HNP DISCUSSION PAPER

Resource Allocation for Health Equity:

Issues and Methods

Finn Diderichsen

September 2004

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Health, Nutrition and Population (HNP) Discussion Paper

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Health, Nutrition and Population (HNP) Discussion Paper

Resource Allocation for Health Equity: Issues and Methods

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Paper prepared for the World Bank's Resource Allocation and Purchasing Project

Abstract: In this paper, we discuss methods to allocate national health care funds to purchasers or insurers of health care. For administrative reasons, resources are usually allocated as they always have been—which relates more closely to the existing structure and demand than to need. Resource allocation through capitation is needed to achieve equity in access to health care or health outcome. Capitation should be based on epidemiological or sociodemographic need factors. The author discusses how to select and weight need factors and provides examples from high- and low income countries.

Keywords: resource allocation and purchasing, health care financing, resource allocation, capitation, health equity, need, access

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FOREWORD

Great progress has been made in recent years in securing better access and financial protection against the cost of illness through collective financing of health care. This publication – *Resource Allocation for Health Equity: Issues and Methods* by Finn Diderichsen – is part of a series of Discussions Papers that review ways to make public spending on health care more efficient and equitable in developing countries through strategic purchasing and contracting services from nongovernmental providers.

Promoting health and confronting disease challenges requires action across a range of activities in the health system. This includes improvements in the policymaking and stewardship role of governments, better access to human resources, drugs, medical equipment, and consumables, and a greater engagement of both public and private providers of services.

Managing scarce resources and health care effectively and efficiently is an important part of this story. Experience has shown that, without strategic policies and focused spending mechanisms, the poor and other ordinary people are likely to get left out. The use of purchasing as a tool to enhance public sector performance is well documented in other sectors of the economy. Extension of this experience to the health sector is more recent and lessons learned are now being successfully applied to developing countries.

The shift from hiring staff in the public sector and producing services "in house" from non governmental providers has been at the center of a lively debate on collective financing of health care during recent years. Its underlying premise is that it is necessary to separate the functions of financing health services from the production process of service delivery to improve public sector accountability and performance.

In this Discussion Paper, Diderichsen observes that there is an "inverse care law in rich and poor countries". Although poor people shoulder the greatest burden of disease, they receive a smaller share of health care resources than health and better-off people. In other words, health care resources are distributed inversely in relation to need. The author observes that this relationship holds true from country to country and within countries across socio economic groups.

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Lead Economist
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INTRODUCTION

Poor people shoulder the greatest burden of disease but receive a smaller share of health care resources than do the healthy and better-off. In other words, health care resources are distributed inversely in relation to need. This phenomenon is known as "the inverse care law." It holds true from country to country and within countries across socioeconomic groups.

THE INVERSE CARE LAW AT WORK IN RICH AND POOR COUNTRIES

The notion of the "inverse care law" was coined in the United Kingdom (Tudor Hart 1971), but the most striking examples of its existence today are seen in poor countries. In the rich parts of the world, socioeconomic inequalities in health have been recognized for decades, but they are - in relative terms as great in poor countries (Evans et al. 2001).

This disparity in health status is confirmed by data from several demographic and health-surveys (DHS) gathered in 43 low- and middle-income countries in the 1990s (table 1). Socioeconomic inequalities in mortality are large—both in absolute terms (measured as a rate difference between poor and rich) and in relative terms (measured as a concentration index). A partial explanation of these inequalities lies in the differential reach of immunization programs across income groups, with much better coverage in richer quintiles (table 1, columns four and five).

Table 1. Mortality for Children Aged under Five Years by Income Quintile, Selected Low- and Middle-Income Countries (rates per thousand)

	Poorest quintile	*Richest quintile*	*Rich-Poor difference*	*Concentration index*
Mali	298	169	-129	–0.090
Nigeria	240	120	-120	–0.128
India	155	54	-101	–0.169
Egypt	147	39	-108	–0.231
Bangladesh	141	76	-65	–0.084
Indonesia	109	29	-80	–0.210
Brazil	99	33	-66	–0.259
Vietnam	63	23	-40	–0.159

Source: Gwatkin, et al. (2000).

THE PRO-RICH INEQUALITY IN CARE

Inequalities in health are an effect of differential distribution of several determinants of health, including health care and, to some extent, even differential susceptibility to health effects of those determinants (see below). Take, for example, the differential reach of immunization programs, usually government financed, across income groups (table 2).

Table 2. Full Immunization Coverage, Selected Low- and Middle-Income Countries (percent)

	Poorest quintile	*Riches quintile*	*Rich-Poor difference*	*Concentration index*
Mali	15.8	55.6	39.8	0.211
Nigeria	13.9	58.1	44.2	0.279
India	17.1	65.0	47.9	0.262
Egypt	65.1	92.5	27.4	0.069
Bangladesh	47.2	66.7	19.5	0.077
Indonesia	42.9	72.1	29.2	0.026
Brazil	56.6	73.8	17.2	0.066
Vietnam	42.2	60.0	17.8	0.068

Source: Gwatkin, et al. (2000).

The immunization rates among the poor are particularly low and the inequalities across income groups high in Mali, Nigeria, and India but even the other countries in table 2, the inequalities are substantial. Among the 43 countries studied by Gwatkin and others (2000), coverage in the rich quintile averages between 25 and 30 percentage points higher than in the poorer quintiles. Preventable infectious diseases predominate among the poor, and there is an obvious mismatch between the distribution of the avoidable burden of disease and the distribution of highly effective preventive services—often provided free of charge—to deal with them.

Even in the distribution of overall health care spending across income strata, there is ample evidence of the "inverse care law" at least in low- and middle-income countries.

