Using selected diagnoses to improve the Chilean capitation formula

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Abstract

Objectives: To contribute to the policy discussion of equity and health financing in Chile by evaluating the improvement in the capitation formula for paying PHC providers by using selected diagnoses. The socio-economic status of the municipalities and the urban/rural location of providers are used to adjust current capitation payments to providers. Issues have been raised about the ability of the formula to predict the utilization of PHC. In this study we test if adding individual information, such as age, gender and selected diagnoses improves the formula's explanatory power. Age, gender and diagnosis are important variables because of their strong relationship to increased morbidity risk and to needs for preventive and reproductive health care respectively. **Methods:** A sample of 10,000 individuals was drawn and two years utilization-of-services data was collected from a region in Chile. Information on age, gender, socio-economic status and urban/rural residence, the number of preventive or curative visits and the presence of seven key diagnoses was collected. Regression analysis and two tests to identify the best model were performed: i) R-square, which measures the proportion of the variance in *individual* expenditures and ii) "predictive-ratio" which measures the accuracy of prediction at the group level (where 1.0 indicates perfect prediction). **Conclusions:** We recommend to add age, gender and two diagnoses; hypertension and diabetes to the current capitation formula. The explanatory power of this model at the individual level was 28.5% and at health centre level the "predictive ratio" was close to 1.0.

Keywords: capitation, risk adjustment, Chile health care system, primary health care

1 Introduction

Chile has a mixed health care system with public and private insurance and public and private providers. Within the public system affiliates can register with public primary health care facilities (PHCF), which are managed by local municipalities. The major source of funding for PHCF is a system of capitation payments from the Ministry of Health (MOH) for their registered enrollees. Municipalities are divided into four categories – urban non-poor, urban poor, rural non-poor and rural poor – and different per-capita values for the capitation are set for each category. A PHCF receives the same capitation for all of its clients depending on the category of the municipality it is located in.

Capitation systems provide strong incentives for efficiency for health care providers because they set a prospective budget within which providers should manage their resources. At the same time capitation systems may lead to incentives to discriminate against enrollees with predictable high health care costs, with which the provider will make a predictable "loss" when comparing the capitation with the resources needed. There is consensus in the health economics literature that capitation should be adjusted and reflect the resources needed (1).

In this paper we analyse the current system of capitation payments for PHCF, using a dataset of 10,000 enrollees, created for this study. We compare the current capitation formula with alternative models of capitation payments emerging from the risk-adjustment conceptual framework. We develop a proposal for an improved formula of capitation, which could serve as the basis for discussion among Chilean health policy makers.

The paper is structured as following; firstly, we present background information on the Chilean health care system and the role of primary health care in the system (section 2). We then lay-down the conceptual framework and define the research questions (section 3), and present the variables and the methodology (section 4). In section 5 we present the results and finally we discuss the findings and provide some recommendations (section 6).

2 Background: PHCF in the Chilean health care system

Near-universal access to health care has been achieved in Chile through public and private health insurance. Each contributor has the obligation to insure against the risks of health care costs, and to pay a mandatory contribution of 7 percent of his income. He has the choice to insure

with the public system, Fondo Nacional de Salud (FONASA) or with one of 35 private insurers or Instituciones de Salud Previsional (ISAPRES). About two thirds of the population are insured with FONASA, about 20 per cent with one of the ISAPRES and about 13 per cent have coverage by other means (2).

The government subsidises the health expenditures of the public system. FONASA classifies its affiliates into four income groups, denoted by the letters A (poorest) to D (richest)[1]. With the exception of those insured in group A, who are exempt from the payroll tax and all co-payments, all other affiliates of FONASA have the option to select public or private providers that hold agreements with FONASA. The public provision includes services rendered by primary health care facilities and public hospitals. In primary health care facilities, affiliates have access to free treatment and free selected drugs; there are co-payments in secondary and tertiary care. FONASA affiliates who want access to the private providers network have to pay co-payments, FONASA pays only a portion of the costs.

