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# Approaches to Capitation and Risk Adjustment in Health Care: An International Survey

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## ABSTRACT

This report is a survey of current capitation methods in health care finance in developed countries. It was commissioned as part of the fundamental review by UK Ministers of the formula used to allocate health care finance to local areas in England, being carried out under the auspices of the Advisory Committee on Resource Allocation (ACRA). The study was commissioned in February 1999 and completed in May 1999. It was informed by a review of published literature and an extensive network of contacts in government departments and academic institutions.

A capitation can be defined as the amount of health service funds to be assigned to a person for the service in question, for the time period in question, subject to any national budget constraints. In effect, a capitation system puts a "price" on the head of every citizen. Capitations are usually varied according to an individual's personal and social characteristics, using a process known as risk adjustment. In most nations, the intention is that the risk-adjusted capitation should represent an unbiased estimate of the expected costs of the citizen to the health care plan over the chosen time period (typically one year). There is an element of capitation funding in the health care systems of almost all developed countries. Capitation is seen as an important mechanism for securing both equity and efficiency objectives.

The review examined capitation schemes in 19 countries and concentrated on major strategic risk adjustment schemes implemented at the national or regional level. It identified two broad approaches to setting capitations, which we term matrix methods and index methods. The fundamental difficulties affecting both approaches are a lack of suitable data and the problem of disentangling needs effects from supply effects on health care utilization.

Almost all schemes rely on analysis of empirical data, and various analytic methods have been used for setting capitations. Numerous need and cost factors have been used in setting capitations. However, the choice has usually been determined more by data availability than a compelling link to health care expenditure needs. The review concluded that there were elements of many schemes that may be of relevance to the review of methods currently used in England, and which deserve further investigation. However, until improvements in data availability are in place, it is difficult to envisage major enhancements to methods currently in use.

## FOREWORD

This paper reports the results of a survey of current risk adjustment (or capitation) methods in health care finance in nineteen developed countries. It was commissioned by the NHS Executive, as part of a fundamental review by Ministers of the formula used to allocate finance to local areas in England, to be carried out under the auspices of the Advisory Committee on Resource Allocation (ACRA).

The review was commissioned in February 1999 and completed in May 1999. It has been informed by a survey of published literature and an extensive network of contacts in government departments and academic institutions. We are very grateful for the immense amount of help we have received from colleagues in numerous countries. However it is inevitable, given the very compressed timetable and variations in the accessibility and quality of published material and expert advice, that the paper contains some gaps and misinterpretations. Furthermore, we caution that health care systems are changing with great rapidity, and that this report merely offers a snapshot. We nevertheless hope that it gives a reasonably balanced view of current practice.

The paper concentrates on major strategic risk adjustment schemes implemented at the national or regional level. There exist a number of more modest schemes, which operate at a local level, or which are confined to narrow aspects of health care. We have not been able to pursue these within the time available.

We have chosen to emphasize breadth of coverage rather than detailed examination of individual schemes, in the hope that the inquisitive reader will pursue further the issues of interest. In terms of coverage, perhaps the major limitation of the paper concerns practice in the USA, where we have chosen to concentrate on just two of the major programmes: the Medicare capitation scheme, and the Veterans Equitable Resource Allocation scheme. Given adequate resources, it would have been interesting to explore further the numerous capitation schemes being implemented or tested by health plans and state governments in the USA. However, time constraints have precluded a more comprehensive review.

The report is in two parts. Part A discusses the general themes underlying capitation, while Part B describes specific schemes in operation in 19 countries.

The production of this report would not have been possible without the generous help of numerous correspondents. These are listed on the following page. In addition, we should like to thank Mark Groom at the NHS Executive for guidance, and our colleague Trevor Sheldon for immensely helpful comments.

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# PART A: General Findings

Part A is organized as follows. Section 1 examines what is meant by capitation and risk adjustment in health care finance, and section 2 examines its purpose. Section 3 discusses general principles that arise in seeking to set capitations. Section 4 summarizes our findings, and section 5 offers some general conclusions and recommendations for designers of risk adjustment schemes.

## 1. WHAT IS RISK ADJUSTMENT IN HEALTH CARE FINANCE?

There exists an enormous diversity in health care systems in the developed world. However, there is a feature common to almost all. They in effect seek to devolve responsibility for arranging health care to a health care 'plan'. This plan might be an insurance pool (in the US), a geographical area (in Sweden and the UK) or a sickness fund (in the Netherlands and Germany). These plans are charged with organizing specified types of health care for a designated population (whether defined by geography, employment type or voluntary enrolment) over a given time period. To an increasing extent such plans have been an important focus for securing expenditure control. To this end, a central feature of all the arrangements mentioned above has been the requirement to set prospectively a global budget for health care expenditure for each plan. The intention is that the plan should then deliver the required health care to the population at risk within a specified budget, thereby securing the required expenditure control.

Of course the extent to which health care plans have the power to control the expenditure for which they are responsible varies considerably between health care systems. In the United States, Healthcare Maintenance Organizations might be able to negotiate contracts with a wide range of 'preferred' providers in a highly competitive market, and might therefore be considered to exercise substantial control over expenditure. In the United Kingdom, the referral and prescribing practices of general practitioners have an important influence on expenditure, so that – as gatekeepers – they can be considered to have some degree of control over any expenditure for which they may be collectively responsible. On the other hand, in social insurance systems such as Germany and Belgium, providers continue to be reimbursed mainly on the basis of services provided, and many patients continue to enjoy considerable autonomy over which providers they can use. There is therefore very limited scope for plans to secure major reductions in expenditure. In these circumstances, the scope for efficiency gains is limited to improvements in administrative efficiency and (possibly) some variations in reimbursement rules (for example varying levels of copayments).

Furthermore, a number of arrangements might exist for handling variations in expenditure from the prospective budget. These might entail:

1. renegotiating the budget retrospectively with the payer,
2. running down (or contributing to) the plan's reserves,
3. varying the premiums, local taxes or user charges paid by the plan members,
4. in the extreme, rationing health care to the population at risk.

Clearly these arrangements imply big differences in the 'hardness' of the budget constraint confronting plans, a further important determinant of the effectiveness of the budgetary system.

Given the central importance of the budget in the systems sketched above, it is hardly surprising that the methods used to set budgets have come under intense scrutiny. Different arrangements have been used in different countries. A spectrum of approaches exists, encompassing three general categories.

1. There is in effect no budget, and the plan is retrospectively reimbursed fully for all expenditure incurred (fee-for-service). This is administratively simple. However, it offers little incentive on the part of the plan to restrain expenditure – instead it offers a perverse incentive to maximize the amount of health care delivered. Although still used in many health care systems, it is becoming increasingly unsustainable.
2. The plan is reimbursed for actual activity, but only on the basis of a set of standard fees and charges (e.g using diagnosis-related groups - DRGs). This prospective payment method gives an incentive to minimize costs on individual episodes of care, but no incentive to restrain the number of episodes. Indeed it may offer an incentive to maximize the number of episodes (perhaps in the form of readmissions), and to exaggerate the severity of the episode in terms (say) of the recorded DRG.
3. The plan is funded prospectively for *expected* activity. Here the plan must operate within a budget which is not influenced by current activity, and therefore has an incentive to restrain both referrals and the costs of referrals. The adverse consequences may be a tendency to skimp on the quantity or quality of health care offered, or to introduce rationing and waiting. The prospective budget may be based on realistic forecasts of future expenditure, or it may be deliberately set lower than such forecasts, for example to encourage efficiency improvements.

The movement from approach 1 to approach 3 shifts increasing levels of risk from the funder to the plan. In practice many systems employ a mix of methods. For example, in Norway counties are funded partly on the basis of expected expenditure needs, and partly on the basis of DRG activity [1]. In the Netherlands, sickness funds are funded prospectively on the basis of expected expenditure, but a complex retrospective reimbursement scheme moves the basis of funding back towards fee-for-service [2]. In the United Kingdom and many other countries, a prospective funding mechanism is dampened by reference to historical spending levels.

While the first two approaches towards setting health care plan budgets have certain attractions, increasing numbers of health care systems are moving towards the prospective setting of budgets based on expected activity. Clearly a number of methods might be used to construct such budgets: for example, bilateral negotiations between funder and plan, or extrapolation of historical expenditure levels. However, such methods are in general heavily criticized because they appear arbitrary, and may perpetuate existing inefficiencies and inequities. Increasing use has therefore been made of more scientific approaches towards setting budgets, most notably in the form of *capitations* [3].

A capitation can be defined as the amount of health service funds to be assigned to a person with certain characteristics for the service in question, for the time period in question, subject to any overall budget constraints. In effect, a capitation system puts a ‘price’ on the head of every citizen. Clearly the health care needs of citizens vary considerably, depending on personal factors such as age, morbidity and social factors. Considerable effort has therefore been expended on a process known as *risk adjustment*, which seeks an unbiased estimate of the expected *relative* costs of the citizen to the health care plan, given the individual’s characteristics. It is important to note that, if the overall budget is set at unrealistically low levels, then all capitations will be less than expected outturn expenditure. However, in these circumstances the intention is that the risk-adjusted capitations should continue to reflect the *relative* health care expenditure needs of citizens.

In many insurance markets other than health care (for example home insurance, or vehicle insurance), the insurer will effectively calculate a risk-adjusted capitation in setting a premium for the purchaser of the insurance policy. For example, in setting a premium for car insurance, an insurer will usually explore all the characteristics of the individual which they consider to be relevant, such as age, driving record, type of car, and area of residence. In these circumstances the actuarially fair premium can be considered the equivalent of the risk-adjusted health care capitation.

However, the peculiar nature of health care has meant that free markets in insurance cannot in general operate. Most notably, most societies recoil from the idea that 'sick' individuals should have to pay more for health care insurance than their healthier counterparts, so there is almost always a requirement that contributions (in the form of taxation or insurance premiums) should be independent of health status or risk profile. This arrangement entails an implicit transfer in the funding arrangements from the healthy to the sick (and often from the rich to the poor). Thus, outside of the private health care market, risk-related premiums are rarely encountered in health care. However, the usual risk pooling arrangements found in health care do not obviate the need to calculate the notional premiums in the form of capitations if different health plans are to be given equitable budgets and therefore treated fairly. The reasons for this are discussed further in Section 2.

Although a given capitation sum might be notionally assigned to an individual, there is in general no expectation that the health plan should spend precisely that amount on the individual. For example, although a national capitation of (say) £407 per annum may be assigned to a person aged 45-64, it would be absurd to expect every such individual to receive that expenditure per annum from the NHS. Rather, the capitation offers an *expected* level of expenditure, around which there might exist substantial variation. Under these circumstances the plan is expected to manage the risk inherent in the demand for the services for which it is responsible. Furthermore, the plan may not necessarily be required to spend at the assumed level of funding. For example, in Scandinavian health care systems, local governments are able to some extent to vary funding levels from those assumed by the central government by changing local taxes [4], and in Switzerland sickness funds might fund variations in expenditure levels by varying the insurance premiums they charge from the assumed level [2].

Clearly a further issue of importance when implementing a capitation system may be the estimation of the size of the population of interest in each plan. We do not consider this explicitly here, but note that it is often of fundamental importance. For example, recent developments in the English NHS require capitations to be based on the size of the patient lists for general practitioners. These are thought to be unreliable, and may compromise the reliability of the associated distribution of funds. Similarly, in systems where people change plans frequently, or are registered only when they use services, there may be considerable uncertainty as to the size and characteristics of the population at risk.

A capitation can be very rudimentary – at its simplest (as in Spain) assigning an equal amount of funding for each citizen, regardless of circumstances [5]. Successive degrees of refinement using risk adjustment can then be envisaged. For example, in many of the risk adjustment schemes used in systems of social insurance (such as Israel, Germany and Switzerland) the capitation is based on rudimentary demographic data, thereby introducing a number of different categories of individual based on age and sex. Clearly age and sex may be important determinants of expenditure variations, but there exist many other potential risk adjusters. In incorporating further factors into the risk adjustment mechanism, most capitation schemes have been constrained by data availability.

This report seeks to report the 'state of the art' in implemented risk-adjusted capitation methods. There are a small number of similar surveys offering alternative perspectives [2, 6, 7].

## 2. WHAT IS THE PURPOSE OF CAPITATION?

It is important to keep in mind that the imperative driving most capitation systems is that of securing control of expenditure. If the level of health care expenditure were seen to be unproblematic, then the interest in setting prospective budgets, and therefore in developing capitations, largely disappears. Under such circumstances, there is little incentive to move far from the relatively straightforward (albeit highly inefficient) fee-for-services approach to funding, possibly with added incentives to treat 'underserved' sections of the population. However, given that expenditure control is of concern, and that prospective budgets must therefore be set, the question arises: why use capitations? There are two principal reasons, relating to equity and efficiency.

The equity arguments tend to reflect a requirement to secure equal access to health care (for equal health needs) and/or equal payments in the form of premiums or taxes (for equal income or wealth). Explicit equity objectives underlying health care capitations are most frequently found in centrally controlled public sector health care systems. For example:

'… to monitor progress towards the achievement of fairness in health funding.' (New South Wales Resource Distribution Formula, [8])

'… to overcome territorial inequalities in social and health conditions.' (Italian regional resource allocation mechanism, [9])

'… to divide up funding equitably between the four … regions.' (New Zealand Population Based Funding Formula, [10])

' … to secure equal opportunity of access to those at equal risk.' (English resource allocation formula, [11])

These objectives reflect two broad types of objective: to secure equity of health, and to secure equity of access to health care. The former objective is largely rhetorical, and few practical attempts have so far been made to adjust capitations in order to address inequalities in health (an exception is the modest adjustment made for aboriginal ethnic groups in the New Zealand Population Based Funding Formula). In practice, however, the objective of seeking to offer equal access to health care to those in equal need has been the health objective underlying almost all such schemes.

A slightly different approach to equity underlies more devolved systems of health care, of the sort found in Scandinavia, where local governments are responsible for organizing the majority of local health care. Here, the central government supports health care expenditure with grants in aid, the principal objective of such grants being to enable local communities to deliver some 'standard' level of health care whilst levying some standard rate of local taxation. The equity objective relating to access then remains similar to the centrally controlled state schemes. For example, the Finnish State Subsidy System seeks to secure 'equality of opportunity of access for equal need' [12]. However, local communities might then enjoy a certain amount of freedom as to the level of health care they choose to offer, the associated local taxes they levy, and the user charges (copayments) they levy. Thus such schemes seek implicitly to offer equity of *opportunity* both in terms of access to health care and in terms of levels of payment (in the form of local taxes and charges).

Implicit equity objectives on the payment side also underlie some of the schemes of social insurance found in northern Europe. For example, the risk adjustment scheme in use in German health care has the predominant objective of reducing variations in insurance premiums between plans [13]. Less explicit adjustment schemes used in Japan and France, where a citizen's choice of insurance plan is limited, appear to have similar objectives [14].

Efficiency objectives are implicit in most capitation schemes, in the sense that all such schemes are embedded within a budgeting system which seeks to make purchasers and providers more responsive to issues of the costs and benefits of their actions. However, efficiency considerations tend to be most conspicuous in the capitation schemes used for health care systems with competitive health plans, such as those found in Belgium, Germany, Israel, the Netherlands, Switzerland, and the United States Medicare system. In such systems there is usually a legal requirement for plans to set premiums which are independent of a member's health status, or the number of dependants covered by the insurance. Furthermore, if premiums are income-related (as for example in the Netherlands or Germany) plans would – if unconstrained by regulation – wish to recruit high income members in preference to otherwise identical low-income citizens, and members with low numbers of dependants in preference to those with large dependent families.

This situation gives competitive health plans a strong incentive to 'cream-skim' healthy, young, rich citizens, with low numbers of dependants. That is, they have an incentive to scrutinise potential members to assess whether or not their expected annual costs exceed their capitations, and to reject applications for whom this is the case. Even if 'open enrolment' is stipulated (under which a plan must in principle accept all applicants) Newhouse [15] shows how plans can effectively deter high risk applicants, or encourage high risk members to leave the plan. If left uncorrected, cream-skimming would lead to increasing inequalities in premium rates and profit levels between plans that practised cream-skimming and those that did not do so. In the extreme, it might lead to certain sections of the population being unable to find insurance.

In this context, it is worth noting that many of the systems of 'managed competition' between health plans are highly regulated, and in practice offer the plans little scope to secure efficiency improvements from providers, who continue to be reimbursed on a fee-for-service or national standard fee basis. This lack of leverage in pursuing provider efficiency increases the incentive for plans to target their energies either towards the socially wasteful activity of cream-skimming, or towards the inefficient practice of quality skimping (for example, delivering less than the socially desirable level of care to high needs patients). In these circumstances, the purpose of the risk adjustment scheme is to seek to reduce the manifest inefficiencies that emerge.

This review is not directly concerned with the incentives that emerge in a competitive health care insurance market, and so for the most part will put to one side the many interesting efficiency issues that emerge when seeking to implement such a market. More detailed discussion of these issues can be found elsewhere [2, 6, 7, 16-20].

The policy prescription of capitation emerges from both the equity and efficiency arguments sketched above. Essentially a capitation seeks to answer the question as to how – given that health care expenditure is to be constrained – the limited resources available should be distributed between health care plans. The purpose of a capitation is to ensure that plans should receive the same level of funding for people in equal 'need' for health care, regardless of extraneous circumstances (such as area of residence and level of income). A well designed capitation system may in many circumstances be able to address both efficiency and equity considerations of the sort described above.

## 3. SETTING CAPITATIONS

Once the principle of allocating funds on the basis of capitation has been established, the question arises: how are those capitations to be derived? In answering this question, three fundamental choices must be made: the global amount of finance to be distributed for the service in question; the factors to be incorporated into the capitation; and the weights to be placed on those factors. The first consideration – the global sum of money available – is principally a political decision, and beyond the scope of this paper. We therefore concentrate on the choice of factors and the weights to be attached.

We can think of the capitation for a given individual as that person's relative expenditure *needs*, and the characteristics to be taken into account in calculating those needs as *needs factors*. The general principles that should be applied when choosing needs factors should be that *ceteris paribus* they represent demonstrably material influences on the need to consume the service under consideration. This raises the important question as to whose judgement should be used in deciding what constitutes 'need' for a particular health care service. Such judgements might be principally judgmental For example, the methods of the Resource Allocation Working Party [21] used for many years in the English NHS used standardized mortality rates as the basis for allocating funds, a method which was consistent with common sense, but which was based on fragile empirical evidence.

The broad principle that informs most recent work on capitation funding is that the main yardstick for deciding whether a putative 'needs factor' should be used as a basis for capitation is whether it explains actual spending patterns amongst plans in a statistically significant manner. That is, the actual spending behaviour of the health care sector is used to infer appropriate needs factors. Of course this means that it may not be possible to accommodate some aspects of so-called 'unmet' need within the capitation methodology. Unmet need can be considered under two headings: general and specific. General unmet need arises when the services provided are considered inadequate to meet expected standards for the population at large, perhaps because of inadequate aggregate funding. In these circumstances, the usual assumption is that the organization under scrutiny will nevertheless allocate spending to citizens in proportion to need, so that its spending pattern offers useful information on the *relative* needs of recipients of services. It is therefore assumed that there is no systematic discrimination against classes of individuals.

Specific unmet need, on the other hand, arises when particular groups within the population – such as ethnic minorities, those living in rural areas, or patients with particular conditions – are not receiving the services to which they are entitled, when compared with the general pattern of utilization within the population as a whole. Under these circumstances, the use of empirical spending patterns to infer needs is problematic, as the models developed will perpetuate the implied inequity. However, even if need currently judged to be unmet were to be incorporated in some way into a capitation system, it is not clear how this adjustment would encourage recipients to direct the extra resources to the intended targets. We would argue that - without additional mechanisms to encourage redirection of resources – mere

adjustment of the capitation cannot secure such changes. Analysis of actual current patterns of service delivery to derive capitations in most circumstances therefore appears to offer the most appropriate methodology for setting capitations, and we found few examples of capitation schemes which were not based on empirical data.

There remains however the question of which organizations should be examined to infer needs factors. In general, it has become the practice almost universally to use the behaviour of all relevant health care plans as the basis for inferring needs factors. In some loose sense this implies an interest in seeking to infer (say) the national average response to population characteristics to form the basis for capitations. Thus, plans with varying levels of efficiency and varying policy priorities may be included in the analysis. In principle, there is no reason why this approach should be adopted. For example, if the central funder were to judge that a particular subset of health plans were delivering services in a particularly efficient and appropriate manner, they might legitimately choose to use spending patterns amongst those plans alone to inform capitations. Of course this presumes that the situation within the chosen plans could then be extrapolated to the entire population of plans to whom funds are to be distributed.

