An approach to the analysis of health care needs and resources

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SUMMARY A semi-quantitative method of analysing the relationship between health care resources and need is described. It utilises the Donabedian model which expresses needs and resources in equivalent units in order to estimate the ratio of resources to need. The optimum resource/need ratio is regarded as that pertaining to the reference population; deviation from this optimum ratio in the subunits of the reference population is interpreted as a manifestation of inequitable resource distribution. An example is presented of the application of the method to the Greater Glasgow Health Board and its five constituent districts for the years 1974–77. It is argued that this method might, without undermining the principle of geographical equity, meet some of the objections to the more rigid ‘formula’ approach in the report of the Resource Allocation Working Party (RAWP) and in the Scottish Health Authorities Revenue Equalisation (SHARE) report.

Both the RAWP¹ and the SHARE² reports attempted to formulate a means of allocating health care resources in accordance with relative need. Baldly stated, their remit was to seek to balance the equation:

HEALTH RESOURCES = HEALTH NEED

An imbalance had arisen, it was felt, because resources were becoming increasingly ‘finite’ while need, as expressed by demand, appeared to be ‘infinite’. The reports went further than previous official pronouncements on health policy in emphasising the principle of geographical equity in order that ‘every person would have an equal opportunity of access to the health facilities which they need’.²

The formulas proposed by these working parties encountered several criticisms which were directed mainly at the various implicit and explicit assumptions about the nature of need. The purpose of this paper is to propose an alternative method of formulating the need-resource equation which is capable of accommodating different perceptions of need but also sufficiently quantitative to be useful for detailed rational planning.

Method

(1) THE DONABEDIAN MODEL

Donabedian defined need as ‘states likely to make demands on the medical care system’.³ He suggested that the abstract concept of need could be translated

into more tangible ‘need equivalents’, defined ‘services or resources required to provide the service which will satisfy the need’. Both ‘resources’ and ‘need’ may, according to this approach, be expressed in equivalent terms (Fig. 1).

Fig. 1 The Donabedian model (simplified).

As with other concepts of need, the necessity for a value judgement remains, since ‘need-satisfying equivalents’ cannot be quantified using purely objective criteria. However, if a certain level of resources is regarded as optimum for the satisfaction of a given unit of need, an optimum level of resources per unit of need may be estimated.

(2) INDICES OF NEED AND RESOURCES

In order to calculate resources per unit of need, indices of both need and resources must be selected which are amenable to quantification, preferably by means of routinely collected data. No single index of either need or resources is likely to satisfy all points of view, and a series of alternative options should be considered. Table 1, for example, lists four indices of need and four indices of resources for which data are usually available. These indices may be paired with

Table 1 Examples of indices of needs and resources

Indices of needs	Indices of resources
DEMOGRAPHIC (for example, population density, birth rate, fertility rate)	FINANCIAL (for example, capital expenditure, revenue expenditure)
MORTALITY (for example, crude death rate, age-specific death rate, cause-specific death rate, SMR)	PHYSICAL (for example, health centre and hospital numbers and location)
MORBIDITY (for example, health service utilisation rates, sickness absence rates, notification rates of communicable diseases)	STAFFING (for example, numbers of medical, nursing and paramedical employees)
SOCIOECONOMIC (for example, distribution of income groups, social class, indices of deprivation)	CLINICAL (for example, immunisation rates, operation rates)

each other in 16 combinations, not all of which may be appropriate in the eyes of a particular health authority. Obviously the longer the lists of indices, the larger is the number of potential pair combinations.

(3) RESOURCES PER UNIT OF NEED: CALCULATING THE OPTIMUM

In the context of geographical resource allocation, the 'optimum' level of resources per unit of need is usually regarded as that which results in equal access to health care resources. In other words, the optimum level of resources per unit of need should be identical for all of the subunits of the population and for the reference population as a whole. The level of resources per unit of need pertaining to the reference population becomes, in effect, the 'norm' against which the subunits may be compared.

Thus, if a multidistrict area, for example, has a level of resources of x per head of population relative to a need of y per head of population:

let x be ONE NORMATIVE RESOURCE UNIT
and let y be ONE NORMATIVE NEED UNIT
and let the RESOURCE/NEED RATIO be x/y

At area (the reference population) level:

$x/y = 1$ (the OPTIMUM RESOURCE/NEED RATIO)

The 'needs' of one of the districts (the subunits of the reference population) may then be expressed as NORMATIVE NEED UNITS (NNUs) while the 'resources' may be expressed as NORMATIVE RESOURCE UNITS (NRUs). The ratio of resources to need may then be calculated as follows:

RESOURCES PER UNIT OF NEED = $\frac{\text{NO. OF NRUs}}{\text{NO. OF NNUs}}$

'Equitable' resource distribution throughout the districts requires that this ratio, like that of the area, is

unity. The resource/need ratio is therefore a function of the relative levels of the indices of need and resources; it does not indicate absolute levels of either dimension. For example, while a resource/need ratio of 2.0 suggests that the relative provision of resources in relation to need is double the optimum, this could reflect either a more generous allocation of resources or a lower level of need (or both) than exists in the reference population.

(4) EXAMPLE OF THE COMMUNITY HEALTH SERVICES IN GLASGOW

The Greater Glasgow Health Board came into existence on 1 April, 1974. It comprises a population of just over 1m people. There are five constituent districts, each of which has a designated district general hospital. Although there is a considerable cross-boundary flow of patients receiving secondary and tertiary care, the districts are encouraged to aim for self-sufficiency in the provision of the less specialised community health services, mainly maternal and child health, community nursing, and preventive services.

