor vehicles. There is little sex difference in the mortality rates from malignancy (mainly leukaemia) which comes second. The later effects of congenital anomalies, which comprise nearly 10 per cent of the deaths, account for a larger proportion (though not number) of female than male deaths. Respiratory diseases cause 8 per cent of male and nearly 11 per cent of female deaths in this age-group.

Mortality of young adulthood (age 15–24: Table 6)
'External causes' (including suicides and other injuries, but predominantly motor vehicle accidents) are responsible for 65 per cent of male and 43 per cent of female deaths in this age-group. Malignant disease, accounting for almost 10 per cent of male and more than 14 per cent of female deaths, comes second, followed by respiratory, nervous (including psychiatric) disorders, and circulatory disease.

Trauma is thus the major killer of children, adolescents, and young adults, particularly males. The declining use of the motor car following upon the successive increases in the price of petroleum might be expected to reduce the toll of deaths on the roads. However, when road deaths are compared in terms of mode of travel, motorcyclists contribute most to the mortality figures calculated as persons killed per 100 million passenger miles (Table 7). Thus, if for economic reasons motorcycles and mopeds become more popular, the number of road deaths might increase.

Table 7. *Comparative death-rates by mode of travel* (*Great Britain*) (Social Trends no. 3, 1972).

	Air *(1962–71)*	Rail *(1962–71)*	Bus/coach *(1962–71)*	Car *(1971)*	Motor-cycle* *(1971)*
Persons killed per 100 million passenger miles	1·5	0·06	0·2	1·5	27·8

* Includes mopeds and scooters.

Table 8. *Causes of death, ages 25–44 (England and Wales, 1972).*

Cause		Males				Females			
		No.		*% total deaths*		*No.*		*% total deaths*	
Malignant diseases		1,941		20·2		2,401		38·0	
Circulatory diseases	Ischaemic heart disease	2,107	3,154	21·9	32·8	327	1,325	5·2	21·0
	Others	1,047		10·9		998		15·8	
External causes	Motor vehicle accidents	1,026	2,612	10·7	27·2	–	929	–	14·7
	Suicide	642		6·7		347		5·5	
	Others	944		9·8		582		9·2	
Respiratory diseases		617		6·4		463		7·3	
Other causes		1,290		13·4		1,198		19·0	
Total deaths		9,614		100·0		6,316		100·0	

Table 9. *Causes of death, ages 45–64 (England and Wales, 1972).*

Cause	Males				Females			
	No.		*% total deaths*		*No.*		*% total deaths*	
Diseases of circulatory system:								
Ischaemic heart disease	28,598	39,557	36·6	50·6	7.673	16,358	17·0	36·3
Other heart diseases	2,530		3·2		2,473		5·5	
Cerebrovascular diseases	5,379		6·9		4,459		9·9	
Others	3,050		3·9		1,753		3·9	
Malignant diseases:								
Trachea, bronchus, and lung	10,146	21,929	13·0	28·1	2,509	17,989	5·6	40·0
Breast	–		–		4,729		10·5	
Alimentary tract	5,433		7·0		3,605		8·0	
Others	6,350		8·1		7,146		15·9	
Respiratory diseases (including bronchitis)	7,923		10·2		3,812		8·5	
Other causes	8,630		11·1		6,857		15·2	
Total deaths	78,039		100·0		45,016		100·0	

Mortality of adulthood (age 25–44: Table 8)
The pattern of mortality in this age-group begins to reflect the predominance of chronic degenerative disease in the population as a whole. Circulatory disease, mainly ischaemic heart disease, claims nearly one-third of male lives, while trauma (including motor vehicle accidents and suicides) accounts for more than a quarter of male deaths, with malignancy not far behind in third place. In females, the largest group consists of malignant disease (38 per cent of female deaths in this age-group), of which breast cancer forms a third, followed by circulatory disease and trauma.

Mortality of middle age (age 45–64: Table 9)
Half of all the male deaths in this age-group are caused by circulatory disease, of which three-quarters are attributable to ischaemic heart disease. Of the malignant diseases, which form the second largest male group (28 per cent), cancers of the trachea, bronchus, and lung constitute almost half. Respiratory disease, including chronic bronchitis, contributes 10 per cent of the male deaths in middle age. The largest proportion (40 per cent) of female deaths in this age-group are caused by a variety of malignancies, including those of the breast, alimentary, and respiratory tracts. Circulatory disease, of which about half is ischaemic heart and a quarter cerebrovascular, kills almost as large a percentage (36 per cent). Respiratory disease other than bronchial carcinoma is relatively less important. Unlike their male counterparts, when middle-aged women die from respiratory diseases, causes other than chronic bronchitis are mainly responsible.

Mortality of later life (age 65 and over: Table 10)
More than half of all deaths in the later years are caused by circulatory disease, mainly ischaemic heart and cerebrovascular disease. Malignancy and respiratory disease, in almost equal proportions, come second in both sexes. No single malignancy dominates the others in either men or women, while pneumonia is the commonest respiratory cause of death in females, and chronic bronchitis just holds this position in males.

Trends in mortality rates
While mortality has declined in all age-groups since 1950, with the sex difference persisting over that period, certain conditions have increased their relative contributions to the death-rate. Among them

Table 10. *Causes of death, ages 65 and over (England and Wales, 1972).*

	Males				Females			
Cause	*No.*		*% total deaths*		*No.*		*% total deaths*	
Diseases of circulatory system								
Ischaemic heart disease	56,763		28·4		56,197		24·3	
Other heart disease	10,900	105,600	5·5	52·9	19,525	139,277	8·4	60·1
Cerebrovascular disease	25,910		13·0		45,189		19·5	
Others	12,027		6·0		18,366		7·9	
Malignant diseases								
Trachea, bronchus, and lung	15,205		7·6		–		–	
Alimentary tract	11,661	39,778	5·8	19·9	12,213	33,626	5·3	14·5
Others	12,912		6·5		21,413		9·2	
Respiratory diseases								
Pneumonia	16,664		8·4		22,804		9·9	
Bronchitis	17,428	36,829	8·7	18·5	–	31,768	–	13·8
Others	2,737		1·4		8,964		3·9	
Other causes	17,305		8·7		26,749		11·6	
Total deaths	199,512		100·0		231,420		100·0	

may be counted: 'cot deaths', motor vehicle accidents (especially in the 15–24-year age-group), lung and breast cancer, and ischaemic heart disease. The most encouraging downward trends may be perceived in the mortality from infections, strokes, respiratory disease (excluding lung cancer), neonatal and maternal causes.

Morbidity

Non-psychiatric hospitals

The commonest conditions associated with discharge or death from non-psychiatric hospitals in Great Britain are listed in Table 11. The younger age-groups have higher rates for trauma (which includes self-poisoning) than the older age-groups, who have higher rates for circulatory and respiratory disease.

Self-poisoning: a disturbing trend

Alderson has drawn attention to the dramatic rise in the admission rate for self-poisoning over the past twenty years (19). Cross-sectional analysis shows that the rates are highest for young women, but cohort analysis reveals a striking rise in each succeeding cohort with no evidence of an age-peak in early adult life. Usually, self-poisoning is a psychiatric problem which presents to the general medical wards in the first instance, and its accelerating incidence must arouse concern amongst health planners. The slight decline in the accomplished suicide rate is the only hopeful sign to emerge in recent years.

Psychiatric hospitals (Table 12)

There are even greater doubts about the diagnostic accuracy of this information than about that of the non-psychiatric patients. Certain over-all trends are apparent, however.