In the extreme, use of actual health care spending patterns to infer needs factors would result in simply replicating existing spending patterns as the basis for capitations, an outcome which would defeat the purpose of capitation. Rather, the intention is to model the level of expenditure that would arise given some standard set of circumstances. From a statistical viewpoint, this suggests that developing statistical models which seek to maximize explanation of existing spending patterns is not necessarily a desirable objective in itself. Rather, the intention should be to explain variation caused by *legitimate* (needs) factors, and to ignore variation caused by irrelevant factors such as variations in local efficiency levels, accounting methods or policy choices. In order to distinguish these irrelevant factors from legitimate needs factors, we call them *illegitimate* (non-needs) factors, although the literature often refers to them as supply factors. In using this expression it is important to note that we are not implying that local influences on expenditure are necessarily illegal or undesirable. We are merely indicating that – for the purposes of deriving a general capitation – their influence on expenditure patterns should be ignored if at all possible.

Whether a factor is considered ‘legitimate’ may be a matter of the policy context within which the capitation scheme is embedded. This consideration is particularly important in relation to provider costs. In England, the tradition has been to assume that health plans are unable to control general input prices caused by local economic factors, and so some adjustment is made for such variations using general wage data and land prices. However, every effort is made to avoid use of health sector prices as the basis for an adjustment to capitations, as these can be influenced by local health plan policy. On the other hand, the US Medicare system makes an unadjusted reimbursement for variations between counties in *per capita* expenditure on health care, presumably on the grounds that such variations are – for whatever reason – beyond the control of health plans. Such issues have been the subject of strong debate within competitive health care markets (such as Belgium and the Netherlands), where the extent to which plans can control the supply of local physicians and provider prices is the subject of some dispute [22, 23].

There is furthermore a need to avoid use of factors which may be vulnerable to manipulation by the recipient agencies, or that create perverse incentives. For example, a history of previous inpatient utilization is a good predictor of current utilization [24]. Indeed the new risk adjustment system for Medicare to be implemented in 2000 uses a 15 point ‘Diagnostic Cost Group’ scale, based on the diagnosis code of recent hospital episodes, as an important element in setting capitations [25]. However, use of previous utilization may often be ruled out as a suitable capitation factor because it is vulnerable to manipulation by providers, and

may create an incentive to offer more care than is strictly necessary, or to distort reports of diagnosis, in order to attract higher capitations in the future. Indeed, in the extreme case where past expenditure is used as a crude predictor of future expenditure, the system of financing effectively reverts to one of full retrospective reimbursement.

The selection of needs factors to be considered in a health care capitation has often been a highly complex and controversial process. At least six reasons can be put forward for this:

- relevant data are often in short supply;
- research evidence on appropriate needs factors is sparse, dated or ambiguous in its implications;
- there is great difficulty in establishing the extent to which a particular needs factor is independent of other needs factors, that is, in handling covariances between needs factors;
- it is very difficult to disentangle legitimate needs factors from other policy and supply influences on utilization;
- it is often difficult to identify the health care costs associated with a proven needs factor;
- the recipients of public sector budgets often feel they have a clear idea about which needs factors will favour their area, and so will seek to influence the choice of needs factors through the political process.

There are essentially two approaches to identifying needs factors: normative and empirical. Under the normative approach, needs factors are selected on the basis of epidemiological and other scientific evidence. Under the empirical approach, needs factors are selected on the basis of a proven association with health care spending. The latter approach dominates capitation methods currently in use.

Once needs factors have been identified - in whatever fashion - weights must be attached to them which reflect their relative influence on the need to spend. This may entail simply identifying the average expected health care expenditure for a citizen with certain characteristics (age, sex, ethnicity, etc.). Of course such methods require the necessary individual level data to be available. Where only aggregate data are available, the tendency has been to rely on the results of statistical methods such as regression analysis to identify weights. We have found that such analyses have been performed with varying levels of refinement and statistical rigour. In practice data limitations have heavily influenced the methods used.

Whatever method is used, it is important to recognize the limitations of any capitation system. Newhouse *et al* estimate that it is possible to predict – at the very most – 20 percent of the variance in annual expenditure on health care for individuals [26]. The remaining 80% is the subject of entirely random fluctuation. Age and sex can explain only a small fraction of the total variance amongst individuals (typically less than 1%). The introduction of additional individual factors, such as employment status and housing tenure, can offer useful additional explanatory power. However, to date, major further gains in explanatory power has been achieved only by incorporating measures of previous health care utilization or health status, in the form of professional diagnosis, self-reported morbidity, previous inpatient spells, previous health care expenditure or previous hospital diagnosis [27-29].

One of the implications of the poor predictive power of most practical capitation system is that there is a limit to which meaningful budgets can be devolved to health plans covering small populations (such as under the now defunct system of general practitioner fundholders in England). Martin *et al* demonstrate the dramatic increase in budget risk confronted by plans covering small populations, and recommend a number of managerial devices for managing such risk [30].

In considering the data limitations encountered in most systems, it is important to note that – in principle – the personal (or plan-wide) factors on which any risk adjustment is to be based should incorporate only characteristics that are universally recorded (across all plans in receipt of funds), consistent, verifiable, free from perverse incentives, not vulnerable to manipulation, consistent with confidentiality requirements, and plausible determinants of service needs. In practice, this severely limits the choice of variables, as limited information which conforms to such criteria is available on the joint characteristics of individuals. In the UK, available personal characteristics are confined to age and sex. Some countries – most notably Sweden – have a much larger set of data available on individual citizens, incorporating issues such as welfare and employment status, housing tenure and marital status. And some countries have universal access to certain aspects of patients health care utilization records.

Because of the limitations associated with individual level data, many risk adjustment schemes resort to the use of more aggregate data relating to the plan as a whole. However, although this may offer access to considerably more data, even then there may be limitations. In the UK, the decennial Census of Population - the principal source of such aggregate information – presents only a limited number of 'standard' contingency tables, and quickly becomes out of date. Alternative sources of information, such as social security data, homelessness data, school pupil data, morbidity data and so on, may to varying extents be vulnerable to manipulation or inconsistently recorded across health care plans, and therefore may be judged unsuitable for capitation purposes.

The considerations noted above imply that complex statistical and econometric considerations surround the development of capitations based on empirical data. In principle the methods used should be able to accommodate serious data limitations, to distinguish between legitimate and illegitimate sources of variation in utilization, and to offer results that are statistically robust and readily implemented as a capitation formula. As we shall indicate in the next section, most current methods use fairly rudimentary statistical methods, and few have paid a great deal of attention to the above criteria.

## 4. FINDINGS

In this section we summarize our findings, which are described more fully in Part B. The section describes the types of capitation scheme in place, the methods used to derive capitations, the factors used as a basis for risk adjustment, and approaches to risk management.

*Types of schemes*

Many of the broad principles underlying capitation are identical whatever system of health care is in place. It is therefore in many respects artificial to categorize the types of scheme in operation. However, it is helpful to consider two broad types of capitation scheme currently in use:

1. Schemes which seek to put an explicit capitation 'bounty' on the head of a potential member of a health insurance plan. Such schemes are required in health care systems with competitive health insurance. A plan will usually be obliged to accept all applications for enrolment, but may be able to employ numerous indirect mechanisms to deter potentially bad risks or to encourage good risks. The principal purpose of risk adjustment in these circumstances is to minimize the incentive for such cream-skimming by seeking to minimize the variation between capitation and expected expenditure. The principal focus of such mechanisms is therefore on efficiency issues relating to the operation of the insurance market.

2. Schemes which seek to adjust for different health care needs in captive populations, such as local government areas or employee insurance schemes. Such schemes are most common where the principal purchaser of health care is the public sector. The risk adjustment mechanism may be directed at securing equal funding for equal need (as hitherto in the NHS) or at providing equal state subsidy for equal need (as in many Scandinavian systems, where local government is the principal organizer of health care). The principal focus is therefore on equity issues, in the form of offering equal levels of care (or the potential for equal levels of care) for citizens regardless of the health plan in which they are forced to enrol.

In general, the bounty schemes use simpler methods and have been less adventurous than the population schemes. This may reflect the lack of data on which capitation can be based, or may be the result of the more complex legal environment within which the scheme must operate. Typically, adjustments are confined to age, sex and disability or welfare status. However, several bounty schemes make a crude adjustment for area of residence, albeit with no attempt to adjust for supply variations. And increasing interest is being shown in use of previous health care utilization as a possible risk adjuster (as in the new Medicare+Choice scheme to be introduced in 2000). An exception to the general principle of caution amongst bounty systems is the risk adjustment formula in use in Belgium, which makes use of a variety of variables describing the aggregate social characteristics of a plan's population.

The population schemes have been far more adventurous. They have sought, using a variety of methods, to link spending needs to a wide variety of social and demographic variables. Perhaps the apotheosis of this approach is represented by the matrix of capitations developed in Stockholm County, and shortly to be used at a national level in Sweden [30]. This extends the familiar age/sex capitations to include variables such as marital status, housing tenure and employment status, as well as previous health care utilization. It is made possible by the comprehensive personal record of social circumstances and health care utilization maintained for all Swedish citizens.

Table 1 (page 24) summarizes the schemes examined in this study. It indicates the individual level and aggregate data used for setting capitations.

*Methods of analysis*

Almost all capitation schemes are based to a large degree on empirical data, and rely predominantly on analyses of existing patterns of health care utilization. There are some exceptions. For example, the current Italian and Scottish systems rely to some extent on standardized mortality ratios as a needs adjuster, without direct reference to the link between SMR and utilization. And in Norway the composite index of needs used to distribute central grant to counties has been developed using a mixture of empirical evidence and political judgement.

As noted above, the use of historical utilization data as the basis for capitations presumes that there is no systematic unmet need within the healthcare system. Clearly if this is not the

case, then empirical data must be amended to take account of under-utilization by the relevant population. Few systems make such an adjustment. An exception is the New Zealand formula for personal health care, in which an explicit adjustment is made to take account of the fact that the Maori population is believed to underuse health care facilities.

At the opposite end of the spectrum to unmet need is the possibility of 'supplier-induced demand', leading to higher utilization amongst groups with particularly high access to medical care. This possibility has been the subject of some concern. For example, in Belgium there has been considerable debate over whether to retain physician supply in the regression equations used to distribute funds to health plans [32]. The outcome has been that it has been excluded, meaning that health plans are not compensated for variations in physician supply available to their beneficiaries, even though the plans may have no control over the consequent variation in utilization. In other schemes, such as those in force in the Netherlands and US Medicare, variations in local expenditure have been included in the formulae, even though there may be an element of supply effect that causes some of the variation.

Associated with this issue is the need for capitation setting mechanisms in principle to adjust for inescapable variations in costs between health plans. Many schemes use standard DRG costs as the basis for measuring utilization in order to avoid some elements of local price variation. Others, such as those in Northern Ireland, Finland, New South Wales, New Zealand and Scotland, make adjustments for higher costs of delivering some services in rural areas. The US Veterans Equitable Resource Allocation scheme makes an adjustment on the basis of the comparative level of wages paid by their providers (an approach which has been criticized for rewarding inefficiency [33]).

Risk adjustment processes employ two broad approaches to setting capitations: a *matrix* approach and an *index* approach. Under the matrix approach, one or more dimensions of need (such as age, sex, ethnic status, disability status, etc.) are used to create a grid of capitations, in which each entry represents the expected annual health care costs of a citizen with the associated characteristics. Thus the matrix might comprise (say) eight age categories, two sex categories, three ethnic status categories and two disability status categories, giving rise in its unadulterated form to 8x2x3x3 = 96 cells, for each of which would be required estimation of a capitation.

Several schemes use a matrix approach based on age alone (France, Israel) or age and sex (Germany, Switzerland). An example of a more refined matrix method, employing measures of age, sex, housing tenure, employment status and marital status, is the Stockholm approach noted above. For empirical estimation purposes, the matrix approach usually requires a substantial database of individual level data for which all the relevant needs factors are recorded, and for allocation purposes it requires universal and reliable recording of individual level data amongst health care plans. Other matrix schemes are found in Alberta, the Netherlands, New Zealand and US Medicare (see Part B).

Statistical or judgmental methods can be used to reduce the number of cells employed within the matrix . For example, in the Netherlands, age (19 categories), sex (2), urbanization (5) and employment/disability status (5) are used as the basis for capitations, implying the need to estimate 19x2x5x5 = 950 capitations. In practice the problem is reduced by setting a rudimentary matrix of capitations for age and sex (19x2 = 38 cells). It is then assumed that the impact of urbanization and employment/disability status is independent of age and sex. The dimension of the problem can then be reduced considerably by assuming (say) that the same 'urbanization' factor applies to all citizens in rural areas, regardless of age and sex. This means that just 5 urbanization and 5

employment/disability factors need to be defined, in addition to the 38 age/sex capitations [34].

An alternative approach to reducing the dimension of the matrix problem is to combine adjacent cells which are either very sparse or which show little variation in capitation. This is the method employed in Stockholm County.

Under the index approach, aggregate measures of the characteristics of a plan's population are combined to create an index which seeks to indicate the aggregate spending needs of a population. An example is the Belgian risk adjustment scheme, which employs a series of such indices based on factors such as demography, mortality, population density, proportion unemployed, proportion disabled and housing quality [23]. The use of the index approach opens up the potential for an enormous increase in the data that can be used as the basis for capitations. In particular, where plans are based on geographical entities, Census data become available as the basis for setting expenditure targets.

A new problem emerges when relying on such aggregate data, in the form of the ecological fallacy. This is the possibility of identifying a relationship between a putative needs factor and health care expenditure at the aggregate level which does not hold at the individual level (the focus of capitation methods). Most analysts seem to have been aware of the potential for this problem, and many have sought to minimize it by using disaggregate data wherever possible, but are often constrained by data limitations. The English approach to identifying needs factors appears to be the most technically advanced in this respect (see Part B), and has been tested in Finland, Northern Ireland, Quebec and Scotland.

Several schemes use a hybrid approach. Preliminary capitations are based on a rudimentary matrix (based, say, on age and sex). The entire matrix is then adjusted by an index specific to each plan. This is of course the method used in England, which sets rudimentary capitations on the basis of age to which is applied a further adjustment based on an index of health authority spending needs. The method is also applied in one form or another in New South Wales, Finland and Italy.

In summary, a variety of methods have been employed to infer capitations, which – although a distinction is in many ways artificial – can loosely be divided into matrix methods, based on individual data, and index methods, based on aggregate data. Almost all are based on existing patterns of resource use. A major problem is distinguishing between legitimate (needs) effects and illegitimate (supply) effects on utilization. Although widely recognized, there have been few serious attempts to address this issue outside of the UK. Use of the index approach can introduce the additional problem of the ecological fallacy.

*Factors included in risk adjustment formulae*

Numerous factors have been incorporated into the schemes described in this paper. See Part B for details. The choice of many – if not most – appears to have been influenced more by availability of data than by compelling evidence of a link with health care expenditure needs. This section summarizes the findings. It is important to note that, although a factor might be included in a capitation formula, it may not necessarily play a particularly strong role in influencing the allocation of funds.

1. Demography

Only two of the risk adjustment mechanisms (Spain and the US Veterans Administration scheme) failed to take some account of demographic factors in the form of age and sex groups, although a variety of levels of aggregation have been used. In Spain, a crude *per capita* allocation is used – it seems – because of the political impossibility of implementing a mechanism based on consensus between the regions which is more sensitive to spending needs. The US Veterans Administration scheme rejected use of an age factor because the demographic profiles of its recipient plans were broadly similar.

2. Ethnicity

Several schemes make an explicit adjustment for a citizen's ethnic group, treating ethnicity in the same way as age and sex, effectively making it a third dimension of demography. Examples are the use of a three way classification (aboriginal, Torres Strait Islander, other) in New South Wales, a similar scheme (Maori, Pacific Islander, other) in New Zealand, and an aboriginal category in Alberta. These schemes make very large adjustments for small but highly disadvantaged ethnic groups. It is noteworthy that Stockholm County rejected use of ethnic status in its risk adjustment mechanism because it is believed that Swedish immigrant communities under-use services, and so might be disadvantaged within a scheme based on empirical measures of utilization.

3. Employment/disability status

Several mechanisms (for example, The Netherlands, US Medicare, New Zealand, Alberta, Northern Ireland) use a statutory measure of employment and/or disability status, such as social security categories, as the basis for a risk adjuster. For example, the Dutch scheme uses five categories: employed, permanently sick, temporarily unable to work, unemployed, pensioner. These indicators have the advantage that they are universally recorded and are regularly updated. Their principal disadvantages are that they are not specifically designed for capturing variations in health care needs and that they are vulnerable to systematic mis-recording or manipulation. Furthermore, they are at their weakest within the population for which risk adjustment is most important – those of pensionable age.

4. Geographical location

Geography may have an important influence on expenditure for three reasons: variations in need (not captured by other factors); variations in the extent to which need is expressed (in the form of utilization); and variations in local health care supply and policy. Disentangling these sources of variation on health care costs is a profound problem.

Several capitation schemes make quite marked adjustments on the basis of geographical location. For example, the US Medicare scheme adjusts on the basis of average health care costs by county of residence, leading to large variations in the basic capitation. The Dutch risk adjustment scheme uses five categories of 'urbanization', for which the capitation can vary (say) from minus 11% (rural) to plus 18% (heavily urban) in specialist health care. No attempt is made to determine whether some of the variations in costs might be due to variations in supply. The assumption appears to be that health plans are unable to control such variations in costs, and so must be appropriately reimbursed.

More considered treatments of cost variations can be found in certain public sector schemes. Examples include Finland (which pays increased capitations to 'archipelago' and remote municipalities) and New South Wales and New Zealand (a supplement for remote communities). The schemes in force in Scotland, Wales and Northern Ireland make some adjustment for the higher costs of delivering community health and ambulance services in rural areas. In England there are large variations in labour and land costs between regions, and the English capitation scheme therefore makes an adjustment for variations in provider costs.

As well as a cost adjustment, the New South Wales Resource Distribution Formula uses a generic needs index which includes a measure of rurality. The Belgian formula uses a measure of population density, though the rationale for its use in the formula is not clear.

5. Morbidity and mortality

Mortality rates (crude and standardized) are used in a number of schemes, such as those in operation in New South Wales, Belgium, Wales, Scotland, Northern Ireland, Italy, New Zealand and Norway.

Morbidity is in some cases incorporated using statutory measures of permanent disability, such as those in use in Belgium, Finland, the Netherlands, US Medicare. The Northern Ireland formula for acute care includes a measure of low birth weight in infants.

The most adventurous use of morbidity data can be found in the US Medicare+Choice scheme to be introduced in 2000. This uses what is known as a Principal Inpatient Diagnostic Cost Group (PIP-DCG), which indicates the most severe inpatient diagnosis experienced by the citizen over a one year period. Each citizen is allocated to one of 16 PIP-DCG categories of increasing severity, and capitations adjusted accordingly. Other schemes (most notably the Netherlands) have considered use of previous diagnosis as a needs adjuster, but have so far not implemented. A recent enhancement of the Stockholm formula uses previous utilization as a basis for disaggregating citizens into low and high need categories.

An interesting alternative approach to capitation is reported from the Netherlands [35]. This study notes the very much higher expected health care costs associated with death (on average 15.3 times the expenditure incurred by survivors). It therefore tests the implications of retrospectively reimbursing insurers with a revised capitation for members who die. The researchers find that the improvement to capitations would be small, principally because of the small numbers of deaths, and conclude that this is not a fruitful line of enquiry.

6. Social factors

Numerous social factors can be found in risk adjustment schemes, their use being predominantly opportunistic (that is, usually based on data availability rather than a direct link to health care needs). Examples include:

Homelessness (New South Wales)
Educational attainment (New South Wales)
Unemployment (Belgium, the Netherlands, Stockholm)
Welfare status (Alberta, New Zealand, Northern Ireland)
Marital status (Norway, Stockholm)
Family structure (France, Norway)
Housing quality (Belgium)
Housing tenure (Stockholm)

Social class (Stockholm)
Cohabitation (Stockholm, Northern Ireland)
Income (Finland)

7. Other factors

An adjustment is made for estimated private sector utilization in New South Wales.

*Risk management*

It is important to note that implementation of many schemes has been extremely cautious. There has been a general reluctance to move rapidly from historical levels of expenditure, so most allocations derived using the methods described above are heavily damped to avoid large fluctuations in budgets. For example, some schemes guarantee that no allocation will be cut in real terms, and merely direct growth money to plans currently under their expenditure targets. The Norwegian scheme is deliberately heavily weighted by previous activity, and the prospective allocations play only a subsidiary role in determining allocations. Some schemes (most notably the Netherlands) have in place an elaborate retrospective 'safety net' to offer some protection to plans from variations in expenditure away from budgets. Scandinavian schemes allow local governments to vary spending levels away from national targets, with marginal expenditure being raised from local taxation or user charges. Many competitive insurance schemes allow plans to accumulate reserves, which can be used to absorb surpluses and deficits and which therefore spread variations in expenditure across years. And there are other schemes (Italy, Spain) where there exist few real sanctions for overspending, so that the budgets are in practice rather notional.