For this study, the following three need indices were selected: (i) the estimated total home population; (ii) the infant mortality rate; and (iii) the proportion of the population lacking the three basic housing amenities of bath, hot water, and inside lavatory ('urban deprivation').

One resource index only was selected, namely, the total revenue expenditure on community health services.

This permitted the creation of three need-resource pairs:

- Pair 1 Total population—expenditure.
- Pair 2 Infant mortality rate—expenditure.
- Pair 3 'Urban deprivation'—expenditure.

The data on population and infant mortality were obtained from the published tables of the Registrar General for Scotland, the data on housing amenities from the ward library of the 1971 Census, and the financial data from the treasurer's department of the Greater Glasgow Health Board. The years 1974–77 were studied.

For each of the need-resource pairs, normative need units, normative resource units, and resource/need ratios were calculated for each of the five districts for the years 1974–77 inclusive.

Results

Tables 2, 3, and 4 express the selected measures of needs and resources in the five districts in terms of normative need units (NNUs) and normative resource units (NRUs). The ratio of resources to need (NRU/NU) is shown in the last column. The resource/need ratio of each district may be compared

with that of the whole health board population, which is regarded as having the 'optimum' resource/need ratio (that is, unity). For each of the three need-resource pairs, the south-east district has the highest resource/need ratio and the east district the lowest, with the other districts occupying intermediate rankings. Figs. 2 and 3 illustrate the changing annual resource/need ratios in the east and south-east

Table 2 *Needs and resources in Greater Glasgow Health Board: population (thousands) and revenue expenditure (£ thousands) on community health services, 1974-77*

District	Need index	Resource index	Resource/ need ratio
	Population* (NNU)	Expenditure (NRU)	NRU/NNU
North	205.3 (0.19)	3 720.9 (0.19)	1.00
West	255.6 (0.23)	4 204.2 (0.22)	0.96
East	234.6 (0.21)	3 711.6 (0.19)	0.90
South-east	229.2 (0.21)	5 054.7 (0.26)	1.24
South-west	169.4 (0.15)	2 649.7 (0.14)	0.93
ALL DISTRICTS	1094.1 (1.00)	19 341.1 (1.00)	1.00

* Mean total population based on estimates of Registrar General for Scotland 1974-77 inclusive.

Table 3 *Needs and resources in Greater Glasgow Health Board: infant mortality rate and per caput revenue expenditure (£) on community health services, 1974-77*

District	Need index	Resource index	Resource/ need ratio
	Infant mortality rate (NNU)	Expenditure (NRU)	NRU/NNU
North	16 (0.89)	18.12 (1.02)	1.15
West	16 (0.89)	16.45 (0.93)	1.04
East	24 (1.33)	15.82 (0.89)	0.67
South-east	15 (0.83)	22.05 (1.25)	1.51
South-west	21 (1.17)	15.64 (0.88)	0.75
ALL DISTRICTS	18 (1.00)	17.68 (1.00)	1.00

Table 4 *Needs and resources in Greater Glasgow Health Board: percentage of households lacking all three basic amenities (bath, hot water, and inside lavatory) (1971 census) and per caput revenue expenditure (£) on community health services, 1974-77*

District	Need index % households (NNU)	Resource index Per caput expenditure (NRU)	Resource/ needs ratio NRU/NNU
North	21.1 (1.13)	18.12 (1.02)	0.90
West	14.0 (0.75)	16.45 (0.93)	1.24
East	27.8 (1.49)	15.82 (0.89)	0.60
South-east	12.1 (0.65)	22.05 (1.25)	1.92
South-west	19.0 (1.02)	15.64 (0.88)	0.86
ALL DISTRICTS	18.6 (1.00)	17.68 (1.00)	1.00

districts respectively. The position of these two districts in relation to the 'optimum' resource/need ratio (unity) remained similar throughout the four-year period with the exception of 1977, when the sharp decline in the ratio 'expenditure/infant mortality rate' in the south-east district was consequent upon an unusually high infant mortality rate.

Discussion

The approach to resource allocation described here has both advantages and disadvantages. Its advantages include its quantitative basis, its flexibility, (in terms of its capacity to accommodate varying perceptions of both need and resources), its applicability to population units smaller than those considered by the RAWP and SHARE reports, and its relative simplicity. Among its disadvantages are its 'normative' methodology and its dependence on available data.

An underlying theme of this paper is the recognition of the inherent difficulty in defining needs and resources. The Donabedian model should

Fig. 2 *Changing annual resource/need ratio in east district, 1974-77.*

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Fig. 3 Changing annual resource/need ratio in south-east district, 1974-77.

be regarded not as a means of overcoming this but as the conceptual framework within which indices of 'presumed' needs and resources may be expressed in relation to each other. Indices of 'real' needs and resources, on the other hand, might be expected to interact dynamically and to exhibit evidence that the level of resources actually influences directly the level of need. It would be fallacious, however, to expect proxy indices to display a dose-response relationship of this kind.

Any rational system of allocating resources must be seen to be fair. The RAWP and SHARE philosophy of the need for geographical equity has been widely accepted, but practical attempts to implement it have met with resistance, usually because of dissension on the precise definition of need. In particular, the use of the standardised mortality ratio (SMR) as a 'proxy' for morbidity has been controversial. Many urban health authorities have complained that the RAWP and SHARE formula fails to take sufficient account of inner city deprivation. Other authorities, attempting to apply the formula principle to subregional or, in Scotland, to subarea levels, have met problems related to the availability and statistical significance of data. The

method described in this paper offers a more flexible alternative to the RAWP and SHARE formula while upholding the twin objectives of geographical equity in resource distribution and the development of a quantitative expression of the relationship between needs and resources.

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