Table 3 Distribution of Government Health Care Expenditure Accruing to the Poorest and the Richest Population Quintile in Seven Sub-Saharan Countries

	Primary care		*Total Care*	
	Poorest quintile	*Richest quintile*	*Poorest quintile*	*Richest quintile*
Côte d'Ivoire	14	22	11	32
Ghana	10	31	12	33
Guinea	10	36	4	48
Kenya (rural)	22	14	14	24
Madagascar	10	29	12	30
Tanzania	18	21	17	29
South Africa	18	10	16	17

Source: Castro-Leal, et al. (2000).

Morbidity in the poorest quintile is typically 2.5 times higher than in the richest (table 1) while the proportion of care allocated to the poor is the inverse—the richest quintile gets 2.5 times as much as the poorest (table 3).

This means that the richest quintile relative to need receives more than 6 times more care. To achieve an allocation of health care resources proportional to need, following principles of *horizontal* equity, more than 25 percent of the health care budget will have to be shifted from the richer to the poorer quintiles.

The causes of the pattern of utilization inversely related to need are several. Hanson and others (2001) point out that some of best documented obstacles to good care for the poor are related to health service organization and delivery—particularly low technical quality, high fees, and long waiting times. Compared to the potential benefit, the time and money costs endured by the

patients are so high that demand and use are low in despite the great need among the poor. How health care is financed—through out-of-pocket payments or by tax or social insurance premiums is of major importance here. But as seen in table 2, even many free government programs for immunization are inequitably distributed. Shortages and poor distribution of both drugs and trained staff are key issues. Behind all this is the way resources are allocated to health care institutions and populations.

RESOURCE ALLOCATION FOR EQUITY IN CARE OR EQUITY IN HEALTH

If we not only want to allocate resources proportionate to the greater morbidity among the poor but also want to reduce the social inequalities in health, we have to look more closely at the *vertical* aspects of equity—that is the unequal treatment of unequals (Culyer and Wagstaff 1993; McIntyre and Gilson 2000). In other words, deprived groups should receive preferential allocation of health care resources to achieve more rapid improvements in their health, thereby reducing inequalities in their health vis-à-vis richer groups.

This distinction between horizontal and vertical aspects of health equity is thus closely linked to two different issues in health policy: how to reduce inequities in access to health care and inequities in health status.

Improving access to health care for all was regarded as the key to reducing inequalities in health status in the now rich countries when they were still poor. When Sweden in 1930 had a life expectancy of a little more than 60 years, equal to what India has today, social inequality in child mortality was a major motivation for establishing free mother-and-child care (Myrdal 1942). Now 70 years later when life expectancy in Sweden is 20 years longer, health equity is still a major issue in Swedish health policy (SOU 2000) as it is in many other rich countries (Mackenbach and Bakker 2002). Since the publication of the Black Report in Britain 1980, focus in the rich countries has shifted from access to health care to other material and behavioral determinants of health inequality (Townsend and Davidson 1982). In the poor countries, however, unequal access and quality of health care is—for good reason—still considered a major determinant of inequality in health (Gwatkin 2002). In this paper we therefore concentrate on methods for allocating resources to improve equity in access to health care and to reduce inequities in health status.

THE INFRASTRUCTURE OF INEQUITY

Historically—as medical science has developed, treatments have become available for increasingly complex conditions, and the costs of medical care have risen far beyond the average household budget.

A FRAGMENTED SYSTEM OF HEALTH INSURANCE

Every society has developed systems to collect revenues, pool funds to spread risks, and transfer these funds to health care providers. This means that a third party—the purchasing authority—takes over purchases of care from providers, thereby interrupting the direct economic transaction between patient and doctor. The organization with the role of purchaser can be national governments, devolved local governments, social insurance funds, and commercial health insurance companies. Depending on historical and political developments, some countries have

achieved unified systems covering large majorities of the population while others have fragmented systems with different purchasers for different strata of the population. Still others, including many poor countries, still rely on direct payments from patient to provider—that is people have to pay the full price of care when they need it. Private out-of-pocket expenditure directly from patient to provider typically accounts for between 50 and 70 percent of total health spending in low-income countries. For the poor, such a situation raises economic obstacles to seeking much needed care and, when they do use it, makes them suffer from the impoverishing costs of the care they get. It may also make the better-off less willing to contribute to the government revenues through taxation, because they also pay for much of their own care directly.

A fragmented structure—neither efficient, nor equitable, nor politically sustainable—results. In a typical pattern, public employees and others with formal employment are protected through social insurance systems, high-and middle-income groups may carry commercial health insurance, and the rural population and other poor groups may depend on government-provided care, which, because it often is gravely underfunded, in practice means that patients have to pay providers directly (Preker, et al. 2002). Severe inequities, as seen, are a result.

ALLOCATING RESOURCES—ACCORDING TO SUPPLY OR NEED?

Resources, for administrative reasons, are often allocated as they always have been in the past rather than according to any independent method. It is logical to do so, in the short run, as it is reasonable to provide funds for efficient use of a service structure that is already there. But, for historical reasons, existing infrastructure is often poorly distributed, so in practice this method of resource allocation perpetuates inequitable patterns of distribution (Rice and Smith 2001). Whether allocations are decided according to historical budgets, number of beds, or utilization rates of the services, the result is often the same—an increasingly inequitable circular process of high utilization, more resources used to create more supply, which generates more demand and use by some groups and correspondingly less by others. Examples are abundant from both rich and poor countries where the budget share for providers in urban and affluent areas grows—often contrary to an explicit political ambition to move in the opposite direction (Hanson et al 2001).