As well as these aggregate risk management methods, there exist a number of mechanisms for protecting health plans from excessive unpredicted variations in expenditure on individuals, some of which have been fully implemented, others merely considered. These can be summarized as:

- stop loss arrangements, where the central funder assumes responsibility for expenditure on an individual once it rises above a certain 'catastrophic' limit;
- cost sharing, where health plan and central funder share costs, perhaps for all expenditure, or perhaps only once it exceeds a certain threshold for an individual;
- pooling of high risk patients, where certain categories of high risk patient are effectively removed from the capitation scheme;
- carving out certain services, to be treated differently from general health expenditure.

These and other arrangements imply important shifts in risk between health plans and central funder. They are likely to have profound implications for the behaviour of health plans, and it is important that the methods used for setting capitations are not viewed in isolation from the associated risk management schemes.

## 5. SUMMARY AND RECOMMENDATIONS

Capitation is without doubt here to stay. There is a remarkable degree of unanimity that – whatever the structure of the health care system – a policy of cost containment and devolved responsibility for health care entails the need to set prospective budgets on the basis of capitations. The question is therefore not whether to set capitations, but how to do so.
To some extent the preoccupations of capitation schemes will be determined by the health care systems they seek to serve. For example, systems with a competitive insurance market have the principal objective of minimizing cream-skimming, and must focus on the

individual, while systems with captive insurance markets tend to be concerned more with avoiding perverse incentives at a population level. Thus use of prior utilization data may be considered appropriate in the first type of system but unacceptable in the second.

The experience summarized in Table 1 indicates that there exists a wide variety of approaches to setting capitations. To a large extent the systems in use have been chosen on the basis of expediency, most notably in being strongly conditioned by the nature of the data available to policy makers. Thus many schemes have been constrained to the use of crude age and sex adjustments, in the full knowledge that such data are woefully inadequate, but that they are all that are available, and are better than nothing.

Other schemes have gone down the route of disaggregation into several programmes of care and apparently impenetrable formulae. This approach has the rather curious advantage that the lack of transparency makes it difficult for a competitive health plan to assess whether or not a prospective member should be cream-skimmed! Moreover, if based on sound statistical methods, the incorporation of several factors into the capitation formula does improve the chance that the capitation scheme is distributing resources equitably. However, many of the complex systems in use (or proposed) suffer from the weakness of needing to use data that fail to conform to criteria such as being consistent, verifiable, free from perverse incentives, and not vulnerable to manipulation. There is therefore a danger that use of more complex systems introduces opportunities for strategic behaviour on the part of health plans.

This review has been prepared for the English NHS Executive, and therefore reflects the policy preoccupations currently prevailing. The lessons learned are nevertheless germane for all those seeking to implement risk adjustment mechanisms. The study has confirmed that – given the institutional and data constraints currently in force – the methods used for setting capitations in England are as methodologically advanced as anywhere in the countries surveyed. There are however many elements of schemes elsewhere which may offer opportunities for building on the existing methodology. We summarize them as follows.

1. We have little doubt that – if suitable individual level data were available – the matrix approach to setting capitation based on individual level data, as epitomized in the Stockholm model, is the most methodologically satisfactory method of setting capitations because it minimizes the ecological problem associated with the use of more aggregate data, although there is still need for caution in accommodating potential supply effects [36]. Imminent developments in information technology may lead to rapid increases in the availability of individual level data, and policy makers should in our view be ready to take the opportunity they offer and – if possible – to influence the form they take. **The scope for using individual level data for setting capitations should be examined, particularly in the light of possible future developments in data availability.**

2. The use of individual level prior utilization data, in the form of assessed health status, previous diagnosis, previous prescribing history and previous expenditure, has been tested extensively in the US and the Netherlands. This methodology is very important in competitive insurance systems because it dramatically reduces the scope for cream-skimming, and these benefits are felt to outweigh the perverse incentives it introduces to mis-report health status or to increase utilization. The benefits of its use in population-based capitation systems are more questionable. However, utilization data offer a rich source of additional information, and there may be elements of it which deserve further examination. For example, use of data relating to certain non-discretionary types of health care may be particularly germane. **The scope for using data on prior health care utilization as a basis for setting capitations should be examined.**

3. In the same vein, there may be scope for examining the extent to which it is possible to identify certain objective indications of health status which can be used as sensitive indicators of expenditure needs. In particular, several schemes treat certain chronically ill categories of citizen differently to the general population, and this approach appears to offer important scope for improving capitations. **The scope for using certain objective indications of health status as a basis for setting capitations should be examined.**

4. Fundamental to an examination of the suitability of a particular scheme is the issue of who carries the responsibility and who bears the risk for variations in expenditure from assumed capitations. Although many of the schemes examined appear very rudimentary, they are serving financing systems in which the budget holder does not necessarily bear a great deal of risk. This is often because – in one form or another – the central authority in practice bears a large part of the financial risk, either by partially reimbursing overspends or by renegotiating budgets. Alternatively the health plan may be able to meet overspends by varying premiums or local tax rates. In comparison, UK systems appear to place a lot of risk with the budget holder, with few comparable safety valves. There is therefore an argument for examining with some care the risk sharing arrangements in place in other countries. **Careful consideration should be given to the financial risk assumed by recipients of capitations, and whether the design of the capitation scheme needs to be amended to take account of such risk.**

5. Variations in the costs of providing a standard level of service have been a concern in a number of the schemes surveyed. The methodologies adopted have – on the whole – been rather rough and ready, and have addressed major sources of cost variation, such as extreme remoteness. There appear to have been few satisfactory attempts to distinguish between legitimate and illegitimate sources of cost variations. This is an area of research that may benefit from some fundamental conceptual study, and consideration might be given to commissioning such research. **There is a need for a fundamental conceptual study of how variations in the costs of providing a standard level of service should be treated.**

6. Many schemes – including the English – disaggregate services into a number of programmes of care. We recognize that this is often appropriate, given data inadequacies. However, such disaggregation runs the risk that it cannot satisfactorily model substitution of modes of treatment between one programme of care and another (for example pharmaceuticals and elective surgery). We feel that a desirable objective is to minimize the number of programmes of care modelled separately. **The tendency towards increased disaggregation of services in setting capitations should be reviewed, with a view to reducing the amount of disaggregation wherever possible.**

7. Simplicity is an objective underlying many capitation schemes. For example, the US VERA scheme critically examined the distributional implications of a variety of resource allocation methods, and chose to incorporate refinements only when their distributional implications were material [37]. The English system is amongst the most complex currently implemented, and would benefit from a thorough review as regards the materiality of some of the adjustments made. **A thorough review should be undertaken of the materiality of all adjustments made in setting capitations.**

After this review was commissioned, UK government ministers indicated an interest in changing the hitherto unchallenged equity criterion underlying capitation in England – of offering equal opportunity of access for equal need – to one of *contributing to the reduction of avoidable inequalities in health*. This change would introduce major issues that are beyond the scope of this report. However, it is worth noting that – although several capitation schemes purport to address such an equity criterion – in practice there is very little

evidence of serious attention being paid to how such a principle can be made operational. A modest but interesting exception is the treatment of Maori health in New Zealand (see part B).

Our initial reflections on the proposed equity criterion indicate that the general framework for setting capitations is unlikely to be greatly affected by any change, although there will clearly need to be extensive examination of what constitutes a vulnerable population group, how its additional expenditure needs can be calculated, and what mechanisms should be put in place to ensure any additional funds are spent on that population. However, the change of equity criterion would clearly shift the research priorities of ministers, and the above recommendations should now be viewed within the context of such a change.

The optimal solution towards making capitations operational depends on reconciling a number of objectives, amongst which might be included:

- To further society's objectives for health care.
- To seek to make capitations as sensitive as possible to legitimate health needs factors.
- To seek to make capitations as independent as possible from illegitimate factors.
- To maximize the availability of good quality data on which the capitations can be based.
- To minimize the dysfunctional incentives introduced by capitations.
- To lower expectations as to the solutions that capitations can offer.
- To design health care systems that are impervious to the limitations of capitation schemes.
- To minimize the costs of administering the capitation scheme.

Addressing successfully all of these issues is a demanding task. The schemes reviewed here offer a wide spectrum of experience and lessons. It is clear that none can in any sense be held up as a model, and that the most appropriate approach is likely to be heavily dependent on the institutional framework within which capitation must operate. We nevertheless believe that the accumulated experience reported here is likely to offer almost all designers of capitation schemes considerable food for thought.

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**Table 1: Summary of capitation experience in 19 countries**

| Country | Scheme | Plans | Individual level | Plan level | Other factors |
|---|---|---|---|---|---|
| Australia | New South Wales Resource Distribution Formula | 17 Area Health Services (geography) | Age<br>Sex<br>Ethnic group<br>Homelessness | Mortality<br>Education level<br>Rurality | Private utilisation<br>Cross-boundary flows<br>Cost variations |
| Belgium | National Institute for Sickness and Disability Insurance risk adjustment scheme | 100 sickness funds (competitive) | | Age<br>Sex<br>Unemployment<br>Disability<br>Mortality<br>Urbanization | |
| Canada | Alberta Population Based Funding Model | 17 Regional Health Authorities (geography) | Age<br>Sex<br>Ethnicity<br>Welfare status | Remoteness | Cross-boundary flows<br>Funding loss protection<br>Cost variations |
| Finland | State Subsidy System | 452 municipalities (geography) | Age<br>Disability | Archipelago<br>Remoteness | Tax base |
| England | Resource Allocation Formulae | 100 health authorities (geography) | Age | Mortality<br>Morbidity<br>Unemployment<br>Elderly living alone<br>Ethnicity<br>Socio-economic status | Cost variations |
| France | Regional resource allocation | 25 regions (geography) | Age | | Phased implementa-tion |
| Germany | Federal Insurance Office risk adjustment scheme | Sickness funds (employment / competitive) | Age<br>Sex | | Income base |
| Israel | National risk adjustment scheme | 4 sickness funds (competitive) | Age | | |
| Italy | Regional resource allocation system | 21 regional governments (geography) | Age<br>Sex | Mortality | Damping mechanism |
| Netherlands | Central Sickness Fund Board risk adjustment scheme | 26 sickness funds (competitive) | Age<br>Sex<br>Welfare/disability status | Urbanisation | Retrospective adjustments<br>Income base |
| New Zealand | Health Funding Authority | 4 regions (geography) | Age<br>Sex<br>Welfare status | Rurality | Phased implementa-tion |

| | | | | | |
|---|---|---|---|---|---|
| | Population Based Funding Formulae | | Ethnicity | | |

**Table 1 cont'd**

| Country | Scheme | Plans | Individual level | Plan level | Other factors |
|---|---|---|---|---|---|
| Northern Ireland | Health Board Allocation Formula | 4 health boards (geography) | Age<br>Sex | Mortality<br>Elderly living alone<br>Welfare status<br>Low birth weight | Rural costs adjustment |
| Norway | Local Government Finance System | 19 county governments (geography) | Age<br>Sex | Mortality<br>Elderly living alone<br>Marital status | Tax base |
| Scotland | Health Authority Revenue Allocation scheme | 15 health boards (geography) | Age<br>Sex | Mortality | Rural costs |
| Spain | Regional resource allocation system | 7 Comuni-dades Autónomas (regions) (geography) | | | Cross-boundary flows<br>Declining population adjustment |
| Sweden | Stockholm County hospital resource allocation formula | Urbanization | Age<br>Living alone<br>Employment status<br>Housing tenure<br>Previous inpatient diagnosis | | Phased implementa-tion |
| Switzerland | Federal Association of Sickness Funds risk adjustment scheme | Rurality | Age<br>Sex<br>Region | | Income base |
| USA | Medicare + Choice (from 2000) | Mortality<br>Elderly living alone<br>Welfare status<br>Low birth weight | Age<br>Sex<br>Disability<br>Welfare status<br>Previous inpatient diagnosis<br>County of residence | Labour costs | Phased implementa-tion |
| USA | Veterans Equitable Resource Allocation | Mortality<br>Elderly living alone<br>Marital status | Dependency (x2) | Mortality | Sparsity cost adjustment |
| Wales | Health Authority allocation formula | Mortality | Age<br>Sex | | |

# PART B: Summary of Experience in 19 Countries

This part of the report gives details of the capitation schemes examined in nineteen developed countries. Given the severe time and resource constraints under which this report was written, it has proved impossible to be comprehensive. Rather, we have sought to illustrate the principal preoccupations of different countries and the differences in the methods used. We have emphasized implemented schemes rather than proposals or speculative research, but where it has been readily accessible we report research findings.

*CONTENTS*

## AUSTRALIA

Australia is organized on federal principles. The Commonwealth (the federal government) funds about two thirds of health care expenditure by means of a hypothecated income tax, known as the Medicare levy. Under Medicare the Commonwealth has a responsibility to ensure universal access to medical care. Outside of the hospital sector, providers are principally private practitioners who are reimbursed by Medicare on a fee for service basis. The public hospital sector offers free care to all citizens, and is funded jointly by Commonwealth and State governments. The responsibility for expenditure control and arranging contracts with public hospitals (implicit and explicit) lies with the individual states.

The principal tool for cost control in the hospital sector has been the use of DRGs. Several states have experimented with geographical capitation (for example, Queensland and Western Australia). However, only New South Wales currently uses such explicit resource allocation methods.

The New South Wales approach has been developed and refined over a number of years, and the following description is based on its latest manifestation (1998/99). The Resource Distribution Formula (RDF) is 'used as a planning tool to guide the allocation of funding to the 17 Area Health Services and to monitor progress towards the achievement of fairness in health funding'. It seeks to indicate an equitable share of available resources. Thus the claims made for the RDF are relatively cautious.

A number of principles are set out for guiding the development of the RDF, including the need to incorporate the assessed needs of the population, variations in the costs of delivering care, and the use made of private health care. In addition, the RDF is expected to reflect the need for Areas to improve the health status of priority population groups, notably Aboriginal people and homeless people. It is noteworthy that the Areas manifest enormous differences in socio-economic and settlement patterns.

The methods used are as follows. A global annual budget is determined and distributed between nine components (health care programmes), as shown in the table. For each component, certain expenditure unrelated to population size is first deducted. The remaining expenditure is then distributed between Areas using an appropriate capitation methodology. The resultant allocations are summed to obtain an Area's total allocation. An adjustment is made for cross-boundary flows.

**Distribution of health care expenditure between programmes**

| ***RDF Component*** | ***%*** |
|---|---|
| Population health | 0.65 |
| Oral health | 1.40 |
| Primary & community | 6.94 |
| Outpatients | 10.07 |
| Emergency services | 5.18 |
| Acute inpatient | 57.40 |
| Mental health | 7.26 |
| Rehabilitation & extended care | 9.77 |
| Teaching and research | 1.33 |

The broad elements of each capitation formula are:

1. The population (usually weighted by age and sex);
2. An Aboriginality factor;
3. A homeless factor;
4. An adjustment for private hospital care;
5. A rurality factor.

An assumption about the Area's ability to raise revenue from private patient fees is also built into the formula. This is currently based on historical revenue patterns, but it is intended to move towards a better measure of revenue raising capacity.

Up to 36 age/sex categories are used for each service component, with the precise number of categories used depending on the nature of the service. Quantification of the age/sex weights is based on empirical data, and in a few cases judgement.

For population health, primary and community, outpatient and emergency services an adjustment is made for Aboriginal and Torres Strait Islanders. Each member of the resident population in this group by a factor of 2.5 compared to the rest of the population. The homeless adjustment is similar, but must be based on an estimate of the homeless population, to which a weight of 2.5 is also applied. Thus the effective populations used in the RDF are increased by these two adjustments (to the extent that an Area's population includes Aboriginal and Torres Strait Islanders and homeless people).

Central to the needs element of the RDF is a Generic Needs Index which has been developed at the University of Newcastle. It is defined as:

GNI = 97.51 + 0.4*SMR – 0.4*EDOCC – 0.9*RUR

Where SMR is the Standardized Mortality Ratio for ages under 70, EDOCC is an index of educational and occupational status, and RUR is a rurality index. The rurality index is based on four categories of settlement (remote, rural, major urban and metropolitan). Additional refinement was undertaken within each type of settlement. The generic needs index is based on a statistical analysis of variations in hospital utilization in 154 local government areas. 57% of the variation in utilization was explained by the model. The generic needs index varies from 82% of the state average (in Northern Sydney Area) to 168% of the state average (in Far West Area).

The generic needs index is used for most of the programme components. However separate needs indices have been developed for oral health. This weights the population according to age, rurality and ethnicity, on the basis of data from the National Oral Health Survey. In rehabilitation and extended care services, a 'blended need index' is applied to the age/sex cost weights. This comprises:

- The age adjusted rates of people living alone (weighted by 3);
- A socio-economic index of relative disadvantage (weighted by 2);
- A rurality variable (weighted by 1).

Details of this index are not given, but it is less redistributive than the generic needs index. The mental health component of care is currently based on historical expenditure.

The adjustment for private utilization occurs in the hospital component of care, and is required because the resource allocation methods used yield a measure of *total* expected hospital utilization (both public and private). Private health care by Area residents is

therefore costed (using standard DRG rates from hospital records) and where such care is considered to be a substitute for public sector care, the associated expenditure deducted from the Area allocation. Some damping is applied to allow for the possibility of the private sector inducing demand which would not have arisen in the public sector.

An adjustment is made for the supposedly higher costs of services in rural and remote areas, based on the observation that – throughout Australia – age-standardized rates of hospital admissions are 23-40% higher in remote areas than state capital cities. The Dispersion Costs Factor is based on an empirical analysis of the additional costs of care found in rural areas, after taking account of any variations due to age, sex and generic needs.

In addition, a negotiated sum is paid to remote Areas to compensate for the higher costs of running ambulance and other patient transfer services.

The Health Department has an ambitious programme of future research priorities which includes:

- Reviewing the generic need index;
- Refining mental health and oral health components;
- Refining certain age/sex weights;
- Refining the cross boundary flow adjustment;
- Reviewing the private care adjustment;
- Reviewing the treatment of revenue.

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**BELGIUM**

Organization of Belgian health care is in the hands of five mutualities with non-profit status and a single public sector insurance fund. The mutualities are comprised of coalitions of about 100 local sickness funds, with between 400 and 450,000 members. The local sickness funds and the public sector fund are open to all residents of a locality. Insurance is compulsory for all citizens, though there is free choice of sickness fund. Sickness funds must accept all applicants, and all must charge the same income-related premium. This is effectively a national tax collected by the central government, accounting for 36% of expenditure. There is in addition a very small premium collected by the fund, which can vary between funds. General taxation is the principal other source of finance (38%).

Equity and universal access are important principles in the Belgian health care system. There is therefore a compulsory level of basic health care, which nevertheless differs between two population groups. The bulk of the population (85%) is covered for both major risks (inpatient and long-term care) and minor risks (outpatient care and pharmaceuticals). The remaining 15% (principally self-employed) is covered for major risks only, though supplementary private insurance can be bought. All funds must offer the same level of basic health care insurance to the relevant population group. Mutualities take part in national negotiations over the levels of reimbursement for procedures and services. However, once these have been set, funds have little influence over the member's choice of provider or the prices charged by providers, which they appear to reimburse passively. Competition between funds is therefore confined to variations in supplementary services (which may be offered at attractive rates to certain population groups), geographical convenience and speed and accuracy of settling claims (Kesenne, 1996). In practice, citizens appear frequently to choose a fund on the basis of its ideological stance, and exhibit little inclination to change funds.

Clearly, if no risk adjustment were undertaken, the above arrangements would lead to grotesque variations in the financial positions of the different funds, depending on the demographic, socio-economic and income structure of their members. In fact, historically the funds had effectively been reimbursed for actual expenditure, offering no incentive for efficiency. However in 1995 a risk adjustment mechanism was introduced which seeks to allocate finance prospectively to the sickness funds in line with their expected spending needs. This scheme is administered by the National Institute for Sickness and Disability Insurance (INAMI), a government agency responsible for co-ordinating health policy.

The new arrangements were put in place by the Article 196 of the Royal Decree of 12 August 1994. This sought to allocate available funds to the mutualities according to the health care risks associated with their members. It introduced the notion of 'normative expenditure' $N_I$ for each mutuality i, which is effectively a needs adjusted spending requirement. Then if the total national budget available is B, the actual allocation to mutuality i is given by:

$$F_i = \frac{N_i}{B}.rB + \frac{E_i}{\sum_i E_i}.(1-r)B$$

where $E_I$ is the actual expenditure of mutuality i and r is a factor which weights normative expenditure relative to actual expenditure. Clearly if r=1, then the needs assessment alone would determine the allocation, while if r=0, the historical *proportion* of expenditure would determine the allocation. In practice, r was cautiously set to 0.1 in the first three years of

operation (1995 to 1997). The intention is that it should rise to 0.4 within a short time scale (2002).

In practice, the actual expenditure of a mutuality will in general vary from the allocation $F_i$. To date, mutualities have been held responsible for only 15% of any variation. That is, a mutuality in surplus can retain only 15% of its surplus (to be used as a provision against future deficits), while a mutuality in deficit must itself cover only 15 of the deficit. The intention is that this percentage should increase to 25% by 2002.