Depressive psychoses are the commonest causes of admission in both sexes, with schizophrenia and the psychoneuroses in second and third places respectively. The psychoneuroses are prominent in

Table 11. *Commonest cause of discharges or death in Great Britain (HIPE, 1972).*

Males	*Females*
1. Digestive disease	1. Pregnancy, childbirth, and puerperium
2. Heart and circulatory disease	2. Breast and genital tract disease
3. Respiratory disease	3. Heart and circulatory disease
4. Malignant disease	4. Digestive disease
5. Trauma	5. Respiratory disease

Table 12. *Admissions to psychiatric hospitals and units (England and Wales, 1972).*

Diagnostic group	All admissions *Rate*	%	First admissions *Rate*	%
Males, all ages				
Schizophrenia	68	21·4	12	11·1
Other conditions	61	19·2	25	23·0
Personality and behaviour disorders	37	11·8	14	12·5
Psychoneuroses	37	11·5	16	14·8
Depressive psychoses	32	10·2	4	8·0
Alcoholism	25	8·0	8	7·1
Senile and pre-senile dementia	12	3·8	7	6·1
Other psychiatric conditions	12	3·6	5	4·5
Drug dependence	5	1·6	2	1·7
Alcohol psychosis	5	1·4	1	1·3
Mental handicap	2	0·7	1	0·5
Other psychoses	22	6·8	10	9·5
Total	318	100·0	110	100·1
Females, all ages				
Other conditions	104	24·1	40	26·5
Schizophrenia	70	16·2	13	8·7
Depressive psychoses	69	15·9	16	10·5
Psychoneuroses	69	15·9	29	19·4
Personality and behaviour disorders	36	8·3	11	7·6
Other psychoses	31	7·2	15	10·4
Senile and pre-senile dementia	27	6·1	15	10·1
Other psychiatric conditions	15	3·3	7	4·4
Alcoholism	7	1·6	2	1·3
Drug dependence	2	0·5	1	0·6
Mental handicap	2	0·5	<1	0·3
Alcoholic psychosis	2	0·4	<1	0·3
Total	434	100·0	149	100·1

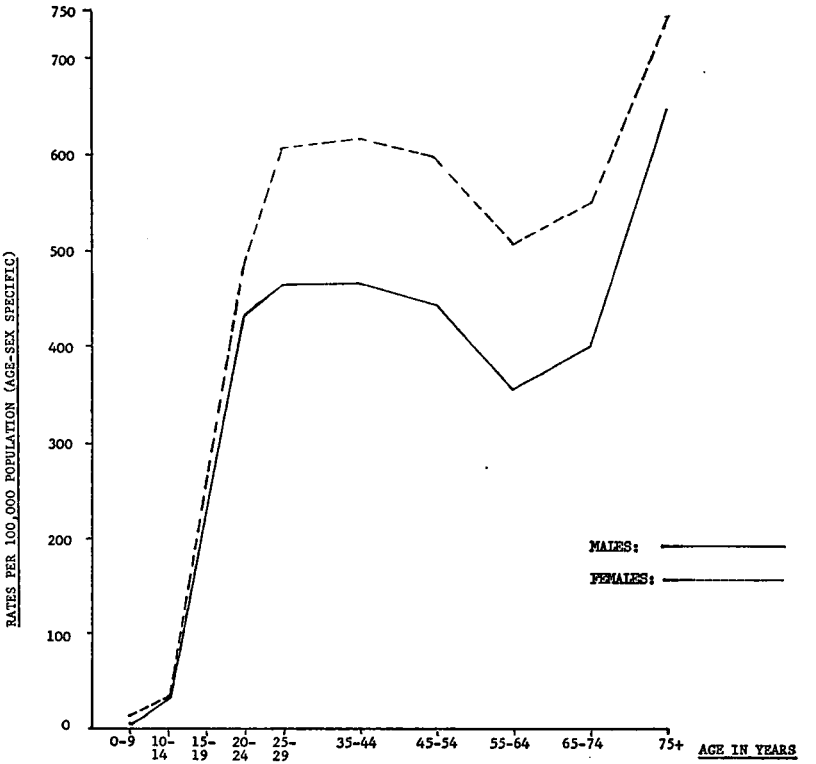

Figure 3. All admissions to mental illness hospitals and units, England and Wales, 1972.

younger people, while the organic psychoses are commoner in the elderly (particularly women). Drug addiction and alcoholism are major problems in males. Fig. 3 demonstrates the distinctive age distribution of admissions to mental hospitals with a peak in the 20–40 age-group and a rising admission rate after the age of 65 years. The numbers of patients being treated in mental hospitals will almost certainly continue to decline over the next few years as a consequence of the 'open-door' policy.

General practice morbidity

Both the National Morbidity Survey of General Practice (1970–1) and the General Household Survey (1971) identified consultations with general practitioners. A comparison of the findings is shown in Table 13.

Table 13. *Commonest general practice consultations as revealed by the General Household Survey and National Morbidity Survey*

Males	*Females*
General Household Survey	
Respiratory disease	Respiratory disease
Injuries	Circulatory disease
Circulatory disease	Locomotor disease
Digestive disease	Diseases of nervous system and special sense organs
Diseases of nervous system and special sense organs	Mental disorders
National Morbidity Survey	
Respiratory disease	Respiratory disease
Circulatory disease	Mental disease
Diseases of nervous system and special sense organs	Circulatory disease
Injuries	Genito-urinary (inc. breast disease)
Locomotor disease	Locomotor disease
Skin disease	

Table 14. *Comparison of percentage consultations in four studies of general practice.*

	Morrell, 1970	*G.R.O. Logan,* 1958	*Fry,* 1958	*Davies,* 1958
Diseases of respiratory system	25·3	23·1	30·0	29·9
Mental, psychoneurotic, and personality disorders	12·0	4·4	8·5	—
Diseases of digestive system	7·9	8·6	12·0	5·8
Diseases of nervous system (including eyes and ears)	7·3	9·5	—	—
Diseases of skin and cellular tissues	6·9	8·4	10·0	9·7
Diseases of bones and organs of movement	6·9	6·7	6·5	5·9
Diseases of circulatory system	6·7	5·3	6·0	8·0
Accidents, poisoning, and violence	5·1	8·2	—	6·3
Others	22·0	25·8	27·0	34·4

Source. Morrell *et al.* (1970). *Jl R. Coll. Gen. Practit.* **19**, 331.

Various workers have collected data from their own studies, and all confirm the preeminence of respiratory disease in the pattern of general practice consultations (Table 14).

The Royal College of General Practitioners, on the basis of figures from Fry, suggests that the commonest causes of consultations in an average general practice, in order of frequency, are: (1) upper respiratory infections, (2) emotional disorders, (3) gastro-intestinal disorders, and (4) skin disorders.

The College further suggests that of patients attending with chronic conditions the largest single group suffers from 'chronic rheumatism', with chronic mental illness in second place (20). This estimate is worth comparing with the data on chronic disability and handicap, collected by Harris (17) and Bennett *et al.* (15).

Morbidity presenting to school medical officers

Steiner undertook a study of school entry medical examinations in Newcastle-upon-Tyne in an attempt to assess their diagnostic effectiveness (21). In the course of the study 1,255 school entry medical forms were scrutinized and an estimate made of the proportion of 'clinically significant' defects found (Table 15). Apart from dental caries and infestation, which were excluded from the analysis, upper respiratory disorders were most frequently recorded. Speech and

Table 15. *Defects recorded at school entry.*

Type of disorder	*Total recorded*	*Clinically significant*	*Clinically significant* %
Nose, throat, otitis media	199	93	43
Vision and squint	129	75	58
Orthopaedic	102	50	49
Speech	58	48	83
Hearing	38	30	79
Undescended testis	35	25	71
Skin disease	70	21	30
Chest disease	42	15	36
Enuresis	46	14	30
Heart murmurs	24	12	50
Disorders of behaviour and stability	26	6	23
Fits and epilepsy	13	5	38
Others	92	35	38
Total	874	429	49

hearing disorders were thought to constitute the group with the largest number of 'clinically significant' disorders.

