

31595

# Risk Pooling in Health Care Financing: The Implications for Health System Performance

Peter C. Smith and Sopic N. Witter

September 2004



Public Disclosure Authorized

Public Disclosure Authorized

Public Disclosure Authorized

Public Disclosure Authorized

Public Disclosure Authorized



**RISK POOLING IN HEALTH CARE FINANCING:  
THE IMPLICATIONS FOR HEALTH SYSTEM PERFORMANCE**

**Peter C. Smith and Sophie N. Witter**

**September 2004**

## Health, Nutrition and Population (HNP) Discussion Paper

This series is produced by the Health, Nutrition, and Population Family (HNP) of the World Bank's Human Development Network ([HNP Discussion Paper](#)). The papers in this series aim to provide a vehicle for publishing preliminary and unpolished results on HNP topics to encourage discussion and debate. The findings, interpretations, and conclusions expressed in this paper are entirely those of the author(s) and should not be attributed in any manner to the World Bank, to its affiliated organizations or to members of its Board of Executive Directors or the countries they represent. Citation and the use of material presented in this series should take into account this provisional character. For free copies of papers in this series please contact the individual authors whose name appears on the paper.

Enquiries about the series and submissions should be made directly to the Editor in Chief. Submissions should have been previously reviewed and cleared by the sponsoring department which will bear the cost of publication. No additional reviews will be undertaken after submission. The sponsoring department and authors bear full responsibility for the quality of the technical contents and presentation of material in the series.

Since the material will be published as presented, authors should submit an electronic copy in a predefined format as well as three camera-ready hard copies (copied front to back exactly as the author would like the final publication to appear). Rough drafts that do not meet minimum presentational standards may be returned to authors for more work before being accepted.

The Editor in Chief of the series is Alexander S. Preker ([apreker@worldbank.org](mailto:apreker@worldbank.org)); For information regarding this and other World Bank publications, please contact the [HNP Advisory Services](#) ([healthpop@worldbank.org](mailto:healthpop@worldbank.org)) at: Tel (202) 473-2256; and Fax (202) 522-3234.

ISBN X-XXXXXX-XX-X

© 2004 The International Bank for Reconstruction and Development / The World Bank  
1818 H Street, NW  
Washington, DC 20433

All rights reserved.

# Health, Nutrition and Population (HNP) Discussion Paper

## Risk Pooling in Health Care Financing: The Implications for Health System Performance

Peter C. Smith<sup>a</sup> and Sophie N. Witter<sup>b</sup>

<sup>a</sup> Professor of Economics, Centre for Health Economics, University of York, York, UK

<sup>b</sup> Research Fellow, Centre for Health Economics, University of York, York, UK

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

**Abstract:** Pooling is the health system function whereby collected health revenues are transferred to purchasing organizations. Pooling ensures that the risk related to financing health interventions is borne by all the members of the pool and not by each contributor individually. Its main purpose is to share the financial risk associated with health interventions for which there is uncertain need. The arguments in favor of risk pooling in health care embody equity and efficiency considerations. The equity arguments reflect the view that society does not consider it to be fair that individuals should assume all the risk associated with their health care expenditure needs. The efficiency arguments arise because pooling can lead to major improvements in population health, can increase productivity, and reduces uncertainty associated with health care expenditure.

The report considers four classes of risk pooling: no risk pool, under which all expenditure liability lies with the individual; unitary risk pool, under which all expenditure liability is transferred to a single national pool; fragmented risk pools, under which a series of independent risk pools (such as local governments or employer-based pools) are used; and integrated risk pools, under which fragmented risk pools are compensated for the variations in risk to which they are exposed. It notes that small, fragmented risk pools, which are the norm in developing countries, contribute to seriously adverse outcomes for health system performance. It therefore argues strongly for integration of risk pools as an important health system stewardship responsibility. There are numerous practical difficulties in making integration operational, so the report offers some guidance on implementation, noting that optimal design of risk pooling arrangements depends heavily on local circumstances. It concludes with suggestions for a number of measures of health system performance that can offer indications of the success of risk pool integration.

**Keywords:** resource allocation and purchasing, health care financing, risk pooling, devolution, health care finance, capitation and risk adjustment, coverage.

**Disclaimer:** The findings, interpretations and conclusions expressed in the paper are entirely those of the authors, and do not represent the views of the World Bank, its Executive Directors, or the countries they represent.

**Correspondence Details:** Peter C. Smith; Centre for Health Economics, University of York, York YO10 5DD, UK; Tel: (44) 1904 433779; Fax: (44) 1904 432700; Email: <mailto:pcs1@york.ac.uk> Web: <http://www.york.ac.uk/inst/che/psmith.htm>; Sophie N. Witter, 5 Wilton Road, Ilkley, LS299PG, UK, Tel: 01943 604413, email: <mailto:sophiewitter@blueyonder.co.uk>



## Table of Contents

<b>FOREWORD.....</b>	<b>VII</b>
<b>ACKNOWLEDGMENTS .....</b>	<b>IX</b>
<b>INTRODUCTION.....</b>	<b>1</b>
<b>WHY RISK POOLING IN HEALTH CARE FINANCE?.....</b>	<b>1</b>
<b>APPROACHES TO RISK POOLING.....</b>	<b>5</b>
NO RISK POOLING .....	5
UNITARY RISK POOL .....	7
FRAGMENTED RISK POOLS .....	8
INTEGRATED RISK POOLS.....	10
<b>PRACTICAL ISSUES .....</b>	<b>12</b>
THE INSTITUTIONAL FRAMEWORK FOR RISK POOLING.....	12
MEMBERSHIP CRITERIA FOR RISK POOLS.....	13
SIZE OF THE RISK POOLS .....	13
SETTING CAPITATION PAYMENTS.....	15
VARIATIONS IN THE BENEFIT PACKAGE .....	17
RETROSPECTIVE RISK SHARING .....	18
OVERLAPPING RISK POOLS .....	19
PAYMENT SYSTEMS AND RISK SHARING .....	20
<b>RISK POOLING IN LOW- AND MIDDLE-INCOME COUNTRIES .....</b>	<b>21</b>
<b>LOCAL CIRCUMSTANCES .....</b>	<b>27</b>
<b>CONCLUSIONS .....</b>	<b>29</b>
<b>TECHNICAL APPENDIX.....</b>	<b>31</b>
MODELING THE NUMBER OF CLAIMS .....	31
MODELING THE SIZE OF CLAIMS .....	32
SOME ELABORATIONS .....	34
<b>REFERENCES.....</b>	<b>35</b>





## 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 – *Risk Pooling in Health Care Finance: The Implications for Health System Performance* by Peter C. Smith and Sophie N. Witter – 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, Smith and Witter review the role of revenue pooling and risk sharing in resource allocation and purchasing. The authors observe that in collective financing of health care, there is no reason that an individual’s own financial contribution to the revenue pool should be related health risks, health care utilization and spending patterns. Rather, it is policymakers that determine the extent to which an individual’s financial contribution depend on their financial means, their utilization of health services and other factors. By “uncoupling” revenues and expenditures in this way, policy makers have a powerful instrument to achieve both re-distributional and health equity goals.

*Alexander S. Preker*

Lead Economist  
Editor of HNP Publications



## **ACKNOWLEDGMENTS**

The authors thank Jack Langenbrunner, Maureen Lewis, Alex Preker and Paul Shaw of the World Bank, Philip Davies of the World Health Organization, and participants at the workshop for comments. In addition, the authors of this Report are grateful to the World Bank for having published it as an HNP Discussion Paper.



## INTRODUCTION

This report examines risk pooling in health care finance, with particular reference to developing economies. *Pooling* is the health system function whereby collected health revenues are transferred to purchasing organizations. Pooling ensures that the risk related to financing health interventions is borne by all the members of the pool, not by each contributor individually. Its main purpose is to share the financial risk associated with health interventions for which the need is uncertain.

The purpose of the report is to (i) identify modalities of pooling particularly relevant to developing countries; (ii) assess the impact of various ways of pooling on health system performance; (iii) provide guidelines to design functional pooling arrangements in a variety of health systems context; and (iv) present best practice. The report covers issues related to purchasing only to the extent that they directly relate to the risk-pooling function.

The report is arranged as follows. The next section examines the rationale for risk pooling. It is followed by a discussion of the various types of risk pooling that exist. The following section examines the issues that arise when seeking to implement risk pooling in practice. Experience in low- and middle-income countries is then discussed. The report ends with a discussion of the implications for health care policy.

## WHY RISK POOLING IN HEALTH CARE FINANCE?

In contrast to many of life's necessities, an individual's need for health care is uncertain. While an individual's expenditure on (say) food is regular and largely predictable, that same individual's expenditure on health care is to largely unknowable, both in magnitude and timing. It is therefore intrinsically difficult for an individual to make financial provision for episodes of sickness or even chronic health care needs. Furthermore, if (as is generally accepted) most individuals are risk averse, they would value arrangements that protect them from this uncertainty in expenditure.

Despite this large uncertainty, health care expenditure needs of individuals *can* often, to some extent, be predicted. Other things being equal, older people tend to have higher spending needs than younger people (except for the very young), and people with chronic health conditions tend to have higher spending needs than healthy individuals. To the extent that characteristics such as age and health status can be measured, predictions of health care spending for a particular individual can be improved. Developments such as genetic testing offer the prospect of refining further such predictions.

However, as Newhouse and others [1] have shown, even if every conceivable factor contributing to an individual's health care spending could be measured, only about 20 percent of the variation in annual expenditure could be predicted. And, in practice, even if excellent information systems are available, that figure rarely rises above 10 percent [2].

The uncertainty in health care expenditure has two elements: its timing and its magnitude. Suppose first that all individuals were expected to incur the same health care expenditure over the course of their lifetimes and that the only uncertain element is the timing of that expenditure. Then, in principle, financial provision for health care could be made in the form of identical individual health care funds, to be used as required over the course of the individual's lifetime, and that are run down to zero by death. Such a fund could be endowed on all citizens at birth, or could be financed by regular contributions from the individual, say, over a working lifetime. The role of the individual fund is to protect the citizen from lumpy expenditure needs of uncertain timing, and to offer unhindered access to necessary health care when the need arises. In effect, the annual risks associated with health care expenditure are pooled across an individual's lifetime.

This sort of principle underlies the use of medical savings accounts in countries such as Singapore [3]. In a similar vein, there has been some examination in developed countries of the extent to which an individual's death is the major indicator of the timing of health care expenditure, on the grounds that the year before death is known to be a period of particularly intense use of health care, but the findings suggest that this is only one of many important predictors of expenditure [4].

In practice, the timing of expenditure is only one element of the uncertain need for health care confronting individuals, and there are also substantial variations in the lifetime expenditure on health care associated with different individuals. We might characterize the spectrum of lifetime expenditure as moving from "healthy" individuals (low lifetime expenditure) to "unhealthy" individuals. In practice, individuals with chronic medical conditions might be expected to be toward the unhealthy end of the spectrum.

Society could in principle take the view that the pursuit of health and consumption of health care are matters strictly for the individual to arrange, and offer the individual no intervention from the broader community to compensate for variations in health care expenditure needs. Such an extreme individualistic position has rarely been adopted in practice. Instead, to a greater or lesser extent, all systems of health care implicitly *pool* the risks associated with individual health care needs.<sup>1</sup> The World Health Organization defines *risk pooling* as "the practice of bringing several risks together for insurance purposes in order to balance the consequences of the realization of each individual risk" [5].