The formula in use to calculate normative expenditure $N_I$ must be based on scientific evidence, must be transparent and comprehensible to the users, and must be capable of being applied in a relatively straightforward fashion (DULBEA/KUL, 1997). The Royal Decree sets out a number of criteria that can be taken into account in setting normative expenditures including:

- The social and professional circumstances of a fund's members;
- The numbers of widows, widowers and orphans;
- The numbers of disabled members;
- The numbers of pensioners;
- The numbers of poor members;
- Demographic factors;
- Mortality rates;
- Degree of urbanization;
- Unemployment rates;
- Household composition;
- Revenue.

The formula currently in use has been developed by a team of academics from the Université Libre de Bruxelles and the Katholieke Universiteit Leuven. In the absence of individual level data, the researchers have developed statistical models linking the *per capita* expenditure of the 100 sickness funds to the characteristics of their members. Different models have been developed for population groups such as: the economically active; the retired; widowers and widows; invalids; and the economically active self-employed. Considerable care has been devoted to the development of the models, with attention being paid to issues such as theoretical acceptability, multicolinearity, statistical significance, heteroskedasticity, and model specification. The recommended models are documented in the researchers' report (DULBEA/KUL, 1997).

The dependent variable is the average costs of health care for the group in question. Potential explanatory variables include indicators of demography, unemployment, income, mortality, disability, and geographical data such as population density, an index of local housing quality, hospital beds per 100,000 population and a measure of local physician supply (rates per 10,000 population). An example of the results obtained is given using the weighted ordinary least squares regression for the economically active population in the following Table.

**Regression of expenditure on needs and supply factors, economically active**

| Variable | Coefficient | T statistic |
|---|---|---|
| Proportion of women | 24377 | 2.98 |
| Proportion aged 40-99 | 10856 | 2.71 |
| Proportion unemployed | 33214 | 5.17 |
| Proportion in public sector | 9919 | 2.76 |
| Mortality rate (crude, 4 years) | 1095614 | 2.52 |
| Proportion disabled | 26843 | 1.99 |
| Density | 334 | 1.58 |
| Physician supply | 1431 | 5.22 |
| Housing | 1163 | 5.15 |
| Constant | 508 | 0.11 |
| Adjusted $r^2$ | 0.848 | |
| Standard error | 217211 | |

This regression equation forms the basis for the allocation to each fund. Its normative expenditure is effectively based on the predicted expenditure arising from this model (although it should be noted that a rather convoluted methodology is employed to this end). Considerable debate occurred over whether to include the medical supply variable in the formula, as it can be argued that local supply is beyond the control of the sickness fund, given that insurers are not allowed to enter into bilateral agreements with providers. In the event it was (rather surprisingly) decided that the sickness funds should be held responsible for seeking to counteract supplier-induced variations in expenditure, and the variable was deleted from the final equation. (Note that the equation was not re-estimated omitting the supply variable, so the coefficients reported above were used.)

Models such as this were estimated for a total of 12 different groups of the population and expenditure categories. In general, different variables were selected for each model, but the principles of model development and selection were unchanged. The supplementary insurance scheme was treated separately from the basic scheme described here.

An important concern with the current Belgian system of risk adjustment is that the sickness funds are being given responsibility for expenditure over which they have no effective control, without adequate risk compensation. In particular, if they are unable to bargain bilaterally with providers, they are at the mercy of local supply conditions, and there is an argument therefore that supply considerations should be included in the formula. In the future, it is hoped that individual level data will become available, and that it will then become possible to refine the risk adjustment process. In the meantime, it is quite likely that the only feasible means of controlling costs is for the sickness funds to cream-skim healthier citizens for whom the capitation exceeds expected expenditure.

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## CANADA

Canada has a federal constitution, and comprises 10 provinces and two territories. Coverage of health care insurance is universal and comprehensive, with funding coming predominantly from public sector resources. The organization of health care is the responsibility of the province, subject to national minimum requirements. The federal government makes a uniform *per capita* contribution to finances for each province, representing about 40% of public sector finances.

Each province employs its own system of delivering and financing health care. Historically, the system has relied on fee-for-service for physicians, and bilateral negotiations between province and provider in the annual determination of hospital budgets. However, there have recently been moves towards the notion of some sort of internal market (OECD, 1995), and capitation schemes covering different aspects of health care are in existence or have been considered in a number of provinces. The Canadian health care system is well suited to the development of capitation methods, and it will be surprising if they do not become more widespread in the near future. A recent report assesses policy options in Canada, and is an invaluable source for details of current schemes in Canada (Hutchison *et al*, 1999).

One of the more ambitious schemes currently in use is the Population Based Funding Model in use in Alberta since 1997/98. This covers about 90% of all health care expenditure, and is used to allocate funds to 17 regional health authorities with average populations of about 160,000. Principles to guide the funding allocation methodology were established by the Minister's Health Services Funding Advisory Committee, which specified that 'the methodology should emphasize equity, simplicity, flexibility and transparency. Should there be a need to introduce compensating factors or adjustments to funding to a particular region, such factors or adjustments should be based on sound evidence, easily explained, and open to regular validation.'

The total provincial budget is determined annually at a political level. Certain province-wide expenditure is deducted. The remainder of the budget is split into seven expenditure 'buckets' or categories, as shown in the following table. The community care programme embraces public health issues such as promotion and prevention.

**Distribution of health care expenditure between programmes**

| ***Expenditure pool*** | ***Allocation 1998/99 ($m)*** | ***Percent*** |
|---|---|---|
| Acute inpatient | 939 | 46.4 |
| Acute emergency | 318 | 15.7 |
| Acute clinic | 65 | 3.2 |
| Acute day procedure | 66 | 3.3 |
| Long-term care | 405 | 20.0 |
| Home care | 149 | 7.4 |
| Community care | 82 | 4.0 |
| **TOTAL** | **2024** | **100.0** |

The funding model is based on good population data from the Population Registry, which (subject to some minor problems) accurately records the following details of every resident of the province: address, sex, age, welfare status and ethnicity. This enables the province to construct detailed population estimates based on the above characteristics on a particular date. There are five items deemed relevant to health care capitations: age, sex, two classes of low income ('welfare' and 'premium support'), and aboriginal status.

The following contingency table is then employed for capitation purposes. Notice that the aboriginal, welfare and premium support adjustments are applied only to those of working age. If a citizen is in more than one socio-economic category, he or she is placed in the highest relevant category, ordered as aboriginal > welfare > premium support.

**Structure of Alberta capitation matrix**

| Age | Standard | | Aboriginal | | Welfare | | Premium support | |
|---|---|---|---|---|---|---|---|---|
| | M | F | M | F | M | F | M | F |
| <1 | | | | | | | | |
| 1-4 | | | | | | | | |
| 5-9 | | | | | | | | |
| 10-14 | | | | | | | | |
| 15-19 | | | | | | | | |
| … 5 year bands… | | | | | | | | |
| 60-64 | | | | | | | | |
| 65-69 | | | | | | | | |
| 70-74 | | | | | | | | |
| 75-79 | | | | | | | | |
| 80-84 | | | | | | | | |
| 85-89 | | | | | | | | |
| 90+ | | | | | | | | |

This methodology gives rise to 28 aboriginal cells (containing 3.3% of the population), 28 welfare cells (3.6%), 28 premium support cells (12.0%) and 40 other cells (81.1%), giving a total of 124 mutually exclusive population groups.

The capitations for each cell are built up using empirical utilization data for each expenditure pool, which can be directly matched to all cells in the above matrix. The use of raw fee-for-service costs data has been avoided wherever possible, as these may be influenced by local supply conditions. Instead, every effort has been made to base the costings used on province-wide standard costs per unit of activity. For example, in inpatient care, a standard cost is assigned to every episode within a particular diagnosis-related group, in preference to the use of actual costs. This sort of approach was implemented for most expenditure pools.

Capitations were not derived for community care expenditure, which was instead allocated in proportion to the allocations calculated for the other expenditure pools. A set of adjustments is made for cross-boundary flows of patients within the province, based on the standard cost methods used in the setting of capitations. Regions are guaranteed no loss of funding from one year to the next. As a result, any allocation to a region which results in a reduction in funding from the previous year is adjusted so that the region suffers no such loss. The sum involved is deducted on a proportionate basis from the allocations of all the gaining regions.

An analogous scheme is in operation in Saskatchewan (32 health districts, average population 30,000) and was planned (but never it seems implemented) in British Columbia (20 regional health boards). Pampalon (1998) describes exploratory work in Quebec, using methodology similar to that developed in England. See Hutchison *et al* (1999) for further details.

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**ENGLAND**

The United Kingdom National Health Service (NHS) was set up in 1948, and is one of the biggest centrally planned organizations in the world. It is part of the UK public sector and is funded principally out of general national taxation. The NHS delivers over 95% of the country's health care and spend about 6% of the country's gross domestic product. It is Europe's largest single employer. The NHS in England is managed by the central NHS Executive, which is answerable to the national Secretary of State for Health. The service is administered locally by 100 Health Authorities, with average populations of about 500,000. These are appointed by the Secretary of State for Health, and are responsible for arranging health care on behalf of all citizens resident within their geographical boundaries.

Each year the national government allocates the overall NHS budget in the annual public expenditure negotiations. The cash-limited budget for hospital and community services is then set by the central NHS Executive in the light of this total allocation. The Executive distributes the funds available to the health authorities in the form of fixed budgets, which are set according to a capitation principle. The English NHS has long been the pioneer in the development of risk adjustment.

Current capitation methods in England use a three stage capitation method. First, an adjustment is made for eight age categories. The 1997/98 capitations for hospital and community health services are shown below (from NHS Executive, 1997).

| Birth | 0-4 | 5-15 | 16-44 | 45-64 | 65-74 | 75-84 | 85+ | Mean |
|---|---|---|---|---|---|---|---|---|
| 1839 | 400.3 | 188.3 | 262.9 | 393.7 | 776.6 | 1392 | 2379 | 456.5 |

The second stage is then, for each service, to apply a needs adjustment, based on a needs index reflecting characteristics of the area in which the citizen lives (rather than individual characteristics). This adjustment has the effect of raising or lowering the age weighted capitations by a fixed percentage in every area. The derivation of the needs indices is described in detail below.

Finally, an adjustment is made for variations in input costs between different parts of the country. This adjustment uses the results of a statistical analysis of general wage data, and in 1997/98 resulted in parts of central London receiving capitations 47.1% in excess of much of the rest of England (Institute for Employment Research, 1996).

The founding principle of the NHS is that health care should be free at the point of delivery, and that those in equal need should be entitled to equal access, regardless of their personal circumstances or where they live. The concept of equity is therefore fundamental to the operations of the NHS. As a result, given the wide variations in health care needs found in the population, there has been great concern that the allocations of the budget to health authorities should be equitable. The usual interpretation of an equitable allocation of funds is that it should give each health authority the ability to purchase a standard package of health care for its residents, bearing in mind the health care needs of the population, local health care costs, and the overall budget the national government chooses to allocate to the NHS.

There has therefore long been a debate in the UK about how NHS funds should be distributed to geographical areas (Mays and Bevan, 1987). In particular, in the hospital and community health services (HCHS) sector, there has been a history of allocations on the basis of capitation formulae. The rationale for using formulae is that, without such formulae, observed expenditure is likely to reflect the historical supply of health care as well as population needs, and that the use of historical expenditure as a basis for future budgets

would therefore create a perverse incentive to inflate expenditure levels in order to attract larger budgets. In contrast, a formula seeks to indicate the amount an area would spend if it were to adopt some standard level of health care provided with a standard level of efficiency, taking into account the area's demographic and social characteristics. The budget indicated by a formula should therefore be independent of the actual policies adopted in an area.

The first formulae were based on the work in the 1970s of the Resource Allocation Working Party (RAWP), which was set up by the Secretary of State in response to the gross inequities in provision evident at that time. The RAWP was asked to recommend a system for the allocation of resources which was responsive to the health needs of the population, and to identify and correct inequalities in the existing pattern of resource distribution. It recommended distributing revenue resources on the basis of population, weighted according to three local factors: first, adjustments were to be made for differences in the *age/sex structure*; second, account was to be taken of differences in the *need* for health care, over and above any demographic considerations; and third, account was to be taken of the unavoidable geographical differences in *costs* of providing services (Department of Health and Social Security, 1976). The principle of a *weighted capitation* formula has remained intact since the RAWP report, and informs the current study. It gives rise to a budget calculation as follows:

$$Budget = PerCap \times Pop \times (1 + a) \times (1 + n) \times (1 + c)$$

where *PerCap* is the national average per capita expenditure, *Pop* is the local population, *a* is an age/sex adjustment, *n* is a needs adjustment and *c* is a cost adjustment. The national average values of *a*, *n* and *c* are zero.

The aspect of the RAWP recommendations that excited most controversy was the use of condition-specific Standardized Mortality Ratios (SMRs) as a proxy for relative needs. However, the RAWP methodology represented a major advance in the scientific allocation of NHS funds, and until 1990 they were used as the basis for allocations to the 14 Regional Health Authorities. (Regions were at that time an administrative tier intermediate between national and health authority level.) The financial allocations implied by the RAWP methodology were used as targets, to which actual regional allocations were to converge over a number of years. They implied a substantial redistribution from the south to the north of the country. There was no requirement that the RAWP methodology should be used for allocations to health authorities within a Region's boundaries. However, many Regions used the RAWP principles as the basis for a subregional formula.

Although it gained widespread acceptance, the RAWP formula was criticised on a number of grounds, most importantly that there was no empirical justification for the assumption that standardized mortality ratios are linearly related to health care needs. In 1985 the UK Government therefore set up a Review of RAWP. The stated aim of the review was to improve the accuracy with which the formula measured relative need, because the Regions were gradually converging towards their targets and it was thought that fine tuning was required. The majority of the work was based on ordinary least squares (OLS) regression analyses of the determinants of hospital utilization in small areas. The principal focus was the index of relative morbidity, for which the Review recommended several changes. It was suggested that SMRs for all causes of death for the under 75 age group should become the basis of the mortality measure, in the place of all-age mortality measures. In addition, it was recommended that the weighting given to SMR should be reduced, and that a small weighting should be given to an index of social deprivation in the formula.
In the event, the national government decided to implement only part of the Review's recommendations (Royston *et al*, 1992). The implemented formula for regional allocations (which remained in force from 1990 to 1994) contained the square root of the under 75 SMR

for all causes as an index of morbidity, but the use of a social deprivation index was rejected by the Thatcher government. The Review was subjected to fierce criticism on a number of methodological grounds, most importantly relating to the limited dataset analyzed, the absence of any costing data and the use of OLS regression methods (Sheldon and Carr-Hill, 1992). It is also noteworthy that few of the 14 Regions used the new formula for their own internal allocation of funds to health authorities. However, the Review did represent a first attempt at developing an allocation formula based on empirical evidence, and the principle of basing a formula on observed utilization patterns received widespread support. Therefore in 1993 the NHS Executive sought proposals for a new empirical study which was undertaken by the University of York.

The York study sought to use a more comprehensive and up-to-date dataset, to model the resource implications of utilization more reliably, and to rectify some of the statistical shortcomings identified in previous work (Carr-Hill *et al*, 1994a, 1994b; Smith *et al*, 1994). Underlying the study was an intention to identify a national 'average' response (in terms of observed inpatient utilization) to variations in health care needs, after adjusting for any variations in supply. Of course, any methodology based on empirical observation relies on the assumption that some measure of health care utilization can be used as an indicator of health care needs. In practice this is unlikely to be the case. However, the criticism of the original RAWP methods suggests that any non-empirical alternative was likely to cause heated debate within the NHS.

The York team considered two types of determinant of demand to be important in causing utilization: the health care needs of the population, and the supply of health care facilities. The need for health care is an elusive concept that cannot be measured directly. However, based on a mass of epidemiological evidence, it is possible to construct a wide range of potential *indicators* of need, including indirect social determinants of demand for health care as well as direct measures of health status. The consideration of supply effects reflects the widely held belief that the availability of health care services affects demand for those services in two ways: first, when there is excess demand, supply constraints affect the care that can be offered; and second, there is evidence to suggest that supply of physicians can induce demand (Cromwell and Mitchell, 1986).

The intention was therefore to build a statistical model relating utilization to indicators of needs and supply. However, a further complication was the insight that - as well as influencing utilization - supply may itself also have been influenced by utilization and needs in the past. The study therefore encountered a considerable challenge in seeking to disentangle the impact of supply from the impact of needs on utilization. That is, although it is possible to say that utilization $U_i$ in area i is a function of needs $N_i$ and supply $S_i$ in area i:

$$U_i = f(N_i, S_i)$$

it is also plausible to suggest that supply might in turn be influenced by utilization, needs and possibly other determinants, labelled $X_i$, as follows:

$$S_i = g(U_i, N_i, X_i)$$

Clearly the pair of equations is a simplification of reality. In particular, for example, supply is probably influenced by *past* needs and utilization. However, given the limited availability of data, further elaboration of this model is fruitless from an empirical perspective. The York team therefore assumed that present needs and utilization are reasonable proxies for previous levels.

This model implies that there are two sorts of socio-economic variable: 'legitimate' indicators of health care needs, and other variables which are merely correlates of supply, independent

of any needs consideration. In these circumstances, an indiscriminate statistical regression of utilization on a wide range of socio-economic variables will fail to distinguish between the two types of variable. This emphasizes the need to seek to introduce explicit measures of health care supply into any model of utilization. Moreover, if simultaneity of the sort implied by equations (1) and (2) exists, it is inappropriate to employ conventional OLS regression methods to estimate (1) as they may lead to serious biases (Maddala, 1990). Instead, it is necessary to use methods such as two stage least squares regression to take account of the simultaneous determination of U and S. This insight was crucial to the York study, which represented one of the first attempts to use such methods in UK health care.

Using the theory developed above, the aim of the empirical work was to seek to explain small area variations in NHS inpatient utilization. The units of analysis used in the empirical study were 4,985 small areas with average populations of about 10,000 covering the whole of England. The reasons for using small areas have been set out elsewhere (Royston *et al*, 1992). In summary, they are that use of larger areas may result in the identification of spurious correlates of utilization (the 'ecological fallacy'); and that adequate data are not available at a smaller level of aggregation. For each small area, data were assembled relating to socio-economic conditions, the supply of health services, and the utilization made of inpatient services.

The socio-economic variables comprised detailed demographic data, health status variables derived from statutory returns, and broader social and economic variables derived from the 1991 Census of Population. The demographic data were used to standardize all variables for which age and/or sex were thought to be a important determinants. The intention was that demographic variables should not enter into the model, as demographic considerations were to be accommodated in the separate age adjustment. The health status variables included a variety of age-specific standardized mortality ratios, standardized indices of self-reported morbidity, and low birth weight data. A total of 42 socio-economic variables thought to be possible influences on demand for health care were used.

Four supply variables were created, reflecting the availability of health services to the small area's population. They sought to measure the accessibility of NHS inpatient facilities, the accessibility of family practitioner services, the accessibility of private inpatient facilities, and the provision of residential and nursing homes. The problem of deriving accessibility measures is that it is necessary simultaneously to reconcile the supply of facilities, their proximity to the small area of interest and the impact of competing populations. This was achieved using the methods of spatial interaction modelling.

Utilization rates, standardized for age and sex, were calculated from a database of all hospital inpatient episodes in 1990/91 and 1991/92 (including day cases), a total of over 17 million records. Several utilization measures were tested, such as numbers of episodes, bed days, and a variety of cost estimates. In the event, it was found that the definition of utilization employed did not affect the results to any great extent.

A small area's utilization was modelled as a function of supply and needs, using two stage least squares regression methods. Because of their very different patterns of needs and utilization, separate models were estimated for acute and psychiatric specialty groups. Using an explicit modelling procedure potential indicators of health care needs were deleted from a comprehensive 'unrestricted' model until no further variable could be excluded without altering the nature of the model in a statistically significant fashion. Tests were made to assess whether the model was statistically well specified, and to ensure that the two stage least squares method was justified in preference to ordinary least squares (Godfrey, 1988).

Even given an explicit methodology of the sort used in this study, there is room for considerable judgement as to how the preferred model is chosen. The intention was to develop models which satisfied three criteria: statistical adequacy, parsimony, and intuitive plausibility. Literally hundreds of alternative specifications were examined by the study team and their advisory groups, including detailed scrutiny of a shortlist. The procedures used were documented in a painstaking 'audit trail', and the massive data set was made available for external scrutiny. The methods used and the results obtained were subjected to independent review by external statistical and econometric experts. Moreover, it should be emphasized that the choices were made before explicitly modelling their resource allocation consequences.

Development of satisfactory empirical models of utilization was not the end point of the analysis. The purpose of the modelling stage was to identify unambiguous indicators of need for health care, over and above any supply considerations. However, the models identified are not suitable as the basis for resource allocation formulae because they contain indicators of supply. The final stage of the study was therefore to run a regression of utilization on the needs indicators alone, omitting the supply variables. This equation is in effect a truncated reduced form of utilization. It captures not only the direct impact of needs variables on utilization, but also the indirect effect, to the extent that supply reflects legitimate needs. However it excludes 'illegitimate' supply effects.