Prevalence of childhood disorders

Two studies will be quoted in an attempt to convey the apparent pattern of childhood morbidity. Rutter *et al.* estimated the prevalence of physical disability in 10–12-year-old children in the Isle of Wight. They found asthma to be the commonest disorder with eczema and epilepsy in second and third places respectively (22). Stark and Bassett estimated the prevalence of childhood conditions requiring continuing medical attention at the Craigshill health centre, Livingston, in a child population at risk of 3,555. Of the problems identified, two-thirds were attributed to 'psychosomatic disorders'—enuresis, asthma, and behaviour disturbance—of which enuresis formed the largest single group (23).

Chronic disability: children

The size of the problem of chronic disability or handicap in childhood is not precisely known. The Isle of Wight study revealed a surprisingly high prevalence (one child in every six) of children suffering from at least one of the following four handicaps: educational retardation, physical handicap, psychiatric disorder and intellectual retardation, in that order of frequency. Table 16 shows the relative numbers of children placed, or awaiting placement, in special classes or schools at the end of 1971. The 'educationally sub-normal' formed by far the largest group.

Table 16. *Handicapped pupils requiring and receiving education in special classes and schools in accordance with sections 9(5) and 56 of the Education Act, 1946 (year ending December 1971).**

Handicap	*Total receiving special education and awaiting places*
ESN	95,840
Maladjusted	16,030
Physically handicapped	12,872
Delicate	8,452
Partially hearing	4,981
Deaf	3,799
Partially sighted	2,439
Blind	1,235

* *Source. The Health of the School Child, 1971–72* (London: HMSO).

Chronic disability: adults (Table 17)
A nationwide survey of the handicapped and impaired in Great Britain revealed that diseases of bones and organs of movement (mainly arthritis) accounted for the largest single group (over a million) of handicapped individuals in the community. Circulatory disease, mainly strokes, and neurological disorders came second and third respectively. Multiple sclerosis was judged to be the most severely handicapping condition of younger people, although it did not form the largest numerical group (17). On the other hand, a prevalence study of functional disability in Lambeth confirmed the high prevalence of locomotor disease in women, but found that chronic respiratory disease was the commonest condition associated with disability in men, and in the sample population as a whole (15).

Table 17. *Main causes of impairment of people over 16 years living in private households in Great Britain (Harris, 1971).*

	Estimated numbers		
Main causes	*Men*	*Women*	*Men and women*
Diseases of bones and organs of movement	351,000	836,000	1,187,000
Diseases of circulatory system	199,000	292,000	491,000
Diseases of central nervous system	163,000	197,000	360,000
Diseases of respiratory system	179,000	104,000	283,000
Diseases of sense organs (including blindness)	92,000	186,000	278,000

Sickness absence from work and industrial disease
When certified incapacity from work is examined in terms of days off work, respiratory and circulatory diseases form the largest 'diagnostic' groups in men, while respiratory and mental disorders are most frequently recorded in women.

Of the principal causes of incapacity from industrial accidents, sprains and strains of joints and adjacent muscles form the group responsible for most spells of incapacity for both sexes in 1971–2, with fractures causing the longest average duration of spells (24).

The recently established Employment Medical Advisory Service reported the frequency of industrial disease notified to them in 1974. The largest problem numerically was chrome ulceration, to which workers in the chromium plating industry are vulnerable, followed by lead poisoning (mainly from paint) and epitheliomatous ulceration

(from pitch tar and mineral oil). The commonest single cause of gas poisoning in 1974 was chlorine (88 out of 268 reported cases) (25).

Venereal disease

Since 1949 there has been a steady increase in the number of patients attending venereology clinics for the first time. Gonorrhea, particularly in women, and 'non-specific infections' appear to have increased most, while syphilis has declined markedly (Table 18). Throughout this period, there has been a gradual improvement in venereology out-patient facilities, and a perceptibly changing attitude to sexual mores. Both of these factors may have contributed to the stimulation of 'demand' for such services.

Table 18. *Venereal diseases* (Social Trends, no. 5 [HMSO, 1974]). *Patients seen at hospital clinics.*

Cases (in all stages) dealt with for the first time at any centre	1949	1959	1969	1971	1972	1973
Syphilis:						
Male	9	2	2	2	2	3
Female	7	2	1	1	1	1
Chancroid and non-specific infections:						
Male	25	38	80	113	124	156
Female	10	14	44	73	81	57
Gonorrhea:						
Male	24	28	39	42	39	42
Female	5	7	16	20	21	25

Mortality and morbidity: a summing up

It is clearly impossible to summarize the major causes of ill-health in the community without incurring criticism. The following list of conditions deserving medical attention cannot be comprehensive, in an absolute sense, since it is based on the foregoing presentation of selected data.

In children and young adults, congenital and developmental disorders, accidents (both in the home and on the roads), and emotional disorders appear to be the major problems. The disturbing phenomenon of 'cot death' awaits explanation in pathological and epidemiological terms. Childhood cancer, particularly leukaemia, remains a tragic burden despite noteworthy therapeutic advances. Infestation and dental caries are familiar to all school medical

officers, as are upper respiratory infections, speech and hearing disorders, epilepsy, and minor orthopaedic abnormalities. 'Psychosomatic' disease, such as enuresis, asthma, and eczema, and educational failure probably contribute most to childhood morbidity. Mental subnormality is a huge problem in itself, as are 'maladjustment' and physical handicap in their contribution to chronic disability. Venereal disease, particularly gonorrhea, is now a major public health hazard, though not on the scale to be found in the United States.

The *older section of the population* is afflicted by circulatory (mainly ischaemic heart) disease, respiratory disease (mainly chronic bronchitis and infection), and cancer (predominantly of the lung, breast, and digestive tract). Ischaemic heart disease mortality continues to increase in younger as well as older men, and lung cancer rates in women are beginning to reflect their increased smoking habits. Psychiatric disorders (particularly psychoneuroses, personality disorders and alcoholism) are widely prevalent, as are skin and genitourinary disease. Arthritis, cardio-respiratory disease, and strokes account for most chronic illness, particularly in women, who often outlive their ageing male contemporaries.

Little mention has been made of social pathology, including poverty, overcrowding, unemployment, homelessness, criminal and political violence. The importance of these factors in provoking ill-health in the broadest sense tends to be overlooked. An admirable attempt to research this area is described in the report *Born to Fail* produced by the National Children's Bureau, who demonstrated that one child in sixteen (one in ten in Scotland) born in Britain in one week in March 1958 could be described as 'socially disadvantaged', ie belonging to a large or single-parent family, badly housed, and from a low income family. Compared to controls, these children, by the age of 7, suffered poorer health and educational attainment (26). The implications of this work are wide-ranging, and are of direct relevance to doctors, educationalists, and politicians.

The natural history of disease: a recapitulation

Before exploring some of the practical possibilities offered by the preventive approach, it is worth reviewing the major causes of mortality and morbidity in the light of our knowledge of their natural histories, the indispensability of which was stressed earlier in the paper.

Our understanding of the aetiology, course, and prognosis of many of the communicable diseases is reasonably complete, although further investigations are desirable into viral infections and sexually transmitted diseases. We are profoundly ignorant, by contrast, of the natural history of most chronic disease. Despite many years of research, the ageing process itself remains an enigma. Most forms of cancer, circulatory disease, respiratory disease, and arthritis await aetiological clarification as well as a more refined appreciation of prognosis and the likely effect of medical intervention. There has been much speculation, mostly fruitless, on the prepathogenesis of the major psychoses, the psychoneuroses, personality disorders, drug and alcohol addiction, and most forms of mental subnormality. The relationships between physical, emotional, and educational retardation in children have been studied, but many questions remain unanswered. Accidental injuries and death now constitute an enormous public health problem, yet the elucidation of the environmental and personal determinants of trauma has scarcely begun. Confusion surrounds the aetiology of defective intra-uterine growth and many common inherited and congenital disorders.

