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Procedia Social and Behavioral Sciences 2 (2010) 7137–7144

Procedia
Social and Behavioral Sciences

Selected Papers of Beijing Forum2006

Public Health Security and Forecasting Economic Trends

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Abstract (draft Aug 6, 2006)

This paper examines the effects of economic and demographic trends upon the costs and provision of health services among countries at different stages of development, and in particular how different financing methods lead to different roles for the Ministry of Health—and the likelihood they create of a public health system crisis. First, the trends in Medical Technology, demographics and national health spending as projected by the OECD, the WHO and the Society of Actuaries is presented. The analysis proceeds to examine divergences between sub-sectors (elderly v. young, poor v. rich, urban v. rural, hospital v. clinic or doctor). Special attention is given to the question of whether a widening gap between groups (urban v. rural, rich v. poor) will cause average per capita expenditures to rise more or less rapidly, and the extent to which it may cause of result from public v. private financing. The ability of financing mechanisms to promote or disrupt harmony in response to two major challenges (1. Rising Costs 2. Biologic Catastrophe) are then discussed. Careful attention is given to the differences in the causes of individual health expenditures and national health expenditures, and the relationship of each to income of the person, or of the national as a whole. This provides a foundation for a typology of Ministry of Health and Ministry of Finance responses to (a) Long Term Trends and (B) Public Perceptions.

The economics of budgeting is shown to be a task that is both inherently technical, and also political, relying ultimately on public support. It is concluded that it is up to the people and the political process to determine the amount of money in total available to pay for health care costs, and the task of the national health authority to use that funding wisely to obtain the best health outcomes, satisfaction with care, and trust between patients, physicians and hospitals.

Introduction

The rising cost of providing the people with health security has imposed major strains on government finances and social solidarity in both developing and developed countries over the last thirty years. Some have chosen to change the mix of public and private financing, and rely more on individual personal contributions. Yet one of the consequences of a globalized high-technology style of medical practice is that a person with serious illness requiring major treatments (such as organ transplant or chemotherapy) is not able to afford such treatment without financial assistance. Typically, 70% of medical costs are for just 10% of the population, while half of the people incur only very small costs (Getzen, 2004). In the main OECD economies, the few most seriously ill patients (top 1%) have treatment cost in excess of USD $100,000—an amount that cannot be afforded by the typical family. Thus some form of partial or universal national health insurance is found in all of these countries.

What is not so generally recognized is that while the seriously ill account for most of the costs in a national health plan, the cost of the national health plan does not depend on how sick the population is. Primarily, the cost of care depends upon the style of medical practice adopted and the salaries of doctors and medical workers—factors that

doi:10.1016/j.sbspro.2010.05.066

increase rapidly as per-capita income increases. Thus in a rapidly developing country such as China, the cost of caring for the population's health will rise rapidly (usually 1.1 to 1.5 times as fast as average worker's incomes) (Fogel, 1999). This process of increasing cost to meet a modern global standard of medical care takes many years, which provides some temporary budgetary relief. However, in the long run a developing country must realistically expect to devote a larger share of its GDP to health care or risk major social upheaval.

The upheaval of rising health cost exerts most pressure along two dividing lines, between urban and rural, and between factory workers and factory managers. Through television and newspapers the urban workers become aware of the great and expensive medical advances available in the city, and travel their seeking treatment—but usually without any means to pay for such therapies except limited reliance on contributions from family members. Similarly, the urban factory worker finds that the clinic they attend does not offer the same appearance or array of equipment as special hospital available to wealthy managers, and become increasingly dissatisfied with the standard of care.

It is important to emphasize that social dissatisfaction is not due to a lack of medical care, but rather to a different standard of medical care (urban v. rural; workers v. wealthy) which creates a perception that life-saving therapy is being needlessly withheld, or withheld only because of profit considerations. Often the health of the two groups is not much affected by the differences in care—but the perceptions, and thus the political realities, are very much affected. Even in very wealthy and highly egalitarian countries, such as Sweden, there is often a perception that some groups of rural farmers or poor city works are disadvantaged in the medical care system.