One further important consideration is that entire localities lie within administrative areas (Health Authorities) which may exhibit systematic differences in funding, clinical practice and data quality. A further refinement was therefore to specify the final regression using multilevel (hierarchical) modelling techniques (Goldstein, 1987). This methodology has enjoyed widespread acceptance in the educational sector, where it has been used to disentangle the effects of individual, class and school on educational attainment. However, its use in the health sector is at a relatively early stage of development (Gatsonis *et al*, 1993). In the York study it was used in order to extract from the analysis systematic differences in utilization caused by health authority effects, which can also be interpreted as supply effects, and so should not be reflected in a resource allocation formula.

Tables 1 and 2 indicate the variables that were contained in the final acute and psychiatric models developed by the study team and its advisers. All the variables included are direct indicators of ill health, or powerful indicators of deprivation. It is noteworthy that the standardized mortality ratio for those aged under 75 continues to play a part in the models. Also, the inclusion of a variable reflecting elderly people living alone suggests that the availability of support from family and social carers may have a significant impact on NHS costs.

*Table 1: Variables used in the York acute model*

| **Acute needs variables** |
|---|
| Standardized limiting long standing illness ratio (under 75) |
| Standardized mortality ratio (under 75) |
| Proportion of economically active who are unemployed |
| Proportion of pensionable age living alone |
| Proportion of dependants in single carer households |

*Table 2: Variables used in the York psychiatric model*

| **Psychiatric needs variables** |
|---|
| Proportion born in New Commonwealth |
| Proportion of pensionable age living alone |
| Proportion of persons in lone parent families |
| Proportion of dependants with no carer |
| Proportion of adult population permanently sick |
| Standardized mortality ratio (under 75) |

Strictly speaking, the two models described above indicate the need for *inpatient* services, which account for only 45% of total HCHS expenditure. Therefore, the questions arise: in what proportions should the acute and psychiatric models be combined, and - in the absence of any empirical data - how should the non-inpatient services be treated? In the event, in first implementing the above results in 1995, the Department of Health broke down the HCHS budget into three classes of programme. Acute inpatients and outpatients and a range of other services, such as maternity, were allocated using the acute model, which accounted for 64% of the allocation. Psychiatric services, accounting for 12% of the budget, were allocated according to the psychiatric model. And a range of other services - such as community services and mental handicap - accounting for 24% of expenditure, were allocated with no needs model.

Since that first implementation, the principles used in the original York study have been extended so that almost all HCHS expenditure is now allocated using the York indices. The exception is certain community services, for which a range of interim indicators developed using a similar methodology (Buckingham *et al*, 1996). The principles used in the York study have now been extended to prescribing expenditure, for which a capitation formula has now been developed based on general practice level data (Rice *et al*, 1999). The needs variables chosen model are set out below, and from 1999 the model has been used as the basis for allocating £4.5 billion prescribing expenditure to health authorities.

*Table 3: Variables used in the York prescribing model*

| **Prescribing needs variables** |
|---|
| Proportion of the adult population permanently sick |
| Proportion of dependants with no carer in household |
| Proportion of working age who are students |
| Proportion of population that are babies (< 1 year) |

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**FINLAND**

The main responsibility for health care in Finland rests with the 452 municipalities, many of which have very small populations, the average being 11,000. Every citizen has the right to health care regardless of ability to pay or place of residence. Health care is mostly financed and provided by the public sector. Because of the small size of many municipalities, hospital care is organized into 21 hospital districts, with each municipality being forced to arrange hospital care with the district within which it lies. Primary care is organized around 270 public health centres. The nature of the care delivered is a matter for negotiation between municipality and these public sector providers. There are large differences between municipalities in organization, expenditure levels and waiting time for elective surgery. The government sets an upper limit on the copayments a municipality can charge.

The health care system is financed by national taxes (21%), municipal taxes (41%) and private payments (mainly user fees) (24%). Some of the national taxes are distributed to the municipalities in the form of the State Subsidy System (SSS). Municipalities' revenues consist mainly of an income tax, a property tax and the SSS. The local income tax for all municipal services is levied as a fixed proportion of income (currently on average about 17%). Thus under the SSS an expenditure needs $N_i$ is calculated for each municipality i, and its state subsidy $S_i$ is calculated as:

$$S_i = N_i - r^* POP_i$$

where $r^*$ is the national standard per capita tax set by the government and $POP_i$ is the local population. This enables every municipality to levy the same local tax rate $r^*$ if its expenditure conforms to the state's estimate of expenditure needs $N_i$. The SSS seeks to promote efficiency in the delivery of health care, and to secure equal opportunity of access to health care at some standard level of local tax. It is intended that the needs assessment should be based on data that are easily available from each municipality, reliable and not subject to local manipulation.

Each municipality sets its own health care budget. The financing of all marginal expenditure must be borne by the local income tax. It is not unusual for budgets to be exceeded, and the overspend must then be financed through a supplementary budget. The level of the budget itself can of course be reduced by reducing expenditure (through increased efficiency or reduced level of service) or by increasing copayments up to the national limit. The increased use of copayments (essentially a tax on the sick) has been the source of some concern (Koivusalo, 1999).

The methods for calculating health care needs estimates have changed twice since an important reform of the SSS in 1993. In the period 1993-96 the factors included in the needs assessment were population, age structure, mortality, population density, land area, and archipelago status. In 1997 new criteria were introduced, based on population, age structure, and an age-standardized measure of invalidity pension status (morbidity). That is, the fundamental basis for the needs calculation is the age structure of the population (in five age groups: 0-6,7-64, 65-74,75-84,85+). This is augmented by an index of morbidity defined as the ratio of numbers of invalidity pensioners divided by the total population for ages 15-54, expressed as a fraction of the national average. The effective needs index $N_i$ this yields for municipality i is of the form:

$$N_i = \alpha P_i^a + (1-\alpha) * P_i * PENS_i$$

where $P_i^a$ is the age weighted population of municipality i, $P_I$ is its crude population, $PENS_i$ is the local index of invalidity pensions, and $\alpha$ is a weighting factor, reflecting the relative importance of the demographic and invalidity weightings, and currently set at (roughly) 0.75.

A final adjustment of plus 10% is then made for six archipelago municipalities (with no road connection to the mainland) and of plus 5% or plus 15% for 33 municipalities defined as either slightly or deeply 'remote'. These adjustments appear to be based on minimal objective evidence, and are based largely on political considerations.

Current methods in Finland appear to be a compromise between scientific evidence and political expediency, and there has been active research into a more scientifically robust method, carried out by National Research and Development Centre for Welfare and Health (STAKES), under the supervision of the national Ministry of Social Affairs and Health. The research has sought to translate the small area methods used in England to the Finnish situation, using the municipality as the basic unit of analysis, aggregated with adjacent municipalities where populations are small. This resulted in 166 observations. Supply variables used were distance to the nearest specialist hospital, number of beds per head of population and numbers of primary care doctors per head. Potential needs variables included measures of mortality, disability, migration, housing, education, income, unemployment and living alone.

The results indicated that the most statistically important needs variables were the index of invalidity pensions (positive association with expenditure needs) and local income (negative). The recommended models were:

1. Primary health care sector, expenditure needs $N_1$:

$$N_1 = P_1$$

where $P_1$ is the local age and sex adjusted population for primary care.

2. Non-psychiatric hospital sector, expenditure needs $N_2$:

$$N_2 = P_2 PENS^{0.28} INC^{-0.23}$$

where $P_2$ is the local age and sex adjusted population for the non-psychiatric hospital sector, PENS is the local index of invalidity pensions, and INC is the average local income.

3. Psychiatric sector, expenditure needs $N_3$:

$$N_3 = P_3 PENS^{0.67} INC^{-0.53}$$

where $P_3$ is the local age and sex adjusted population for the psychiatric sector.

These models have not been implemented, but were used to inform the choice of the 'invalidity pensioners' in the implemented model.

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## FRANCE

The French population is almost entirely covered by the statutory health insurance system (*Assurance-maladie)*. Within the *Assurance-maladie,* individuals are allocated to a sickness fund which depends on their employment sector. Most of the population (80%) is covered by the dominant statutory sickness fund, the *Regime General*. In addition, 87% of the population also belongs to a supplementary sickness fund (or *mutuelle*) which provides services and reimbursement not covered by the statutory sector, mainly in primary care and drugs.

Broadly speaking, patients have freedom of choice concerning hospital providers, which are predominantly run by the public sector. Providers charge the patient for services provided according to a set fee schedule, and the patient claims reimbursement for all or part of the charge from the statutory sickness fund.

The level of coverage provided by the statutory sickness funds varies (subject to a basic minimum requirement). However, patients have little freedom as to which sickness fund they enrol in. The funds were until recently financed by means of income-related payroll taxes paid by employee and employer. Rates vary between the funds. There is a modest risk adjustment scheme in force, which seeks to adjust for differences in the ratio of beneficiaries to contributors between funds – an imperfect attempt to correct for differences in the tax bases. However, it does not take into account variations in the needs or incomes of the funds' beneficiaries.

Cost control and regional health inequalities have been major preoccupations of policy makers in France (CREDES, 1998; Lancry and Sandier, 1999). To that end, a major policy reform, known as the Juppé Plan, was proposed in 1995, with the aim of improving the finances of the *Assurance-maladie*. The Plan envisages a general move towards centralisation of both the finance and delivery of French health care.

As part of the plan, since 1997 a regional resource allocation scheme has been in force (Haut Comité de la Santé Publique, 1999). The objectives are to secure cost control and to address the health inequalities between the regions. It is prompted by the belief that there is a link between inequalities in supply of health care and inequalities in health, and so seeks to redress the supply inequalities. The intention is to move towards a system of equal provision of health care for equal needs, which minimizes geographical, cultural and economic barriers to access.

Under the scheme, the national Parliament votes annually a fixed sum to be assigned to the statutory sickness funds. This is allocated to the 25 Regions using a rudimentary risk adjustment process. It entails calculating an age-adjusted capitated target for each region. Allocations take into account historical spending patterns, and the intention is that all regions should converge towards their target (*budget objectif*) in 15 to 20 years.

In practice the mechanisms for securing adherence to regional expenditure targets are rather feeble. In the pharmaceutical and outpatient sectors, the region (*Agence Régionale de l'Hospitalisation*) is at the mercy of nationally agreed fee schedules. In the hospital sector, regions have theoretical control over expenditure, in the sense that they are able to set annual budgets for the hospitals under their control. There appears to be little research to date into whether such budgets have materially affected the volume, type or efficiency of health care delivered. Therefore it remains to be seen whether the regional resource allocation mechanisms represent a realistic tool for securing cost control and reducing inequalities.

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## GERMANY

Health care insurance in Germany is compulsory and universal. Up to 1996, citizens were eligible to enrol in the local sickness insurance fund determined by the location of their place of work. In addition, some of the population were enrolled in an alternative fund, based on employer or occupation. Some white collar workers could opt to join an alternative 'substitute' sickness fund. Sickness funds were obliged to accept all eligible applicants. There were about 1,000 such funds.

Major reforms to the German health care system were implemented in 1996 under the 1993 Health Care Act (*Gesundheitsstrukturgestez*), which introduced the right of all citizens to enrol in the substitute insurance fund of their choice. Thus explicit competition between funds was introduced. It has resulted in a great number of mergers between sickness funds, the number of which now stands at approximately 500.

The sickness funds are financed by premiums, which take the form of a payroll tax and are shared equally by individual and employer. In setting premiums, funds cannot discriminate between members on the basis of age, sex or health status. In practice, premiums are based on the individual's income.

All dependants of a contributing member of a fund are automatically covered by the sickness fund. In principle, all funds are expected to offer a common level and quality of health care. This covers most risks other than long-term care of elderly people.

This form of social health insurance continues to cover about 90% of the population. The rest of the population is wholly covered by private insurance. Private insurers tend to set premiums on the basis of age and sex, but not health status.

Before the 1996 reforms, the German system resembled the prevailing Austrian and Japanese systems, in that (loosely speaking) health insurance funds covered discrete segments of the population. The financing requirements of each fund therefore depended on the health status of its members (determined by factors such as age, sex, socio-economic status). Furthermore, the fund must cover non-earning dependants of members, and so the ratio of members to dependants is an important determinant of financing requirement. Finally, because premiums depend on member's earnings, the level of premiums set by a fund would also depend on the earnings of members.

Thus – other things being equal – insurance premiums were relatively high

- for funds whose members had relatively low health status
- for funds with a large proportion of non-earning dependants;
- for funds whose members had low average earnings.

McCarthy *et al* cite variations in premium rates of between 11.8% and 16.8% amongst the 267 local sickness funds, and the spread was even greater amongst the 700 employer sickness funds (7.8% to 15.9%). Of course other things may not necessarily be equal, and the premium variations may in addition reflect variations in medical practice, variations in efficiency and variations in prices.

It is important to recognize that - so long as there was limited freedom to move between sickness funds - these variations may not have necessarily constituted a major problem. In the same way that local taxes might vary between jurisdictions, so some variation in health insurance premiums might be seen to be legitimate. We have not uncovered any evidence on who ultimately bore the costs of higher premiums (the economist's notion of incidence).

Premium increases may for example be borne entirely by the employer, who must pay workers higher pay in compensation for their increased contributions.

However, major variations in premium rates were widely perceived to be inequitable, as it breaches the German concept of 'solidarity'. Members of different schemes in otherwise identical circumstances may pay different premiums for identical benefits (Wysong and Abel, 1996). In addition, blue collar workers did not have the right enjoyed by some white collar workers to choose a substitute fund. Moreover, the variations in premiums may lead to serious economic distortions if they affect employer costs significantly, and it is clear that by the 1990s the variations in premiums had become unsustainable (Pfeiffer, 1996). Finally, even before the 1996 reforms, the substitute sickness funds had the opportunity and incentive to encourage the enrolment of citizens with good health status, low numbers of dependants, and high incomes. Although in principle illegal, it is probably the case that there existed mechanisms for securing a limited amount of such 'cream-skimming'. The 1996 reforms, introducing mobility of enrolment, have made the potential problem of cream-skimming much more serious and immediate.

The federal government has therefore since 1994 introduced a complex risk adjustment scheme, administered by the Federal Insurance Office (*Bundesversicherungsamt*). This calculates transfers between sickness funds which reflect the nature of the health care risks assumed by each fund. Thus funds which are judged to be 'low need' (on the basis of health status, dependants and income) contribute to the transfers and 'high need' funds are recipients of transfers. The purpose of the scheme is that no sickness fund should be financially disadvantaged (or advantaged) due to the risk profile of its membership (Files and Murray, 1995).

A measure of health care expenditure need $N_I$ is derived for each fund I, based on the characteristics of all individuals (the numbers of members and dependants and their health status). The fund has an income base (or 'financial power') $B_I$ which depends on the earnings of its members. A national standard contribution rate r* (percentage of earnings) is set. Then, if fund i were to levy the standard contribution premium, its income would be $r^* B_I$. The transfer it receives (or contributes) is then given by $T_I = N_I - r^* B_I$, the difference between its health care needs rating and its notional income. Nationally, r* is chosen so that the sum of all the transfers $T_I$ is zero.

Thus the system is such that – if all funds were to spend the same amount on citizens with given needs characteristics – they should be able to charge the same level of premiums. In effect, it seeks to compensate simultaneously for differences in needs and differences in income bases between funds. The system is analogous to the English system of revenue support grants for local authorities, which are designed to enable local authorities with different needs and different tax bases to levy the same rate of local tax, if they deliver a standard level of service with a standard level of efficiency.

The fundamental objectives of the German risk compensation scheme are therefore to eliminate inequities in insurance premiums, and to offer a 'level playing field' for competition between sickness funds, thereby minimizing the incentives for cream-skimming. If the risk adjustment mechanism were perfect, then the only reasons for variations in premiums would be variations in medical practice and variations in efficiency.

The risk compensation scheme was implemented partially in 1994 and fully in 1995 (when pensioners were first included). It involves some very large transfers of the order of 15billion DM from contributing funds to receiving funds (Pfeiffer, 1996). There has been some (though by no means dramatic) convergence in premiums charged.

In practice, risk adjustment is far from perfect, and the only needs adjusters used to date have been age and sex. There is a surprising lack of individual level data available within the German health care system, and so this is perceived to be the best that can be achieved at present. There is a strong debate about the need to include adjustments for variations in prices between different parts of Germany, but this has so far not been implemented. There is of course considerable disquiet about the absence of more refined techniques of risk adjustment (Wysong and Abel, 1996). In particular, funds with relatively high proportions of the chronically ill and disabled are likely to be disadvantaged. The major impediment to further refinement of the risk adjustment mechanism is the absence of universal and reliable data collected by the sickness funds.

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**ISRAEL**

Ninety-six percent of the Israeli population is covered by health insurance, which is provided by four sickness funds, of which one dominates the market. Before reforms in 1995, the sickness funds were financed by income-related premiums they collected from their own members, and so had a strong incentive to focus their recruitment on the wealthy, the young and the healthy. In January 1995 the national government introduced a system of national health insurance (Chinitz, 1994). Amongst other measures, this defined a basic basket of health care services to which all residents are entitled. Residents may now choose with which of the four sickness funds they wish to ensure. The funds must offer the basic package of care, and must accept all those who wish to enrol.

Health care is now financed by tax revenues. The national government determines the overall level of expenditure, which is then distributed to the four sickness funds on the basis of a capitation formula. To date the capitation formula has been based only on age, using nine categories. The risk adjustment mechanism appears to be seeking to secure both a fairer distribution of resources and reducing the incentives for cream-skimming.

Certain 'serious illnesses', such as Gaucher's disease, thalasemia major, haemophilia, dialysis and AIDS, are excluded from the capitation system and are reimbursed separately. Mental health and geriatric services are financed directly by the national government.

Ofer (1998) reports that the Ministry of Health appears to believe that the new arrangements have led to some reduction in the inequities inherent in the old system. They are however concerned that data availability and reliability appear to be a major impediment to improvements, and wish to ensure that any refinements are based on sound evidence. The Ministry has therefore been cautious in seeking further refinement.

However, there has been much concern at the inadequacy of this risk adjustment method amongst the academic community, and some research into possible enhancements has been reported. The emphasis to date has been on measures of health status, and a broad consensus has emerged that such measures should in principle be incorporated into the formula. Both survey-based and administrative-data-based methods of doing this are being actively explored (Rosen *et al*, 1999). In addition, two of the sickness funds favour introducing socio-economic factors into the formula. There is furthermore some concern that the funds may not face equal input prices, as the dominant fund enjoys greater market power than the others.

Ginsburg et al (1997) take advantage of the national psychiatric case register to report a potential model for use in the psychiatric hospital sector based on prior utilization and diagnosis. They conclude that measures of prior utilization (in the form of the number of inpatient days in the previous five years) are important in refining capitations, but that diagnosis adds only modest explanatory power. The authors claim that the perverse incentive to increase hospital use associated with such a capitation formula is not a major concern.

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## ITALY

Since 1980 Italy has had a national health service (the *Servizio Sanitario Nazionale – SSN*), with national and regional taxation forming the principal source of finance. The intention is that coverage should be comprehensive and uniform. Care is delivered by a mixture of public and private sector providers. Funds are distributed from the central government to 19 regional governments and two autonomous provinces, which in turn allocate funds to about 198 local health authorities, geographically defined and covering populations of about 250,000. Adherence to budgets is not one of the strong points of the Italian public sector, and there are regular overspends, partly because of the *ex ante* underfunding of the SSN, which are usually made good by the central government (via the regions). Health authorities have little direct incentive to economize on expenditure.

Since the inception of the national health service, attempts have been made to establish an objective basis for allocating resources to the regions. Mapelli (1999) outlines the history, which is summarized in the table, and which he characterizes as being a state of permanent negotiation between the regions and the central government. The basis of allocations was often changed in response to immediate political pressures, sometimes during the financial year in question.

**Development of capitation methods in Italy 1980-1998**

| **Period** | ***Criteria*** |
|---|---|
| 1980-81 | Various indicators of health risk |
| 1982-84 | Historical expenditure |
| 1985-91 | Age adjusted capitations |
| 1992-96 | Resident population (simple capitation) |
| 1997- | Age and sex adjusted capitations with additional indicators of need |

One of the principles underlying the Italian health care system, as set out in law 833/78, is territorial equity, with the principle of equalization occurring in a number of guises:

1. Overcoming territorial inequalities in social and health conditions (article 2);
2. Guaranteeing uniform levels of health care to all citizens (article 3);
3. Guaranteeing health equality in all regions (article 4);
4. Guaranteeing levels of health care in a uniform fashion across all regions, progressively eliminating structural and performance differences between the regions (article 51).

In practice, the resource allocations mechanisms used have sought to address only the second and fourth of these concepts.