A more equitable alternative might therefore be to allocate resources according to some type of *capitation*—that is a certain amount per capita in the population a purchaser or institution is expected to serve. The capitation should be proportional to expected need, in accordance with the objective of horizontal equity in access to health care. Despite all our epidemiological knowledge, our ability to predict individuals' future health and health care need is still very limited (Kapur et al. 2000). Moreover, variations across individuals can be predicted with some precision only by introducing previous morbidity and utilization into the models. For private purchasers this alternative then encounters the problem that risk in health care cannot (for equity reasons) be adjusted the same way as in other insurance markets. Most societies are—theoretically—unwilling to let individual risk influence individual premiums because morbidity usually is inversely related to ability to pay. Even when risk is pooled through purchasers, notional premiums still have to be calculated in the form of capitations for different purchasers so they can be given budgets that enable them to treat patients with equal need equally.

RESOURCE ALLOCATION AND PURCHASING IN HEALTH CARE

It has always been a fundamental requirement of governments on all levels to be able to allocate funds for public services among institutions or populations that are potential competitors for such funds (Smith, Rice, and Carr-Hill 2001). Increased interest in capitation has often been linked to health care reforms where a clear distinction is introduced between purchasers and providers. As mentioned, purchasers can be local administrative units under a national authority, commercial insurance companies, local governments, or social insurance funds. The rationale for introducing capitation formulas differs somewhat depending on exactly how these different purchasers work (Rice and Smith 2001).

Some countries have *centralized public* systems where tax revenues are allocated to local purchasers responsible for the population in a geographical area. The legitimacy of centralized systems strongly depends on their ability to treat citizens equally, independently of where they live and whether that area has high health care needs. Risk-adjusted capitation is therefore constructed to secure equal opportunities for local health care areas to provide the same level of care independently of geographical variations in need.

In *devolved public* systems, local governments are accountable for purchasing (and often delivering) health care service and usually have the right to use local tax revenues to finance it. Political demands for equity in care, combined with across-area variations in the local tax base and health care needs, will result in unequal taxation rates. Many countries therefore have systems that compensate for variations in the tax base and variations in health care needs.

In *competitive insurance* markets, purchasers may try to compete with premiums, for example, by increasing efficiency and controlling provider costs. A much easier way may be through "cream skimming"—keeping the cheap, healthy, young, and rich consumers and getting rid of the costly, poor, old sick. Regulating this market through risk-adjusted capitation (adjusted by expected need) in competitive insurance markets thus serves the primary function of reducing incentives for "cream skimming," thereby protecting market efficiency.

Many other countries have systems of *social insurance* run by governments, employers, or local communities. The premiums charged will, without risk-adjusted capitations, depend on the average income and health of the insurance fund members, and, as they may vary considerably by region and economic sector, inequalities will result. Keeping payment-side inequities low will usually motivate capitation through central revenues or redistribution across insurance funds.

These examples show that the development of risk-adjusted capitation is driven by concerns of both efficiency and equity (Rice and Smith 2001). Both are crucial for the political and economical sustainability of all kinds of health care systems. In most countries where capitation systems have been introduced, there has also been an underlying, but often decisive, concern for cost containment, setting fixed global budgets for purchasers. Methods for allocating resources to purchasers are therefore, independently of how much they actually reallocate, of importance for keeping the delicate balance of efficiency, equity, and sustainability—the partially conflicting goals of all democratic welfare policies (Diderichsen 1995).

Remarkable as it may seem, if there at all has been any discussion at all about whether these systems can contribute to the ultimate goal of equity *in health outcome,* it has seldom been followed by any detailed analysis of methods (Culyer and Wagstaff 1993).(See below.)

METHODOLOGICAL ISSUES: HOW TO CONSTRUCT RESOURCE ALLOCATION FOR EQUITY IN ACCESS

As pointed out above, allocating resources according to historical budgets when determined mainly by existing supply and its use, perpetuates and reinforces existing inequities. But directly measuring need for health care is nearly impossible technically. The *absolute* level of resource need is usually determined politically, when the overall health care budget is fixed, or economically, through different population groups' ability to pay. Discussion here can therefore be limited to ways of determining the *relative* levels of need across population groups. Need is related to, but cannot be equated, with morbidity, suffering, and disability. The potential effect of services in question is also relevant—there is no need for ineffective care. If the effectiveness of care can be regarded as equal across population groups, variations in morbidity could be used as a proxy for need.

Resource allocation based on risk-adjusted capitation has to make empirically more or less well-founded assumptions on the following three issues:

- The size of the population the purchaser or institution is expected to serve
- The characteristics of individuals or populations that can be demonstrated to have significant influence on the need for health services and could therefore be useful in predicting the relative size of capitation or budgets
- The weight given each of these factors when translated into monetary terms.

MORBIDITY AND MORTALITY AS PROXIES FOR NEED

If need is proportional to morbidity, epidemiological data on the incidence and prevalence of disease would be appropriate indicators of relative need. Insofar as variations in mortality rates are proportional to morbidity rates, even mortality statistics would be useful. Data on morbidity or mortality are either generated within the health care system by registration of discharges and visits, through vital registration systems, or through population surveys. If mortality data are available from vital registration systems with good coverage data on age-specific mortality rates such as infant- or under-five-mortality might be good indicators. In Britain age-standardized mortality rates were used for some years as the main indicator of need and are still used, now in combination with other sociodemographic variables (see below).

The use of mortality data raises several issues. One is the unclear relationship between mortality and need for health care—is there a 1:1 relationship where, say, 10 percent higher mortality should motivate 10 percent higher capitation? We cannot answer that question properly.

Most countries—rich and poor—are facing epidemiological transitions with declining mortality and increasing or unchanged morbidity in nonlethal conditions—often with a different demographic and socioeconomic pattern. Mortality might then be decreasing in relevance as a

reflection of need. Using mortality rates—at least in theory—may also introduce a perverse incentive. Effective care that lowers mortality rates would be punished via a declining budget.