A further significant extension of the capabilities of preventive medicine depends primarily on our ability to defend an ideal which is easily sacrificed when finance is scarce. That ideal is embodied in the continuing search for a deeper understanding of the natural history of disease, particularly at the stage of prepathogenesis, and its fulfilment depends on the recognition of the overwhelming case for an unremitting, appropriately planned research effort.

Applying preventive solutions

While public and professional attitudes are slowly changing in a direction that may facilitate the advocacy and application of prevention as a means of solving health problems, there remain many serious constraints of an administrative, economic, social, and political nature. These may be overcome provided that the health planner is convinced that the introduction of a specific preventive measure, which may be expensive, is justified.

In this section, some of the possibilities offered by all three forms of prevention will be outlined, and their potential contribution to the improvement in the health of the community will be appraised in the light of the evidence which has been presented. Finally, in the form

of a concluding statement, a series of priorities—demanding either urgent preventive action or research—will be enumerated.

PRIMARY PREVENTION: THE PROMOTION OF HEALTH AND THE PREVENTION OF SPECIFIC DISEASES

Prevention is concerned with measures aimed at the promotion of health as well as the obliteration of specific diseases. The promotion of general health and well-being involves the use of health education, genetic, environmental, and social engineering, and the removal of external hazards. Efforts may be directed towards the manipulation of the environment or towards the modification of individual patterns of behaviour. Traditional public health measures have achieved considerable success with the former, but have made few inroads into the latter. Provided the co-operation of local and central statutory authorities is obtained, the purification of water supplies, the demolition of slums or the institution of minimum standards of hygiene, cleanliness, and industrial safety, are realizable objectives. The alteration of life-long habits such as eating, exercising, drinking alcohol or smoking tobacco presents difficulties on an altogether more daunting scale. Their solution may depend ultimately on the purposeful amalgamation of expertise drawn from both medicine and the behavioural sciences.

All societies, consciously or otherwise, utilize health education in the normal processes of child-rearing, social functioning, and the transmission of cultural values and customs. Behaviour patterns established early in life are seldom influenced by the individual's perception of the effect of such behaviour on his health. Consequently, attempts to establish new patterns of behaviour by appealing to the individual's sense of responsibility rather than to his sense of group identity have usually been futile. Efforts to dissuade young people from cigarette smoking appear to have succeeded in conveying a knowledge of the health hazards of the habit while failing to achieve any effect on the behaviour pattern itself (27). Health education campaigns may be extremely expensive, and evaluation studies are rare.

The field of preventive nutrition is a large and potentially exciting one. Few would deny the disadvantages of infant feeding via the bottle as compared to the breast, which is more satisfactory in terms of nutritional content, protection from infection, and the unhindered establishment of the mother–child relationship. The addition to food of nutrients such as vitamins A and D to margarine, iron and calcium

to bread, and iodine to salt has been aimed at the prevention of deficiency states, although the continuation of such practices often owes more to custom than to necessity. Attention has been drawn to the magnitude of dental caries in children, yet few local authorities have fluoridated their water supplies although empowered to do so for more than a decade. The importance of dietary factors in the aetiology of coronary artery disease is controversial, as is the significance of the association, reported by some studies, between water hardness and mortality from ischaemic heart disease.

The practical difficulties of manipulating the dietary intake of a population for preventive purposes are three-fold. First, it is necessary to demonstrate a convincing association between a dietary factor and ill-health; second, there must be a clearly beneficial effect from modifying the diet; and third, the presumed rewards must adequately compensate for the inconvenience and, perhaps, self-denial incurred by the change of diet.

In the nineteenth century, the sanitary reformers were able to implement some of their proposals by participating directly in social policymaking. Today a large body of legislation ensures minimum standards of hygiene safety, and basic amenities for the guidance of local housing authorities, and the involvement of the medical profession in the planning and designing of modern residential and occupational environments is negligible. The reasons are partly historical, in that doctors today rarely view themselves as promoters of the public health in the nineteenth-century sense, and partly attributable to present ignorance about the interrelationship of the social environment and the newer epidemics of degenerative and mental disorders. Intervention studies in this area require careful observation and evaluation if the 'improvement' of social conditions is to be channelled along constructive and economic lines.

Protection against specific noxious environmental hazards may be afforded by a variety of techniques in current use: avoidance of occupational exposure to agents such as radiation, lead, asbestos, and dangerous machinery; the use of accident protection devices such as crash helmets, car safety-belts, and fire-guards; and the counselling of marriage partners at risk of reproducing children affected by genetic or chromosomal disorders. There are many other examples.

The most alarming environmental hazard is the cigarette, the successful control of which has eluded the most vigorous efforts. The

Swedish government has recently embarked on an ambitious programme aimed at rearing all children born in 1975 and later in a cigarette-free environment. The general strategy is to render cigarette smoking obsolete within a few years by means of progressively increasing the tax on tobacco at an annual rate well in excess of inflation, combined with an aggressive policy of selective health education (28).

Infection remains a prominent cause of morbidity and mortality in childhood, and the role of immunization as a preventive weapon is a leading one. Whooping cough, for example, is a disease which has a high attack rate when herd immunity is low. The risk of neurological damage following pertussis vaccination is extremely small but widely publicized, and the Joint Committee on Vaccination and Immunization have recently reiterated their recommendation that the vaccine should continue to be offered in a triple form together with diphtheria and tetanus vaccines (29). The dilemma, however, remains and its resolution may have to await an assessment of the effects on the susceptible population of the next outbreak of whooping cough. The arguments relating to immunization policy as a whole are changing constantly, and it is important that widespread discussion continues.

SECONDARY PREVENTION: EARLY DISEASE DETECTION

The growing disenchantment with sophisticated therapeutic technology, combined with the development of automated laboratory and data-processing techniques, has stimulated interest in the idea of seeking out unrecognized disease and treating it before irreversible pathological changes have taken place. Over the past few years a considerable debate on this subject has simmered within the medical profession. The seemingly relentless advance of conditions such as cancer and ischaemic heart disease has produced a favourable climate for the introduction, perhaps prematurely, of measures designed to diagnose and treat such disorders at an early stage.

Screening, of course, has been practised for many years. Mass radiography for the early detection of pulmonary tuberculosis enjoyed favour while tuberculosis was common in the community, costs were reasonably low, and radiation hazards less well appreciated. Today, mass radiography would seem to offer benefit mainly to specific groups, such as immigrants from areas where tuberculosis is endemic, rather than to the general population.

Cervical cytology is routinely performed as a screening procedure

in many countries, but was introduced as an act of faith rather than of reason. Its value is unproven since the natural history of invasive carcinoma of the cervix is uncertain. Carcinoma-*in-situ* is presumed to be premalignant, which it may well be; controlled trials, however, are unlikely to be carried out now and the true value of cervical cytology cannot therefore be assessed.

Breast cancer kills approximately 11,000 women each year in Britain and pressure is mounting for the introduction of screening clinics following the publication of results from a controlled trial in New York (30, 31). A combination of palpation and mammography was offered to 31,000 women aged between 40 and 65 years as part of the New York Health Insurance Plan. Rescreening was carried out on the three subsequent years. Over a seven-year period, 108 women died of breast cancer in the control group, compared with 70 in the screened population. This represented a reduction in mortality of about one-third, a statistically highly significant result.

Closer examination of the data revealed that the improved outcome was confined to women over 50 years (and mainly to the age-range 50–59). Furthermore the response rate to the screening invitation was relatively high (65 per cent) and may have reflected the insurance-orientated organization of the study. Finally, as the authors admit, the possibility remains that these short-term results are not confirmed in the long-term.

There is an important aspect to breast cancer screening which tends to be underestimated. Of 1,215 women screened at the West London Cancer Screening Clinic, Ealing, 231 (19 per cent) were referred for a surgical opinion, 119 (9·8 per cent) underwent biopsy, and cancer was diagnosed in 17 (1·4 per cent) (32). Therefore 102 women (86 per cent of those biopsied) suffered the inconvenience, anxiety, and anaesthetic risk unnecessarily. Patients who seek medical advice spontaneously for advice about a breast lump are understandably anxious about the possibility of cancer. We know too little about the psychological effects of confronting a woman, who has an unsuspected lump discovered, with the possibility of malignancy and mutilating surgery.