In the extreme, all health care resources available for people of all needs could be pooled, and access to health care determined solely by clinical need. If patients are charged no out-of-pocket fee for such access, this arrangement implies an implicit redistribution of resources from the

---

<sup>1</sup> In the English language the concept of "risk" is ambiguous, and has at least two quite distinct connotations relevant to this paper: risk defined as the relative propensity to incur health care expenditure (in the sense of a "high-risk patient"); and risk defined as the unpredictable variability associated with a particular expected level of expenditure. The creation of risk pools refers to both definitions. It amalgamates individuals with different expected health care needs (definition 1), but also reduces the per capita variability in total health care needs (definition 2). Both notions of risk are of fundamental importance in the design, management, and performance of the health care system. If there is any doubt about the intended meaning, we use the expression "variability" when employing the second sense of the word.

healthy to the less healthy. This is the principle to which certain unitary systems of health care aspire, as for example in the U.K. National Health Service (NHS). The intention is that equal opportunity of access should be offered on the basis of clinical need only, regardless of any other individual characteristics such as wealth or area of residence. In practice, all systems of health care exhibit a mix of these two extreme principles of no pooling and complete pooling.

Any health care risk pool must be financed, but pooling implies that there is no reason the magnitude of individual contributions to the finance should be related to health status or health care utilization. Rather, society must choose the extent to which individual financial contributions depend on financial means, health care utilization, or other factors. Whatever system is chosen, a crucial constraint is that the revenues received must be sufficient to provide the desired system of health care.

The World Health Organization [5] illustrates two of the redistributive issues implicit in risk pooling (from healthy to sick, and from rich to poor) by means of two stylized scenarios:

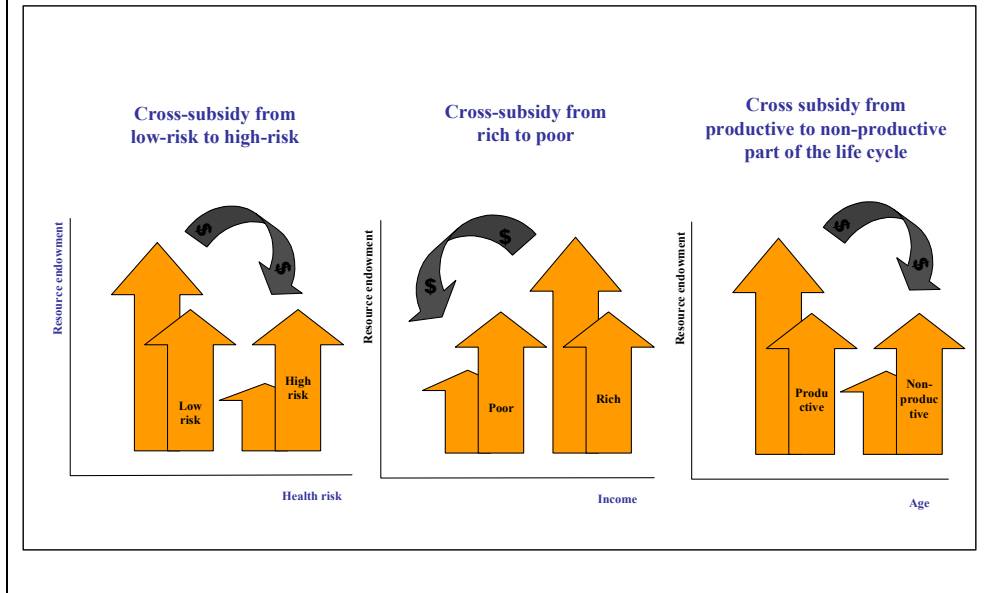
- Members might make equal financial contributions, but the pool effectively enables a transfer to be made from the relatively healthy to the sick (the risk pooling function). A community financing program charging members a flat rate might be expected to function in this way.
- Members might make equal use of health care, but by seeking differential financial contributions the pool effectively enables a transfer to be made from the rich to the poor (the income redistribution function). This is the aim of health financing systems that base contributions on income (for example, many social insurance programs).

To these we would add a third:

- Members might make equal financial contributions and make equal use of health care across their lifetimes, but the pool enables a transfer to be made depending on the stage of the individual's life cycle. This is the life cycle redistributive function of the risk pool.

These concepts are illustrated in the resource allocation and purchasing (RAP) concept note as in Figure 1 [6].

**Figure 1: Pooling of revenues implies transfers (a) from healthy to sick (b) from rich to poor and (c) across life cycle**



There are two broad categories of argument in favor of risk pooling in health care, reflecting equity and efficiency considerations. The equity arguments reflect the view society does not feel that it is fair that individuals should assume all the risk associated with their health care expenditure needs. Instead, all or some of that risk should be spread across a given risk pool. This implies an equity objective of offering equal access to health care for members of the risk pool in equal need, regardless of their personal circumstances.

In developing countries, the equity argument is particularly acute for two reasons. First, the pattern of burden of disease (still predominantly communicable diseases) is closely related to poverty: the poor (those least able to pay) are the ones most in need to treatment. Second, low absolute levels of income mean that even modest financial contributions can lead to inability to seek treatment or adverse consequences from seeking treatment (such as indebtedness or reduced expenditure on other essential items).

As well as offending most people's notion of fairness, an absence of risk pooling is likely to be inefficient. Most obviously, risk pooling transfers health care resources to the poor, who are at the margin likely to be able to benefit more from health care than the rich. Pooling therefore can lead to major improvements in the population's health. Such health gain is likely to be desirable in its own right. Moreover, with no pooling, poorer citizens who could benefit from health care (and may thereby become more economically productive) might languish untreated and become a burden on society. Pooling can reduce or eliminate a large degree of uncertainty associated with health care expenditure, thereby leading to widespread improvements in individual utility.

Treating and preventing communicable diseases is likely to be particularly efficient, both because of the high cost-efficiency of many interventions and the high returns to society. There



are numerous positive externalities from increasing access to prevention and treatment, both in terms of limiting the spread of infectious diseases like tuberculosis, and in wider economic terms (such as improved returns on education and higher workforce productivity).

## APPROACHES TO RISK POOLING

The nature of the risk pooling arrangements is a matter of policy choice, which will be heavily influenced by a nation's circumstances and its policy priorities. In western European countries risk pools are frequently entire regions or nations, reflecting the equity objective of securing universal coverage, often referred to as the *solidarity principle*. In the US risk pools are more heterogeneous, being based on factors such as age (Medicare), poverty (Medicaid), or employment. In spite of the acute equity and efficiency considerations noted above, many developing countries attempt very little risk pooling. Government funds may provide a small subsidy to public facilities, but the bulk of health financing comes directly from households in the form either of user payments (officially sanctioned out-of-pocket fees) or, more commonly, informal payments (unofficial, non-regulated, but often crucial to the functioning of the health system). The World Development Indicators [7] show private health expenditure for 1990-8 as 66 percent of the total in low income countries (reaching 77 percent in South Asia), compared with 37 percent for high income countries.

There are essentially four classes of approach to risk pooling, considered in turn: no risk pool, unitary risk pool, fragmented risk pool, and integrated risk pools.

### No Risk Pooling

When there is no risk pooling, individuals are responsible for meeting their own health care costs as they arise. In its purest form, this entails patients' meeting user charges as they are incurred, with no subsidy of prices for poorer people and denial of treatment when the patient lacks the financial means to pay.

The large degree of uncertainty suffered by all citizens regarding future health care expenditure is likely to lead to high general dissatisfaction with the health care system. Some expenditure uncertainty associated with this arrangement can be removed using a competitive insurance market. Insurers will set individual premiums based on their assessment of an individual's risk profile. In these circumstances, the function of insurance is to eliminate the expenditure uncertainty associated with health care but not to transfer health care resources between individuals. In effect, as the ability to predict expenditure needs improves, such insurance becomes a method of prepayment for health care (rather than insurance), with the principal objective of smoothing known expenditure needs across a lifetime. The expenditure needs associated with individuals with different risk profiles cannot be pooled, otherwise the insurance plan becomes a risk pool, with equal premiums for different risks.

Most private insurance arrangements use the citizen's previous health record as an important element in setting a premium (*experience rating*). Thus, even if a *current* episode of health care is covered by an insurance contract, the patient may implicitly pay for the episode in the form of increased *future* insurance premiums. Indeed, many citizens will effectively become uninsurable for some or all health care risks in a system with no risk pooling. It is for example hard to

imagine the bulk of AIDS patients in Sub-Saharan Africa and Asia either being offered or being able to afford market-based insurance premiums. In practice, society might need to put in place some sort of health care for those unable to pay charges or insurance premiums, which in effect is a “safety net” risk pool comprising the poor and the sick.

In many circumstances, private insurers who wish to charge risk-rated premiums are confronted by a profound lack of information about the health status of their applicants for coverage. If—for lack of this personal information—they are forced to charge a single premium to all insured, they create a risk pool and the problem of *adverse selection* arises. The premium reflects the average costs of health care. But individuals may be able to judge more accurately than the insurer whether their own risk is above average (the sick) or below average (the healthy). If such private information exists, the sick may purchase the insurance, the healthy may not. Thus, with voluntary enrolment, the insurance pool in time becomes less healthy, leading to increased premiums and in turn withdrawal of the comparatively healthy members of the remaining pool. The insurance function therefore breaks down, leading to market failure.

In theory there may be ways in which private insurers can overcome the adverse selection problem [8]. For example two types of insurance contract might be offered. The first has a low premium but requires a significant co-payment on the part of the insured if any health care costs are incurred. The second requires a higher premium but no co-payment. It can be shown that, if there are only two types of individual (healthy and sick), healthy people will select the first type of insurance, sick people the second type. This leads to the creation of two risk pools based on health status. In practice, the situation is much more complex than this stylized example, and whether an insurance contract can be designed to overcome the adverse selection problem is highly questionable.

In the pursuit of equity objectives, many systems of health care insist that an insurer must charge all insureds within a risk pool the same premium (or the same rate of premium as applied to some measure of income or wealth) regardless of health risk. Under this regime, known as *community rating*, the insurer cannot discriminate on price, but instead has an incentive to *cream skim* the relatively healthy. Even if such cream-skimming is formally illegal, it is in practice difficult to prevent insurers from deterring sick applicants, or even from discriminating against those they assume to be high risk (e.g., AIDS orphans). In these circumstances, some individuals might become uninsurable, or insurers might withdraw from the market, in the extreme leading to insurance market failure. The problem of cream skimming under community rating arrangements will be exacerbated by any increased ability of insurers to distinguish between good and bad risks, brought about by developments such as genetic testing.

A further inefficiency associated with an absence of risk pooling is caused by the transaction costs associated with calculating and collecting user charges (in a system with no insurance). A system using informal payments from patients directly to providers may in some circumstances economize on such costs but will give rise to profound inefficiencies and inequities in other aspects of system performance [9].

With risk-rated health care insurance, the transaction costs include assessing an individual’s health care risks, writing appropriate insurance contracts, monitoring the individual’s utilization

of health care, and reimbursing providers. In short, the information and auditing requirements of a health care system with no risk pooling may be considerable. Many forms of risk pooling may reduce the magnitude of such transaction costs. This is an important consideration for health systems in low income countries, which typically have low information technology and managerial capacities.

Finally, by definition, any health care system that relies on individuals to make their own financial provision for health care expenditure will fail to address many issues of public health, which are a central concern in many low-income countries. A side effect of pooling is that the risk pool can act as a focus for programs related to population health that the individual or the private insurance market cannot address.<sup>2</sup>

### UNITARY RISK POOL

Under the unitary risk pool, revenue (whether generated by general taxation, social insurance, health care insurance, or user charges) is placed in a single central pool that seeks to cover a chosen package of health care services. Payments are then made to providers in line with patient demands. Under the unitary model, risk pooling must be mandatory, in the sense that rich or healthy citizens cannot opt out of contributing. The mandatory risk pool is one possible policy response to counter the manifest inefficiencies and inequities associated with adverse selection, cream-skimming, and transaction costs.

It is nevertheless not without its own potential inefficiencies. In particular, an important administrative function is then to ensure that all providers are offering uniform levels of care, in line with the chosen package. Unless systems of provider reimbursement are chosen carefully, there may be a strong incentive for supplier-induced demand [10]. As well as being inefficient, supplier induced demand may lead to variations in the package received, breaching many equity principles. Payment mechanisms can be introduced that reduce the incentive to induce supply such as shifting away from fee for service and informal fees toward block contracts. This may partly explain why many unitary risk pools such as those found in the former Soviet Union, have often been associated with fixed payment system such as salaries. Such mechanisms lead to their own difficulties such as supplier *suppressed* demand and assuring provider quality standards.