Thus the health policy expert must deal with two major facts that are not well understood by the public, or even by many government officials.

1. The cost of a medical care system depends more on the level of GDP in a country rather than the amount of sickness, or the efficiency of the medical providers.
2. The people's level of satisfaction with a health system depends more on its perceived fairness and equity, rather than how well it actually performs in objective measures of health status (morbidity, mortality).

These imply that the task of maintaining public support for the health system may be even more difficult for rapidly developing countries that the task of obtaining the financing to cover the cost. While economists may provide expert forecasts of the amount of financing required, they are less able to provide advice on the management of systems and perceptions to maintain public support.

Forecasting Trends in Health Costs

A major review of health expenditure forecasts and the effects of aging across many countries has recently been completed for The World Health Organization (Rannan-Eliya and Wijesinghe, 2006) and the Society of Actuaries is currently undertaking a major project on forecasting long-term trends in medical costs, with specific attention to the extra cost burden of retirees (Getzen, 2006a). What both of these studies emphasize is the range of uncertainty involved in making such forecasts, and the inability of technical economics to fully come to grips with the social and technological forces that ultimately may prove most important in driving health care costs. Both reviews lay out the types of models that are available for forecasting health care costs, and demonstrate the deficiency of the standard "demographic projections" most commonly used.

The major factors driving health care costs higher are the increasing income of the people seeking and providing medical care and the development and spread of medical technology, not an increase in illness (since the rate of illness is actually decreasing in most parts of the world and among most population segments), nor the increase in the number of aged (Getzen, 2006b). The method of financing should logically play a role in determining the level of financing, but studies to date have not been able to obtain any definitive results on the effects of organization and financing—perhaps because the variations are so many that no single variable can effectively capture such a complex process.

Results from Different Types of Health Expenditure Forecasting Models

Forecasting of health expenditures can range from simplified trend extrapolation (basically, that the growth rate for the next twenty years will be approximately the same as it was during the last twenty years) to complex models that incorporate general equilibrium feedback affects across the entire economy. The strengths and weaknesses of each are briefly described below (see Getzen 2000b for a more complete discussion).

· **Univariate Trend Model.** In a univariate forecast model, only data on prior health expenditures is used to project future spending. Such simple trend projections are surprisingly accurate, often explaining more than 80% of the growth in national health expenditures over time.

· **Demographic Age/Sex Group Projection Model.** In these models, the relative spending of each age-sex group (e.g., males 20-25, females 40-45, etc.) is projected into the future, allowing for growth in expenditures do to changes in the relative age-sex composition of the population. Even though this method is among the most commonly used, results have been disappointing, as age-sex adjustment has never been able to explain more than 2% or 3% of the growth in health spending.

· **Disease Group Projection Models.** In disease models, spending on each separate disease (stomach cancer, myocardial infarction, stroke, etc.) is projected into the future, based upon future disease prevalence. Historically, such models have not been able to predict growth in health expenditures, and often predict the wrong direction (i.e., that health expenditures in 2005 should be less than in 1985 because major disease prevalence has decreased).

· **Multivariate Econometric Model.** Econometric models begin with historical data on prior health spending (as in a univariate trend model) and add other variables, such as the growth in per capita incomes, number of doctors, extent of public financing, etc. Adding more variables allows econometric models to predict 90%—95% of the growth in national health spending.

· **General Equilibrium Multi-Sectoral Model.** General equilibrium models use a set of equations to represent all of the sectors of the economy, allowing for interaction and feedback effects between health and other sectors (housing, agriculture, manufacturing) and with macroeconomic policy (central bank interest rates, unemployment levels, trade balances). While theoretically appealing such general equilibrium models are challenging to compute, and in practice have not been able to predict spending trends.

Review of the performance of health spending forecast models indicates that the realistic choices are between a simple univariate trend model, and a more complex (but still not as complex as full-economy macroeconomic general equilibrium models) multivariate econometric models. The United States government for many years has used a simple ad hoc mixture "GDP + 2"—projecting that future expenditures for the population covered by Medicare will grow at a rate equal to that of average per-capita income plus 2%. A major drawback of such a simple model is that it does not allow for any sudden change, or to model the affects of any government policy intervention.