The 1996 law 662/96 has established new criteria which can be used for calculating capitations. They are: resident population, age and sex adjusted expenditure, under 75 standardized mortality ratios, epidemiological indicators, and 'indicators of particular territorial circumstances considered useful for defining health needs'. Mapelli uses the 1998 allocation to illustrate the new system.

First, a total expenditure figure is determined through negotiations between the Treasury and the Ministry of Health. This is then divided into a number of functions, of which hospital services comprise 47%. National age weights are then determined for each programme, as follows:

**Percentage of expenditure by programme, and cost relativities by age**

| *Service* | *%* | *0* | *1-4* | *5-14* | *15-24* | *25-44* | *45-64* | *65-74* | *75+* |
|---|---|---|---|---|---|---|---|---|---|
| Public health | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Prescribing | 12 | 1.000 | 0.969 | 0.695 | 0.693 | 0.771 | 2.104 | 4.176 | 4.290 |
| Specialist care | 13 | 0.052 | 0.052 | 0.052 | 0.534 | 0.534 | 0.058 | 0.085 | 0.064 |
| Elderly | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Hospital care | 47 | 2.326 | 0.377 | 0.290 | 0.424 | 0.593 | 1.006 | 2.113 | 3.390 |
| General practice etc | 12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

The prescribing age weights used in the allocation are based on region-specific utilization rates, and the figures given above are national averages only. The national hospital care age weights are adjusted according to the cube root of the under 75 standardized mortality ratio experienced in the region.

The adjusted age weights are used to allocate each programme of care to the regions, and the programmes summed to derive the region's total 'theoretical' allocation for the year. This is compared with the sum the region would have been allocated if it had continued to receive the same proportion of the national health care budget as in the previous year. The new allocation is obtained by adding one third of the difference to the theoretical allocation. Finally, a cross-boundary flow adjustment is made, and a subtraction made for the assumed level of finance that can be raised from local sources (around 65%).

The chosen formula is based partly on evidence (age weighted utilization rates) and partly on judgement (the cube root of SMR). An important consideration is that the parameters chosen for the formula must be accepted by the regions, and this gives rise to the potential for continual compromise and pressure for change. It also gives rise to delay in allocating budgets to regions (Mapelli, 1998).

The regions must in turn allocate their resources to health authorities, and some have used capitation methods. An example is Emiglia Romagna (1998), which has since 1996 allocated to its 13 health authorities (*unità sanitarie locali*, or USLs) on a weighted capitation basis. The region seeks to reflect the principles of the national system. The main objectives are to ensure the transparency of the allocations, and distributive equity (Agenzia Sanitaria Regionale, 1998). The regional allocation process uses broadly similar methods to the national system, but uses local data and some different assumptions. Prescribing expenditure is allocated on the basis of 10 age/sex weights, derived from local data. Specialist services expenditure is allocated on the basis of eight age weights derived by the Friuli Venzia Giulia region. Hospital use is based on local expenditure in fourteen age/sex groups, with costings being based on standard DRG weights. For hospital services, 50% of the under 75 standardized mortality ratio is applied to each USL's age/sex curve. It is not clear from the documentation whether this means the square root of the SMR, or 50% of the variation from the regional average.

Thus the Italian system has distinct parallels with UK methods, but the less stable political environment has given rise to frequent changes.

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## THE NETHERLANDS

For most citizens, Dutch health care comprises two elements of compulsory insurance: the *Ziekenfondswet* (ZFW), which covers primary care and short-term hospital care, and the *Algemene Wet Bijzondere Ziektekosten* (AWBZ), which covers exceptional medical expenses such as serious illness or long-term disability. This insurance is managed by about 26 sickness funds. All citizens earning less than a certain income (63% of population) must purchase both types of insurance, but are free to choose with which fund they insure, with open enrolment every year. Higher income earners can opt out of ZFW cover, and are usually covered by private health care insurance. Coverage under AWBZ is compulsory for all citizens.

All those insured under the ZFW scheme make earnings-related payments into a central sickness fund administered by the Central Sickness Fund Board (*Ziekensfondsraad*). The employer also makes a matching income-related contribution. The resultant revenue covers about 90% of the expenditure requirement. The revenue is distributed to the individual sickness funds by the Board using a risk adjustment process described below. The remaining 10% of the expenditure requirement is raised by each of the sickness funds by means of a 'community rated' premium, levied at the same *per capita* rate on all adult members of the fund. In principle the funds can offer different modalities of basic health care cover although to date this has not been attempted on any significant scale. In addition, sickness funds can offer supplemental health insurance, offering benefits beyond the basic cover (such as some dental care), which is not subject to regulation.

The Board seeks to distribute its central ZFW revenues to each of the individual sickness funds on the basis of its estimates of a fund's spending needs. This risk adjustment scheme is designed so that – if each scheme spends at the level assumed by the central Board – it would be able to levy the same community rated premium on its members. The purpose of the risk adjustment is to remove the incentive for sickness funds to 'cream skim' healthier patients.

The risk adjustment procedure starts with the central government estimating the annual health care spending requirements of the population at risk. This is assigned to 38 five year age/sex groups on the basis of relative spending requirements, derived from historical national health care expenditure data (Ziekenfondsraad, 1999). This yields the familiar age/sex expenditure curves. These data are then multiplied by factors based on five statutory categories of employment status and disability, calculated separately for the following age groups: 0-14; 15-34; 35-44; 45-54; 55-64; and over 64 as in the table. Note that the factors have been rounded, and that the relevant factor is applied to dependants of to the head of household in groups 2,3 and 4.

**Capitation adjustments by age and employment status**

| **Group** | ***0-14*** | ***15-34*** | ***35-44*** | ***45-54*** | ***55-64*** | ***65+*** |
|---|---|---|---|---|---|---|
| Permanently sick head of household | - | 2.60 | 2.45 | 1.90 | 1.42 | - |
| In employment | 0.98 | 0.93 | 0.83 | 0.76 | 0.74 | - |
| Temporarily/partially unable to work | 1.04 | 1.09 | 1.20 | 1.18 | 1.00 | - |
| Unemployed and dependants | 1.09 | 1.06 | 1.00 | 0.94 | 0.88 | - |
| Pensioner | - | - | - | - | - | 1.00 |

Finally, five regional factors are applied, based on historical levels of expenditure in areas with different levels of 'urbanization'. Different factors are applied for hospital care, specialist care and other care. The factors vary from 1.18 (for specialist care in extremely urban

areas) to 0.89 (for specialist care in rural areas). The precise purpose of the regional adjustment is not clear, but it has the effect of preserving inter-regional variations in expenditure levels. In effect, it models regional differences in provider supply, as well as regional differences in provider costs and health status (to the extent that they are not accounted for by the age, sex and employment/disability risk adjusters).

**Capitation adjustments by level of urbanization**

| **Budget heading** | **Level of Urbanization** | | | | |
|---|---|---|---|---|---|
| | Very High | High | Medium | Low | Rural |
| Hospital care | 1.04 | 1.03 | 1.01 | 0.97 | 0.94 |
| Specialist care | 1.18 | 1.03 | 0.98 | 0.93 | 0.89 |
| Other care | 1.02 | 1.01 | 1.02 | 1.01 | 0.95 |

The resultant capitations are applied to the numbers in each category insured in sickness fund i to obtain an estimate $N_i$ of its spending needs. A national estimate r* of the community rated premium is selected. Then the revenue $R_i$ of fund i is given by:

$$R_i = N_i - r^* A_i$$

where $A_i$ is the number of adults insured with fund i, the fund's income base for the community rated premium. If the sickness fund plans to spend differently from its assumed level $N_i$, the associated burden must fall on the community rated premium.

The above mechanism is *ex ante*, and is based on numerous assumptions about the future year's health care activity and expenditure. A complex *ex post* adjustment is made at the end of the year to account for variations from the assumptions (McCarthy *et al*, 1995). The intention is to protect the sickness funds from variations from the planning assumptions which are beyond their control, such as numbers of insurees and health care prices (which are set nationally, although from 1996 funds have been able to exert some small influence on provider prices).

In practice it appears that this *ex post* adjustment has hitherto been so cautious that sickness funds are reimbursed for all but a small fraction of the variation between actual and predicted expenditure. The intention is gradually to reduce this reimbursement and thereby transfer an increased proportion of the risk associated with the ZFW scheme to the sickness funds.

The 'exceptional expenses' scheme (AWBZ) is not capitated. It is a national risk pool for catastrophic and long-term illness, and is effectively a 'fee-for services' reimbursement package. This is for two reasons. First, sensitive risk adjustment is much more difficult for such types of care, and second there is concern about quality skimping in the long-term care sector (van Barneveld *et al*, 1997).

The Dutch risk adjustment mechanism has been the subject of intense scrutiny by Dutch researchers, who have made some of the most important contributions to the international debate about risk adjustment. An English language bibliography is given at the end of this section. The principal focus of the research effort has been to determine whether refinements to the risk adjustment process are (a) feasible and (b) justified, given the objective of the scheme.

The principal line of enquiry has examined the extent to which indicators of an individual's previous health care utilization offer useful evidence with which to improve the individual's capitation. Van Vliet and Van de Ven (1992) summarize the main issues, and demonstrate that moving from a simple demographic (age/sex) capitation model to a model which also

includes measures of prior utilization improves the proportion of variance in health care costs explained from 2.4% to 7.2% (out of a maximum 13.8% of variance that could potentially be explained by statistical methods). They conclude that, in the short-term, measures of prior utilization can substantially improve capitations. However, use of such indicators might introduce a perverse incentive to increase utilization in order to improve future capitations. Van Vliet and Van de Ven therefore conclude that – in the longer-term – measures of unavoidable hospital utilization and chronic health status may be a more appropriate basis for capitation.

A variety of alternative models of prior utilization have been tested. Lamers and Van Vliet (1996) summarize some alternatives, focusing on the duration of the utilization history to be incorporated. They find that a longer (three year) history offers considerable improvements over a shorter (one year) history. An important refinement to such prior utilization models is to introduce hospital diagnosis groups. Lamers (1998) reports on the diagnostic cost group method, which assigns patients to one of five groups according to the expected costs of treatment for a given diagnosis. Substantial improvements in predictions of future costs (and therefore capitations) are reported. However, the potential for perverse incentives and manipulation of data is noted. Van Vliet and van de Ven (1993) test the use of both diagnosis and previous expenditure, and conclude that both are needed to develop adequate capitation payments.

An interesting alternative approach to capitation is reported by Van Vliet and Lamers (1998). They note the very much higher expected health care costs associated with death (on average 15.3 times the expenditure incurred by survivors). They therefore test the implications of retrospectively reimbursing insurers with a revised capitation for members who die. They find that the improvement to capitations would be small, principally because of the small numbers of deaths, and conclude that this is not a fruitful line of enquiry.

More generally, an important issue in capitation is the extent to which health plans should be protected from extreme (catastrophic) demands on their finances. Van Barneveld, Van Vliet and Van de Ven (1996) explore the implications of removing predictably 'high cost' patients from the risk adjustment scheme, based on previous year utilization. They find that such methods would considerably reduce the incentive for cream-skimming. Van Barneveld *et al* (1998) compare three approaches to pooling: pooling of *ex ante* high risk patients, pooling of *ex post* high costs, and proportional pooling. They confirm that removal of high risk patients is the most effective option.

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## NEW ZEALAND

The New Zealand health care system bears many similarities to the pre-1999 NHS. It is funded out of general taxation. Until 1997 there were four regional health authorities, responsible for the purchase of health care on behalf of their residents, with populations of between 650,000 and 1,000,000. Although the regions have been retained for the purposes of resource allocation (see below), the authorities have been abolished and replaced by a single *Health Funding Authority* (HFA) which purchases care from a range of 23 state-owned providers known as Hospital and Health Services (HSSs), as well as private and voluntary providers. Although originally envisaged as profit-making enterprises, HSSs are now not-for-profit. They are expected to act collaboratively and focus on health gain as their principal objective.

The Ministry of Health sets strategic objectives for the HFA, which in 1998/99 were to improve health status, improve, promote and protect the public health, and to promote the independence of the people of New Zealand. In addition, an explicit objective is set for Maori health: namely, to improve Maori health status so Maori will have the opportunity to enjoy the same level of health as non-Maori.

Once the total amount of funding for New Zealand's health and disability services has been set by the national government, the money is divided between the four regions in the form of capped budgets. To this end, three population based funding formulae (PBFF) have been developed: for personal health, for public health, and for disability support services. There is no requirement for the HFA to adhere to the spending implied by each formula, only to the aggregate budget.

The common approach of the three funding formulae is to determine each region's population, broken down into age, sex, and ethnic groups, and to weight this population according to the relative cost of providing services (personal health, disability support, or public health). Each region's share of the total 'cost-weighted' population of New Zealand becomes its share of total funding. In addition, each formula takes into account a small number of other factors that are believed to have a significant impact on the need for services. There are occasional payments to one or more of the regions outside of the capitation scheme for specific purposes (for example, reorganization of services or special waiting time initiatives).

### Personal health PBFF

A formula of some sort has been in place for personal health services since 1983, when it was used to distribute funds for secondary care to 29 hospital boards. Before that, allocations had been largely on a historical basis. Primary care was not included. The formula went through a number of manifestations. By 1993, a formula was in use that – as well as age/sex composition - included a measure of the number of citizens with chronic illness and a deprivation score based on socio-economic and ethnicity measures.

The 1993 formula was perceived to be unsatisfactory for a number of reasons, including:

- Its objective was unclear;
- Concern at how it adjusted for special health care needs;
- Volatility in the needs adjuster used;
- A lack of adjustment for population dispersion;
- Concern at how it adjusted for the health needs of ethnic groups.

A review was therefore set up, and in 1995/96 the current PPBF implemented, allocating about $3,800million.

The objective of the current formula is: 'to assist in achieving equality of access to core personal health services according to need'. The formula has two components: for primary and secondary care.

The primary care component is based on age, sex and 'community services card' (CSC) populations. A CSC is issued to citizens on low incomes (in receipt of some sort of income support). The total CSC population of each region (card holders and dependants) is known from national government records. It is then distributed to age and sex groups on the basis of a Treasury microsimulation model. This yields estimates for each region of the populations in the following contingency table.

**Structure of primary health care capitation matrix**

| | CSC holders | | Non CSC holders | |
|---|---|---|---|---|
| Age | Male | Female | Male | Female |
| <1 | | | | |
| 1 to 4 | | | | |
| 5 to 14 | | | | |
| 15 to 24 | | | | |
| 25 to 44 | | | | |
| 45 to 64 | | | | |
| 65 to 74 | | | | |
| 75 to 84 | | | | |
| 85 plus | | | | |

National cost weights were derived based on estimates of the national average utilization of primary care services for each group using a number of data sources relating to pharmaceuticals, general practitioners, nursing, midwifery, dental and laboratory services. Some analytic work was required to infer weights where data sources were inadequate (for example, some of the data sources did not distinguish CSC holders from non-CSC holders, and others did not use such fine age bands).

In addition, it is hoped to included ethnic-specific cost weights in primary care once suitable data become available.

The secondary care component is based on age, sex and ethnicity. The appropriate populations estimates were applied to the following contingency table.

In the first instance, national cost weights were based on estimates of the national average utilization of secondary care services for each group, using DRG-based hospital in-patient and day case discharge data. Stays longer than six months were excluded from the analysis. It was assumed that other secondary care services (community, accident and emergency, outpatient) were distributed in proportion to implied in-patient and day case utilization.

**Structure of secondary health care capitation matrix**

| | Maori | | Pacific Islanders | | Other | |
|---|---|---|---|---|---|---|
| Age | Male | Female | Male | Female | Male | Female |
| <1 | | | | | | |
| 1 to 4 | | | | | | |
| 5 to 14 | | | | | | |
| 15 to 24 | | | | | | |
| 25 to 44 | | | | | | |
| 45 to 64 | | | | | | |
| 65 to 74 | | | | | | |
| 75 to 84 | | | | | | |
| 85 plus | | | | | | |

The empirically based weights described above are further adjusted to take account of what is perceived to be unmet need amongst the Maori population. The methodology for making this adjustment is based on a statistical analysis of utilization and mortality data, standardized for age, in 74 Territorial Local Authorities. This yields a 'benchmark' utilization for a population with the same under-65 SMR as the Maori. Actual Maori utilization is then scaled up to reflect the utilization that would be expected if – given its under-65 SMR – it were to exhibit the same utilization as the general New Zealand population. Male and female populations were examined separately. The results are summarized in the following table.

**Calculation of the Maori needs scaler**

| | Maori SMR<65 | Maori actual Utilization (%) | Maori expected Utilization (%) | Maori unmet needs scaler |
|---|---|---|---|---|
| Male | 180 | 119 | 139 | 17% |
| Female | 196 | 129 | 133 | 3% |

Thus on the basis of this analysis, the empirically observed Maori cost weights are increased by 17% (amongst males) and 3% (amongst females).

In a similar vein, an additional adjustment is made to regional allocations on the basis of variations between observed utilization and expected utilization (given the age, sex and ethnicity adjusted under-65 SMR). This results in some small further adjustments to regional needs allocations (a maximum of 1.9% adjustment).

In addition to the needs factors described above, a number of cost issues are of concern in New Zealand. In particular, there is concern that rural areas have higher costs in relation to: rural hospitals; GP services, ambulances and transport assistance, and that urban areas have higher wage and salary costs.

A survey of regional health authorities estimated the net extra costs of serving rural areas ($39.3 million in 1995/96) and these are distributed to regions on the basis of numbers of people living more than one hour from a settlement of 30,000 people or more.

Additional concerns had been raised in the review as to financial and cultural barriers to access of health care, but no action was taken in relation to these concerns. The results emerging from the above mechanisms are being phased in over a three year period.

**Disability support services PBFF**

Disability support services were allocated on the basis of a formula for the first time in 1995/96 and account for about $1300million. The objective of the formula is 'to achieve an equitable distribution of funds according to need for disability support services that cannot reasonably be met by individuals, taking into account (a) targeting regimes and (b) equity of access to similar but not necessarily identical services. Disability support services are defined as services for a 'person who has been identified as having a physical, psychiatric, intellectual, sensory or age-related disability (or combination of these) which is likely to continue for a minimum of six months and result in a reduction of independent functioning to the extent that ongoing support is required'. Clearly this definition embraces the UK notion of social care as well as health care. It includes acute mental health services used by people with a psychiatric disability.

The first stage in the allocation process is to split the national expenditure block into four categories. In 1995/96 this resulted in the following division:

- Age related 56%;
- Psychiatric 17%;
- Intellectual 18%;
- Physical/sensory 9%.

A separate sub-formula was developed for each of these groups, which are discussed in turn.

These sub-formulae are themselves built up from several blocks of services. Thus, for example, in the age-related category there are four blocks: residential; home help; assessment and service co-ordination; and other community services. Age, sex (and in some cases ethnicity) specific expenditure estimates are derived from a number of sources. The summation of these yields a contingency table for all disability support services with the following form:

**Structure of disability support services capitation matrix**

| | Maori | | Non-Maori | |
|---|---|---|---|---|
| Age | Male | Female | Male | Female |
| <1 | | | | |
| 1 to 4 | | | | |
| 5 to 14 | | | | |
| 15 to 24 | | | | |
| 25 to 44 | | | | |
| 45 to 64 | | | | |
| 65 to 74 | | | | |
| 75 to 84 | | | | |
| 85 plus | | | | |

The Maori-specific cost weights are in some cases derived in an innovative fashion – for example, in residential care for the elderly, the age weights used for Maori are those of non-Maori who were younger (by 4.6 years for males, 5.9 years for females) to reflect their earlier ageing.

A number of additional issues were considered for inclusion in the disability support services formula, but were rejected either because the evidence did not support an adjustment, or

because the adjustment would not be material, or because there was an absence of conclusive evidence. These included:

- Pacific Islanders (insufficient evidence of an effect);
- Remote populations (not material);
- Socio-economic need (inconclusive evidence);
- Financial access, especially the access of elderly people to residential care (not material).

The introduction of the formula was phased in stages.

**Public health PBFF**

Public health is a relatively small part of New Zealand health care expenditure (about $80 million). It is divided into six blocks (physical environment (24%), well children (18%), nutrition and exercise (7%), well young people (33%), injury prevention (5%), and other population promotion (12%). Different methodologies were used to develop cost weights for each block, disaggregated by age and ethnicity. This results in an aggregate set of cost weights for the following categories.

**Structure of public health capitation matrix**

| | Maori | | Pacific Islanders | | Other | |
|---|---|---|---|---|---|---|
| Age | Male | Female | Male | Female | Male | Female |
| 0-4 | | | | | | |
| 5 to 14 | | | | | | |
| 15 to 24 | | | | | | |
| 25 to 64 | | | | | | |
| 65 plus | | | | | | |

Outstanding issues still under investigation are the possibility of including a geographical dispersion factor, and a review of the ethnic cost weights.

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## NORTHERN IRELAND

Northern Ireland has, like the rest of the United Kingdom, a National Health Service organized on a geographical basis by four Health and Social Service Boards. Unlike the rest of the UK, health and social care are integrated. Until recently, resources were allocated to the Boards using a system known as PARR (Proposals for the Allocation of Revenue Resources), devised in 1978. This followed closely the methods of RAWP used in England until 1990.