Although payment for primary health care (PHC) is only about 9 % of public health expenditures (2000), reaching some Ch$ 106 billion pesos (US$171 million), PHC has been developed as a central component within the health care infrastructure. There are four basic types of public PHCF: rural medical stations, rural health posts, rural health centres, and urban health centres. Rural medical stations are buildings used as temporary sites for periodic visits by medical teams. Rural health posts provide services to catchments areas of 1,000 people. Rural health centres are located in communities of 2,000 to 5,000 people. Urban health centres provide ambulatory care.

Chile is going through a demographic and epidemiological transition. This transition is characterized by a decrease of the population under the age of 15 and an increase in the percentage of seniors, where women outnumber men. Communicable diseases are no longer the leading health problems; rather non-communicable diseases are on the rise in both relative and absolute terms. Hypertension is a major risk factor for cardiovascular diseases. Women show higher rates than males for hypertension, obesity and physical inactivity, and among women of lower socio-economic status the prevalence is even higher. Diabetes was significantly more frequent in subjects with hypertension (3;4).

1 In addition, there is fifth category E, who are non-FONASA beneficiaries, but can use public facilities on a fee-for-sevice basis.

PHCF provide preventive as well as curative services. Most of the health promotion and non-communicable disease prevention efforts are clustered under the following standardized programmes:

– Well-baby and Healthy Children, targeting children from 0-9 years,

– Maternal Health, encompassing family planning and pre- and post-natal interventions,

– Adult Health, targeted at identifying and managing risk factors among adults (40-64) and seniors (65+).

The preventive programmes directed to adults and seniors are relatively new and are associated with two programmes dedicated to control two chronic diseases, hypertension and diabetes. Many of the new interventions require difficult changes in behaviour; obesity or compliance with drugs regimes (diabetes) that are difficult for clients to accept. Therefore they require intensive information, education and communication (IEC) efforts (5). In addition to IEC and prevention, the services of PHCF encompass curative or morbidity consultations. More complex interventions are referred to the secondary level.

Public PHCF have four sources of funding:

– a capitation programme funded by the MOH, according to the number of registered beneficiaries (about 60 % of public funding),

– direct payment of the MOH for specific diseases, like acute respiratory infections or promotion activities (about 12 % of public funding, the proportion had increased during the last five years),

– discretionary funding by the municipalities who manage the PHCF (about 27 % of the public funding),

– revenues from fee-for-service payments by non-FONASA beneficiaries (about 1%)

In the capitation programme, the MOH calculates a prospective basis capitation rate for the average registered beneficiary, which should cover the full cost of care according to some norms, which is intended to cover labour, administrative costs, and a percentage for non-labour inputs such as pharmaceuticals (6). The basis capitation rate is differentiated according to the type of municipality where the PHCF is located. For that purpose, the municipalities and their covered

populations were ranked from the most well off to the poorest, and the lowest quartile of municipalities in that ranking was defined as "poor". Municipalities were defined as "rural", in the case where more than 30 % of their population was living in rural areas according to 1992 national census (7).

Capitation rates are normative and two considerations prevailed: (i) PHCF in rural municipalities would need more financial resources than those in urban areas, (ii) PHCF in poor municipalities would need more financial resources than in non-poor areas. Table 1 shows the capitation payments in 1999 and 2000 per registered beneficiary.

Table 1 Per-capita Value of Capitation Payments by Socio-Economic and Urbanization Level of the Municipality (current pesos)

	1999	2000
Urban non-poor	793	841
Urban poor	936	955
Rural non-poor	952	1,009
Rural poor	1,123	1,191

Source: (2)

Given that the capitation programme covers about 60 % of the funding of PHCF, the methodology under which the capitation rates are calculated has a strong influence on the financial situation of PHCF. An examination of the appropriateness of the present formula and an analysis of alternatives models of capitation payments are the focus of this study.

3 Conceptual framework and research questions

3.1 Risk Adjustment of capitation payments

Capitation is a fee paid by a health financing agency to a health care provider for each of its registered affiliates for the provision of services to these affiliates for a fixed period, usually one year. Unlike a fee-for-service system, in which the renumeration is directly linked to the volume

of services for the individual patient, a capitation is prospectively paid, regardless what the specific services will be for these enrollees during that year.