Almost all forecasts of health expenditures predict steady growth over the coming decades, putting increasing strain on government and private finances. However, while forecasts are in agreement that the problems of health financing will get worse; none is able to say how much worse they must become before a crisis occurs.

Preparing for a Crisis

A health crisis, even of major proportions, usually does not cause national health expenditures to rise by an amount sufficient to be visible in long-run trends, or to cause problems for the economy. In part, this is due to the limits imposed by fixed budgets (see "Modeling Health Expenditures at Multiple Levels" below) which force the additional spending on the epidemic or hurricane victims to be offset by reductions elsewhere. The major economic costs of epidemics and other natural disasters come mostly from disruptions in the economy, as when AIDS reduces the effective working hours of adults, or when avian flu causes trade and travel to be diminished, rather than from the costs of medical treatment.

Projected increases in the costs of national health security due to the rising trend of medical care costs are more worrisome than any natural disaster or disease. It is possible that the increasing strain of paying for healthcare will eventually reach a breaking point, much as the increasing strain caused by moving tectonic plates sometimes results in a catastrophic earthquake. While the strain of rising costs is certainly real, and apt to be worrisome to officials in the Ministry of Health as well as in the Ministry of Finance, experience of the OECD countries clearly indicates that China and other developing countries could support increasing health expenditures for many years. Indeed, the experience of Korea, Singapore and other rapidly developing Asian countries shows indicates that expanding the health sector is not a problem. A rise in medical spending to 5% or even 10% of GDP is likely to be quite

sustainable, and may even help sectors of the economy. This, however, does not imply that the rise in health expenditures will not cause a crisis.

A true crisis in public health occurs when the public loses faith in the system. Regardless of how many people get sick during an epidemic or are injured and die in a hurricane, so long as the public has faith in the ability of the government to restore normalcy, the event will pass without catastrophic consequences to public health as a system. The dire consequences of hurricane Katrina in the United States were due not to injury and loss of life, regrettable as those were, but to the perception that the government failed to care for the people. Even more problematically, it appeared as if those who were wealthy could take care of themselves or receive aid, while poor urban residents were made to suffer needlessly.

Rising costs can readily be born if they are spread across the population through a national health security scheme, particularly in a nation with a growing economy. Forcing a single person or family to pay for treatment without help is likely to cause the perception of a split in society, where some receive care and some do not. In countries where the individual must pay a lot for care, the degree of trust in the medical profession and the public health system is reduced. This is particularly true in some countries with supposedly complete public health care systems that are so seriously under-funded that "gifts" from patients paid out of pocket provide most of the physicians' incomes, or are necessary for access to surgery or pharmaceuticals. The erosion of trust due to unequal payments is far more likely to create a crisis in public health than the occurrence of an epidemic. The expected rise in health care costs will not cause a problem, if it is spread across the population through a national financing mechanism. The problem is not pressure, but pressure born un-evenly. Thousands of pounds of pressure do not break a dam, but if that pressure is uneven, the dam may split and fall.

Modeling Health Expenditures at Multiple Levels

Why is so much more money spent on patients with a heart attack in Boston than on patients with a heart attack in Bangladesh? Why do doctors in Beijing spend more on treating heart attack victims today than was spent thirty years ago? The most important reason is obvious, Boston spends more than Bangladesh because it has more money, and doctors in Beijing today spend more than their parents did thirty years ago because China has become a richer country. Health care spending is first and foremost a budgetary phenomenon, and must be analyzed as such.

Studies of health care cost at the national level routinely demonstrate that cost rises with increases in per capita income. However, this linkage between income and expenditures is often not found in studies of individual health care costs. Indeed, some studies even show spending on medical care to be higher, not lower, for the poorest persons within a country (Wagstaff, van Doorslaer and Paci, 1991). This reasons why the disparity between individual and national correlations occurs, and related issues concerning the analysis of costs and policy decisions, are discussed below. A model of expenditure determination and allocation in two levels (macro and micro) is presented. Results from 40 empirical studies are then reviewed, illustrating that the estimated correlation of expenditures with income becomes larger as the level of aggregation becomes larger. A discussion section considers why the disparity between micro and macro results is so frequently unrecognized or even denied, despite the volume and prominence of the evidence.