Case data on morbidity and mortality from records within the health care system will be severely biased by variations in record-keeping efficiency across institutions and regions. Good records will be positively associated with resources and quality of care, and therefore less relevant as an instrument for making the allocation pattern more equitable. The exception might be in for diagnoses (and countries) where it seems reasonable to assume that everybody getting that condition will be hospitalized and cases are registered according to standardized criteria. Examples of such conditions in rich countries might be myocardial infarctions, stroke, cancer, severe injuries, and psychosis. Efforts are being made to in some countries to use those data (Andersson et al 2000). Israel uses some of these diagnoses—excluding them from the risk-adjustment formula and allocating their share of the resources based directly on their occurrence. When services are fragmented and access is unequal, as in most low-income countries, case records will be a less reliable source of information on morbidity.

In most low-income countries, mortality and morbidity data will be unavailable on a regular basis for local areas, as they are based mainly on surveys on population samples that cannot be broken down to small geographical areas. When using self-reported morbidity from surveys, one has to be aware that studies have shown that contextual factors influence the correspondence between self-reported morbidity and more objectively measured and medically defined morbidity. Particularly in some poor countries, the socioeconomic gradient of self-reported morbidity and well-being is different and even reversed in relation to more objectively measured morbidity and mortality (Sen 1999). Whether caused by inequities in education or access to care or by other cultural factors, this discrepancy will lead to biased conclusions drawn from this type of models. This problem occurs mainly when more transient health problems are measured and is less problematic in rich countries. In Sweden, for example, the relation (in absolute terms) between self-rated health and future mortality is unaffected by age or social class (Burström and Fredlund 2001). Few countries, however, have data on self-reported health broken down to a low geographical level. One exception is the United Kingdom, where the 1991 census included a question on long-standing limiting illness.

SOCIODEMOGRAPHIC INDICATORS OF NEED

Because of all these complications when using epidemiological data directly as proxies for need, most countries have chosen to use a shorter or longer list of demographic and socioeconomic indicators related to need (in the following called *need factors*).

As noted, our ability to predict variations in health *across individuals* is limited. Studies from low-mortality countries show that even a combination of several demographic and socioeconomic determinants (e.g., age, gender, ethnicity, marital status, education, and employment) seldom explains more than a few percentage points of the variation, and even with the introduction of data on earlier morbidity these figures seldom reach beyond 20 percent (Kapur et al 2000; Rice and Smith 2001). Even if the same figures derived from studies in low-income countries may be somewhat higher, the basic observation still holds: that the future health of individuals is very difficult to predict.

Variations *across geographical areas* or other populations, however, may be better explained by these sociodemographic need factors. This will often be the case in urbanized societies where housing segregation usually implies geographically contrasting population structure in terms of age, ethnicity, income, and other characteristics. In more rural societies, area variations may more often be influenced by geographical and cultural factors. When "purchaser populations" are linked to insurance funds they will more or less, by definition, differ according to demographic and socioeconomic characteristics.

The selection and weighting of need factors has to be based on some kind of empirical analysis. As overall measures of need and morbidity is problematic for the reasons discussed above, most countries use existing patterns of utilization or (better) costs as the yardstick for testing and weighting different potential need factors. To use patterns of utilization or costs may seem to contradict the argument presented above—that allocating resources according to utilization would preserve and even aggravate inequities. But it is *not* variations in utilization across purchasers that should be used as the yardstick but rather variations across those demographic, socioeconomic and epidemiological variables that are potential determinants of need.

Using utilization to weight need factors

The usual way to approach this issue is to construct models where utilization or costs are regressed against potential need factors (Carr-Hill et al 1994). Confounding factors such as supply of health care should also be included as they might influence utilization and may be unevenly distributed across population groups classified according to the need factors. A regression model will then look like the following, where β1 represents a range coefficients linked to the different sociodemographic "need factors" and β2 represents coefficients for "supply-factors":

(1) Utilization/cost = β1need factors + β2supply-factors + constant.

The need factors are then selected and weighted with the help of the nonzero values of the different β 1's.

This method, however, builds on some assumptions that should be carefully evaluated.

We have to assume equity in utilization across groups within the population served by each purchaser. This means that variation in utilization across different levels of each need factor used should be proportional to variations in need. In other words, the distribution of unmet needs, unjustified utilization, or both is independent of the need factors used in the model.

This question can be tested with an analysis similar to the one outlined above but including some indicator of need in the model. In practice, need will usually be represented by some measure of morbidity. β3 represent a coefficient for morbidity. Interaction terms (β13) for the combination of need factors and morbidity should also be included as the effect of morbidity on utilization should be the same independently of sociodemographic characteristics (Wagstaff, van Doorslaer, and Paci 1991).

(2) Utilization/cost = β1need factors + β2supply-factors + β3morbidity + β13needfactors*morbidity + constant.

If all the β1's changes to zero when morbidity measures are introduced in the model, we have reason to believe that the distribution of unmet need or unjustified utilization is unrelated to the need factors. But that conclusion will depend strongly on whether our measure of morbidity is a good reflection of need—or more specifically, that the misclassification that naturally occurs is unrelated to the need factors.

Often this type of analysis is based on surveys, and morbidity measures are self-reported questions on morbidity. As mentioned, this measure might be biased across different socioeconomic groups, and conclusions should be made with care (Sutton et al 1999). Others point out that the relationship between use and morbidity may be modified by sociodemographic factors (Newbold et al 1995). If, with unbiased measurement of morbidity, we get nonzero values of β1 there might be reason to adjust the weights for the respective need factors accordingly.

Unit of analysis—individual or aggregate

To perform analysis (1) described above, we need data sources where data on utilization or costs across units of analysis can be linked to information on both need factors and supply. Two types of study design are usually adopted, with units of analysis being either individual (e.g., Diderichsen et al 1997) or aggregates of individuals (e.g., Carr-Hill et al 1994). This corresponds to what is usually called individual- or group-level (ecological) studies in epidemiology. Ecological studies might be the only alternative when only aggregate data on utilization are available. The advantage of the ecological approach is that the range of different data available on both need factors and supply is often much greater than at the individual level. The problem is that the weights derived from the analysis might be seriously biased by "cross-level bias"—which means that weights estimated by group-level studies might be biased if applied in an individual-level capitation. This is a potential problem as far as risk-adjusted capitation formulas are used at the individual level (see below).