The objective of most capitation systems is that of securing control of expenditure, so the increasing number of services delivered by the health care providers does not lead directly to increased payments by the financing agency. Capitation systems therefore are based on the idea of pooling risks not only by the financing agency but also by the providers. The capitation takes into account that some beneficiaries may not use the services at all, while others may use them more often than the average.

The calculation of capitation rates to providers has been the focus of conceptual and empirical work on risk adjustment. Within the framework of risk adjustment, capitation rates should reflect health needs of the beneficiaries. The concern is twofold:

– *Equity considerations*: Beneficiaries with equal health need should have equal chances to get adequate health services. This can only be achieved if the revenues of the health care facilities reflect the health needs of their registered beneficiaries, so differences in the mix of health needs between enrollees are reflected in different revenues of these providers. Defining capitation rates in a way that allows resources to follow health needs, has for a long time been a concern in tax financed national health services systems which distribute budgets to local health care authorities or providers. More recently, policy makers in social health insurance systems discuss how different contributions rates should support equal access to health care (1).

– *Creating appropriate incentives.* Encouraging cost containment, avoding "cream skimming", generating information that is useful for case management and avoiding gaming of risk adjustment information. Under a capitation system there is not a direct link between the volume of services a health care provider delivers and the resources obtained. Providers could make "profits" with some clients and "losses" with others. In the case where enrollees have the choice whether or not to register with a provider, providers have strong incentives to scrutinize potential clients, in order to assess whether or not their expected annual costs exceed their capitation payments. Even if open enrolment is stipulated, and health care providers must accept all applicants, plans can effectively deter high risk applicants, or encourage high risk members to leave (8). If capitated providers engage in "cream skimming", trying to enrol people with expected low expenditures, clients with bad health status might find it difficult to get registered at all, and incentives to treat them adequately might be low. Therefore, capitation systems should be designed

to reduce the likelihood that providers make large predictable losses on certain groups of potential clients.

Both concerns – equity and avoiding of cream skimming – do not necessarily lead to the same conclusion. For example, an unexpectedly high utilization of health services is not an issue from the "cream skimming" perspective, because health providers can not react in advance; however it can be a problem from the equity perspective if it produces a different burden for different capitated providers and influences the chances for adequate treatment.

The most straightforward way to design capitation rates is a flat rate, the same for all clients of a health care provider and across providers. Flat capitation rates, however, are likely to overpay or underpay providers for certain patient groups, so they are not recommended. Improved capitation systems approach a client's relative health needs and expenditures try to identify and integrate variables, which help to predict these expenditures; these variables, which are called *risk adjusters* are used to modify the flat rate.

There two main approaches to risk adjusting: *empirical and normative*. Under the empirical approach, risk adjusters are selected on the basis of a proven association with health care spending, and capitation rates are modified accordingly. For clients of a certain type (identified by the set of risk adjusters), who typically have above average health care spending, capitation rates are set above average as well. In contrast, under the normative approach, the main concern is not with predicting utilization and expenditure patterns, but to *change* them. Risk adjusters are chosen in a way that capitation rates for clients of whom it is thought that they underutilize the health care system are set so that providers have incentives to encourage those clients to register and demand medical care.

Several types of models, using different sets of risk adjusters, have been developed and are implemented in various health care systems. We have grouped them under the following: i) demographic models, ii) socio-economic models and iii) epidemiological and health status models. All of them are empirical, but some can also be used under the normative approach.

Risk adjustment of capitation payments in most health care systems has started with *demographic models*, using age and gender as risk adjusters. Sometimes belonging to a special subpopulation is used as risk adjuster:

– *Age and Gender*. Many studies have demonstrated that there are pronounced differences in the average per capita usage of health care resources and expenditures by age groups and gender (9). When using age and gender as risk adjusters, capitation rates will be higher

for the elderly, and among the young, rates will be higher for women than for men. Age and sex can be easyly documented, and their use for risk adjustment in most cases is generally accepted by all parties.

– *Special Subpopulations.* The rationale for developing separate models for selected subgroups is that they are vulnerable populations or that there is a concern that they may underutilize the system. For instance, some capitation systems make an explicit adjustment for ethnic group, in the same way as for age and gender. Often this is done in a normative way, as to create incentives for providers to give special attention to these subgroups.