A committee of inquiry has recently recommended to the government that a national screening programme for breast cancer is not justified on present evidence (33). The danger persists, however, that the final decision may be precipitated by public pressure.

A review of screening procedures was undertaken in 1968 for the

Nuffield Provincial Hospitals Trust, and more recently for the purpose of a *Lancet* publication (34, 35). Both concluded that the case for a substantial extension of screening activity was weak and that many screening procedures already in operation, with the exception of antenatal screening for rhesus antibodies and the detection of phenylketonuria in the newborn by means of the Guthrie test, were of dubious value. Holland, in his summary of the *Lancet* series, was particularly sceptical of the prospects for preventing cardiovascular, malignant, and mental disease by mass (including multiphasic) screening, and urged that more attention be directed towards identifying high-risk individuals, and detecting disorders, such as visual and hearing loss, amenable to continuing care rather than cure.

The essential point about screening is that the doctor's relationship with the patient is very different from that of the conventional consultation, where the patient seeks medical help which may or may not bestow benefit. When the doctor takes the initiative and attempts to identify evidence of early disease or increased risk of developing disease, he bears responsibility for converting a 'healthy' into a 'sick' or 'at-risk' individual. This is justifiable only if he can improve the prognosis for the individual rather than merely lengthen the timespan of known illness. The doctor has an overwhelming moral obligation to evaluate the likely effects of the screening procedure in advance of its introduction, for even if no harm to the individual can be foreseen, the diversion of resources into the screening effort will have implications for other competing arms of the health and social services.

The ethical constraints apply with less force to 'case-finding' procedures, which are usually confined to patients who have already sought medical attention, than to prescriptive screening which aims to confer benefit on individuals who have not sought such contact. The evaluation of screening is a subject which has preoccupied many authors, who have concerned themselves with three overlapping issues: the ethical, scientific, and economic criteria by which a screening proposal should be judged. For a detailed analysis of these, the reader is referred to Wilson and Jungner's WHO document published in 1968 (36).

TERTIARY PREVENTION: REHABILITATION

The recent upsurge of interest in the plight of the disabled may be attributed in part to a belated recognition of the changing pattern of

Table 19. *Priorities for prevention.*

Number	*Disorder*	*Primary*	*Secondary*	*Tertiary*	*Research*
Age-group, 0–44 years					
1. *Disorders causing death*					
A	External causes (accidents, poisonings, and violence)	Education, road and home safety			Aetiology
B	Malignancy				Aetiology
C	Congenital anomalies	Avoidance of teratogens, genetic counselling	Prenatal diagnosis	Rehabilitation	Aetiology and prenatal diagnosis
D	Circulatory (mainly ischaemic heart disease)	Stop smoking	Stop smoking		Aetiology and intervention studies
E	Infection	Immunization, improve social conditions			Aetiology and immunology
2. *Disorders causing disability*					
A	Psycho-social (inc. mental/intellectual/educational)	Family planning, improve social conditions		Medical education, rehabilitation	Aetiology and natural history intervention studies
B	Respiratory	Stop smoking	Stop smoking, avoid allergens		Aetiology
C	Central nervous system			Rehabilitation	Aetiology and natural history
D	Musculo-skeletal (inc. arthritis)				Aetiology
E	Traumatic	Education, road and home safety			Aetiology
F	Dental caries	Fluoridation	Dental check-ups		

Age-group, 45 years and over					
3. *Disorders causing disability*					
A	Circulatory (ischaemic heart disease and stroke)	Case-find (male) hypertensives, stop smoking	Stop smoking	Rehabilitation	Aetiology and intervention studies
B	Musculo-skeletal (inc. arthritis)				Aetiology
C	Eye and ear				Evaluate screening
D	Respiratory	Stop smoking	Stop smoking		Aetiology
E	Traumatic	Education, road and home safety			Aetiology
4. *Disorders causing death*					
A	Circulatory (ischaemic heart disease and stroke)	Case-find (male) hypertensives, stop smoking	Stop smoking	Rehabilitation	Aetiology and intervention studies
B	Malignancy (esp. lung)	Stop smoking			Aetiology
C	Respiratory	Stop smoking	Stop smoking		Aetiology

disease. Care is now accorded a status at least equal to that of cure, though it lacks dramatic appeal. The creation of the new specialty of rehabilitation medicine is a significant practical expression of a greater awareness of the psychological and social, as well as physical, needs of the chronically ill.

One of the main recommendations of the Tunbridge Report (37) was that multidisciplinary assessment units should be established throughout the country in order that the relevant rehabilitation decisions could be made for each patient. Such units are rare and the prospects for more are not bright in the present economic climate. There is a perennial danger that the interests of the chronically ill and the elderly will slip, almost unnoticed, to the bottom of a list of priorities despite official protestations to the contrary.

PRIORITIES FOR PREVENTION

The selection of priorities always results in injustice to sectional interests who seldom perceive their own case in unemotional terms. Because priorities are never absolute, it is incumbent on planners to review decisions constantly and to avoid the adoption of inflexible postures. It is useful, however, to establish a framework within which discussions may take place, and the accompanying chart (Table 19) has been constructed for this purpose.

The disorders have been ranked vertically in order of presumed 'importance' while suggested preventive action, including research, is ranked horizontally in order of presumed 'timeliness'. As differing viewpoints are brought to bear on this scheme, a continual modification of the original priorities is envisaged in order that a new order may evolve. There is therefore no final version.

CRITERIA OF 'IMPORTANCE'

The allocation of a numerical order of the listed disorders has emerged from a consideration of the effect of **age**, as well as of **mortality** and **morbidity**, on priority assessment (see Appendix). Since the underlying assumptions, or value-judgements, are subjective and therefore open to challenge, they will be enumerated.

1. Selected indices of mortality and morbidity may be used to assess the relative contributions, and therefore importance to the community, of the various causes of mortality and morbidity.

2. The pattern of disease is such that there is a discernible, consistent distinction between the major health hazards threatening the

'younger' population (those under 45 years) and those threatening the 'older' population (those 45 years and over). The arbitrary nature of the population division at the age of 45 years is recognized.

3. Disorders causing death and disability are higher priorities for prevention in the 'younger' than in the 'older' population.

4. In the younger age-group, disorders causing death are higher priorities for prevention than disorders causing disability.

5. In the older age-group, disorders causing disability are higher priorities for prevention than disorders causing death.

6. Disorders causing perinatal mortality are unlikely to decrease in number beyond a certain irreducible minimum and may therefore be excluded from this analysis.

7. Disorders causing chronic illness are more disabling than disorders causing acute illness.

CRITERIA OF 'TIMELINESS'

Effective preventive medicine is possible only if a number of simultaneous conditions prevail. These conditions, which may be described as the criteria of 'timeliness', influence the success with which priorities can be maintained even after the criteria of 'importance' have been agreed upon and applied. The criteria include:

1. The state of knowledge of the natural history of disease.

2. The known effectiveness and safety of a preventive measure, particularly in comparison with conventional therapeutic intervention.

3. The estimated cost in terms of finance and other resources.

4. The acceptability of the measure to the community.

Table 19 sets out horizontally four possible courses of action for each disorder—primary, secondary, tertiary prevention, and research. Appropriate measures (including the instigation of research) are suggested for each disorder in accordance with the criteria of 'timeliness'. This structure reflects a belief that, in general effective primary prevention is more desirable than effective secondary prevention, which in turn is more desirable than effective tertiary prevention. Where no effective preventive measure exists, a research effort to develop one is obligatory.