The Northern Ireland Health and Social Services Executive has some time been concerned to update PARR, and in 1994 established a Capitation Formula Review Group to examine the potential for change. The terms of reference of the Review Group were to recommend a formula that 'provides the best measure of the relative need for health and social care in Northern Ireland'. The Review Group initiated a programme of research and has already made some recommendations which have been implemented in 1998/99. Its work is continuing, and further changes can be expected. This section reports the system currently in force.

The building blocks for Northern Ireland health and social care are nine programmes of care, as follows:

- acute services (40% of total expenditure);
- elderly care (25%);
- maternity and child health (6%);
- family and child care (5%);
- mental health (9%);
- learning disability (7%);
- physical and sensory disability (3%);
- health promotion and disease prevention (2%);
- primary health and adult community (3%).

Separate formulae have been developed for each programme of care, as summarized below, and additional research has been undertaken into rurality. Discussion of the family and child care programme is omitted.

### Acute services

A research team from Queen's University and the University of York sought to apply the methods currently used in England to Northern Ireland data. The team had access to better data relating to inpatient costs, private beds and welfare benefits than were available for the English study. Numerous potential needs variables were tested. The following acute sector formula was derived, and formed the basis for implementation in 1998/99.

**Acute sector needs formula**

| *Needs variables* | *Coefficient* |
|---|---|
| % of over 75 living alone | 0.1076 |
| % in receipt of family credit | -2.1947 |
| % in receipt of income support | 0.0788 |
| all ages standardized mortality ratio | 0.2712 |
| % of births low birth weight | 0.0513 |

A multiplicative model was used, so the coefficients are to be applied exponentially to the variables. The index for a Board is applied to 36 age/sex capitations derived for the acute sector.

**Elderly**
Further research is being undertaken into this programme of care. As an interim measure, an age weighting (three age groups) weighted by age-specific rates of limiting long-standing illness has been implemented.

**Maternity and child health**
The basic unit of capitation is the number of births (a three year rolling average). As an interim measure, one third of the programme is weighted according to the Standard Spending Assessment for children's personal social services used until recently in English local government. This incorporates the following measures:

- % in non-self-contained accommodation;
- % in lone parent families;
- % in rented accommodation;
- % in receipt of income support;
- % priority housing need.

The remaining two thirds of the programme is not weighted according to need. Further research is being undertaken into this programme of care.

**Mental health**
Further research is being undertaken into this programme of care using the methodology developed in England, but with a broader dataset. A number of possible alternatives have been considered as an interim measure. The chosen approach is to use 14 age/sex bands and the community mental health index in use in England. This incorporates the following variables:

- % in households with no car
- % single, widowed or divorced;
- % in single parent households;
- under-75 standardized mortality ratio.

**Learning disability**
Currently four age weights are used for this programme of care. The index for hospital services is further weighted by a Board's under-75 standardized mortality ratio. This needs index was chosen in preference to a number of possible alternatives on the grounds that it 'most closely represented the perceived redistribution'. Community services are further weighted by 'the number of persons having at least one contact with a provider'. Further work is in hand.

**Physical and sensory disability**
Three age weights are used for this programme of care. These are further weighted by the under-75 standardized mortality ratio. This needs index was chosen on the grounds that it 'offered a reasonable solution' given the questionable materiality of further refinement.

**Health promotion and disease prevention and primary health and adult community**
These programmes of care are allocated on the basis of total relevant population, weighted by the under-75 standardized mortality ratio.

**Rurality**

In 1998/99 two adjustments for costs associated with rurality were made. The costs associated with ambulance services were adjusted in proportion to the 'average miles per patient carried'. And the costs associated with community health services were adjusted according to the numbers of patients living more than three miles from their GP surgery (see the Scotland section for details).

The issue of rurality has assumed considerable importance in Northern Ireland, and the Review Group has commissioned a series of studies into the issue. Its concerns are (a) the impact of rurality on service costs and (b) the impact of rurality on health care needs.

The study of service costs used spatial interaction modelling to examine the impact of rurality on costs of nursing, health visitor, midwifery, occupational therapy, chiropody, day centres, ambulance services, accident and emergency services and community social work. The research examined both travel costs and the influence of scale diseconomies associated with dispersed service provision. Decisions have not yet been taken on implementation. The study of rural needs is examining whether rurality is fully accommodated within the needs indices currently being developed, and is still in progress.

The programme of work initiated by the Review Group is still in progress, and further changes to the capitation formula can be expected.

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## NORWAY

Norwegian health care is the responsibility of local government, in the form of 19 counties and 435 municipal councils. Hospital services are the responsibility of the counties, which are grouped into five hospital regions. Primary health care and social services are the responsibility of the municipalities.

Hospital services are funded by local taxation (mainly local income tax) and block grants from the central government. From 1980 until 1997, the block grants were allocated to counties on the basis of a needs assessment formula which included criteria such as the local *per capita* income, the age structure of the population, and population density. Counties are not obliged to adhere to the expenditure implied by the needs assessment. They set budgets according to local circumstances, with however all marginal spending being met be local taxation. A maximum local tax rate is specified by the national government, and in practice has been used by all counties. Any variations in expenditure above the needs assessment must therefore be met by increases in other local taxes, by reductions in expenditure on other services, or by use of financial reserves. There has been some concern that these arrangements led to inadequate capacity in the hospital sector, as indicated by increased waiting times for elective admissions.

The system of block grants was changed in 1997. Part of the grant continues to be paid on the basis of a needs assessment formula (albeit in a changed format). However, the remainder of the grant is paid on the basis of the current year's inpatient activity, using national standard DRG costs. This arrangement has introduced some incentive to increase hospital activity, as an increase in activity will lead to an increase in future funding. In 1997 the block grant was based 70% on the needs assessment and 30% on current DRG activity. In 1999 these weights changed to 50% and 50%. Counties continue to enjoy the freedom to set budgets different to their weighted needs assessment.

The current needs formula is based on a regression analysis of county expenditure on acute hospitals, with various socio-demographic variables, such as age structure of the population, density, travel distances, mortality and marital status as potential explanatory variables. This analysis was 'adjusted' using a mixture of empirical evidence and political judgement to arrive at the following expenditure needs formula. Note that the weights are not readily interpreted as the units of measurement vary.

**Norwegian health care needs index**

| VARIABLE | Weight |
|---|---|
| Proportion aged 0-15 | 0.103 |
| Proportion aged 16-18 | 0.029 |
| Proportion aged 19-34 | 0.128 |
| Proportion aged 35-66 | 0.247 |
| Proportion aged 67-74 | 0.138 |
| Proportion aged 75+ | 0.188 |
| Mortality rate 0-64 | 0.104 |
| Proportion aged 16-59 divorced | 0.023 |
| Proportion in single adult households | 0.040 |

Similar methods are used for distributing central government grants-in-aid to municipalities.

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## SCOTLAND

The finance of Scottish health care is (currently) arranged along broadly similar lines to that found in England. It is funded out of national general taxation, and arranged locally by 14 geographically defined health boards accountable to the Secretary of State for Scotland, with average populations of 370,000. In future, Scottish health care will become the responsibility of the Scottish government. A distinctive feature of Scotland is the massive contrast between the predominantly urban Greater Glasgow health board (population 900,000), exhibiting the problems expected of large conurbations, and the remote Highland and Island boards, with completely different problems of accessibility and dispersed population.

Cash-limited funds for hospital and community health services are distributed annually using the Scottish Health Authorities Revenue Equalisation (SHARE) model, introduced in 1979. It allocates 77% of all NHS expenditure in Scotland. Health care services are divided into six categories:

- Non-psychiatric, non obstetric (accounting for 52% of SHARE expenditure)
- Obstetric (5%)
- Mental illness (inpatient and day cases) (15.5%)
- Mental handicap (4%)
- Day and outpatients (12.5%)
- Community (11%).

In the largest non-psychiatric, non obstetric category, national utilization rates (inpatient bed days) are calculated over a three year period by 14 age/sex groups. For each health board, these are aggregated into weighted populations for two age groups: 0-64 and 65+. The weighted 0-64 population is multiplied by the all causes standardized mortality ratio (SMR) for those aged 0-64 in the board. This varies from 0.81 in Grampian to 1.26 in Greater Glasgow. No SMR is used for the elderly population. The weighted population aged 65+ is however multiplied by the national geriatric cost factor (GCF), which currently has a value of about 0.66. This seeks to reflect the difference in the daily inpatient costs between elderly patients and younger patients (aged 0-64). The two weighted populations are then added to yield the board's total weighted population for non-psychiatric, non obstetric services, which is used to distributed the total sum available nationally for the category.

Day and outpatient capitations are calculated in a similar way, except that the data source (the General Household Survey) is less comprehensive. A coarse age grid is used (just 4 age groups). The under 65 SMR is applied to the under 65 population, but no geriatric cost factor is applied to the elderly population.

In the obstetric category, births are used as the basis for calculating capitations, and the age of the mother (by five year band) used as an adjuster.

In the mental handicap category, age alone is used as the basis for calculating capitations.

In mental illness, marital status, in addition to age and sex, is used as the basis for calculating capitations. No further SMR adjustment is applied. This gives rise to the following matrix.

**Mental illness capitation matrix**

| | Age | 0-14 | 15-24 | 25-44 | 45-64 | 65-74 | 75+ |
|---|---|---|---|---|---|---|---|
| Male | Single | | | | | | |
| | Married | | | | | | |
| | Other | | | | | | |
| Female | Single | | | | | | |
| | Married | | | | | | |
| | Other | | | | | | |

In community services there is no reliable evidence on utilization. Expected per capita costs for just three age groups are used: 0-14; 15-64; and 65+. These are applied to the board's population. For the costs of the under 65 group, the board's under-65 SMR is also applied to the expected costs. No adjustment is made to the over-65 expected costs.

Community expenditure is divided into services that are from a provider perspective affected by sparsity (such as community nursing) and those not so affected (such as clinics). A further adjustment is then made for the impact of sparsity on costs of delivering services affected by sparsity. All patients are given a score according to their proximity to a GP surgery as follows:

**Weights for calculating sparsity factor**

| ***Distance*** | ***Score*** |
|---|---|
| < 3 miles | 0 units |
| 3-4 miles | 3 units |
| 4-5 miles | 4 units |
| > 5 miles | Plus 1 unit per mile |

Distance along footpaths attracts double weighting, across water triple weighting. The sparsity factor is then the ratio of a board's actual sparsity score to its expected score. It ranges from zero (in Greater Glasgow) to 10.53 (in Western Isles). The sparsity factor is then applied with a weighting of 0.3 to all services thought to be affected by sparsity. That is, the adjustment factor used is calculated as (0.3*sparsity factor + 0.7).

Extensive research has recently been undertaken into the use of alternative capitation methods in Scotland, which have remained largely unchanged for 20 years. A recent consultation document recommends adoption of empirically-based indices of health care needs which have been derived using the methodology developed in England, but are based on much more extensive and up-to-date datasets (Scottish Executive Health Department, 1999). Other significant developments include some disaggregation within different services (for example, six acute hospital groups are recommended), and a more refined approach than SHARE to measuring the extra costs associated with remoteness. The aim of the recommendations is to 'promote equitable access to health care'. The main study report examines models for hospital and community services, prescribing and general medical services expenditure.

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**SPAIN**

Spain's health care is organized on a regional basis. Historically health care was financed on the basis of actual expenditure. Under the 1986 *Ley General de Sanidad* (General Health Care Law), seven of the 18 regions (Comunidades Autónomas), covering about 57% of the population, were given powers to organize health care for their citizens. The remainder of Spanish health care was organized by INSALUD, the National Institute of Health. Articles 43 and 49 of the Spanish Constitution give all citizens the right of access to health care, and the objectives of this reform were 'to correct health inequalities and to guarantee equality of access to public health care services in all Spain'. To that end, the General Law states that 'health policy will be oriented towards overcoming social and geographical inequalities' (art. 3.3).

In practice the Law was implemented using simple unweighted capitations to derive annual expenditure targets. However the extent to which regions had by 1994 moved towards their capitated targets varied considerably, with the actual allocated budgets depending on bilateral negotiations between national government and region. Ten of the remaining 11 regions not covered by the 1986 Law were also given notional targets by INSALUD calculated on a simple capitation basis, the exception being Madrid, which is a very high spending region and which continues to be funded on the basis of historical expenditure.

Even the negotiated budgets appear to have been fairly notional, and there is a history of over-spending, which the national government meets through periodic write-offs of accumulated deficits (for example in 1983, 1989 and 1994). There appears to be little effective managerial control over expenditure, amongst either the seven Comunidades Autónomas or the regions remaining under state control. In principle, regions have the power to raise supplementary taxes to finance increased expenditure on health care, but to date only two have done so (Reverte-Cejudo and Sánchez-Bayle, 1999).

In 1994 an attempt was made to rationalize the system amongst the seven regions to which capitation was applied. The principal steps taken were by national and regional governments:

- To agree that 1991 should act as a base year for the purposes of population estimates and expenditure;
- To agree to a 10 year transition period to full capitation funding under the auspices of the joint committee Consejo de Política Fiscal y Financiera (CPFF);
- To write off the accumulated deficits of all regions' health care expenditure (on the grounds that they arose from unfair expenditure allocations);
- To review the capitation formula every four years (most recently in 1997).

Although a number of proposals for weighting capitation have been developed, it has proved politically impossible to secure an agreement for setting expenditure targets that goes beyond simple unweighted capitation. In essence, the need to secure political consensus amongst the diverse regions has led to a paralysis in moving towards a more needs-based formula. The only adjustments currently made to simple capitations for the period 1998-2001 are therefore:

- An adjustment for cross-boundary flows;
- An adjustment for teaching and research expenditure;
- An adjustment to compensate regions with declining populations.

It turns out that all three of these adjustments benefit Catalonia, the region which has been most in excess of its capitated target, reflecting the historically high levels of health care expenditure in the region.

The current arrangements have been heavily criticised, on the grounds that they give more weight to political expediency than any concept of equity (Rico, 1997; López Casasnovas, 1998b; Cabasés Hita, 1998). However, although there are proposals for more refined methodologies (López Casasnovas, 1998a) there appears to be no immediate prospect of improvements.

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**SWEDEN**

Swedish health care is publicly funded and provided, and is organized by the 26 county councils. Most of the necessary finance is raised from local income taxes. In recent years some counties have introduced internal markets in health care, along the lines of the UK model. Although the market structures remain in place, there has however been some retreat from a market model, and a move towards co-operation and partnership (Whitehead *et al*, 1997).

An example of the Swedish implementation of the internal market is Stockholm county council, which is described by Diderichsen *et al* (1997). Stockholm has a population of 1.7 million and a fixed health care budget of about £1.6billion. About 90% of the budget is distributed to nine geographically defined health authorities with populations of between 50,000 and 300,000. Until recently allocations to health authorities were based on historical activity. However, a mathematical formula is now used as the principal basis for this distribution.

The development of the Stockholm formula was helped considerably by the availability in Sweden of comprehensive linked records of all individuals in the country, based on a unique personal identification number. Moreover, actual costs of individual health care expenditure have been available since the advent of itemised billing in 1994. This facilitates construction of a detailed dataset of the characteristics and health care utilization of all citizens (in fact the analysis described by Diderichsen *et al* makes use of a 30% random sample).

Multivariate Poisson regressions were used to identify the demographic and socio-economic variables that had the greatest association with utilization, leading eventually to the model summarized by Diderichsen *et al*. It is based on (a) age in 10 bands; (b) four socio-economic characteristics based on employment; (c) four classes of cohabitation and marital status and (d) five classes of housing, according to tenure and size. Incorporation of sex into the model was found to be unnecessary. In principle the inclusion of the above factors would result in a 10x4x4x5 contingency table, requiring the estimation of 800 capitations. In practice in 1994 not all the characteristics were found to be salient for all age groups, and a technique known as 'matrix compression' was applied to reduce the number of separate capitations to reasonable proportions. The following table summarizes the major components of the model in the form of a matrix containing just 51 capitations.

**Condensed Stockholm capitation matrix**

| | Medical & Surgical | | Psychiatric | |
|---|---|---|---|---|
| Age | Owner occupier | Rented | Owner occupier | Rented |
| <1 | 7200 | | 0 | 0 |
| 1-24 | 1900 | 2100 | 400 | 600 |
| 25-64 cohabiting | | | | |
| Higher non-manual | 3100 | 3600 | 400 | 800 |
| Other non-manual | 3700 | 4300 | 600 | 900 |
| Manual | 4000 | 4400 | 900 | 1300 |
| Not employed | 5300 | 6400 | 1400 | 2400 |
| 25-64 living alone | | | | |
| Higher non-manual | 3600 | 3900 | 900 | 1600 |
| Other non-manual | 3600 | 4200 | 1000 | 2400 |
| Manual | 3900 | 4600 | 1400 | 3800 |

**cont'd**

| | | | | |
|---|---|---|---|---|
| Not employed | 5100 | 5400 | 4900 | 12700 |
| 65-84 | | | | |
| Cohabiting | 13500 | 16500 | 500 | 1000 |
| Living alone | 15400 | 18200 | 1100 | 2100 |
| >84 | | | | |
| Cohabiting | 27600 | 29800 | 300 | 1000 |
| Living alone | 24200 | 29400 | 500 | 1000 |

The *per capita* weightings implied by these capitations range from 119% in central Stockholm to 86% in south-east health authority. The allocations based on this analysis have been phased in gradually. Extra funds have been found for health authorities hardest hit by the new distribution.

It is noteworthy that the psychiatric model omitted a potentially important variable (non-Nordic immigrants) on the grounds that such citizens are judged to have unmet need which is not reflected in utilization. If an immigrant category had been included, it would have indicated a negative effect on capitations.

The hospital model has recently been considerably refined by developing a separate matrix for the sickest 5% of the population (which account for 50% of expenditure). Inclusion in this model is on the basis of 'costly diagnosis groups', determined by hospital admission diagnosis over a specified period. The groups used are based on ICD chapters, and include: cancer, ischaemic heart disease, cerebrovascular disease, arthritis, arthrosis, hip fracture, schizophrenia, and other psychoses. Inclusion of these factors in the matrix (along with the socio-economic and demographic variables) leads to an improvement in the predictive power of the capitations. Implementation is currently being considered.

The updated model will from 2000 form the basis for a *national* resource allocation scheme that will allocate funds between the 26 Swedish counties. This scheme will of course also have to accommodate the variations in tax-raising capacities of the counties, along the lines of the Dutch and German schemes.

The matrix summarized above is used for hospital care, including psychiatry and geriatrics, but not primary care or social care. A separate model has been developed for primary care, where there is clear evidence that disadvantaged populations underuse facilities relative to others. A small area methodology is therefore used. First capitations are set for the following coarse age groups, using data from the Malmö region:

| Age | 0-4 | 5-15 | 16-64 | 65-74 | 75-84 | 85+ |
|---|---|---|---|---|---|---|
| Weights | 2.9 | 1.1 | 1.0 | 1.8 | 2.6 | 3.4 |

Three data items are collected for each small area:
P1 Proportion with low and middle income (<200,000 SEK)
P2 Proportion aged 45-64 unmarried or divorced
P3 Proportion born abroad or foreign citizens.
A linear regression was performed with these variables as the explanatory variables, and the proportion aged 16-64 either permanently sick or with at least 30 days of sickness in a one year period as the dependent variable. The resulting equation was:

Need = 0.102*P1 + 0.251*P2 + 0.064*P3

In order to smooth extreme values, each small area was assigned to tertile classes for each of the three variables. That is, instead of using the local value of (say) P1, the small area was assigned to one of three classes in respect of P1 depending on whether it lay in the lower third, the middle third or the upper third of values. The mean value of P1 for the relevant tertile is then substituted for the area's actual P1 value. The same is done for the variables P2 and P3. Thus there are 3*3*3 = 27 different classes of small area. The age weights given above are then raised or lowered depending on the 'Need' score obtained for the small area when the tertile scores are entered in the above equation. That is, the age-related weight for every citizen aged 16-64 in the small area is lowered or raised depending on the small area's adjusted need score.

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## SWITZERLAND

Responsibility for health care is in the hands of the 26 cantons (regions). Health care is financed by a system of about 200 insurance funds, of which 12 cover about 90% of the population. Although insurance is not compulsory, 99% of the population is insured. Citizens are free to switch between insurance funds every six months without penalty. Premiums are paid by individuals on a *per capita* basis. The law defines a standard (albeit comprehensive) basic package of care to be provided. For this standard package of care, these lump sum premiums cannot vary according to health care risk factors (such as age, sex or health status), but they can vary according to canton. Premiums can vary if the insuree agrees to vary the terms of the policy (for example, a reduction in premium might be available if an HMO or preferred provider package is accepted).