Many decisions are subject to aggregate constraints and are best described by models that operate at two levels. For organ transplants, the total number available is determined by how many are harvested, while allocation is made based on need, tissue match and sometimes geography. Nursing homes allocate spaces on the basis of need, referral, gender or other variables while the total number served may be constrained by the number of beds. Similarly, the availability of physician services, at least in the short run, may be constrained by the number of physicians. Rank orderings also operate under global constraints (i.e., only one runner can come in first, and only three win medals, no matter how good the athletes are individually). Financing and expenditure decisions are frequently made at several distinct levels. For research grants, total funding is determined by some federal agency or foundation, and then allocations are made based on quality, appropriateness, and perhaps geography or previous relationships at the project level. For a health system with a financial budget constraint, total expenditures are determined at the macro (usually national) level and then allocated across individuals at the micro level.

In the simple two level allocative model presented here, the total is determined at Level I by one set of variables, and at Level II the total is allocated to individuals by some other set of variables (which may or may not overlap: see Blalock, 1964; Coleman, 1990, Hannan, 1991, King, 1997). In the system of equations below, the aggregate total

"**X**" is determined by some set of large scale variables (L) at the macro level, and allocated across individuals so that each receives some fractional allocation "*a*" of the total which depends on individual attributes (s_i).

X = X(**L**)macro determination (level I, **LARGE** variables)

x_i= a(s_i)***X**allocation to individuals (level II, *small* variables)

Capacity constraints are often bent or broken in the short run, as when a state runs a temporary budget deficit that must eventually be made up, or when a hospital operates at 110% of capacity until staff are burnt-out or supplemented. Indeed, defining large and small in temporal rather than spatial terms provides an alternative use of the two-level model: in such a perspective the L_g are long-run variables and the s_i are short run (Getzen 1990, 2000b, Ruhm 2001, 2004).

The explanation given above is sequential (total determined at level I, *then* allocated at level II), but the process is usually simultaneous. Also, while micro and macro are here represented as entirely separate, some interaction between levels is common. The willingness of the public to spend on medical care and the efficiency and equity of the system are best viewed as jointly determined, even though there may be some inertia and time lags involved. Similarly, changes in the method of allocating organ transplants perceived as more fair, or more life prolonging, or more favorable to participating hospitals, may have the effect of increasing the number of organs harvested. Yet flexibility does not mean that constraints are not real. Budgets do exist, and in the long run largely determine how much can be spent on health care, education or research.

A binding constraint is established at the top in the two-level model presented above. The model could be extended to more levels, multiplying the number of budget constraints at various levels in cascading tiers. On the other hand, the constraint could be relaxed, so that the separation of micro and macro level variables becomes less absolute—a sort of soft budget model. At the extreme, one could craft the model as having some collective higher level variables, but no collective constraint at all. In that case, the group mean would go up or down as individual attributes change, with aggregate totals allowed to vary freely. This unconstrained version is much closer to the models developed in education research for estimation of student, teacher and school level effects often termed "hierarchical" or "multilevel linear models" (which are well described in Bryk and Raudenbush, 1992; Goldstein, 1995; Rice and Jones, 1997; and Carey, 2000). In these models the influence of macro variables adds to (rather than limiting) micro level variation. Such freedom is not costless. The capacity constraint which facilitates the solution of allocative models (e.g., only one gold medal winner, total kidneys transplanted is limited by the number harvested, total inpatients on each day is limited by the number of beds, or total payments to providers is limited by premiums collected) becomes problematic in such a general linear model, and is apt to create aggregate specification errors. Whether one should use a hierarchical linear model or an allocative budgetary model depends on the characteristics of the process being studied (Rice and Jones, 1997; Rosenkranz and Luft, 1997).

Empirical studies of health care costs at the national level show that expenditures rise rapidly with per capita income. However, studies of individual medical costs show only modest effects, or even declines associated with higher incomes. Reconciling this disparity in empirical results requires that analysis be carried out on multiple levels, with a conceptual framework connecting individual and group (ecological) behavior.