Furthermore, because members of a unitary pool have little incentive to moderate their demands on health care resources, the potential exists for *moral hazard*, in the form of excessive consumption of health care resources. Unitary risk pooling removes the usual economic barrier of the price mechanism to consumption, and therefore carries with it the potential for use of health care in excess of the chosen package of care. In developed countries, this problem has been addressed by several instruments of managed care such as utilization review and health care gatekeepers [11].

In developing countries, the frequent presence of large indirect costs of health care consumption imposes considerable barriers to access for the poor. Attending health centers often entails considerable personal costs, in the form of lost income from work (especially in the case of day

---

<sup>2</sup> Because of their public good characteristics, such programs are almost always provided free to the user, implying that any direct charging mechanism is likely to be ineffective.

laborers and peasants), travel costs, and time spent getting to and waiting in health facilities. Even in the absence of direct charges, households are unlikely to make frivolous use of health services. A study of the cost-effectiveness of directly observed therapy short course treatment for tuberculosis patients in Pakistan found a correlation between economic status and drop-out rates. Although treatment was free, the time implications of attending clinics daily were serious, and it was found that the economically active were most likely to fail to complete the treatment [12]. Under these circumstances, the problem of moral hazard is manifested as a problem of inequity of access to the standard package of care, particularly for the poor and residents of rural areas.

The notion of a compulsory risk pool carries with it an implication of a curtailment of individual choice about the nature of the package of health care made available. This can lead to inefficiencies in two ways: first, it may remove an element of competition from the supply of health care, and second it may prevent individuals from securing a package of care in line with their preferences for which they are willing to pay. These considerations have assumed preeminence in the debate over the reform of the U.S. health care system. In other contexts such as the transitional countries of the former Soviet bloc, the tension between the old traditions of solidarity and the new desire to enhance quality and responsiveness of services have led to a spectrum of pooling and financing arrangements.

### **FRAGMENTED RISK POOLS**

In practice, pursuit of a pure unitary system of risk pooling is usually unfeasible and may be undesirable. Although a large unitary risk pool in principle effects complete risk sharing across a nation and minimizes variations in expected expenditure, it brings with it enormous practical difficulties associated with managerial control and coordination. As a result, almost all nations devolve health care purchasing arrangements to smaller organizations, so that the risk pool becomes fragmented.

The potential for fragmentation occurs whenever more than one risk pool exists. Under these arrangements, individuals might be assigned to a particular pool depending on criteria such as:

- Where they live (geographical risk pools)
- The nature of their employment
- Their personal characteristics such as age or health status
- Their personal choice (e.g., competing insurance funds).

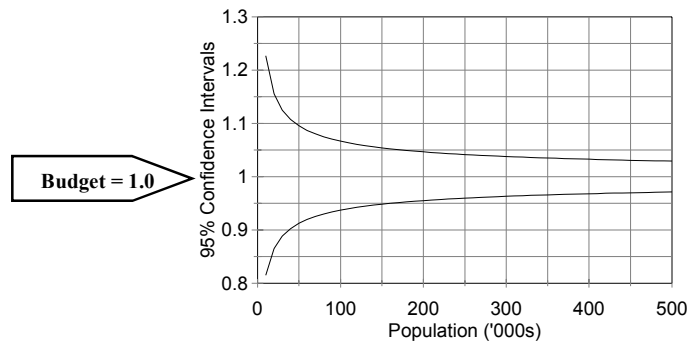
Membership in a *particular* risk pool may be voluntary (as in the case of competitive insurers) or mandatory (as is usually the case with geographically defined risk pools). Society may nevertheless insist that all citizens are members of at least one pool.

Fragmented risk pools will in general be of variable population size and imply variable per capita expected expenditure. Broadly speaking, pools with a higher proportion of older and sicker members will incur higher per capita expenditures. For example, the U.K. NHS is organized into about 100 geographical risk pools (known as health authorities) covering populations of about 500,000. It is estimated that—given the demographic and social characteristics of the population—the per capita spending needs to deliver a standard level of health care among the health authorities vary between 79.5 percent and 135.4 percent of the

national average [13]. Similar variations are likely to be found when the fragmentation is based on employment, and the variation may be larger if based on age or health status.

In general, a larger number of small risk pools will exhibit higher levels of variation in spending needs than a system with a small number of large risk pools. Furthermore, the level of uncertainty in predicting such needs will increase as the risk pool gets smaller, because of the increased importance of random fluctuations in the population at risk. Martin and others [14] show how, as individuals are amalgamated into a risk pool, and the size of the risk pool increases, the per capita random variation in expenditure reduces (figure 2). In the extreme, fragmented risk pools become households or individuals, and the system effectively becomes one of no risk pooling.

**Figure 2: Shows 95% confidence intervals for actual acute sector expenditure in relation to an annual budget as population size increases (England 1991/1992)**



Source: Martin, Rice and Smith, *Social Science and Medicine* (1998)

If left unadjusted, the variation in expenditure needs between risk pools is undesirable on both efficiency and equity grounds. The efficiency arguments are particularly important in competitive insurance systems, when variations in the per capita needs can lead to variations in insurance premiums unrelated to efficiency [15]. The competitive insurance market therefore breaks down unless corrective action is taken. The equity arguments are manifest. Fragmentation implies that pools with sicker, poorer memberships must charge higher premiums than their less disadvantaged counterparts. Both these problems have been addressed through the methods of risk-pool integration, discussed in the next section.

An example of fragmented risk pools can be found in Austria, where health care is organized by sickness funds based on employment sector [16]. Revenues are generated by income-related social insurance payments by employers and employees to the relevant fund. Plans vary in both health care needs and revenue bases, and there is no formal attempt to effect transfers between plans. As a result, premium rates vary substantially between funds for both employers and

employees. This sort of arrangement, with no transfers between risk pools, can be termed a *pure* fragmented system of risk pools.

### INTEGRATED RISK POOLS

Whenever an attempt is made to devolve health care purchasing arrangements there is a danger that the risk pool will be fragmented, leading to the numerous adverse consequences for efficiency and equity (see also below). The policy response to the efficiency and equity problems brought about by fragmentation has been to develop the notion of *integrated risk pools*. Under this arrangement, the individual risk pools of the sort discussed above can remain in place, but financial transfers are arranged between pools so that some or all of the variation caused by pure fragmentation is eliminated. In this section we discuss the approaches to integration that have been adopted.

If it is assumed that the health care system should deliver a standard package of care to all citizens, the most obvious cause of variations in the spending needs of fragmented risk pools is the size of the population covered. A first step toward integration is therefore to base funding of integrated risk pools on a *capitation payment*. This can be defined as the notional or actual contribution to a risk pool's revenue associated with a particular pool member for a given period of time. In its simplest manifestation, a capitation system would give an equal per capita amount to each risk pool. While offering a rudimentary correction for variations in the size of pools, this approach fails to reflect any variations in per capita needs between pools.

Many countries have therefore developed *risk-adjustment* methods, which alter the capitation payment associated with an individual, depending on the individual's characteristics such as age, social circumstances, and health status [17]. A summary is given in the next section. The risk-adjusted capitation scheme seeks to compensate risk pools for variations in exposure.

The operation of a system of transfers between risk pools might take the form of central collection of revenues, and disbursement to risk pools on the basis of estimated spending need. In some systems, an equivalent mechanism is effected in the form of collection of revenues by the pools themselves, followed by financial transfers from low-need pools to high-need pools on the basis of needs, without the intervention of a central intermediary.

If revenues (in the form of insurance premiums) are collected by the individual pools, a distinct issue is the extent to which they are compensated for variations in the revenues base. For example, if revenues take the form of a payroll tax proportional to income, then—for the same package of health care—pools with relatively large numbers of high-earning individuals and low numbers of non-earning dependants will be able to charge lower premium rates than their less well endowed counterparts.<sup>3</sup> If this is considered unacceptable on payment equity grounds, a second set of transfers will be needed between pools to adjust for variations in revenue bases. The two sets of transfers correspond to the risk-pooling and income-redistribution functions noted in the previous section. Some transitional countries such as Estonia, which set up

---

<sup>3</sup> Note in this section the distinction between a *premium rate* (the income per unit of the revenue base) and the *premium* (the amount paid by a particular member). Most systems of managed competition seek to secure equal premium rates, not equal per capita premiums.

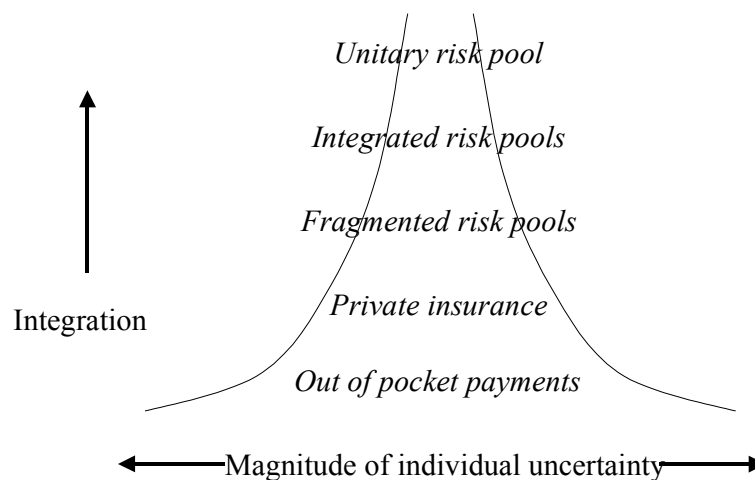
decentralized health insurance funds with local collection powers in the first wave of reforms, found it hard to equalize between wealthier and less well-off regions. This led to a re-reform in 1994, with the establishment of a central sickness fund for tax collection, from which per capita allocation of funds could be made to local sickness funds.

In practice, integration of the risk-pooling and income-redistribution payments can be effected simultaneously within a single payment system. If  $N_i$  indicates the total expected expenditure needs in pool  $i$ , and  $B_i$  is the revenue base for insurance premiums in pool  $i$ , then the policy objective is to secure an identical rate of premium  $r^*$  for all pools. This is achieved by noting that—using this global premium rate—the difference between revenue and expenditure in pool  $i$  is  $r^*B_i - N_i$ . This difference is the contribution of pool  $i$  to the risk-adjustment pool (which becomes a receipt if it takes a negative value). For a self-funding system of health care,  $r^*$  must be chosen so that the sum of all receipts equals the sum of contributions to the risk-adjustment pool.

In summary, as risk pooling becomes progressively more integrated, the uncertainty associated with health care expenditure can be reduced. This can be illustrated by means of the “integration pyramid” (figure 3). A system of out-of-pocket payments exposes individuals to the greatest level of uncertainty. Private insurance can smooth some variability, but with risk-rated premiums does little to compensate for variations in health status or income. Fragmented risk pools allow some local sharing of risk but continue to expose members to variations between risk pools. Integration seeks to reduce these variations, which are eliminated under a truly unitary system.

Some of the rudimentary mathematics of risk pooling is discussed in the technical appendix. The many considerations other than risk sharing that influence the choice of risk-pooling arrangements are discussed in the following sections.

**Figure 3: The integration pyramid: as integration increases so the degree of uncertainty borne by the individual decreases**



## **PRACTICAL ISSUES**

The discussion above suggests that—in principle—enormous efficiency and equity gains can be secured by well-designed risk-pooling arrangements. However, numerous practical issues arise in seeking to make the principles of risk pooling operational. This section discusses these issues under eight headings: the institutional framework for risk-pooling arrangements, membership criteria for risk pools, the size of the risk pools, setting capitation payments, variations in the benefit package, retrospective risk sharing, overlapping risk pools, and payment systems and risk sharing.