In addition to allowing use of aggregate data on need factors, some important determinants conceptually are characteristics of the context of ecological studies. Social epidemiology is gathering knowledge that geographical variations in morbidity and mortality are not explained only by compositional factors—that is, the sum of individual determinants—but that contextual factors in terms of structure and culture of local communities may also have a significant etiological role. If such contextual factors also have to be taken into account, "hierarchical" or multilevel models will have to be applied where outcome (utilization) is still measured at the individual level but need factors can be both individual level and contextual factors (Diez Roux 2001). These models will be able to estimate contextual effects without the biases involved in pure ecological analysis.

Most of thee confounding supply variables (such as number of inhabitants per doctor, hospital bed etc) are not characteristics of individuals but of areas or population groups. In addition many surveys used for this type of analysis are done by cluster sampling methods, which need hierarchical models to yield correct estimates of variance. So many authors are arguing for the

application of hierarchical models for these purposes, too (Diez Roux 2001). The major problem with not using them usually is that the variance is underestimated and confidence intervals are therefore too narrow, while the actual estimates of coefficients may not be biased.

Cross-level bias

If we use, for example, age distribution and average costs at area level to infer the effect of individual age on costs, cross-level bias of the effect estimate might arise from two sources (Rothman and Greenland 1998):

- If the cost level varies across areas among people of the same age (confounding by group)
- If the absolute effect of age on costs at the individual level differs across areas (effect modification by group).

Confounding is generally a much more important problem in ecological analysis than in individual-level analysis. In this case, health care supply usually generates demand and utilization and might therefore be a confounder on both the individual and the ecological level. But as variation of supply might be much stronger on the area-level (or other aggregates linked to purchasers), controlling for it carefully is much more important in an ecological analysis than in an individual-level analysis. If there is reason to believe that these sources of bias are of minor importance in the specific case, ecological analyses with groups as the unit of analysis might yield valid estimates. But an individual level analysis might be necessary to indicate whether these biases pose a significant problem.

The two analytical approaches (individual- versus group-level) yield results for two different types of resource allocation models:

- The *matrix model* calculating average costs per capita for each group defined as one or combinations of individual need-related variables
- The *ecological model* calculating coefficients for each aggregate need-related variable, based on a regression of health care costs.

Typical need factors

A number of need factors occur in most models used around the world. In the models of the OECD countries recently surveyed by Rice and Smith (2001), the following variables have been used: demographic factors, socioeconomoic factors, and geographical factors.

Demographic factors. Demographic factors include:

- *Age and gender.* Almost every formula takes age into account. Gender is also a determinant of health care costs, but as the gender distribution may be very equal across areas, it may often be omitted—as in some of the examples below. Most countries have individual-level data on the relation between age, gender, and utilization and therefore apply these variables in a matrix model.

- *Ethnicity*. Ethnicity in terms of race, citizenship, or country of birth is often used both in matrix and ecological models. In some countries, some ethnic groups have been found to underutilize health care—for example, the Maori people in New Zealand and non-Nordic immigrants in Sweden. In New Zealand, estimations have been done on how much the Maoris underutilize health care, and the weights have been adjusted accordingly, while ethnicity has been abolished in the Swedish model.

Socioeconomic factors. Numerous socioeconomic factors occur in models around the world. Employment status is often based on census data (as in England) or social security data (as in Stockholm). Marital status and cohabitation are strongly related to health and utilization and therefore often used. Education or occupation are sometimes used but are often available only with long time intervals from census to census or survey to survey. Income, wealth, and consumption as well as data on welfare recipient status may be available from surveys but more seldom from census data or regular registers. As education determines occupation, and occupation determines income, these three variables are strongly linked, and experience from Sweden and other places shows that applying one of them is sufficient.

Geographical factors. Geographical factors might be relevant either because they catch variation in need factors on aggregate level (e.g., mortality rate) or because they influence market forces influencing the cost of providing care (as in the English example, below) or because the effects of demographic and socioeconomic factors are modified by location (as in the Swedish example, below). The problem is that geographical effects often are strongly confounded by supply-factors.

Selection of Need Factors

In summary, in rich countries age (with high weights for births and people over 75 years) plays a predominant role; the socioeconomic and morbidity-related factors play a relatively minor role in comparison with age. For psychiatric care and community care, however, socioeconomic factors have a stronger impact. In poor countries, age (under five) and poverty play a predominant role, but in rural areas geographical variations that are not secondary to the sociodemographic population structure might also be important.

Variations in input costs across purchasers might also affect variations in costs. Whether they should be adjusted for is usually a political question.

Need factors should be chosen in a way that precludes purchasers from manipulating them. Demographic and socioeconomic characteristics of individuals and areas might fulfill this criterion, but things get much more problematic if diagnostic information is used from previous contacts with health care. This might introduce a type of bias in the risk-adjustment formulas—where providers get incentives to set diagnoses that will benefit future resource allocations.

Need factors should not introduce perverse incentives that counteract efforts to improve efficiency and effectiveness. Using rates of mortality, drug prescription, or doctor-certified absenteeism as indicators of need might, theoretically, discourage efforts to keep those rates down. Even if this threat rarely materializes, the mere possibility will undermine the legitimacy of the model.

Finally, need factors should be available on the population level used for resource allocation (area or other purchaser-defined groups) and their measurement should not be differentially biased across these population groups

Data Availability

Data availability is the most serious limiting factor in the choice of a model, particularly in low- and middle-income countries (Pearson 2002).