The reliance on insurance to pool funds and pay for health care is a root cause of the divergence between individual and group income effects. With insurance, it is the average income of the group, and the fraction of total income the group is collectively willing to devote to medical care, which determines the health care budget, not the income of the particular patient being treated (Getzen, 2000). This is clearly seen, for example, in the treatment of the elderly under Medicare. Collective political decisions about what services are to be covered, what payments are to be made to providers, the rules for review and co-payments, and so on, are much more important quantitatively in determining overall cost than individual patient decisions about whether or not to seek treatment, or which treatment or prescription to use. It is not that individual decisions are irrelevant; it is just that they are overwhelmed by the group decisions to define and fund the program as a whole. To a considerable extent, insurance converts private medical care into something like a "public good" for the group that is covered by the plan (Getzen, 2004).

In those types of medical care where insurance is less significant (plastic surgery, eyeglasses, dental care, mental health counseling), individual behavior is no longer dominated by collective group decision-making, and personal incomes have a large effect upon personal expenditures. It is the individual, rather than the collective, budget constraint that matters in these cases. In the example of organ transplants discussed above, the relevant capacity constraint could occur at the level of the hospital, the region or the nation, depending upon how transplant services

were organized. Similarly, it is the way in which financing and insurance pools are organized that determines the boundaries of the "groups" which are most relevant in determining health expenditures.

Current income elasticity estimates of (largely insured) medical care at the individual micro level are almost always near 0 or negative. Measured income elasticity at the national macro level is consistently positive and large, usually exceeding 1.0. When the unit of observation is intermediate between the micro and macro level—for example at the level of the hospital, health plan, county or region, then the income elasticity is typically somewhere between 0 and 1.0, that is, between the micro and macro level parameter estimates (Parkin, McGuire and Yule, 1987; Blomqvist and Carter, 1997).

The results of more than fifty empirical studies of the effect of income on health care expenditure/utilization have been reviewed, comparing individual, regional and national spending patterns, with and without insurance. While the disparity in the magnitude of income effects across levels of observation is readily apparent, what is less evident is the dominance of income effects at the macro level. When carefully specified, income accounts for more than 90% of the total variance in national health expenditures, and virtually all of the explainable variation (Newhouse, 1977; Getzen, 1990). That is, once income effects are accounted for, the residual variance in national health expenditures is small and shows no consistent association with other variables.[i] The dominance of income effects at the national level establishes a very simple form of group budget constraint and makes the multilevel "allocative model" presented above particularly useful in the analysis of health care costs.

Many who are used to discussing the effects of technology, disease prevalence, hospital construction, population aging, public financing or legislation may be surprised that such factors are not seen as significant independent variables in the determination of national health spending. Yet a review of empirical studies over several decades makes it apparent that none of these, or any of the other variables tested, has a consistently demonstrable effect of substantial magnitude. Perhaps most revealing is the examination of population aging. Aging has a profound effect on *individual* differences in medical spending, not on *average* per capita expenditures. Growth in expenditures on the aged is attributable primarily to increased intensity of service and secondarily to the connection between wealth and increased longevity, rather than to changes in morbidity or the number of elderly. After controlling for the effects of national per capita income, there is essentially zero correlation between changes in the percentage of the population over age 65 and the share of GDP spent on health care (Barer et al, 1989; Getzen, 1992, Chernichovsky and Markowitz, 2004). As one example, from 1980 to 1990 expenditures on acute hospital facility use by U.S. Medicare beneficiaries rose from $19,460 million to $47,842 million (146%) due to increased intensity (with per diem payments rising 190%) while the rate of discharges and days per discharge fell and the number of elderly beneficiaries rose by just 5.5 million (21%) and their average age by just 1/2 year (1%) (Health Care Financing Review, 1998). An analysis of per capita Medicare physician resource use 1993—1998 found that virtually none of annualized 6% real growth could be attributed to the effects of aging, disease prevalence and distribution, or rapid technological change (Buntin et al, 2004). Aging alone (increases in the number of elderly beneficiaries and increases in their average age) can therefore account for only a small fraction of the increase in Medicare expenditures.