### **THE INSTITUTIONAL FRAMEWORK FOR RISK POOLING**

The most important imperatives for risk pooling are to establish appropriate and reliable systems of governance, to assure the collection and stewardship of finances, and to ensure the appropriate reimbursement of providers. These basic requirements are fundamental, and local conditions may seriously circumscribe realistic policy choices. They imply the need for a minimum degree of long-term trust in the institutions of health care, a rudimentary flow of adequate information, and the reliable enforcement of contracts, whether implicit or explicit. Without these desiderata, it is difficult to envisage the feasibility of any system of risk pooling and collective purchasing of health care.

Once these basic institutional requirements are satisfied, numerous fundamental choices must be made about the type of risk pooling employed within a system of health care, including:

- The institutional basis for risk pools (geography, employment sector, employment status, and so on)
- The criteria for membership in a risk pool
- The size of risk pools
- Whether or not the risk pools are competitive
- Whether or not contributions are mandatory
- Whether financial contributions are community rated or risk rated
- The extent to which health care users retain some expenditure risk (in the form of user charges)
- The extent to which there are financial transfers between risk pools
- The extent to which the risk pools are protected from unpredicted variations in expenditure needs by some higher level pooling
- The freedom given to risk pools to choose variations in packages of care, membership entitlement, and financial contributions.

A full discussion of all of these issues is unfeasible, although we discuss some of the more important ones in the following sections. The choice will frequently be heavily dependent on the administrative structures already in place, the nature of governance structures, managerial and informational capacity, and societal preferences.



## **MEMBERSHIP CRITERIA FOR RISK POOLS**

It may be necessary to give careful consideration to criteria for membership in a risk pool. Where pools are defined by geographical residence or employment sector, these may be reasonably unambiguous. However, establishing membership status may be less straightforward if membership (or premium payments) are based on factors such as income, wealth, health status, or employment status.

If insurance is voluntary, “safety net” arrangements must be made for catastrophic health care costs borne by the uninsured (leading to the creation of an implicit safety net for the poor). If the rich are able to “opt out” of contributing to public health insurance and take up private insurance in its place, the financial viability of (and political support for) the public risk pool may be threatened. Where the public risk pool is able to provide only a limited package of care, a more stable solution is to allow those who so wish to take out supplementary private insurance, but to insist that all citizens contribute to the public risk pool.

Under competitive insurance with mandatory enrolment, mechanisms are required to ensure that citizens are members of one (and only one) risk pool. The informational and policing requirements of some of these risk-pooling arrangements may preclude their use in many settings.

## **SIZE OF THE RISK POOLS**

The optimal size of risk pools is a central design consideration. The choice will to some extent be dependent on the purposes of the risk-pooling scheme. For example, the nature of the health care package under consideration has important implications for risk pooling. If it is confined to relatively routine care of common conditions, expenditure is predictable, and care can be delivered at a local level, so small risk pools may be satisfactory. However, coverage of less common, more expensive care may require pooling at a higher level to ensure that random expenditure variation can be managed and providers can be properly regulated.

Small risk pools introduce important additional managerial incentives that may adversely affect system performance in terms of both equity and efficiency, particularly if the pools are subject to very “hard” budget constraints [18]. These arise because the importance of the unpredictable random element of expenditure grows as the size of the risk pool contracts. In these circumstances:

- Small risk pools that perceive that their expenditure will fall below their budget may “spend up” to protect their budgetary position in future years.
- Risk pools that perceive that their expenditure will exceed their budget may be thrown into crisis, leading perhaps to serious unplanned rationing, as they seek to conform to the budget.
- Patients may be treated inequitably. Different small risk pools will be under different budgetary pressures, and so may adopt different treatment practices. Moreover, within a risk pool, choice of treatment may vary over the course of a year if the risk pool’s perception of its budgetary position changes.

- Risk pools may adopt a variety of defensive stratagems such as cream skimming or insuring with a third party against overspending their budget.

The nature and magnitude of these managerial responses will depend heavily on the nature of ownership and governance arrangements in place. They impose implicit or explicit costs on the system which need to be weighed against any benefits brought about by devolving responsibility to small risk pools.

The potentially dysfunctional influences of small risk pools can be abated by stratagems such as:

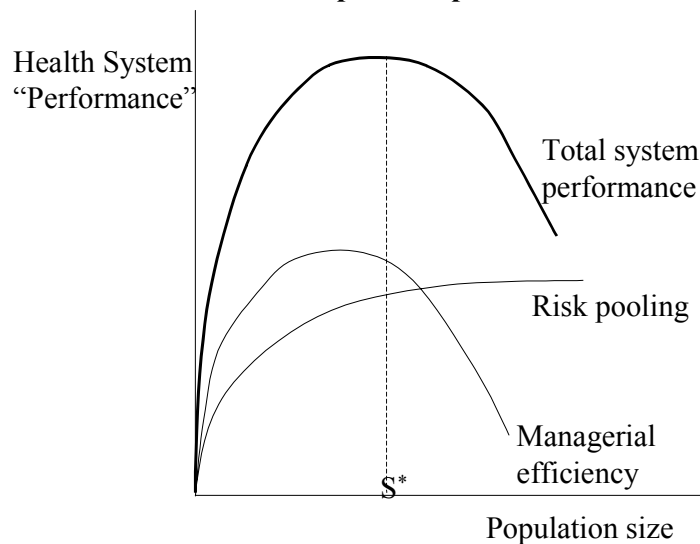
- *Amalgamating risk pools.* Budgets become less susceptible to random per capita variations as the population to which they refer increases. There is therefore a strong argument for allocating a joint budget to voluntary associations of risk pools that wish to share managerial responsibilities.
- *Pooling years.* In the same way, random fluctuations become less important as the time period associated with a budget increases. Risk pool budgets may be more meaningful if they refer to a period longer than the conventional one-year planning horizon. Even if budgets cannot be set for periods longer than a year, arrangements for carrying forward surpluses or deficits to future years may be helpful.
- *Excluding predictably expensive patients.* A small number of patients with serious chronic conditions may account for a large proportion of expenditure, making a significant contribution to the unpredictable variation in expenditure. Where the condition is readily verified, there may be an argument for transferring budgetary responsibility to a higher level risk pool.
- *Excluding certain procedures or services.* In the same way, certain procedures such as those relating to severe mental illness, though rare, may have important implications for budgetary control where they occur. Consideration might therefore be given to transferring all or part of the costs of such procedures to a higher level risk pool.
- *Retention of a contingency fund.* Some risk pools will overspend their budgets, others will underspend. There may therefore be a case for “top-slicing” a certain amount from all budgets at the start of the period to create a contingency fund with which to cover high-spending risk pools. This means that all budgets will appear relatively “tight” at the start of the period.
- *Careful analysis of variations from budgets.* The above discussion indicates that—before any action can be taken—careful examination of the causes of variations from budgets is essential. This might entail installation of useful and timely information systems and audit systems, as well as some sort of peer review.

An important associated consideration is the managerial cost associated with running alternative risk-pooling arrangements. A system of competitive insurance is likely to be particularly demanding in terms of information flows and monitoring. A plurality of risk pools imposes a burden in terms of transferring payments to providers, and collecting premiums, as well as the need to arrange interpool financial transfers. A system of larger, noncompetitive risk pools might be appropriate in circumstances where information and managerial resources are poor.

The choice of risk-pooling arrangement may be influenced by levels and distribution of income, and the nature and magnitude of potential revenue bases. If these vary substantially, big interpool transfers may be needed, and a strong central coordination role is indicated. Paradoxically, this requirement is likely to be particularly important in a system in which there has been substantial purchasing devolution to a large number of small risk pools. If, on the other hand, risk pools have roughly similar per capita income and needs, a less integrated system may suffice.

In summary, there is likely to be a trade-off between the size of the pools and the complexity of the managerial, purchasing, governance, and stewardship functions (figure 4). Equity gains (from pooling) must be traded off against efficiency losses [19]. The shape of the curves, and therefore optimal size, will depend on local circumstances and preferences.

**Figure 4: As population size increases, risk pooling performance improves: however managerial efficiency declines beyond a certain point. Optimal size is at  $S^*$**



### SETTING CAPITATION PAYMENTS

In most systems of health care, it will be unfeasible and undesirable to implement a pure unitary risk pool. Instead, some form of fragmentation is inevitable, and the issue then how much integration can be secured. Depending on the information resources available, this integration might, in the first instance, have to be rudimentary, but any move toward integration is likely to have considerable benefits in terms of shifting resource toward poorer, less healthy populations.

A number of methods of integrating risk pools through capitation can be found in developed nations [17]. The level of sophistication of the risk-adjustment process varies considerably between countries and is highly contingent on information availability. In Spain, the payment is equal for all citizens, and no attempt is made to adjust for variations in per capita needs. In the U.K. NHS, on the other hand, risk adjustment has evolved into a highly elaborate set of formulas based on demographic and social characteristics of the risk pool [20]. Perhaps the most advanced

approach to risk adjustment is found in Stockholm County, where 51 distinct capitation payments have been developed, with the magnitude of the annual payment depending on an individual's age, gender, marital status, housing tenure, and employment status [21].

In Germany, the Netherlands, Belgium, Switzerland, Israel, and many other countries that have sought to introduce competitive health care insurance markets, it is recognized that sickness funds with low health care risk profiles and strong resource bases are able to charge low insurance premiums, and therefore have a competitive advantage that is unrelated to their own performance [15]. If left unadjusted, this arrangement offers funds a powerful incentive to cream-skim members who are healthy, have high incomes, and low numbers of nonearning dependants. The implementation of risk-adjustment schemes is therefore imperative to compensate plans for variations in their risk profiles and revenue bases. In effect, the intention of integration is to enable all plans to levy a standard premium rate if they deliver a standard package of care at a standard level of efficiency, thereby securing a system of integrated risk pools.

Many of the systems of “managed competition” between health insurers are in practice highly regulated and offer the plans little scope to secure efficiency improvements from providers, who continue to be reimbursed on the basis of activity [22, 23]. This lack of leverage in pursuing provider efficiency increases the incentive for plans to target their energies either toward the socially wasteful activity of cream-skimming, or toward the inefficient practice of quality skimping (for example, delivering less than the socially desirable level of care to high-need patients). In these circumstances, the purpose of capitation and risk adjustment is to seek to reduce the manifest inefficiencies that emerge. The many interesting efficiency issues that emerge when seeking to implement a competitive insurance market are discussed in more detail elsewhere [15, 24-30].

In most of Scandinavia, health care is organized at the local government level [31]. It is financed partly by central government grant-in-aid and partly by local taxation and user charges. Because the central grant is fixed, marginal expenditure must be raised from these two local sources. The central government grant therefore seeks to enable municipalities to deliver a standard package of care at a standard rate of local tax and user charges, and therefore fulfils both a risk-adjustment and an income-redistribution role. However, local governments are to some extent free to choose the package of care offered and local tax and user charge levels. The intention of the risk adjustment is therefore to offer local communities the *opportunity* to deliver a standard package of care. However, the residual freedom for the pool to vary from that standard means that this is in effect a system of fragmented risk pools which is only *partially compensated*.

In most centrally planned systems such as those found in the United Kingdom, New Zealand and many Canadian and Australian states, fragmentation takes place in the form of budgetary devolution to local risk pools based on geography. Revenues are generated centrally, so that there is no requirement for any formal income redistribution mechanism. However, there will in general be an important need to adjust for differences in health care need profiles, so that a standard package of care can be offered in every area.

## VARIATIONS IN THE BENEFIT PACKAGE

The definition of the health care benefit package covered by insurance arrangements has become a highly sensitive and unresolved political issue in many developed nations. It represents a form of deliberate or *planned rationing* of health care. Yet finding a satisfactory package definition is important, particularly when unitary and integrated risk-pooling arrangements are sought, as variations in the available package compromise the desired equity objectives. Furthermore, particularly in low-income countries, specification of the benefit package will be an essential step in ensuring that the chosen health care system is within the nation's means.