In *socio-economic models* numerous factors are used, their use being predominantly ad-hoc, and often based on data availability rather than a direct link or a proven relationship to health care needs. Among the main adjusters are region and socio-economic status.

– *Region.* Regional differences in per capita expenditures can be observed in many countries; they are often caused by differences in input prices or practice patterns. Some capitation systems use region as a risk adjuster, to reflect these differences, e.g. risk adjustment in the Medicare+Choice system in the US, or for the sickness fund system in the Netherlands.

– *Socio-economic status.* Socio-economic status is a good predictor for health needs; it is well established that mortality as well as morbidity are higher in low socio-economic groups. There are mixed results, however, whether utilization of health care services and per capita health expenditures increase with decreasing socio-economic status – whereas some studies affirm that socio-economic indicators could be good predictors of utilization of health care (10), others were unable to find such a relationship (11) (12). Therefore, it is controversial whether socio-economic status is a useful empirical risk-adjuster; it might be used as a normative adjuster, however, paying a higher capitation for enrollees of the lower socio-economic strata, in order to make them more attractive to providers.

The *epidemiological and health status models* include mortality, disability and health status

– *Mortality.* Mortality, crude rate and standarized (SMR) are used in a number of schemes for capitating regional health authorities, such as those in Scotland, Nothern Ireland, Italy, New Zealand, England and Norway. Mortality has been suggested because of the high health care expenditures prior to death, but also because it is a good proxy for a

population's morbidity. From the perspective of avoiding cream skimming it is argued that mortality should not be used as a risk adjuster, because most of the excess costs associated with high costs of dying are unpredictable (9). Higher costs prior to death still may be a problem from the perspective of equity, if death rates differ between regions or health care providers. However, SMRs have positive but very low correlations with utilization and need rates (13).

– *Disability.* Permanent disability is used to calculate capitations in Belgium, Germany, Finland, the Netherlands, and US Medicare. The Northern Ireland formula for acute care includes a measure of low-birth weight in infants. Disability and functional health have shown to be relatively good predictors of future expenditures (1).

– *Health Status and Diagnoses.* Since the early 1980's a considerable amount of research has developed risk adjustment models that use diagnoses processed during utilization of health services to calculate risk-adjusted payments. The starting point for all diagnostic-based risk adjustment is the concept that certain diagnoses are good predictors of health expenditures. On the one hand there are pragmatic approaches which identify selectively certain diagnoses which are more common (14), expensive to treat for example psychiatric cases (15) or persons with HIV/AIDS (16). On the other hand there are more elaborate models, which classify the whole spectrum of diagnoses. The two most widely known classification systems are the Ambulatory Care Group (ACG) developed at Johns Hopkins (17), and the Diagnostic Cost Group (DCG) family of models developed at Boston University and Health Economics Research (18;19). The essence of ACG and DCGs is the allocation of people to a restricted number of groups according to diseases diagnosed during prior hospitalization and/or prior outpatient and ambulatory visits, and incorporating this information in the risk-adjusted capitation model. These two models were originally developed in the US, but have been tested in a variety of other countries (20). The studies show that the addition of health status risk adjusters to an age/sex based risk-adjusted capitation payment model is a clear improvement.

3.2 Criteria to Select Among Risk Adjustment Models

Various criteria for selecting the best risk-adjusting model for capitation payments have been developed (9;21;22). The main criteria identified are: statistical performance, measured with R-

square and predictive ratio, administrative feasibility and simplicity, financial incentives and robustness against manipulation.

– The measure of the predictive power of different risk adjustment models, is the conventional *R-square*, which measures the proportion of the variance in individuals' expenditures that is explained by a set of risk adjusters. The percentage of the individual variation that can be predicted by existing prospective models has been estimated for all expenditures (outpatient, inpatient) to reach about 20 percent; for specific types of health services (e.g. only outpatient) it may be larger. The remaining 80 percent is subject to entirely random fluctuation. Age and sex can explain only a small fraction of the total variance amongst individuals, typically between 1%-4%. The introduction of additional individual socio-economic factors, such as employment status, housing tenure, can offer additional explanatory power. However, to date, major gains in explanatory power have been achieved only by incorporating measures of previous health care utilization or health status, in the form of professional diagnosis, self-reported morbidity, previous inpatient episodes, or previous health care expenditure .