Forecasts of National Health Expenditures: Errors of omission and commission

The projection of future health care costs is among the most crucial tasks of fiscal policy analysis, particularly for the Medicare program. Yet if health care costs at one level are modeled and estimated using variables and observations from a vastly different level, then such estimates or projections are likely to be vastly wrong. Adding more variables and more observations will not usually improve the estimates, but doing so can overcome critical resistance by providing an impression of rigor and precision. In attempting to project national health expenditures (NHE), it was soon recognized that the standard "demographic" projection of spending by age-sex categories a) did not explain the rates of growth in expenditures in the past and b) would seriously underestimate future budgetary requirements. Attempts to ameliorate this failure by adding multiple disease categories, patient types, provider settings, insurance plans, regional fixed effects, etc., or shifting to micro-simulation models with ever-increasing specificity and detail, met with little success. Over time, the Office of the Actuary, CMS, learned to rely more and more on a macro perspective that treated per capita GDP as the main driver of spending in order to create the official ten-year projections of NHE (Smith et al. 1998; Peden and Freeland 1998; Getzen 2000b; CMS 2005). It has

become clear that errors accumulate when the aggregate effects of income on budget constraints are omitted, or when the individual effects of morbidity and mortality are mechanically extrapolated.

The lessons learned have not yet been widely applied. Most projections of "health care costs" do not carefully address the disparity between micro and macro estimates, and may not even explicitly acknowledge that such a divergence exists (Lee and Miller, 2002; Seshamani and Gray, 2004; Stearns and Norton, 2004; Goldman et al, 2005; Thorpe, 2005). For example, the Rand Health Insurance experiment, considered a "gold standard" for testing the effects of price elasticity and insurance coverage on individual expenditures, is often misused to create estimates of aggregate regional or national spending, a purpose for which it was not designed, for which it is ill-suited (Finklestein, 2005). Analysts will assert that HIV infection, myocardial infarction or aging will "cause" national health expenditures to rise, while fully aware that higher rates of HIV incidence in Africa, of cardiac disease in Scotland, or of senior citizens in Japan, do not obviously "cause" national health expenditures to be higher. Moreover, it is commonly asserted that reductions in disease morbidity and mortality will reduce U.S. health care costs in the future despite fifty years of experience to the contrary.

Conclusion

Public health security is readily obtainable through the provision of an national health system with broad-based financing covering most or all of the population. Forecasts indicate that the costs of health security will rise rapidly during the next twenty years, but will be affordable by countries experiencing steady growth (an average of 4% or more). However, any lack equity in payment for the system which disadvantages specific groups (rural farmers, urban workers) whether real or perceived, may lead to a catastrophic loss of trust and a true crisis. Disasters, epidemics and other public health emergencies are not likely to cause financial or social problems on a large scale, unless they are mismanaged.

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[i] While the causation of expenditure growth is probably complex and rests upon a number of factors, so far it has not been possible to devise consistent measures of other variables that reliably demonstrate significant effects in rigorous and repeated empirical tests. For example, it is often asserted that the American public is more given to a culture of excess and enamored of flashy new technology than Europeans. Yet attempts to define and measure that "factor" lead to the unsatisfactory "U.S fixed affect dummy variable" that in essence supports an ad hoc claim that the U.S. spends more because they are spendthrifts. Related political culture measures of "egalitarianism," "respect for authority," "social solidarity," "publicness," "centralization," "willingness to wait" and so on have all been found to be statistically significant (or not) in some studies but not others, and all appear to be imprecise and ad hoc either in definition or application. "Technology" is frequently referred to as a causative factor, yet most econometric studies simply take the residual unexplained growth from a time series regression and term that a proxy measure for technological progress, and thus lack objective quantification that can be independently verified (Peden and Freeland, 1998; Buntin et al, 2004). While "the residual" is clearly unsatisfactory as a measure of a major cause, the readily available alternatives (number of patents, lists of major medical breakthroughs, R&D spending) that can be measured in a fairly consistent and uncontroversial manner do not appear to provide significant explanatory power.