In an environment where finances are insufficient to cover all health care, there is an important continuing debate concerning the balance between insuring minor as opposed to catastrophic risks. The Primary Health Care approach focused on prevention and minor, treatable ailments, and made the case that this was both efficient and equitable. Recently, a number of authors have tried to refocus on services for which there is high demand and have raised the question of whether it may be more important to protect against infrequent, but potentially catastrophic risks. These questions are not readily resolved from an equity point of view. Minor health expenditure probably forms the bulk of household expenditure on health care. Shifting coverage to higher cost services increases the possibility that benefits are captured disproportionately by the urban elite, who live closer to secondary and tertiary facilities. On the other hand, it is also true that high-cost health events might disproportionately affect poorer households.

While both developing and transitional countries aspire toward guaranteeing access to a wide range of services, problems in funding give rise to three possible outcomes.

- In the first, a wide range of services continues to be offered, but quality drops, so that patients are obliged to pay for a range of inputs, from top-up payments to staff to drugs, food, and so on. This is common in developing and transitional countries.
- In the second, the basic package of services on offer is narrowed to an “essential package” of services. This was the recommendation of the World Bank in its 1993 World Development Report on Health, in which burden of disease and cost-effectiveness of interventions were used to draw up suggested minimum preventive and clinical service packages. The implication of this is that any wider services are to be purchased in private health markets. A number of countries have tried introducing explicit “essential service packages” in recent years. These raise a number of issues such as their practicality (for example, can cross subsidies between services inside and outside the package be avoided?). However, it is too early to draw firm conclusions.
- The third option is to keep the same breadth of services but to narrow the range of beneficiaries—targeting those under a certain income level, for example, with the remainder forced to pay out of pocket or seek private insurance to cover their needs. An example from the developed world is the attempted targeting of the aboriginal population in New South Wales [32]. In England, a recent attempt to direct resource allocation toward “reducing avoidable health inequalities” similarly implies a targeting of certain resources toward the less healthy [33]. Such strategies raise enormous practical difficulties, and in developing countries resource allocation remains, if anything, skewed toward the better-off rather than the poorest.

We have hitherto usually assumed that the benefit package to be delivered must be uniform across risk pools. In fact, if the integration of risk pools is imperfect, they will in general be unable to offer a uniform package. One of the responses of the relatively underfunded pools may be to alter the package of benefits available, even if—in principle—the health care system seeks to avoid such inequalities. Variations in the package may take the form of prohibition of certain treatments or drugs, poorer quality care (in the form of longer waits, for example), poorer quality facilities (in the form of location or physical condition), or a reduction in patient choice.

In some systems of competitive health care insurance (as in parts of the United States), such variations may be legitimate, and potential members may be offered a trade-off between the extent of the benefit package and the premium paid. Similarly, in systems of local government-based health care, some elements of the package may be subject to local discretion. In all systems of health care, some variation in the package (for example between rural and urban areas) may be practically inevitable. However, many systems of health care seek to offer a uniform package, and reductions in such variations are a policy objective.

If risk pools have the freedom to vary the benefit package, this does not necessarily preclude risk-adjusted capitation methods. The focus of the capitation scheme becomes one of offering the risk pools the *opportunity* to offer a standard package at a standard premium (as in the local government example above). Alternatively, receipt of certain parts of the capitation payment may become *conditional* on the risk pool's offering some part of the benefit package. This splitting of the total capitation payment between risk pools may become essential in systems in which two or more risk pools share the responsibility for covering individuals (see overlapping risk pools, below).

When the resources of a risk pool come under strain, the risk pool may have to ration access to health care and set priorities for access. Treatment may be delayed or refused, even when it falls within the package. Such *unplanned rationing* decisions will often appear arbitrary and unfair (in the United Kingdom, they have become known as “postcode rationing”). In developing countries, unplanned rationing is common and generally results from budgetary shortfalls, unpaid salaries, and drug consignments that do not arrive on time. Unplanned rationing is likely to be particularly prevalent in systems with a large number of small risk pools, as the high random variability in per capita expenditure in such pools increases the probability that budgetary constraints may become binding.

### RETROSPECTIVE RISK SHARING

Prospective risk adjustment between risk pools is usually only the first stage of the resource allocation process. It is almost invariably accompanied by a retrospective stage, in which prospective allocations are altered in the light of actual expenditure experience. A number of arrangements exist for handling retrospectively variations in actual expenditure from the prospective budget. These include:

- Renegotiating the budget retrospectively with the central payer (as effectively occurred for many years in Italy and Spain)

- Running down (or contributing to) the plan’s reserves (as in many systems of competitive insurance funds)
- Varying the future premiums or local taxes paid by the plan members (as in Scandinavia and some competitive insurance systems)
- Varying the user charges paid by the patients (as in Finland)
- Varying the package of benefits available to patients
- Delaying or rationing health care to the population at risk (as occurs to differing extents in the United Kingdom, Norway, and Sweden).

These arrangements might exist in any system of fragmented risk pools and are particularly important when their size is small (and pools are therefore vulnerable to random fluctuation in demand). They imply important differences in the “hardness” of the fragmentation and suggest that—to differing extents—the apparently scientific methods (such as capitation) used to finance health care purchasers might be tempered by many other methods of resource allocation, both prospective and retrospective. As a consequence, the extent to which the financial resources ultimately available to risk pools have been determined by some objective assessment of needs varies considerably between systems.

### OVERLAPPING RISK POOLS

So far the discussion has assumed that an individual is a member of a single risk pool—however defined. In many systems of health care, there may exist *overlapping* risk pools. For example, in the United States it is common to find that health care costs associated with particular conditions (such as mental illness or end-stage renal failure) are “carved out” of regular risk pools, and placed in a condition-specific risk pool [34]. The intention is to remove very unpredictable but high-cost needs from the regular health care pool and to transfer the associated risk to a higher level of aggregation (for example, from state to federal level). In a similar vein, *individuals* with particular chronic conditions might be carved out of the regular risk pool and pooled at a higher level to protect relatively small pools from catastrophic calls on their funds.

Intermediate arrangements are also common under which the low-level pool shares the costs of certain elements of health care with a higher level pool. This is the arrangement in place for inpatient care in Norway, the marginal costs of which are shared between the national and the local government. In many systems of health care (such as France) the state offers a basic package of health care that citizens can choose to augment with supplemental (private) benefits insurance. The renegotiation of devolved budgets with a central payer is also in effect a cost sharing arrangement of this sort, albeit of a rather less structured format.

At the other extreme, systems in which patients are liable for significant charges imply that the risk is shared between the pool and the individual. In effect, some of the risk borne by the pool is shifted downward to the individual. Similarly, arrangements under which citizens can take out supplementary private insurance give rise to a complex rearrangement of risk sharing. For example, in the United Kingdom, some private insurers offer their members side-payments if they agree to forgo a claim and instead wait for public NHS treatment.

Singapore is an example of a system where minor and higher cost risks have been separated and financed through different mechanisms. Individual medical savings accounts (Medisave) provide

intertemporal spread for some ambulatory and minor hospital expenditures, while a national catastrophic illness insurance scheme (Medishield) covers prolonged and expensive treatment (financed by employee contributions, often taken from the Medisave accounts). The first involves no direct risk pooling; the second does pool risks. In addition, there is a complex system of co-payments and deductibles, which involve direct out-of-pocket private payments. However, the context of Singapore is not typical, and even there the state continues to fund 30 percent of health expenditure [3, 35].

### **PAYMENT SYSTEMS AND RISK SHARING**

Up to now the discussion has focused on the health care purchaser as a risk pool. It implicitly assumes that a purchaser will be charged by providers for the health care utilization of its risk pool on a fee-for-service basis (effectively, a spot market in provision). However, other possible charging mechanisms exist, and the risk borne by the risk pool can be profoundly affected by its contractual relationship with providers.

At one extreme, the purchaser might negotiate a block contract with an independent provider, which implies that the provider will give all necessary care to pool members for a fixed sum, regardless of the volume or severity of demands. This arrangement effectively shifts the relevant part of the risk pool from the purchaser to the provider. Such “provider risk pools” comprise the sum of all purchaser risk pools with which it has contracts. The use of block contracts might be a particularly effective means of aggregating a number of small purchaser risk pools.

There exist numerous mechanisms for reimbursing providers that are intermediate between the fee-for-service arrangement (under which all risk remains with the purchaser) and the block contract (under which all risk is transferred to the purchaser). A modest transfer of risk from purchaser to provider occurs when a fixed price per case (e.g., in the form of a diagnosis related group payment) is substituted for fee for service. The risk associated with the *incidence* of a case remains with the purchaser. However, the risk associated with *variations in treatment costs* is transferred to the provider.

An alternative intermediate risk-sharing arrangement might entail a cost-sharing arrangement between purchaser and provider. For example, the purchaser might agree to reimburse 50 percent of the provider’s incremental costs once activity exceeds a certain threshold. Or perhaps the provider might be prepared to take on greater risk (in the form of block contracts) in exchange for a longer term contract [36]. The United Kingdom has had a particularly rich experience of experimentation with contractual form in this vein, although the lack of serious penalties for breach of contract has inhibited careful evaluation [37].

The choice of contractual form (implicit or explicit) between insurer and provider has many ramifications beyond the sharing of risk. For example, at least in the short term, the block contract arrangement removes the price incentive for insurers to restrain the demand for health care among its members but gives providers an incentive to skimp on care. The fee-for-service arrangement leads to an incentive for supplier-induced demand. Considerations such as these must also be taken into account when choosing the optimal level of risk sharing between insurer and provider.



Most developed nations have separated the purchaser and provider function in the belief that this arrangement leads to efficiency gains. The driving force behind such separation has been the desire to develop a market in providers, which can lead to all the putative benefits associated with market competition. In practice, the merits of creating markets in health care provision are still the subject of debate [38]. However, the separation of purchasing and provision appears to be an enduring result of reforms in many countries [39].

In contrast, in many developing countries the purchasing and provider functions continue to be vertically integrated, in the sense that insurance and provision function are not separated, and an implicit block contract between the two is therefore in place. For example, a community-financed health center might both collect premiums and provide care for its locality. Vertical integration may result in some loss of incentives for provider efficiency. However the separation of purchaser and provider imposes a considerable managerial and informational burden on the health care system, so integration may be desirable where managerial capacity is limited. Furthermore, if open access to a provider is guaranteed for all in the locality, vertical integration is an implicit way of creating a local risk pool.

The role of the provider becomes crucial when revenue is raised in the form of user charges. The provider must either collect the charge directly from the patient or ensure that accurate charging information is passed to the risk-pool management. In either case, important transaction costs arise in enforcing payment. Additional transaction costs might arise in auditing the probity of the provider if some or all of the charge is to be remitted to a central agency.

## **RISK POOLING IN LOW- AND MIDDLE-INCOME COUNTRIES**

Where it exists, risk pooling in low- and middle-income countries has usually been partial and fragmented. For example, in some Latin American countries such as Argentina (before its reforms in the late 1990s), coverage by health insurance was organized through professional associations. In this case, risks varied between pools according to the nature of their members' work. Many in the informal sector—often poorer and with higher health risks—were not covered by these risk-pooling arrangements.

In other countries, like Indonesia, social insurance coverage is a perk offered to public sector workers. While this arrangement reflects practical factors—it is harder to collect contributions from small-scale and informal enterprises—it can have a regressive effect, with the relatively better-off receiving higher quality services with some degree of public subsidy. Industrial countries, like South Korea, which started a scheme for civil servants in 1977, have now managed to extend coverage to 94 percent of the population [40]. Others, like the Philippines, have lower coverage rates of around 40 percent for payroll insurance, probably reflecting the different employment structure and level of development of the country. A number of African countries, like Burundi and Namibia, that introduced insurance for public sector workers in the 1980s, continue to have very low coverage, around 10 to 15 percent. There is some correlation—though by no means perfect—between levels of coverage and per capita income (table 1).