Although in principle enrolment should be open to all citizens, risk selection (cream-skimming) has been a major issue in Switzerland. The competing insurance funds have had a clear incentive to encourage entry by young and fit members, and to encourage exit by old or unhealthy members. Indeed some funds apparently had an explicit strategy of seeking out good risks, thereby enabling them to offer low premiums to those they elected to admit. There therefore developed a divergence in the risk profiles of the insurance funds and the associated premiums. The federal government has come under considerable pressure from the disadvantage funds to reduce the evident inequalities.

As a result, since 1993 Switzerland has put in place a system of risk adjustment between insurance funds. The risk adjustment is administered by the Federal Association of Sickness Funds (*Konkordat der Schweizerischen Krankenversicherer*). It is undertaken canton by canton (so that no attempt is made to equalize premiums between cantons). To date the only individual risk factors taken into account have been age and sex.

All insurance companies active within each canton i submit to the Konkordat the numbers of months 'at risk' for each age and sex group within a year, and the associated net expenditure (after deduction of any copayments). The data are aggregated in order to derive canton-wide age/sex expenditure tables, and an average associated premium $p_i^*$. The age/sex table is then applied to each insurance fund's age and sex profile to derive its expected expenditure. The Konkordat then arranges transfers between funds which compensate for any difference between the notional premium income (based on the canton average $p_i^*$) and the expenditure needs. That is, the transfer $T_{ij}$ for fund j in canton i is calculated as:

$$T_{ij} = \sum_a \sum_s E_{as}^j P_{as}^j - P_j p_i^*$$

where $E_{as}$ is the expenditure weight for age group a, sex s, and $P_{as}$ is the population in that age/sex group and $P_j$ the effective population covered by fund j in canton i. The effective population is the adult population plus 0.3 times the child population, and reflects the income base of the fund. The sum of all the transfers in canton i is zero.

No allowance is made for variations in ability to pay, although federal welfare payments assist those on low income with their contribution (Schneider, 1996).

Thus the motivation underlying the Swiss risk adjustment scheme appears to have been a concern that the competitive insurance market was failing, and that co-ordinated adjustments are needed to rectify the failure. The requirement to charge a flat rate premium suggests some concern with equity at a local (canton) level, but the lack of concern with inter-canton variations implies less concern with national equity issues.

Sickness funds themselves are introducing capitation schemes for use in their managed care arrangements (HMO or preferred provider organizations). These have hitherto been based on the national risk capitation scheme.

Research into risk adjustment in Switzerland is limited by the availability of data. Some research has noted the improvements that might be secured by including death or benefit take-up as additional risk adjusters (Beck and Zweifel, 1998). One of the largest Swiss insurers, CSS Insurance, has been examining refinements to the risk adjustment scheme (Beck, forthcoming). It has found that extending the risk adjustment formula to include a simple indicator of (any) hospital utilization in the preceding year leads to a substantial improvement in the accuracy of capitations.

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## UNITED STATES OF AMERICA

US health care can hardly be described as a 'system'. Rather US health care is a diverse and confusing amalgam of regulation and competition, funded from a variety of sources, organized by numerous health care plans, and delivered by a mixture of private and public sector providers. A full review of risk adjustment methods used by states and health care plans is entirely beyond the scope of this review, and awaits more considered appraisal. Instead we concentrate on two major health care plans: Medicare and the Veterans Health Administration. The section ends with a more general (albeit limited) discussion of recent US risk adjustment research.

### *Medicare Capitated Care*

Medicare is the statutory federal insurance scheme for elderly people (aged 65 and over), disabled people, and those with end stage renal failure. It is administered by the federal Health Care Financing Administration (HCFA) and accounts for 17% of all US health care expenditure, providing coverage for 13% of the population.

Medicare members are encouraged to enrol in Healthcare Maintenance Organizations (HMOs), which agree to cover enrolees in return for an annual premium. About 15% of Medicare enrolees take this option in preference to the traditional fee-for-service insurance. The premiums paid to HMOs by HCFA are 95% of the adjusted average per capita cost (AAPCC) of equivalent Medicare beneficiaries enrolled in the traditional fee-for-service programme. The insurance is split into two parts (hospital insurance and supplementary medical insurance, which covers ambulatory physician services, supplies and equipment). Until 1999, the adjustment has considered the enrolee's age, sex, county of residence, welfare status and whether or not they live in a nursing home (Health Care Financing Administration, 1998).

The essence of the adjustment is as follows. For each care group (elderly or disabled people) a matrix of relative needs is constructed from a large database of individual Medicare beneficiaries' claims. The matrix for hospital care for elderly people is shown in the table, with the average Medicare beneficiary given a weight on 1.0. The Medicaid category indicates qualification for Medicaid support, the health care scheme for low income citizens. The appropriate weight is applied to the AAPCC for the county of residence. There has been some concern that the AAPCCs in use are excessively volatile and widely dispersed. Since 1997 they have therefore been damped and 'blended' with the national average.

**Medicare 1999 demographic capitation weights**

The weights reported in the table are derived empirically from expenditure patterns on traditional fee-for-service Medicare beneficiaries, not the capitated HMO beneficiaries. There is some concern that – because healthier patients tend to be attracted to the HMO option – the rates used may be excessively generous for the HMOs, even with the 5% discount to the local AAPCC. However, empirical data on expenditure on HMO patients are not yet available.

The federal Balanced Budget Act of 1997 introduces widespread changes into the Medicare system, and empowers HCFA to introduce a much more aggressive risk adjustment mechanism. As a result, from 2000 a new scheme will be introduced which includes previous inpatient experience as a risk adjuster. HCFA has over many years sponsored an extensive programme of research and pilot studies into risk adjustment, and

'Medicare+Choice 2000' marks the culmination of this endeavour (Health Care Financing Administration, 1999).

The basis of the new capitations is a risk factor table which incorporates: age, sex, whether or not the beneficiary qualifies for Medicaid support, and (for elderly people) whether or not the patient was previously a Medicare younger disabled beneficiary. In addition, an adjustment is made for what is known as a Principal Inpatient Diagnostic Cost Group (PIP-DCG) of the patient (Iezzoni, et al., 1998). This indicates the most severe category of inpatient diagnosis experienced by the citizen over a previous year period. Each citizen is allocated to one of 16 PIP-DCG categories of increasing severity, and capitations adjusted accordingly. The table contains illustrative data, which are based on empirical analysis of expenditure on a 5% sample of Medicare fee-for-service enrolees in 1996.

**Medicare 2000 risk adjustment capitation weights**

| | Age | Base | Previous disability | Medicaid | PIP-DCG Score | Factor |
|---|---|---|---|---|---|---|
| Male | 0-34 | 0.367 | - | 0.125 | 0 | - |
| | 35-44 | 0.380 | - | 0.283 | 5 | 0.375 |
| | 45-54 | 0.487 | - | 0.370 | 6 | 0.458 |
| | 55-59 | 0.615 | - | 0.397 | 7 | 0.697 |
| | 60-64 | 0.760 | - | 0.418 | 8 | 0.822 |
| | 65-69 | 0.541 | 0.415 | 0.440 | 9 | 0.915 |
| | 70-74 | 0.705 | 0.398 | 0.457 | 10 | 1.170 |
| | 75-79 | 0.907 | 0.334 | 0.461 | 11 | 1.271 |
| | 80-84 | 1.077 | 0.287 | 0.445 | 12 | 1.662 |
| | 85-89 | 1.258 | 0.237 | 0.404 | 14 | 2.000 |
| | 90-94 | 1.376 | 0.189 | 0.331 | 16 | 2.438 |
| | 95+ | 1.357 | 0.141 | 0.242 | 18 | 2.656 |
| | | | | | 20 | 3.392 |
| Female | 0-34 | 0.362 | - | 0.192 | 23 | 3.823 |
| | 35-44 | 0.403 | - | 0.312 | 26 | 4.375 |
| | 45-54 | 0.526 | - | 0.367 | 29 | 5.189 |
| | 55-59 | 0.643 | - | 0.397 | | |
| | 60-64 | 0.891 | - | 0.412 | | |
| | 65-69 | 0.453 | 0.605 | 0.433 | | |
| | 70-74 | 0.588 | 0.576 | 0.440 | | |
| | 75-79 | 0.747 | 0.519 | 0.454 | | |
| | 80-84 | 0.918 | 0.415 | 0.423 | | |
| | 85-89 | 1.096 | 0.313 | 0.327 | | |
| | 90-94 | 1.162 | 0.232 | 0.231 | | |
| | 95+ | 1.128 | 0.152 | 0.168 | | |
| | | | | | | |

The national average factor is 1.0. An individual's factor is built up additively. The base is determined by age and sex. To this is added an appropriate disability or Medicaid factor if appropriate. Then, if the beneficiary underwent hospital inpatient treatment in the base year, a further factor is added based on the highest PIP-DCG score of all qualifying inpatient spells. Thus a male aged 78 who qualifies for Medicaid and had an inpatient spell with PIP-DCG score 11 would have a total factor of 0.907+0.461+1.271 = 2.639. That is, the HMO would receive 2.639 times the average capitation for accepting that beneficiary.

The individual's risk factor is – as before – applied to the 'blended and smoothed' local county average costs of Medicare beneficiaries. There is a separate risk factor table for new enrolees with less than one year's medical experience to report. The new risk adjustment scheme is being phased in slowly alongside the previous scheme.

***Veterans Equitable Resource Allocation***

The Veterans Health Administration (VHA) arranges health care for 26 million armed service veterans, with annual expenditure of $17 billion. It is unusual in US health care in that it has a captive membership, and therefore operates like a European centralized health care system. However, many veterans also have other health care insurance and so receive all or some of their care elsewhere. In practice, there are about 3 million current users either wholly or partially deendent on the VHA. Care is organized through 22 regional 'networks' of providers, which purchase care on behalf of those local veterans who seek care. Cost control and geographical inequities in access have been central concerns of VHA, and in 1997 federal legislation was enacted which required the VHA to submit to Congress a plan for allocating funds and personnel 'in a way that ensures that veterans with similar economic status and eligibility priority have similar access to … care regardless of where they reside' (Department of Veterans Affairs, 1998).

The culmination of this process was the development of the Veterans Equitable Resource Allocation (VERA) methodology, implemented in 1997, which seeks to allocate funds fairly between the 22 networks. It is said to support several goals, including:

- treating the greatest number of veterans who have the highest priority for health care, and allocating funds equitably based on the number of veterans having the highest priority;
- recognizing the sometimes special needs of veterans;
- creating an understandable resource allocation system that is reasonably predictable;
- aligning resource allocation policies to the best practices in health care.

The VHA had in place funding allocation systems before the 1997 reform. From 1985 to 1990 it used a DRG-based reimbursement system paid directly to providers, and then moved to a prospective provider budgeting system that proved to be too complex and too onerous to operate. It was moreover heavily weighted towards historical costs, a central concern of VHA, with network unit costs varying by as much as plus or minus 40% from the system average.

VERA seeks to rectify these failings by creating a capitation system for most (89%) of its funding. It creates two general types of patient: those with 'routine' health care needs, and those with 'special' (generally chronic) needs. The building block of VERA is the system-wide capitation for each of these groups, which stood respectively at $2,857 and $36,955. More refined categorization was considered (for example on the basis of age) but the variations between networks were not considered great enough to make such refinement material.

The decision to implement this simplest of all categorization of patients is the result of considerable analysis of more refined diagnostic categories, starting with 470 patient groups used in the 1980s, which was simplified to a 5 groups scheme in the early 1990s. The 'special' grouping now in force comprises the following patient types: transplants, extended care, chronic mental illness, and special care (spinal chord injury, rehabilitation, AIDS). This group accounts for 4% of users and 38% of expenditure. Analysis showed that there was little difference in allocations using a two group or five group system, but that use of just one

patient group would lead to material changes in allocations. The crude categorization used has of course been the subject of criticism and debate (Greene, et al., 1997)

A particular problem faced by VHA is that they have no clear count of the number of patients 'at risk' within a network, as there is no registration requirement. A count of users over the preceding three years is therefore used as a proxy. Note that indicators of an individual's costs reflect both health care needs and the extent to which alternative (non-VHA) facilities are used.

Consideration was given to implementing further adjustments to the above capitations to account for variations in costs which were outside the ability of network management to control. Examples included: fuel and utilities costs, pharmaceutical costs, single encounter (visitor) costs, and labour costs. The only source of variation that was deemed to be material related to labour costs, which account for 65% of expenditure. The VHA therefore developed a 'labor index' which seeks to indicate the variations in salaries actually paid by networks for specific grades of employee. This cost adjustment has been the subject of some criticism, as it ignores cost variations other than labour costs, and labour costs are to some extent within the control of the networks (Finegan, 1997).

The 11% of funds not allocated by capitation is distributed to support education, research and equipment and non-recurring maintenance expenditure. Implementation of the VERA system is being phased over a number of years, and will eventually shift about $522 million of the annual $17 billion budget between networks (Barr, 1999).

***Discussion***

A number of researchers have emphasized the weak power of demographic variables to predict health care expenditure (Anderson, et al., 1990, Ash, 1989, Newhouse, 1986). Furthermore, there was clear evidence that severe selection bias was taking place, and Hill and Brown estimated that – even with the 5% discount on AAPCC – Medicare payments were on average 5.5% higher than they would have been if the HMO population had been insured under fee-for-service (Sing, et al., 1998).

Since the early 1980s HCFA has therefore sponsored a great deal of research and a series of pilot studies to examine the implications of adding previous health care experience to the set of demographic risk adjusters. The intention was to seek to develop indirect measures of a patient's health status from utilization data, rather than to use direct measures of health care encounters such as costs, utilization or procedures, as these might introduce perverse incentives, and effectively take HCFA back towards retrospective reimbursement. The research can be considered under three categories:

1. The Diagnostic Cost Group (DCG) approach uses broad categories of patient based on previous inpatient diagnosis over a defined period to predict expenditure. Diagnoses are clustered into DCGs on the basis of expected future expenditure (Ash, 1989). A patient is allocated to the highest DCG experienced over the given time period. Subsequent work has sought to integrate non-inpatient services into the inpatient-based set of DCGs.
2. The Hierarchical Coexisting Conditions (HCC) model allocates patients to one of 100 disease based groups based on inpatient and non-inpatient diagnoses recorded over a specified period (Ellis, et al., 1996). Unlike the DCG model, it is additive, in the sense that a new diagnosis adds to the capitation, whereas it affects a DCG only if it is more serious than previous diagnoses.
3. The Ambulatory Care Group (ACG) approach is based on non-inpatient based diagnoses. Later refinements have sought to integrate inpatient data where appropriate (Fowles, et al., 1996, Weiner, 1996).

These approaches have succeeded in increasing the proportion of variance in expenditure explained from about 1% using the simple demographic model to 5.4% (PIP-DCG) and 8.6% (HCC).

In addition, HCFA has sponsored research on survey-based measures of health status, which use self-reported measures of health status, functional status, restrictions on activities, and clinical diagnoses as the basis for capitations (Fowles, et al., 1996). Such methods are of course costly, and vulnerable to distorted reporting. However, they lead to substantial improvements in capitations if used in conjunction with prior utilization data (Newhouse, et al., 1989). HCFA has also examined the use of encounter-based risk adjustment for the non-Medicare (under-65) population, and for specific services such as mental health, children and the disabled (Ettner, et al., 1998). Another line of enquiry has examined the issue of developing a 'carve-out' payment system for individuals with particularly high expected expenditures (Frank, et al., 1995, Maguire, et al., 1998).

A particular concern within the Medicare system has been the issue of risk sharing. The intention has been to explore whether different reimbursement schemes would reduce the incentive for biased selection by HMOs, whilst retaining expenditure control. Examples include partial capitation (under which part of the reimbursement remains on a fee-for-service basis), risk corridors (under which risk is shared between HMO and HCFA once expenditure exceeds or falls outside a certain corridor), and reinsurance (under which catastrophic risks are pooled by HCFA). Some pilots have explored these possibilities, but have brought to light as yet unsolved practical implementation difficulties, not least because it has proved difficult to find HMOs willing to volunteer to road test these risk sharing models, as they perceived that the conventional payment method would remain the most advantageous.

Although recent innovations are undeniably improving capitation accuracy, a number of concerns have been expressed. Many believe that biased selection is intrinsic to the Medicare model, and cannot be eliminated however refined capitations become. HCFA is anxious that it should move to models based on encounter data relating to HMO enrolees rather than fee-for-service beneficiaries as soon as possible. There is concern that the PIP-DCG model may lead to unnecessary hospitalizations by plans as they seek to move patients up the PIP-DCG hierarchy. In the same vein, there is a concern that there may be a 'creep' in the severity of inpatient diagnosis recorded by HMOs.

A great deal of experimentation with capitation has also occurred at the state level, especially within the Medicaid programme for the poor. Examples reported in the literature include Washington Health Care Authority state employee scheme (Wilson, et al., 1998), a Minneapolis employer purchaser scheme (Knutson, 1998), Colorado Medicaid (Tollen and Rothman, 1998), the California Health Insurance Plan (Bertko and Hunt, 1998, Trauner and Chesnutt, 1996), Arizona's capitated Medicaid programme for long-term care (McCall and Korb, 1997, Weissert, et al., 1997), Maryland Medicaid (Weiner, et al., 1998) and New York's Medicaid mental health programme (Shern, et al., 1995).

Numerous other risk adjustment mechanisms have been tested in the US, and methodologies are emerging with bewildering speed. Examples include the chronic disease score, based on prescribing data (Clark, et al., 1995, Fishman and Shay, 1999, Von Korff, et al., 1992), the Disability Payment System (Kronick, et al., 1996), and the Clinical Classification for Health Policy Research (CCHPR) method (Cowen, et al., 1998).

As well as examining the mechanics of setting and implementing capitations, research has also sought to examine the impact of capitation on physicians (Grumbach, et al., 1998, Kerr,

et al., 1997, Kerr, et al., 1996, Kerr, et al., 1995, Simon and Emmons, 1997, Stearns, et al., 1992). There is evidence of some ignorance amongst physicians of the risks underlying capitation. There are furthermore clear incentives for quality skimping under capitated care, giving rise to concerns about its impact on the quality of and access to health care. However the cautious conclusion appears to be that – in general – capitation has not to date resulted in measurably inferior health outcomes – indeed in several schemes the reverse seems to have been the case (Berwick, 1996, Cole, et al., 1994, Dudley, et al., 1998, Hohlen, et al., 1990, Leff, et al., 1994, Lurie, et al., 1994, Lurie, et al., 1992, Murray, et al., 1992, Oleske, et al., 1998, Reed, et al., 1994, Shern, et al., 1995). This broad conclusion must however be tempered with concern at the possibility of longer-term detrimental effects, particularly in the field of chronic care (Schlenker, et al., 1995, Shaughnessy, et al., 1994, Shaughnessy, et al., 1995).

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## WALES

The finance of Welsh health care is arranged along broadly similar lines to that found in England. It is funded out of national general taxation, and arranged locally by five geographically defined health authorities accountable to the Secretary of State for Wales. In future, Welsh health care will become the responsibility of the Welsh assembly. A formula is used for allocating about 66% of total National Health Service funds to the five health authorities. The purpose is to 'distribute available resources to health authorities in order that they can secure patient care from NHS Trusts' (Welsh Office, 1998).

The formula is used to allocate hospital and community and family health services (HCFHS) funds, and consists of five parts:

- non-psychiatric inpatient services (62% of allocated expenditure);
- mental illness inpatient services (7%);
- outpatient services (12%);
- community health services (15%);
- ambulance services (4%).

For each part, age/sex weights are derived from national data sources. The ambulance age/sex weights are derived from a combination of inpatient and outpatient weighted populations. In three sectors (non-psychiatric inpatient, outpatient and community health services) the under-75 age weights for a health authority are further weighted by the authority's under-75 standardized mortality ratio. Older ages are not weighted for mortality.

Further cost adjustments are made in community health services and ambulance services to reflect extra costs associated with rurality. In community health services, a sparsity factor is calculated on the basis of the estimated average distance travelled per visit. In the ambulance sector, sparsity is calculated on the basis of road lengths per 1,000 population. It is applied with different weights to outpatient and inpatient weighted populations, in the ratio 5:1.

A review of the funding formula has recently been undertaken by the Resource Allocation Working Group (RAWG). It adopted as underlying principles that:

a) equal need should attract equal resources (equity);
b) the selection of variables and methods used to combine them should reflect the degree of variation in need (robustness);
c) the model used should be clear and simple (understandability).

RAWG considered systems in operation in the rest of the United Kingdom, and examined issues such as rurality, deprivation and market forces (cost variations). It concluded 'after detailed consideration … that the current health authority allocation formula was not sufficient to ensure efficient and effective resource distribution'.

RAWG recommended that Wales should adopt the current English formula, excluding a market forces factor, but including an allowance for rurality. They recommended that a rural cost premium should be applied to services such as community and ambulance services in which rurality is likely to have an impact on NHS costs. After consideration of a range of options, RAWG recommended that the rural cost premium index should be based on the population in electoral wards with densities less than 0.25 persons per hectare.

The RAWG recommendations have not yet been implemented.

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