Data sources are used for two or three different exercises:

- the selection and weighting of need factors
- the application of those factors on the area/purchaser level
- testing variations in utilization for equal morbidity across need factors.

For the first exercise, data sources are needed that include on the individual or the ecological level both health care costs and potential need factors. Supply factors might also be needed in case if there is reason to believe that supply is confounding the need factor coefficients. For the third exercise, data on morbidity will even be needed in the same dataset. For the second purpose, data will be needed on the distribution of need factors for each area or purchaser-population. The data could come from the same or another dataset than the one used for the other purposes, but they should be available in a form that can be broken down for each purchaser-population.

The two types of datasets used for these exercises may not necessarily represent the same population, even if that would be preferable. From epidemiology, the size of the effect of health determinants on health is known to depend on exposure to other contributing causes rather than on any biological property of the specific determinant (Rothman and Greenland 1998). As long as we deal with global measures of morbidity and utilization, such interactions will be of minor importance, and estimates made on one population might be valid even for other populations.

A few rich countries (such as the Scandinavian countries) maintain individual-level databases covering nearly all health care costs for the whole population. These databases can be linked, through personal identification numbers, to other databases, including data on several individual or contextual sociodemographic characteristics (Diderichsen, et al. 1997). This enables use of the same database both to select and weigh need factors and to apply those factors on the area/purchaser level. In many other countries, a similar range of variables will be available only on a small-area level, based on data from health care services and census data (Car-Hill, et al. 1994). In a global perspective, however, this is more an exception than the rule. Analysis related to testing variations in use will usually have to done through household surveys that include data on morbidity (Wagstaff, et al. 1991).

Most countries will have to rely on other sources. For selecting and weighing need factors and applying those factors on the area/purchaser level, household surveys such as Demographic and Health Surveys (DHS) and the Living Standards Measurement Survey (LSMS) are useful (Diamond, Matthews, and Stephenson 2001). Data on health care utilization will have to be

roughly translated into costs. Biases in terms of high nonresponse rates among the severely ill and disabled as well as misclassification of the potential need factors will all reduce the need-factor coefficients. If they are then applied to reallocate resources, the move will usually be in the "right" direction, unlike existing allocations driven by historically and politically determined supply, but not sufficiently to achieve full equity in care.

With models based on LSMS data, where poverty is regressed against a number of covariates included in the census, estimating local poverty levels has proven possible, even if poverty is not measured directly in the census (Elbers, et al. 2002). There is a potential for doing the same thing to estimate local health status and health care needs (Diamond 2001). Even if such synthetic estimates of health are much less precise than poverty estimates, they may still be useful.

RESOURCE ALLOCATION FOR HEALTH EQUITY

Targeting health care resources to populations and services that can deal with the vicious circle of poverty and health is the other major purpose of geographical resource allocation.

This raises the questions of not only how resources should be allocated but also for what type of intervention. Those decisions will have to be based on an understanding of the causes and mechanisms generating the relationship between social position, poverty, and health.

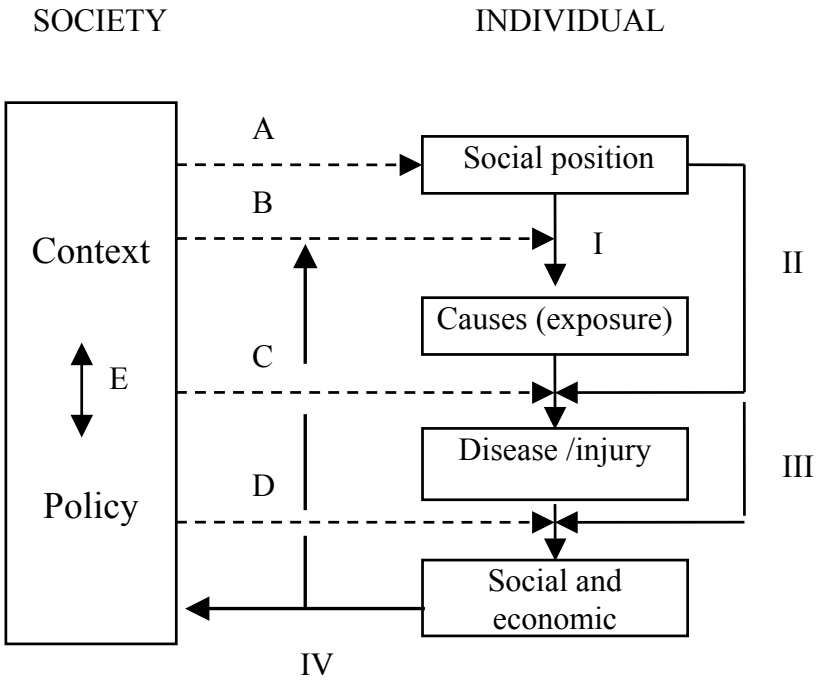
A CONCEPTUAL MODEL FOR THE CAUSES OF INEQUALITIES IN HEALTH AND INTERVENTIONS

Figure 1 illustrates the pathways of the health impact of both social position and social context (Diderichsen, et al. 2001). It shows important entry points for policy and intervention, but other analysts have developed much more elaborate models for understanding potential interventions (Wagstaff 2002). At the individual level, the figure depicts the pathway from social position, through exposure to specific contributing causal factors, and on to health outcome. As many different interacting causes in the same pathway might be related to social position, the effect of a single cause might differ across social positions as it interacts with some other cause related to social position (Hallqvist, et al. 1998). Thus, two separate downstream mechanisms might come into play: d*ifferential exposure* (I) and *differential susceptibility* (II). Both may both contribute to the relation between social position and health outcome and can, as demonstrated elsewhere, be tested empirically (Whitehead, Diderichsen, and Burström 2000).