**Table 1. Introducing Social Health Insurance in Low- and Middle-Income Countries**

<i>Region</i>	<i>Year introduced</i>	<i>Coverage</i>	<i>Per capita income (US \$)</i>
<b>Africa</b>			
<i>Key feature:</i>	Gradual introduction for civil servants and formal sector		
Burundi	1984	10-15 %	150
Kenya	1960s	25 %	260
Namibia	1980s	10 %	2,030
<b>Eastern Europe &amp; FSU</b>			
<i>Key feature:</i>	Transition from tax funded to social insurance		
Estonia	1992	94 %	2,820
Hungary	1992	High <sup>a</sup>	3,840
Russia	1991	High <sup>a</sup>	1,910
Slovenia	1993	High <sup>a</sup>	7,140
<b>Asia</b>			
<i>Key feature (transitional):</i>	Response to declining level of state funding		
Kazakhstan	1995	70-80%	1,110
Vietnam	1993	10 %	200
<i>Key feature (other):</i>	Expansion a response to the growth of the economy		
Indonesia	1968	13 %	790
Thailand	1990	13 %	2,210
South Korea	1977	94 %	8,220
<b>Latin America &amp; Caribbean</b>			
<i>Key feature:</i>	Introduced from 1920s as part of wider package of pensions, unemployment and other benefits		
El Salvador	1960s	11 %	1,480
Argentina	1920s	90 %	8,060
Mexico	1930s	42 %	4,010
Bolivia	1930s	18 %	770
Paraguay	1930s	14 %	1,570

a. Introduced from a 100 percent universal tax funded base—coverage thought to be falling as nonworking lose effective entitlement.

Source: From Witter, et al. [41]

The extent of private insurance is less clearly related to income than to the historic development of health markets. Latin America has relatively high rates of supplementary private health insurance (e.g., around 27 percent in Chile), whereas fast-growing Asian economies such as Malaysia and Singapore remain around the 3 to 4 percent [42].

The failure of social and private insurance programs to achieve coverage beyond 20 percent of the population has renewed interest in smaller scale risk pooling such as community financing initiatives. Schemes like the Bamako Initiative, which was widely promoted in the early 1990s, tend to pool finance regionally. This may increase quality of service, and hence sometimes utilization, but also carries a number of dangers. The first is that it is not common to find interregional cross-subsidies between poorer and richer areas. The second is that distortions may occur in the service pattern, related to payment methods. In China and Vietnam, for example, allowing commune health staff to raise revenue from sales of drugs led, not surprisingly, to a large increase in drug prescriptions [43]. Another issue is the impact on the poorest. Since contributions must be levied in some form, a number of studies have highlighted the difficulty of reaching the poorest, who may lose out (to the moderately poor) on the introduction of such schemes [44]. The goals of financial sustainability of a scheme and reaching the poorest often conflict.

A survey of community finance schemes from a number of countries highlights some successes and failures (table 2). There are a number of tensions—for example, between encouraging local ownership by allowing payments and benefits to vary by region, and tolerating a proportion of failures, as schemes fail to attract members or cannot pay for the range of promised benefits.

**Table 2. Experience of Selected Community Financing Schemes**

Country	Scheme	Premiums	Benefits
<b>Guinea Bissau</b>	<p>The “Abota” scheme was set up in 1980. The primary aim was to improve the local supply of medicines and access to services throughout the year. An initial six-month start-up supply of drugs was provided. Initially revenue was too low but, positively, many people joined the scheme. After several years, 75 percent of adults in the village were included. With free referrals, the scheme grew to cover 20 percent of the national population after 10 years. Problems with undertreatment of patients and government’s conversion of revenue into foreign currency at the national level complicated the scheme. Stronger regulation and accountability was required to ensure the proper use of funds. The lack of an informal drug market and the “localness” of the scheme were seen as major factors in its success.</p>	<p>Villagers were involved in price-setting from the outset through a community committee, with contributions based on what people were willing to pay, rather than service cost. Each year the premium was increased in agreement with the community as benefits became more visible. Annual contribution stood at around a quarter of a chicken per person. Those who had not contributed paid a consultation fee greater than the annual contribution.</p>	<p>Free treatment and medicines at the Village Health Unit. Children of members were exempt from charges. The Ministry of Health eventually agreed to accept referrals to higher levels of government health facilities without extra charge.</p>
<b>Zaire</b>	<p>The hospital prepayment scheme was launched in rural Bwamanda district in 1986 to improve access to hospital services and ensure its revenue. Evidence shows that admission rates are three times higher for insured than for uninsured patients, and that those in high need of hospital care have benefited considerably. Cost recovery rose to 81 percent of recurrent costs within several years, as membership rose. The scheme is managed by a District Management team which works closely with the local community, and is seen as part of the key to success.</p>	<p>The voluntary, community-rated annual premium was initially set at Z20 with a 20 percent copayment, rising with inflation.</p>	<p>A reduction of 80 percent in insured patients’ hospital bill.</p>
<b>Philippines</b>	<p>The community health insurance scheme was initially set up by a nongovernmental mother and child health project, in La Union Province in 1994. Low-income areas were specifically selected. Membership is family- not individual-based to limit adverse selection. Financial analysis to date has been positive, with adjustments made in the criteria for benefits eligibility (e.g. maternity).</p>	<p>The payment schedule was flexible—monthly, quarterly, bi-annual, annual. Premiums are adjusted for family size. Payment was reduced for members of the national Medicare program.</p>	<p>A benefit package was drawn up covering approved essential medicines, and both inpatient and outpatient care at the primary level. Hospital benefits were provided by a contracted hospital, with members facing shorter waiting times.</p>
<b>Thailand</b>	<p>The Health Card Program started in 1983 to promote primary health care in rural areas. Revenue, supplemented by government contributions, is managed by village committees and allocated between primary and secondary level facilities. The scheme has</p>	<p>Initially a one-off payment gave free services with members obliged to use primary services as the first point of contact. Premium design developed</p>	<p>Limited number of free consultations were allowed (e.g., eight illness episodes for a</p>

	<p>around 1.3 million members. Despite its success, continual changes in scheme design have slowed progress. To attract low-risk individuals, many local schemes offer low-interest loans to members. They are particularly attractive to individuals wishing to develop small businesses, generally of lower risk. One problem cited was that premiums were held in the reserve all year and lent out to policyholders, with payments to facilities only made at the end. This delay in payment acted as a disincentive to facilities to develop services, particularly given that inflation would depreciate the value of income received.</p>	<p>over the years. Payments can be made on an individual or family basis or can be linked to particular services.</p>	<p>family of four, or four episodes for an individual). A ceiling was placed on the costs covered (e.g., 2,000 baht per visit). These levels were changed and eventually scrapped as the scheme developed.</p>
<p><b>Guatemala</b></p>	<p>The ASSABA scheme is still in its infancy. Service costs and utilization levels were carefully assessed, although contributions were set on the basis of affordability rather than full cost recovery. Targets were set for utilization of different services. Donor funds were also secured to cover start-up costs. However, delays with legal status, administrative staffing, and definition of benefits and membership rules slowed initial progress.</p>	<p>Membership is family-based and premiums vary by family size.</p>	<p>Services at the primary level (health center and below), including medicines. Both outpatient and inpatient care is provided at a contracted hospital.</p>

Source: Adapted from Witter, et al. [41]

Countries like China and Vietnam illustrate a reversal of the expected trend, in which health financing arrangements move from no risk sharing, to small risk pools, and thence to larger, and more integrated risk pools. Both went from systems with universal (or nearly universal), free coverage (in the 1970s and 1980s) to ones where households bore the brunt of health care (in the 1990s). They are now making slow progress toward developing both mandatory and voluntary risk-pooling systems [45].

In transitional countries, a number of risk-pooling mechanisms either remain from Soviet times or have been developed over the recent period of health sector reform. For example, in many former Soviet republics, local budgets finance a portion of health costs (such as capital expenditure, or coverage for certain population groups such as the unemployed and children), while social insurance contributions are supposed to pay for a guaranteed package of services for the rest of the population. In practice, in spite of arrangements for integrating revenue pools, one or both sources of finance may not be realized, leading to financial crisis and distorted expenditure patterns that compromise efficiency. In both developing and transitional countries, a common response to financial crisis is for staff salaries to continue to be paid, while funds for supplies are cut, seriously compromising staff productivity.

Drugs pose a particular challenge for risk-pooling arrangements. The bulk of household expenditures on health care in low-income countries is spent on drugs. More than 80 percent of drug expenditures are private in low-income countries, according to World Bank estimates. [46] Risk-pooling arrangements should, in principle, cover the cost of drugs, but in practice they are often excluded. In Turkmenistan, for example, when health insurance was introduced in the mid-1990s, drug expenditure was fully reimbursable [47]. Because of rapid price escalation, this gave rise to a swift depletion of the health funds, and full reimbursement for drugs was subsequently removed from the benefit package. Some schemes cover in-patient but not outpatient drugs. This disparity can have adverse consequences for other policies such as reducing length of stay and reducing hospital utilization for minor ailments. Managing demand is often more difficult for drugs than for other health care technologies, so some element of copayments is probably necessary in most health systems, in conjunction with exemptions for the poor and an active regulatory policy that reduces the use of medicines that are not cost-effective.

In practice, almost all systems of health care contain elements of unitary pooling, elements of fragmentation, and elements where individuals continue to bear some risk associated with health care needs. However, important differences between systems exist in the emphasis attached to these approaches to risk pooling. In developing countries, a number of issues need to be addressed:

- The lack of risk pooling in general, with a high (and in many cases increasing) reliance on direct contributions from households. Jowett [48] points out that private spending in low-income countries accounts for just under 60 percent of total health care expenditure—a marked increase on the 35 percent in 1990. There is considerable regional variation, ranging from 55 percent in Africa and 72 percent in Asia. He concludes that government expenditure is being substituted by private spending, even where economies are growing.

- Where risk pools occur, they tend to be small, based either on occupation (e.g., health insurance for public servants) or location (e.g., community financing initiatives).
- The ability to equalize funds across regions of differing funding capacities is poor. Typically large cities with a strong economy have a better network of staff and facilities and higher quality of service. This results mainly from higher private revenue generation by facilities but is also reinforced by disproportionate amounts of public funding. Decentralization programs can reinforce the political and financial autonomy of different regions [49].
- At the same time, few countries have a resource allocation system based on needs. Funding typically follows a historical pattern or is based on existing physical and human infrastructure. In other words, instead of opposing discrepancies, it often rewards them. Where resource allocation formulas have been introduced—for example, in South Africa—it has offered an opportunity to reexamine wider resource allocation issues (such as the allocation to primary facilities) [50].

## **LOCAL CIRCUMSTANCES**

Any assessment of the effectiveness of risk-pooling arrangements depends on the relative weight attached to health system objectives—particular those relating to equity and efficiency—which must be a matter for local choice. Therefore it is highly unlikely that a single risk-pooling model would be appropriate for all nations, even if the economic and social circumstances of nations were very similar. In addition, important economic, geographical, cultural, financial, historical, and social make alternative arrangements more effective in some contexts than others. In short, system design may be highly contingent on local considerations. These might include:

- Preference for equity of payment
- Preference for equity of access
- Potential sources of revenues
- Ease of collecting revenues (taxes, premiums, user charges)
- Efficiency and probity of managerial function
- Nature of existing organizational structure (e.g., local government)
- Nature of existing information bases
- Nature, organization, governance, and ownership of providers
- Nature of available health technologies
- Nature of major health priorities (e.g., AIDS vs infant mortality)
- Size and geography of the country.

Risk pooling has two distinct purposes: the reduction of individual uncertainty associated with health care needs (an efficiency issue), and a transfer of health care resources between individuals (an equity issue). Communities will differ in the importance they attach to transfers of this sort. Local preferences should therefore be important considerations in system design, indicating that choice of risk-pooling arrangements is not just a technical issue.