THE FUTURE OF PREVENTIVE MEDICINE

While Table 19 outlines a possible preventive strategy in fairly specific terms, a flexible approach is essential. Since the field is a rapidly

changing one, it is worth considering some of the possible difficulties and opportunities with which research workers and practitioners may be presented in the foreseeable future.

It would appear that secondary prevention in the form of screening is currently overshadowing both primary and tertiary prevention in terms of advocacy, discussion, and research. The least contentious forms of 'screening' are those where contact with doctors and nurses would probably have occurred anyway (ie case-finding). The general practitioner is in the most strategic position to develop and test case-finding procedures as an extension of his clinical service to his population. The interest and enthusiasm of the family doctor in adopting case-finding techniques, such as the routine measurement of blood pressure on all male patients, may be aroused with difficulty. Thus the limitations of this approach may lie in medical rather than patient reluctance. Attendance by expectant mothers at antenatal clinics is already utilized for case-finding purposes; in the future their range may extend to include the measurement of indicators of congenital abnormalities, and perhaps of social deprivation. The home visits undertaken by health visitors to mothers and babies after hospital discharge present opportunities for the detection of medical, psychological, and social hazards whose effects might be ameliorated by intervention. The school entry examination has almost become incorporated into parental expectations of a 'good' educational service and opportunities abound for the application of more sophisticated methods of detecting educational, physical, and emotional disability. Occupational screening concentrates on vulnerable groups of industrial workers, and is likely to grow in popularity as the occupational health service expands.

The encouragement of the trend away from doctor-initiated towards patient-initiated contacts as the setting for 'screening' (or case-finding) would seem to be more promising than attempts to decimate the 'healthy' population by futile assaults on the presumed 'iceberg of disease'. Multiphasic screening—the application of a battery of tests at one session—has been popularized in the USA by private sponsorship, but has not reaped the expected health benefits for its clients. The selective screening of high-risk groups of the population for early signs of treatable disease, for untreatable conditions which may be alleviated, and indeed for specific risk factors, such as smoking and obesity, may be justifiable provided careful evaluation studies are carried out.

The continuing and possibly increasing problem of infantile 'cot death' gives rise to anxiety. Intervention studies, in the form of improving medical and social care of infants from disadvantaged backgrounds, are of paramount urgency. The extension of antenatal care to embrace all sections of the pregnant population deserves enthusiastic pursuit, and the introduction of screening for neural-tube defects by plasma alpha-foetoprotein estimations would seem justifiable, especially in high-risk geographical areas, providing careful pilot studies have been carried out. Neonatal screening for hypothyroidism should be considered as a possible adjunct to the Guthrie test (38).

The confusion surrounding the objectives and organization of developmental screening of young children should be clarified. The causes of educational and intellectual retardation in children require further elucidation if prevention is to become feasible, and methods of rehabilitating such children should be critically assessed. Childhood emotional disorders, including 'maladjustment' and enuresis, deserve a greater research commitment, and the absurd administrative fragmentation of services for variously handicapped children, who may fall between the three stools of health, social, and educational services, warrants immediate attention.

Primary prevention offers most hope for the control of two causes of increasing mortality, namely accidents and lung cancer. The modification of driving habits requires attention and is obviously difficult without legislation; the improvement of road conditions and vehicle safety requirements are much less problematic, though costly. In theory the sale of tobacco could be prohibited, but the American experience with alcohol suggests that such a policy would be counterproductive. Nevertheless, present restrictions on cigarette sales and advertising are easily circumvented and require reinforcement. The Swedish experiment should be observed, but results are unlikely to materialize for more than a generation.

Upper and lower respiratory infections cause much ill-health in both children and adults, though the scope for prevention, other than by reducing both the active and passive inhalation of cigarette smoke, would appear to be limited. Prompt treatment of acute otitis media in children by their doctors might prevent a proportion of middle-ear deafness, and the level of awareness of general practitioners is probably the determining factor. Close surveillance of atmospheric pollution, which aggravates many respiratory disorders, remains a very worthwhile exercise.

Digestive tract and skin disorders are amongst the most prevalent of all complaints and have stimulated surprisingly sparse preventive efforts. The role of alcohol in the aetiology of acute gastritis, pancreatitis, hepatitis, and cirrhosis suggests that prevention of some digestive tract disorders is at least possible, if improbable.

Coronary risk factors are already receiving much attention, and a variety of intervention trials are under way. Family doctors could be encouraged to undertake their own studies (preferably multicentred) based on risk-factor identification and treatment in the course of routine practice. Research directed towards the investigation of the aetiology of ischaemic heart disease should free itself of the temptation to explore the risk-factor model still further, and fresh approaches should be sought. The rehabilitation of victims of strokes and coronary attacks tends to be a neglected area of clinical management, although much research information is now available.

Epidemiological investigations of rheumatoid and other forms of arthritis have been lamentably few, and prevention does not seem feasible. The scale of the problem is such that even minimal rehabilitation of all arthritics is inconceivable and it may be more realistic to identify and aid only those individuals handicapped beyond a specified arbitrary point. The role of the family doctor in detecting situations of unusually severe hardship cannot be overstated.

Mental illness, including alcoholism and self-poisoning, presents a major challenge to modern medicine. Aetiology remains for the most part obscure, yet research effort is minimal, possibly because of the huge service commitment with which psychiatry is burdened. Paradoxically, the successful rehabilitation of psychiatric patients may have been hindered rather than helped by the 'open-door' policy of mental hospitals since community services may find themselves unable to cope. 'Minor' emotional disorders abound in general practice consulting rooms and an urgent task awaits medical schools whose curricula seldom reflect the prevalence of neuroses, personality disorders, and social malaise in the community, even when the time allotted to psychiatric instruction is generous.

Finally the study of the social environment and its effects on health merits greater enthusiasm. If health is a state of social as well as physical and mental well-being, doctors and social workers should settle their differences and work together, in the true sense. Too often, lip-service only is paid to the idea of the clinical 'team'. Ironically, the prevention of social pathology may ultimately prove easier than

the prevention of mental or degenerative disease since the means of manipulating some aspects of the social environment are already available through the activities of town planners, architects, social workers, teachers, and politicians. As far as modern medicine is concerned, this is unfamiliar territory, and should therefore appeal to inquisitive researchers.

Whose responsibility is preventive medicine?

LEVELS OF DECISION-MAKING

When a departure from traditional policy is contemplated, the health planner must formulate an approach most suited to the nature of the prospective change. For example, where legislation is required to effect a preventive measure (such as the wearing of car seat-belts), a concerted national effort, usually via Parliament, is essential. Conversely, peculiar local conditions or attitudes may militate against the acceptance of centrally imposed directives. While generalizations are often dangerous, the following broad strategy might be considered in conjunction with the various courses of preventive action outlined in Table 19.

PRIMARY PREVENTION often implies radical social upheaval or a modification of life-styles, and may therefore be perceived as representing a threat to personal liberty. For this reason, controversial health promotion measures may require intense political lobbying either at national or local level or both (as in the case of water fluoridation). Primary prevention is thus a **national** and a **local** responsibility.

SECONDARY PREVENTION usually implies early disease detection by screening. The patent dangers of misplaced local enthusiasm for such an approach obliges the central authority to provide, at the very least, firm guidelines for local policymakers. Secondary prevention is probably best initiated at **national** level.

TERTIARY PREVENTION, though often unjustifiably neglected, is arguably the least controversial form of prevention, and is greatly dependent on the extent and quality of local resources. Its fate therefore rests largely on the enthusiasm or otherwise of its **local** advocates.

Finally, RESEARCH ACTIVITY is becoming increasingly problem-orientated in current economic circumstances. The role of **national** policy in directing and supporting research is, inevitably, an expanding one.

These observations are summarized in Table 20.