Ill health has serious social and economic consequences due to inability to work and the cost of health care. These consequences depend not only on the extent of disability but also on the individual's social position (III—*differential consequences*) and on the society's environment and social policies.

The social and economical consequences of illness may feed back into the etiological pathways and contribute to the further development of disease in the individual (IV). It might even, on an aggregate level, feed into the social context of society as well and influence aggregate social and economic development (Sen 1999).

Figure 1. A Conceptual Model for Studying the Health Impact of Social Position and Social Context



Source: Diderichsen, et al. (2001).

The social context including its health policies and other social or welfare policies have thus five main entry points (A to E in figure 1):

Five Entry Points for the Impact of Social Policy in Health Equity

Influencing social stratification (A). The first policy entry point has little relevance for health care but great relevance for education and labor markets policies**.**

Modifying the effect of social position on exposure levels (B). A key mechanism concerns the distribution of causes of illness between population groups. Accordingly, most health policies implemented so far to combat inequalities in health have been aimed at preventing people in disadvantaged positions from being exposed to poverty, bad housing, dangerous working conditions, inadequate nutrition, and the like.

Modifying the effect of specific exposures on disease occurrence (C). Access to private or public resources by which individuals and households can increase their control over important living conditions such as working conditions not only influences their exposure to specific causes of disease but also modifies their effect (Hallqvist, et al. 1998). Children living in extreme poverty (below US$1 per day) have very different mortality rates in different countries, which shows that the national policy context modifies the effect of poverty (Wagstaff 2002). Living in a society with strong safety nets, active employment policies, or strong social cohesion may make day-to-day life less threatening and relieve some of the social stress involved in having very little money or being unemployed (Whitehead, et al. 2000).

Modifying the social consequences of disease (D). The social and economic consequences of disability depend on the labor market, health care financing, and sickness insurance. In poor countries, the impoverishing effects of user fees play an increasing role in the economic consequences of illness. Social consequences of diseases have a much steeper socioeconomic gradient than the incidence and prevalence of the same diseases.

Policies influencing macro-social conditions (E). Social and economic policies might influence social cohesion, integration and social capital of communities, and they reciprocally influence policies.

WHAT THE MODEL SHOWS

This model shows that targeting services to deal with poverty-related inequalities in health can be of five different types:

- Reducing the inequality level among the poor (thereby changing the distribution) of the causal factors mediating the effects of poverty on health in such areas as nutrition, sanitation, housing, and working conditions (B)
- Increasing the intensity of causes that might reduce the susceptibility to health effects of these exposures by such means as vaccination, empowerment, and social support (C)
- Treating and rehabilitating the health problems that constitute the socioeconomic gap of burden of disease (D). The rehabilitation of disabilities, in particular, is often overlooked as a potential contributor to the reduction of health inequalities.
- Strengthening policies that reproduce contextual factors such as social capital that might modify the health effects of poverty (E)

- Protecting against social and economic consequences of ill health though health insurance, sickness benefits, and labor market policies (IV).

Two ways of analyzing resource allocations to reduce inequalities in health will be briefly mentioned.

One way of addressing this problem is illustrated by Gwatkin and Guillet (2000) by calculating the burden of disease in terms of disability adjusted life years (DALYs) constituting the gap between the globally rich and poor. Communicable diseases constitute 79 percent of that gap while non-communicable diseases and injuries constitute 9 percent and 12 percent, respectively. Childhood infections and perinatal conditions are predominate, constituting 49 percent of the gap. Even if similar figures between socioeconomic groups *within* poor countries look slightly different, the message is clear: the gap is overwhelmingly dominated by infectious childhood diseases.

These figures illustrate that economic inequalities and poverty and otherwise generated inequalities in health concentrate in certain disease groups, partly because these disease have an especially steep social gradient and partly because they constitute a large burden of disease in the population. This indicates that targeting resources to the prevention and treatment of specific diagnoses might have an important potential.

Even in England, recent discussions on resource allocation formulas have introduced the issue of reducing inequalities in health, and not only in access. Growing political concern about the persistence of social inequalities in health has led the government to add a new resource allocation objective: "to contribute to the reduction in avoidable health inequalities"—a concern about vertical equity. The review is not yet finalized, and as an interim solution an index of mortality (years of life lost under age 75) has been proposed. A small proportion of the health care budget is now allocated according to this.

Resource allocation to disease prevention to improve health equity has to be based on an understanding of some of the causal relationships outlined above. Efforts should therefore be made to break socioeconomic inequality in health into its different causes so as to allow evaluation of their different roles in mediating the effect of social position and poverty on health (Wagstaff 2002). National policies in Sweden have recently given strong priority to psychosocial working conditions as well as tobacco smoking and alcohol abuse as major causes mediating the effect of social position on health (SOU 2000). A similar British overview recently put strong emphasis on living conditions and health behaviors of mothers and children (Acheson, et al. 1998). The World Health Report 2002 emphasized the enormous potential impact of improvements in nutrition and vaccination programs on the avoidable poverty-related burden of disease. Common to proposals in both rich and poor countries is the emphasis on strong coordination between social policies and health policies in any effort to mitigate social inequalities in health (McIntyre 2002).

FOUR EXAMPLES OF FORMULAS

England, Sweden, Uganda, and South Africa all have programs to reduce social inequalities in health through strategic resource allocation.

ENGLAND: COMBINING INDIVIDUAL AND ECOLOGICAL NEED FACTORS

In England, the resource allocation formula was applied to health care areas (purchasers) for the budget 2001/2002. The formula entails three components: an age factor, additional need factors, and a market force factor capturing variations in input costs of providing health care (DOH 1999). Indexes are calculated separately for acute somatic care, psychiatric care, community care, general practice, and prescription drugs. The following example illustrates the details for acute somatic care.