More generally, the cultural environment might have a central influence on system choice. West European nations have a tradition of solidarity in health care, which makes it possible to effect

large transfers between rich and poor, and healthy and sick, which appear to be unattainable in (say) the United States. In the same way, some countries may find (say) interregional transfers unfeasible, with important implications for risk-pooling arrangements.

The experience in transitional economies has emphasized the need to put in place risk-pooling arrangements that enjoy the trust and support of the population. If there is widespread resistance to the stewardship arrangements, premiums may be difficult to collect, and the rich may opt out of risk-pooling contributions, for example, by purchasing private insurance. If occurring on a sufficiently large scale, such activity might lead to a breakdown of the risk-pooling function. Systems of auditing and assuring financial probity are particularly important in a climate where officials are prone to individual opportunistic behavior. Where direct financial transfers to risk pools are unfeasible, transfers in kind may nevertheless be possible through (say) the central provision of capital infrastructure or personnel.

Risk pools require an organizational structure, and using any structures already in place will often be more efficient than starting from scratch. For example, local government, charitable, or employer structures that enjoy popular support can readily serve as the basis for collecting premiums and paying and supervising providers. Thus, while efficiency and equity considerations might suggest a particular form of risk pooling, this choice might be tempered by the constraints and opportunities offered by existing organizational structures.

The design of risk-pooling arrangements may be heavily influenced by the nature of existing provider organizations. In some circumstances, existing publicly owned institutions such as a network of health centers, can form a natural basis for community-financed geographically defined risk pools. In other circumstances, providers may be predominantly unregulated and entrepreneurial, and a more formal system of purchaser-provider contracts may be required.

Geography can have a profound impact on the choice of risk-pooling arrangement. For example, if development of rural health care is a priority, it would seem sensible to design a system in which separate urban and rural risk pools are established, with a robust revenue transfer mechanism to ensure that rural areas have access to a secure stream of finance that is not at risk from increased demands from their urban counterparts.

Notwithstanding these cautions, the preceding discussion suggests some possible universal indicators of the success of risk pool integration arrangements:

- *Insurance coverage.* The proportion of the population covered by health insurance arrangements
- *Insurance premiums.* The extent of any differences in the premiums paid by identical individuals in different risk pools;
- *Variations in the care package.* The extent of any differences between risk pools in the package of health care for which insured individuals are covered
- *Variations in quality.* The extent of any qualitative differences in health care received by members of different risk pools, for example in the form of waiting time variations
- *Variations in user charges.* The extent of any differences between risk pools in the out-of-pocket charges to individuals in receipt of health care.



Some observed variations between pools may be due to factors other than risk-pool fragmentation, such as variations in the efficiency of the management, or legitimate local choice (such as in integrated local government systems). However, large variations in indicators such as these may also offer strong prima facie evidence of fragmentation.

## CONCLUSIONS

This report has sought to demonstrate that risk-pooling arrangements have important implications for health system behavior and may profoundly affect the purchasing function. Fragmentation of risk pools through devolution poses particular dangers. In developing countries, with high burdens of disease, particularly among the poor, and poor mechanisms for transfer of wealth, there are therefore strong reasons to believe that the trend should be toward larger risk pools than exist at present. Ideally, these would embrace mandatory, universal coverage, in which contributions are either income or community rated and where there is some mechanism for equalization between pools. In practice, the trend has been in the opposite direction, with many countries devolving health care arrangements to local levels and not implementing any risk-pool integration.

Current evidence suggests not only that households are increasingly paying directly for health services in developing countries but also that informal payments may make up the bulk of these payments. In Bangladesh, unofficial payments outnumber official by a factor of five [51]. This payment mechanism is among the least effective from a risk-pooling point of view. Systematic transfers from low to high risk or from rich to poor are unlikely, and there is also no intertemporal pooling for individuals. Indeed, individuals face uncertainty over payments for a single episode of illness, as the rates are not fixed or established in advance. Informal payments can be likened to a blind auction, with patients unsure how much they need to pay to get the quality they seek.

The World Health Report 2000 emphasized the role of government in terms of “stewardship” of the health sector [5]. This attractive vision of a far-sighted and public-spirited regulatory capacity is hard to envisage in the absence of a strong risk-pooling function. While risk pooling is not a sufficient condition, it is nevertheless a necessary one for a wider range of health service functions that we associate with developed health systems such as health technology assessment, population needs assessment, priority setting, collective purchasing, and resource allocation based on need—in short, with a well-developed purchasing function.

Beyond the technical considerations outlined above, there is also the important question of “social capital”: the degree to which a community shares values and is prepared to support communal structures and pool resources. For all the rhetoric of the Alma Ata Declaration, and the emphasis on the virtues of “community participation,” trust and social solidarity have been severely eroded in many areas. In former communist countries, for example, people may have a widespread suspicion of collectivity and officialdom. In such an environment, the establishment of voluntary risk-pooling will be particularly challenging. Though hard to measure, “social capital” theories do point to an important intangible benefit that underlies a strong risk-pooling function [52].

We hope that we have demonstrated that *in principle* the desirability of strengthening risk-pool integration should be uncontested for most health care systems. Rather, the debate surrounds how it can be practically implemented in low- and middle-income countries, particularly when increased devolution and a reliance on community financing and user charges leads to fragmented risk pools. Our discussion has sought to highlight the many considerations that apply to any choice, and we have emphasized that system design will be contingent on local circumstances. We nevertheless believe that there will be few circumstances in which some form of risk pool integration cannot be successfully introduced and strengthened.

## TECHNICAL APPENDIX

This appendix presents some rudimentary mathematics of risk pooling. The main source is the material presented by Daykin, Pentikäinen, and Pesonen (1994). For most purposes it assumes random, independent arrival of claims arising from a homogeneous population of insured risks. These assumptions might be seriously overrestrictive in health care. Claims may not be independent (sometimes arising, for example, from an epidemic). And the insured risks are most certainly not homogeneous. With suitable amendments these complications can be accommodated within the mathematical model presented here. However, they render the models less transparent, and so for the most part the treatment will be confined to the simplest situation.

### MODELING THE NUMBER OF CLAIMS

First consider the number of claims against the risk pool. Assuming first that the expected number of claims in a period is  $n$ , and that they are randomly and independently distributed, they can be modeled as a Poisson process:

$$p_k(n) = e^{-n} \frac{n^k}{k!}$$

where  $p_k$  is the probability of observing  $k$  claims in the given period.

Note that the mean and variance of the Poisson distribution are  $\mu = n$  and  $\sigma^2 = n$ , and that the probabilities are readily calculated using the recursive equations:

$$p_0 = e^{-n}$$
$$p_k = \frac{n}{k} p_{k-1} = \frac{n^k}{k!} e^{-n}.$$

As  $k$  and  $n$  get large, the central limit theorem implies that the cumulative Poisson distribution  $F(k)$ —the probability that  $k$  or fewer claims are received—approximates the normal distribution  $N(\cdot)$ , such that

$$F(k) \approx N\left(\frac{k-n}{\sqrt{n}}\right).$$

Where this is not sufficiently accurate, a convenient approximation to the Poisson distribution is given by:

$$F(k) \approx N\left(\frac{3}{2}\left(k + \frac{5}{8}\right)^{2/3} n^{-1/6} - \frac{3}{2}\sqrt{n} + \frac{1}{24\sqrt{n}}\right).$$

The assumption of a pure Poisson process may be inappropriate—the parameter  $n$  may vary through time because of (a) long term trends (b) cyclical or seasonal variations. This is handled by adopting a mixed Poisson process, in which the parameter  $n$  is multiplied by a mixing variable  $q$ , with a pdf  $h(q)$ , such that  $E(q)=1$ . The parameter  $q$  can be thought of as changing risk propensity, and effectively models the uncertainty in the parameter  $n$ . At any time when the mixing variable takes the value  $q$ , claims are distributed according to a Poisson process with mean  $nq$ , and the mixed Poisson probability  $p_k$  is now given by:

$$p_k = E(p_k(nq)) = \int_0^{\infty} e^{-nq} \frac{(nq)^k}{k!} h(q) dq$$

The key function of the mixing variable is to increase the variance to  $\Phi_n^2 = n + n^2 \Phi_q^2$  where  $\Phi_q^2$  is variance of the mixing variable  $q$ . The mean number of claims remains  $\lambda_n = n$ .

### MODELING THE SIZE OF CLAIMS

Suppose that the size of claims is independent of the number of claims, and are independently and identically distributed as a random variable  $Z$ . First define the probability that—given there are  $k$  claims in the chosen time period—the total claims against the risk pool are less than  $X$ :

$$S^{k*}(X) = \Pr\left\{\sum_{i=1}^k Z_i \leq X\right\}$$

Then the total claim  $X$  will be distributed according to the cumulative distribution function  $F(\cdot)$ , where

$$F(X) = \sum_{k=0}^{\infty} p_k S^{k*}(X)$$

$F(X)$  is the probability that the claims will not exceed a value of  $X$  in total in the chosen time period. Note that for  $k > 0$ ,  $S^{k*}(\cdot)$  satisfies the recursive equation:

$$S^{k*} = S * S^{(k-1)*}$$

The total claim distribution  $X$  is a compound distribution, referred to as a compound Poisson distribution when the claim numbers are Poisson distributed. Under the assumptions of independence noted above, the expected claim  $X$  is merely the product of the expected number of claims  $n$  and the expected size of each claim  $m$ :

$$E(X) = \mu_X = n.m$$

Further, in this Poisson case, the variance and skewness of  $X$  are given by:

$$\sigma_X^2 = n.a_2$$

$$\gamma_X = \frac{n.a_3}{(n.a_2)^{3/2}} = \frac{a_3}{a_2^{3/2} \cdot \sqrt{n}}$$

where  $a_j$  is the  $j$ th moment of the distribution of  $Z$  about zero.

It is sometimes convenient to partition the variance as:

$$\sigma_X^2 = m^2 n + n.(a_2 - m^2)$$

The first term on the right hand side is the variance associated with the Poisson process (that is to variations in the number of claims), and the second term on the right hand side is the variance associated with the size of individual claims.

The total claim distribution  $X$  is referred to as a compound mixed Poisson distribution when the claim numbers are distributed as a mixed Poisson process. In the compound mixed Poisson case the variance and skewness are as follows:

$$\sigma_X^2 = n.a_2 + n^2 m^2 \sigma_q^2 = \sigma_0^2 + \mu_X^2 \sigma_q^2$$

$$\gamma_X = \frac{n.a_3 + 3n^2 m a_2 \sigma_q^2 + n^3 m^3 \gamma_q \sigma_q^3}{\sigma_X^3}$$

where  $\sigma_0^2 = n.a_2$  is the variance in the compound Poisson case. Note that an additional term determined by the variance of the mixing variable is added to the expression for the variance. An alternative way of decomposing the variance of  $X$  is to write it as:

$$\sigma_X^2 = m^2 n + n(a_2 - m^2) + n^2 m^2 \sigma_q^2$$

The three components are:

- the variance associated with the Poisson process (claim numbers only, with no claim size variation or mixing);
- the variance associated with the individual claim sizes;
- the variance associated with mixing.

The standard deviation of  $X$  is sometimes written:

$$\sigma_X = n.m.\sqrt{\frac{r_2}{n} + \sigma_q^2}$$

where

$$r_2 = a_2 / m^2$$

Note that  $r_2$  is merely the square of the conventional coefficient of variation of  $Z$ , and can be thought of as an indication of the riskiness of the claim size distribution.

Then the coefficient of variation of the total claim size is given by:

$$\frac{\sigma_X}{\mu_X} = \sqrt{\frac{\sigma_0^2}{\mu_X^2} + \sigma_q^2} = \sqrt{\frac{r_2}{n} + \sigma_q^2}.$$

Thus for small  $n$  the randomness associated with individual claims predominates, while as  $n$  increases the variation associated with the mixing element becomes more important.