Table 20. *Levels of decision-making.*

Level of preventive action	*Level of decision*
Primary	National and local
Secondary	Mainly national
Tertiary	Mainly local
Research	Mainly national

THE ROLE OF THE HEALTH CARE PROFESSIONALS IN PREVENTIVE MEDICINE

The logistics of a major reorientation of health policy towards prevention are not the concern of this paper. Nevertheless, in anticipation of the almost reflex economic objections, it is useful to review some of the currently available manpower resources of the National Health Service in the light of their potential contributions to a preventive effort.

The **general practitioner** must remain the lynchpin of any community-based medical innovation. He is responsible for a 'community' of men, women, and children, whom he usually knows in their familial context. He is the main source of referral to specialist agencies, and his clinical remit embraces medical care as a whole. His first-hand knowledge of local conditions and people places him in an unrivalled position to extend his preventive activity. Finally, his central role in the proliferating number of clinical 'teams' based in group practices and health centres provides him with links, formal and informal, with social workers, community nurses, health visitors, medical colleagues, dentists, physiotherapists, chiropodists, and other health professionals.

The **community nurse** has regular contact with the elderly, the young chronic sick, and indeed all patients generally dependent on nursing care at home. Like the general practitioners, she has a working knowledge of local people and their expectations, and could act as a useful intelligence service for those health authorities attempting to improve preventive and rehabilitation services.

The **health visitor**, of course, has always had a specifically preventive function in the health service. Her advice to mothers at home often forms the only link between socially deprived families and medical services. Some enthusiastic general practitioners utilize health visitors for the surveillance of their elderly patients, particularly those living alone. Arguably, the burden of any major expansion

of preventive services should fall predominantly upon an appropriately strengthened health visiting service.

Since the Social Services Act (1970), the **social worker** has faced mounting professional pressures. Priorities are determined by a complex web of legislation most of which was enacted in response to outraged public and parliamentary opinion in the wake of revelations of violence and neglect in homes or institutions. Although not responsible for the ills of society, the social worker is a convenient scapegoat for them.

Thus, while it is lamentable that the Act did not fully recognize the potential contribution of the social worker in the prevention of both medical and social ill-health, any attempt to burden social services departments further with 'preventive' duties is unlikely to be welcomed, in the short-term at least.

The **hospital-based professional,** whether medical, nursing, or paramedical, would seem to have little opportunity to undertake preventive measures. Yet it is from this quarter that much of the impetus for a preventive approach has originated. Many clinicians have expressed frustration at their apparent inability to offer more than a salvaging service to many patients whose illnesses might have been alleviated at an earlier stage or, better still, prevented altogether.

The health service **administrator,** while often dependent on clinicians' advice, often helps to bridge the gap between theory and practice. The distribution of resources and the co-ordination of complex multidisciplinary programmes demands managerial skills outwith the capacity of the untrained individual.

Finally, the **community physician,** a novel product of the reorganized health service, has over-all responsibility for the health of his population. Potentially he has a combination of medical and epidemiological skills, along with the long-standing preventive tradition of the public health movement, on which to build a preventive strategy of unprecedented scope and effectiveness. His current role is a somewhat confused one, arising as it does out of an attempt to compromise the varying interests of academics, administrators, and former medical officers of health. Preventive medicine may hold the key to his successful transition to a new kind of medical specialist identity.

Conclusions

1. The escalating cost of health services combined with an apparently insatiable demand for them have together stimulated a marked revival in the idea of preventive medicine.

2. The range of possible preventive measures is wide. Not all are of proven effectiveness, and some are costly. Thus priorities have to be selected.

3. Priority-setting is a complex exercise. Criteria of 'importance' and 'timeliness' are often employed, with the former seldom taking precedence over the latter.

4. Information plays a central role in determining priorities. Health data are abundant, yet fraught with difficulties of interpretation. The assessment of 'community health' and the relative importance attached to its various components employs value-judgements which should be made explicit and exposed to widely based criticism.

5. In this paper, the criteria of 'importance' used for ordering health priorities have taken account, as far as possible, of age, mortality, and morbidity. Thus, the prevention of causes of death in young people (particularly those due to 'external causes') has been accorded top priority, followed by the prevention of causes of disability in the young, causes of disability in the older age-groups, and causes of death in the older age-groups, in that order (see Table 19). However, this scheme is a dynamic one, and there should be no final version of it.

6. The practical implementation of preventive policies is constrained by numerous technical, social, and administrative factors. Much preventive activity is already in progress, yet many measures have not been evaluated scientifically. It would be unfortunate if the principles of effectiveness and safety, now firmly established in the routine assessment procedures for new drugs, were denied to the equally important field of prevention. Conversely, where effective and safe preventive measures exist, they are often inadequately applied. While goodwill may abound, the practical means may not always be apparent. A formal organizational framework is required.

7. The reorganized NHS could provide such a framework. The new specialty of community medicine is searching for a role, and preventive medicine needs a formal advocate. In a time of economic austerity, when new resources are unlikely to materialize, this association could offer an exciting and realistic future for both partners.

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APPENDIX

Assessment of priorities: a numerical approach

The process by which quantitative data has been amalgamated with qualitative value judgements has been commented upon. Although the details constitute a digression from the central argument of the text, it is hoped that the following explanation may provide an insight into the way in which the numerical data has been utilized for the purpose of ordering priorities.

To take account of age, mortality, and morbidity, the population has been analysed within the following two broad age-ranges: (1) age 0–44 years and (2) age 45 years and over; and mortality and morbidity have been examined separately, to be united subsequently by a weighting factor which favours chronic disability.

Disorders causing death

Table A1 lists the four commonest causes of death within each age sub-group in order of frequency (above the dotted lines). In addition, disorders which appear among the top four in any age-group are displayed (below the dotted lines) in all the other age-groups (except for 'cot death' which is inappropriate beyond the age of 4 years). Causes of perinatal mortality have been excluded. Using population estimates based on the Registrar-General's Review of 1972, the age-specific death-rates per 1,000 population have been calculated for each disorder within each age-group. This permits a degree of comparability of the disorders across age-groups.

The relative over-all contribution of each of these disorders has been estimated by calculating their mortality rates within the broad age-ranges 0–44 years and 45 years and over, and ranking them in order of numerical importance.

The results are shown in Table A2.

Table A1. *Disorders (excluding perinatal) causing death: numbers of deaths, and age-specific death-rates per 1,000 population (England and Wales, 1972).*

Age-group	*Disorder*	*No. of deaths*	*Rate per 1,000 population*
A. 0–45 years			
0–1 years	Congenital anomalies	2,757	3·76
	Infection (inc. pneumonia)	1,563	2·13
	Respiratory (exc. pneumonia)	811	1·10
	'Cot death'	460	0·63
	Malignancy	44	0·06
	External causes	391	0·53
	Central nervous system	239	0·33
	Circulatory	76	0·10
1–4 years	External causes	606	0·20
	Infection (inc. pneumonia)	438	0·14
	Congenital anomalies	380	0·12
	Malignancy	264	0·09
	Respiratory (exc. pneumonia)	202	0·07
	Central nervous system	200	0·06
	Circulatory	27	0·01
	'Cot death'	14	0·01
5–14 years	External causes	971	0·12
	Malignancy	453	0·06
	Congenital anomalies	238	0·03
	Central nervous system	185	0·02
	Infection (inc. pneumonia)	173	0·02
	Respiratory (exc. pneumonia)	110	0·01
	Circulatory	88	0·01
15–24 years	External causes	2,741	0·39
	Malignancy	528	0·08
	Central nervous system	266	0·04
	Infection (inc. pneumonia)	224	0·03
	Congenital anomalies	144	0·02
	Respiratory (exc. pneumonia)	151	0·02
	Circulatory	112	0·02
25–44 years	Circulatory	4,479	0·37
	Malignancy	4,342	0·36
	External causes	3,541	0·29
	Infection (inc. pneumonia)	700	0·06