Age Factor

Individual level data are used to construct a matrix according to age groups (table 4) in which weights are calculated as average cost for acute somatic care in pounds sterling per capita over three years 1994–97.

Table 4 Age Weight Calculated as Average Cost forAcute Somatic Care, England, 1994–97 (in pounds sterling per capita)

Age band	Birth	0–	5–15	16–4	45–64	65–74	75–84	85+
Weight	1867	415	210	283	408	760	1,325	2,089

Source: DOH (1999).

Additional Need

The formula also contains an element to reflect relative need for health care beyond the care accounted for by age. The data are based on a small area analysis where variation in costs were regressed on a number of potential need factors and controlled for supply factors such as number of beds and density of doctors (Carr-Hill, et al. 1994). This analysis was done separately for acute somatic care, psychiatric care, and community-care. The results for acute care (with the weights estimated by the regression analysis) are illustrated in table 5 (all variables except the SMR a derived from the 1991 census)

Table 5. Socioeconomic Need Factors Derived from Small Area Analysis, England 1994

Acute somatic care—socioeconomic and health-related need factors	Coefficients
Age-standardized limiting long-standing illness ratio under 75 years	0.2528
Age-standardized mortality ratio (SMR) under 75 years	0.1619
Proportion of economically active who are unemployed	0.0287
Proportion of pension-age individuals living alone	0.0765
Proportion of dependents in single-career household	0.0436

Source: DOH (1999).

The index is then calculated by taking the product of the various socioeconomic and health status factors weighted exponentially by their coefficients: For example, the acute need index is calculated in the following way:

Acute need index = $(\text{LLSI0<75})^{0.2528}$ * $(\text{SMR<75})^{0.1619}$ * $(\text{unemp})^{0.0287}$* $(\text{pension})^{0.0765}$ * $(\text{single career})^{0.0436}$

Market Force Factors

The "*market force factors"* finally is in England made up by indexes for geographical variations in costs of staff (90 percent), land and building prices (10 percent).

SWEDEN: INDIVIDUAL-LEVEL ANALYSIS

Another example is the model used for resource allocation to local purchasers of hospital care in Stockholm County. It is matrix model built entirely on individual-level data. In an individual-level analysis, the approach is similar to the ecological, only the unit of analysis differs (Diderichsen, et al. 1997). A number of available need-related factors are tested and adjusted for the potentially confounding effect of supply. The purpose of this modeling exercise is not to construct a model with maximum explanatory power but rather to estimate the effect of potential need factors and adjust them for potential confounders.

In the matrix approach, the weights are subject to much less cross-level bias and less confounding by supply factors than the ecological approach. The matrix approach can also

include the numerous interactions between the different need factors. It can be seen in table 6 that marital status, for example, interacts with both disability status and education and disability and also with location. In the Swedish example there is no market-force factor since the formula is applied within the same regional labor and housing market.

Table 6 is a simplified version of the matrix used in reality, which has 300 cells with a more detailed age classification (13 groups) and cells for those with missing values on education.

Table 6. Average Costs for Acute and Psychiatric Care in Stockholm County, Sweden (average for all purchasers. in hundreds of SEK per capita)

		Downtown areas	*Suburbs*	
		Tenants	*Owner occupied*	*Tenants*
		36	39	49
Age 0				
Age 1-19		19	17	22
Age 20-64				
Married/Cohabiting	High education	41	35	44
	Low education	52	46	55
	Disability pension	171	150	139
Single living	High education	42	37	56
	Low education	81	53	85
	Disability pension	290	183	271
Age 65+				
Married/ cohabiting		143	114	146
Single living		175	136	169

*Source:*Diderichsen, et al. (1997).

UGANDA: USING HUMAN DEVELOPMENT INDEX AS AN INDICATOR

There are few examples of formulas for need-based resource allocation in low- and middle-income countries. Many countries face the intricate problem that a pro-poor resource allocation not only includes a geographical reallocation but also a reallocation across care-levels in the system. Since there are alternative sources of funding from donors and nongovernmental organizations, particularly in low-income countries, the question arises how to compensate for external inflow of funds. Should the government allocate less in areas with greater inflow of external funds?

Uganda is an example of a country introducing a formula for allocating health care budget to districts, based on the following variables (Pearson 2002):

- 60 percent allocated according to an index on population size in different age groups.
- 20 percent allocated according to the inverse of the Human Development Index constructed (per capita income, life expectancy, school enrolment ratios)
- 20 percent allocated according to the inverse index of per capita donor and NGO spending in the district.

SOUTH AFRICA: MODELS FOR VERTICAL EQUITY

Starting from the assumption that resource allocation should support efforts to achieve vertical equity and reduce health inequalities, McIntyre (2000) develop a formula based on indexes of deprivation, covering some of the most important causes and consequences of ill health. A principal component analysis (PCA) on small area level yielded the following items in the deprivation index (weight in parenthesis):

- Percentage female (0.028)
- Percentage children <5 years (0.181)
- Percentage living in rural area (0.190)
- Percentage older that 25 without schooling (0.141)
- Percentage unemployed (0.040)
- Percentage living in traditional dwelling, shack or tent (0.091)
- Percentage without piped water in house or on site (0.124)
- Percentage without any access to refuse disposal (0.151)
- Percentage without access to phone (0.152)
- Percentage without access to electricity (0.117)
- Percentage living in household headed by a women (0.072)

Each item was weighted according to its contribution to the overall deprivation index calculated by the PCA.

This index turned out to have a very high correlation with an index based on only one item—access to piped water. The experience is therefore to test what a simplified index might yield, as the more complex PCA analysis may not be needed. Experience from many countries has also shown that indexes for rural and urban areas might look very different. As in many other middle- and low-income countries, mortality registration in South Africa is of varying quality across regions. Therefore, the index could not be validated against any measure of mortality and including measures of mortality in the formula turned out to be inappropriate.

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