## SOME ELABORATIONS

We have so far considered “pure” insurance, in the sense that all claims of whatever size must be met by the risk pool. There are of course many arrangements such as reinsurance and copayments which might moderate this extreme case. These might include:

*Excluding large claims:* this entails modeling the distribution of  $S$  as a censored distribution  $S_c(\cdot)$  Which takes the form  $S_c(Z) = S(Z)/S(C)$  for  $Z < C$ , the chosen cut-off.

*Limiting the size of all claims:* this entails modeling the distribution of  $S$  as a truncated distribution  $S_t(\cdot)$  Which takes the form  $S_t(Z) = S(Z)$  for  $Z < T$ , the chosen cut-off, and  $S_t(Z) = 1$  for  $Z \geq T$ . If effected through a reinsurance contract, this arrangement is known as an excess of loss treaty.

*Cost sharing all claims:* this entails modeling the distribution of  $S$  as a distribution  $S_r(\cdot)$  Which takes the form  $S_r(Z) = S(Z/r)$  for all  $Z$ , where  $r$  is the proportion of the claims met by the risk pool.

*Limiting the aggregate of claims:* this is effectively a “stop-loss” reinsurance arrangement under which the distribution function  $F(X)$  for the total claim  $X$  is truncated at some limit  $M$ .

Each of these arrangements serves to reduce the risk exposure of the risk pool, and the analytic properties have been thoroughly explored in the insurance literature.

### Sources

Daykin, C., T. Pentikäinen and M. Pesonen (1994), Practical risk theory for actuaries, London: Chapman and Hall.

Kendall, M. and A. Stuart (1977), The advanced theory of statistics: Volume 1, distribution theory, London: Charles Griffin & Company.

## REFERENCES

1. Newhouse, J. P., Manning, W. G., Keeler, E. B. and Sloss, E. M. (1989), "Adjusting Capitation Rates Using Objective Health Measures and Prior Utilization", *Health Care Financing Review*, 10, 41-54.
2. Van Vliet, R. (1992), "Predictability of individual health care expenditures", *Journal of Risk and Insurance*, 59, 443-460.
3. NERA (1997), *The Health Care System in Singapore*, London: National Economic Research Associates.
4. Van Vliet, R. C. J. A. and Lamers, L. M. (1998), "The high costs of death: should health plans get higher payments when members die?" *Medical Care*, 36, 1451-1460.
5. World Health Organization (2000), *The World Health Report 2000. Health systems: improving performance*, Geneva: World Health Organization.
6. Preker, A. S., Baeza, C., Jakab, M. and Langenbrunner, J. (2000), Resource allocation and purchasing (RAP): arrangements that benefit the poor and excluded groups, Washington: World Bank.
7. World Bank (2000), *The World Development Indicators*, Washington: The World Bank.
8. Rothschild, M. and Stiglitz, J. (1976), "Equilibrium in competitive markets: an essay on the economics of imperfect information", *Quarterly Journal of Economics*, 90, 629-649.
9. Lewis, M. (2000), *Who is paying for health care in Europe and Central Asia?*, Washington DC: Human Development Sector Unit, World Bank.
10. McGuire, T. (2000), "Physician agency", in J. P. Newhouse and A. J. Culyer, *Handbook of health economics*, Amsterdam: Elsevier.
11. Glied, S. (2000), "Managed care", in J. P. Newhouse and A. J. Culyer, *Handbook of health economics*, Amsterdam: Elsevier.
12. Khan, M., Walley, J., Witter, S., Imran, A. and Safdar, N. (Forthcoming), "Costs and cost-effectiveness of different DOT strategies for treatment of tuberculosis: economic results of a randomized controlled trial in Pakistan", *Health Policy and Planning*.
13. NHS Executive (2000), Health authority revenue allocations exposition book, Leeds: NHS Executive.
14. Martin, S., Rice, N. and Smith, P. (1998), "Risk and the general practitioner budget holder", *Social Science and Medicine*, 47, 1547-1554.
15. Van de Ven, W. P. M. M. and Ellis, R. (2000), "Risk adjustment in competitive health plan markets", in J. P. Newhouse and A. J. Culyer, *Handbook of health economics*, Amsterdam: Elsevier.
16. Theurl, E. (1999), "Health expenditure and cost control in Austria", in E. Mossialos and J. Le Grand, *Health care and cost containment in the European Union*, Aldershot: Ashgate.

17. Rice, N. and Smith, P. (2001), "Capitation and risk adjustment in health care financing: an international progress report", *The Milbank Quarterly*, 79, 81-113.
18. Smith, P. (1999), "Setting budgets for general practice in the New NHS", *British Medical Journal*, 318, 776-779.
19. Bojke, C., Gravelle, H. and Wilkin, D. (2001), "Is bigger better for primary care groups and trusts?" *British Medical Journal*, 322, 599-602.
20. Smith, P., Sheldon, T. A., Carr-Hill, R. A., Martin, S., Peacock, S. and Hardman, G. (1994), "Allocating resources to health authorities: results and policy implications of small area analysis of use of inpatient services", *British Medical Journal*, 309, 1050-1054.
21. Andersson, P.-Å., Varde, E. and Diderichsen, F. (2000), "Modelling of resource allocation to health care authorities in Stockholm County", *Health Care Management Science*, 3, 141-149.
22. Brown, L. D. and Amelung, V. E. (1999), "Manacled competition!: market reforms in German health care", *Health Affairs*, 18, 76-91.
23. Schokkaert, E. and Van de Voorde, C. (2000), "Risk adjustment and the fear of markets: The case of Belgium", *Health Care Management Science*, 3, 121-130.
24. McCarthy, T., Davies, K., Gaisford, J. and Hoffmeyer, U. (1995), *Risk-adjustment and its implications for efficiency and equity in health care systems*, Basle: Pharmaceutical Partners for Better Healthcare.
25. Hutchison, B., et al.. (1999), *Capitation formulae for integrated health systems: a policy synthesis*, Hamilton: Centre for Health Economics and Policy Analysis, McMaster University.
26. Oliver, A. J. (1999), *Risk Adjusting Health Care Resource Allocations: Theory and Practice in the United Kingdom, The Netherlands and Germany*, London: Office of Health Economics.
27. Giacomini, M., Luft, H. S. and Robinson, J. C. (1995), "Risk Adjusting Community Rated Health Plan Premiums: A Survey of Risk Assessment Literature and Policy Applications", *Annu. Rev. Public Health*, 16, 401-30.
28. Newhouse, J. P. (1996), "Reimbursing Health Plans and Health Providers: Efficiency in Production Versus Selection", *Journal of Economic Literature*, XXXIV, 1236-1263.
29. Emery, D. W., Fawson, C. and Herzberg, R. Q. (1997), "The Political Economy of Capitated Managed Care", *The American Journal of Managed Care*, 3, 397-416.
30. Van Barneveld, E. M., Van Vliet, R. C. J. A. and Van de Ven, W. P. M. (1996), "Mandatory high-risk pooling: an approach to reducing incentives for cream skimming", *Inquiry*, 33, 133-143.
31. Rattso, J. (1998) (ed), *Fiscal federalism and state-local finance*, Cheltenham: Edward Elgar.
32. New South Wales Health Department (1999), *Resource Distribution Formula Technical Paper 1998/99 Revision*, Sydney: New South Wales Health Department.
33. Sheldon, T. and Smith, P. (2000), "Equity in the allocation of health care resources", *Health Economics*, 9, 571-574.



34. Madden, C. W., Mackay, B. P., Skillman, S. M., Ciol, M. and Diehr, P. K. (2000), "Risk adjusting capitation: Applications in employed and disabled populations", *Health Care Management Science*, 3, 101-109.
35. Nichols, L., Prescott, N. and Kai Hong Phua (1997), "Medical savings accounts in developing countries", in G. Sheiber, *Innovations in health care financing: proceedings of a World Bank conference March 10-11 1997*, Washington: World Bank.
36. Dawson, D. and Goddard, M. (2000), "Longer term agreements for health care services: what will they achieve?" in P. Smith, *Reforming markets in health care: an economic perspective*, Buckingham: Open University Press.
37. Le Grand, J., Mays, N. and Mulligan, J. (1999) (ed), *Learning from the NHS internal market*, London: King's Fund Institute.
38. Smith, P. (2000) (ed), *Reforming markets in health care: an economic perspective*, Buckingham: Open University Press.
39. Saltman, R., Figueras, J. and Sakellarides, C. (1998) (ed), *Critical challenges for health care reform in Europe*, Buckingham: Open University Press.
40. Yang, B. (1996), "The role of health insurance in the growth of the private health sector in Korea", *International Journal of Health Planning and Management*, 11, 231-252.
41. Witter, S., Ensor, T., Jowett, M. and Thompson, R. (2000), *Health economics for developing countries: a practical guide*, Basingstoke: Macmillan.
42. Chollet, D. J. and Lewis, M. (1997), "Private insurance: principles and practice", in G. Sheiber, *Innovations in health care financing: proceedings of a World Bank conference March 10-11 1997*, Washington: The World Bank.
43. Witter, S. (1996), "Doi moi and health: the impact of economic reforms on the health system in Vietnam", *International Journal of Health Planning and Management*, 11, 159-172.
44. Gilson, L. (1997), "The lessons of user fee experience in Africa", *Health Policy and Planning*, 12, 273-285.
45. Ensor, T. (1995), "Introducing health insurance in Vietnam", *Health Policy and Planning*, 10, 154-163.
46. Saxenian, H. (1994), Getting the most out of pharmaceutical expenditures: World Bank HRO paper 37, Washington: World Bank.
47. Ensor, T. and Thompson, R. (1998), "Health Insurance as a catalyst to Change in Former Communist Countries", *Health Policy*, 43, 203-218.
48. Jowett, M. (1999), "Bucking the trend? Health expenditure in low income countries, 1990-5", *International Journal of Health Management and Planning*, 14, 269-285.
49. Collins, C. and Green, A. (1994), "Decentralisation and health care: some negative implications in developing countries", *International Journal of Health Services*, 24, 459-475.

50. McIntyre, D., Bourne, D., Klopper, J., Taylor, S. and W, P. (1991), "A methodology for resource allocation in health care for South Africa", *South African Medical Journal*, 80, 139-145.

51. Killingsworth, J., Hossain, N., Hedrick-Wong, Y., Thomas, S., Rahman, A. and Begum, T. (1999), "Unofficial fees in Bangladesh: price, equity and institutional issues", *Health Policy and Planning*, 14, 152-163.

52. Brehm, J. and Rahn, W. (1997), "Individual-level evidence for the causes and consequences of social capital", *American Journal of Political Science*, 41, 999-1023.





HEALTH, NUTRITION,  
AND POPULATION



HUMAN DEVELOPMENT NETWORK

THE WORLD BANK

---

**About this series...**

This series is produced by the Health, Nutrition, and Population Family (HNP) of the World Bank's Human Development Network. The papers in this series aim to provide a vehicle for publishing preliminary and unpolished results on HNP topics to encourage discussion and debate. The findings, interpretations, and conclusions expressed in this paper are entirely those of the author(s) and should not be attributed in any manner to the World Bank, to its affiliated organizations or to members of its Board of Executive Directors or the countries they represent. Citation and the use of material presented in this series should take into account this provisional character. For free copies of papers in this series please contact the individual authors whose name appears on the paper.

Enquiries about the series and submissions should be made directly to the Managing Editor Joy de Beyer ([jdebeyer@worldbank.org](mailto:jdebeyer@worldbank.org)) or HNP Advisory Service ([healthpop@worldbank.org](mailto:healthpop@worldbank.org), tel 202 473-2256, fax 202 522-3234). For more information, see also [www.worldbank.org/hnppublications](http://www.worldbank.org/hnppublications).



**THE WORLD BANK**

1818 H Street, NW  
Washington, DC USA 20433  
Telephone: 202 473 1000  
Facsimile: 202 477 6391  
Internet: [www.worldbank.org](http://www.worldbank.org)  
E-mail: [feedback@worldbank.org](mailto:feedback@worldbank.org)