Age-group	*Disorder*	*No. of deaths*	*Rate per 1,000 population*
25–44 years	Congenital anomalies	228	0·02
	Respiratory (exc. pneumonia)	588	0·05
	Central nervous system	580	0·05
B. 45 years and over			
45–64 years	Circulatory	55,915	4·76
	Malignancy	39,918	3·40
	Respiratory	11,735	0·10
65 years and over	Circulatory	244,877	37·63
	Malignancy	73,401	11·28
	Respiratory	68,597	10·54

* Population based on mid-year estimates 1972, ie
0–1 years: 734,000 5–14 years: 7,868,000 45–64 years: 11,749,000
1–4 years: 3,102,000 15–24 years: 6,960,000 65 years and over: 6,507,000
25–44 years: 12,108,000

Table A2. *Disorders causing death, ranked according to age-specific death-rates, per 1,000 population.*

	Disorder	*Rate per 1,000*
A. Age 0–44 years (total population = 30,772,000)		
1	External causes	0·27
2	Malignancy	0·18
3=	Congenital anomalies	0·12
3=	Circulatory	0·12
5	Infection	0·10
6	Respiratory (exc. infection)	0·06
7	Central nervous system	0·05
8	'Cot death'	0·02
B. Age 45 years and over (total population = 18,256,000)		
1	Circulatory	16·47
2	Malignancy	6·21
3	Respiratory	4·40

Disorders causing disability

The lack of comparability of the various sources of morbidity data constitutes the major obstacle to the ranking of disabling conditions according to prevalence or severity. This problem may be circumvented, though not solved, by selecting one or two main sources of data felt to be adequate for the purpose.

Three sources have been drawn upon for this exercise:

1. 'Acute' illness: the numbers of patients consulting their general practitioners for specific complaints as reported in the *Second National Morbidity Study of General Practice, 1970–71.*

2. 'Chronic' illness, reported as 'limiting long-standing illness' in the course of the *General Household Survey, 1971–72,* by persons over 15 years.

3. 'Chronic childhood illness' as reported in the Isle of Wight Study of 10–12-year-old children (Rutter *et al.*, 1970). This has been used in the absence of an alternative reliable source of data on the prevalence of childhood handicap.

Tables A3 and A4 list the most frequent disorders causing 'acute' and 'chronic' disability respectively, based on these sources. Age-specific rates per 1,000 have been derived from the population base of the National Morbidity Study and from the mid-1972 population estimates of the Registrar-General. Tables A5 and A6 display the ranking of the disorders in numerical importance.

Table A3. *Disorders causing 'acute' disability. Numbers of patients, and age-specific rates per 1,000 population, consulting general practitioners* (National Morbidity Study, 1970–71).*

	0–44 years		45 years and over	
Disorder	*No.*	*Rate per 1,000*	*No.*	*Rate per 1,000*
Central nervous system (except special senses)	2,867	15·3	2,461	23·5
Eye and ear (except otitis media)	21,424	114·3	10,398	99·2
Respiratory (inc. otitis media)	55,366	295·4	20,817	198·6
Musculo-skeletal	11,231	59·9	15,458	147·5
Traumatic	16,381	87·4	7,733	73·8
Mental	18,305	97·7	13,820	131·9
Circulatory	3,797	20·3	15,535	148·2
Digestive	9,945	53·1	7,809	74·5
Skin	23,121	123·4	9,200	87·8
Genito-urinary	15,308	81·7	6,561	62·6

* Population base of National Morbidity Study: 0–44 years = 187,427; 45 years and over = 104,820.

Table A4. *Disorders causing 'chronic' disability. Prevalence rates per 1,000 (Source:* General Household Survey, 1971–72).

Disorder	0–44 years *No.*	*Rate per 1,000*	45 years and over *No.*	*Rate per 1,000*
Central nervous system (except special senses)	316,966	10·3	257,934	14·1
Eye and ear	165,984	5·4	1,310,315	71·8
Respiratory	551,833	17·9	1,010,947	55·4
Musculo-skeletal	276,237	9·0	1,613,191	88·4
Traumatic	217,375	7·1	566,332	31·0
Mental	2,032,548	66·1	338,133	18·5
Circulatory	169,193	5·5	1,626,223	89·1
Digestive	101,060	3·3	470,226	25·8
Skin	121,722	4·0	—	—
Genito-urinary	—	—	—	—

(*Source. General Household Survey, 1971–72*).

Data for children under 15 years (not included in General Household Survey) derived from Isle of Wight Study (Rutter *et al.*) of 10–12-year-olds.

Table A5. *Ranking of disability in order of consultation and prevalence rates per 1,000 with scores (weighted 5 to 1 for chronicity) assigned to each disorder according to rank (age 0–44 years).*

Rank		*Rate per 1,000*	*Score*
	Acute disorder		
1	Respiratory	295·4	20
2	Skin	123·4	18
3	Eye and ear	114·3	16
4	Mental	97·7	14
5	Traumatic	87·4	12
6	Genito-urinary	81·7	10
7	Musculo-skeletal	59·9	8
8	Digestive	53·1	6
9	Circulatory	20·3	4
10	Central nervous system	15·3	2
	Chronic disorder		
1	Mental	66·1	100
2	Respiratory	17·9	90
3	Central nervous system	10·3	80
4	Musculo-skeletal	9·0	70
5	Traumatic	7·1	60
6	Circulatory	5·5	50
7	Eye and ear	5·4	40
8	Skin	4·0	30
9	Digestive	3·3	20
10	Genito-urinary	—	—

Table A6. *Ranking of disability in order of consultation and prevalence rates per 1,000 with scores (weighted 5 to 1 for chronicity) assigned to each disorder according to rank (age 45 years and over).*

Rank		*Rate per 1,000*	*Score*
	Acute disorder		
1	Respiratory	198·6	20
2	Circulatory	148·2	18
3	Musculo-skeletal	147·5	16
4	Mental	131.9	14
5	Eye and ear	99·2	12
6	Skin	87·8	10
7	Digestive	74·5	8
8	Traumatic	73·8	6
9	Genito-urinary	62·6	4
10	Central nervous system	23·5	2
	Chronic disorder		
1	Circulatory	89·1	100
2	Musculo-skeletal	88·4	90
3	Eye and ear	71·8	80
4	Respiratory	55·4	70
5	Traumatic	31·0	60
6	Digestive	25·8	50
7	Mental	18·5	40
8	Central nervous system	14·1	30
9	Skin	—	—
10	Genito-urinary	—	—

To unite acute and chronic disability, scores, weighted 5 to 1 in favour of the chronic disorders, have been assigned in accordance with rank, as follows:

'Acute' disorders: 1st place = 20 points
2nd place = 18 points, etc.

'Chronic' disorders: 1st place = 100 points
2nd place = 90 points, etc.

This weighting (ie 5 to 1 in favour of the chronic disorders), has been chosen in preference to, say, 2 to 1 or 10 to 1, since the former results in a ranking similar to that achieved by zero weighting, while the latter produces a ranking similar to that achieved by the 5 to 1 weighting.

Table A7 lists the disorders in order of their combined (acute and chronic) scores, within the two broad age-ranges 0–44 years, and 45 years and over.

The ranking of priorities shown in Table 19 was thus derived from an amalgamation of the two Tables A2 (disorders causing death) and A7 (disorders causing disability, with minor modifications.

Table A7. *Ranking of all disorders causing disability according to combined scores of acute and chronic disorders within age-ranges 0–44 years, 45 years and over.*

Rank	*Disorder (acute and chronic)*	*Combined score*
0–44 years		
1	Mental	114
2	Respiratory	110
3	Central nervous system	82
4	Musculo-skeletal	78
5	Traumatic	72
6	Eye and ear	56
7	Circulatory	54
8	Skin	48
9	Digestive	26
10	Genito-urinary	10
45 years and over		
1	Circulatory	118
2	Musculo-skeletal	106
3	Eye and ear	92
4	Respiratory	90
5	Traumatic	66
6	Digestive	58
7	Mental	54
8	Central nervous system	32
9	Skin	10
10	Genito-urinary	4