– *Predictive ratios* are used to test the model prediction accuracy at the group level, the health centre or the group of people with a selected diagnostic, as the unit of analysis. This aggregate level is important because for example, municipalities need to break even at each health centre level and not directly at the individual level. The coefficients from the regression analysis are used to predict the probability of individuals in different risk-groups to use health services or estimate their mean predicted expenditures/visits to the health centre per year. The mean predicted for expenditures or visits is divided by the mean for actual visits, and predictive ratios for different subsets of the population are estimated. A predictive ratio of 1.0 indicates accurate prediction, a ratio less than 1.0 indicates under prediction and a ratio of more than 1.0 indicates over prediction.

– Statistical power and accuracy have to be weighted against other criteria, such as administrative feasibility and robustness against manipulation. For example, models that permit providers easy "upcoding" in order to get higher capitation rates may not be recommended even if their R-square is superior. Other incentives have to be taken into account; for instance models which use only inpatient diagnoses information could provide perverse incentives for health care providers to hospitalize their clients.

3.3 Research Questions

The focus of the present study is to simulate a need based capitation formula for primary health care facilities in Chile, making use of the conceptual framework of risk adjustment. This shall lead to a recommendation to Chilean policy makers for an improved formula for variation in needs among enrolled populations, to facilitate a more equitable distribution of resources.

More specifically, the following research questions are studied:

1) Is the current capitation formula adjusted by a socio-economic and urbanization status of the municipality appropriate for predicting the variation of utilization of primary health care and the corresponding health expenditures by enrollees of public health centres over a year?
2) What model or set of adjusters have a higher explanatory accuracy, i) demographic, age and sex, ii) demographic plus two key diagnostics like hypertension and diabetes or iii) demographic plus seven of the most common and expensive diagnoses?
3) Having selected one model, what are the optimal weights on these adjusters to predict the utilization of the primary health care at the individual and at the health centre level?

4 Data and Methods

4.1 Study population

In order to study the current capitation formula and other models of calculation capitation rates to PHCF, we drew a sample of affiliates of the public PHC network who were registered in the Chilean per-capita programme. The study was carried out in five health centres and 24 posts located in south Chile (Valdivia and Temuco). The locations comprised of 110,000 individuals in 1999 and 123,000 individuals in the year 2000 registered in the per-capita programme. In the selected region about 65% of the population is covered by FONASA, in line with the national average. The rural population comprises of about 35% of the population, which is in line with the national FONASA average of 33% for rural population.

The selected sample was 10,000 affiliates. Every member was: i) registered completely or partially from 1 January 1999 until 31 December 2000, ii) born before 31 December, 2000, iii) afiliated to FONASA, so anybody registered with an ISAPRES or other was excluded, and iv) with a valid entry in the database for date of birth, gender, and FONASA status. The affiliates could be users or non-users of primary health services in the given period.

The sample was stratified, into four homogenous groups according to FONASA methodology of classifying the health centres into four socio-economic categories: poor and non-poor, and urban and non-urban. According to this criterion about 67% of the population lives in municipalities classified as urban and about 36% in municipalities classified as poor.

Table 2: Sample Size and Distribution of 10,000 Affiliates

	Rural	Urban	Total
Poor[a]	11%	25%	36%
Non-poor	22%	42%	64%
Total	33%	67%	100%

Source: (7). [a]Rural poor includes comunes « tipo fijo » that comprises 2% of the population

The age and gender structure of the studied population was extracted from the health centres own age and gender structure. At the time of the study no information was available from FONASA on age/sex structure at the national level or by the four socio-economic categories. The dataset of the health centres is organized by five-year intervals giving 14 age groups for each of the two genders to give 28 groups for each of the five health centres. A random sample was drawn from each of the 28 age/sex groups by the health centre.

4.2 Variables

From each individual of the sample, identified by a unique identifier number, we collected the following variables:

– municipility urbanization status (urban, rural)

– municipality socio-economic status (poor, non-poor)

– health centre post code

– age (0-99)

– gender (male, female)

– FONASA socio-economic status (A-D)

– number of visits to the primary health care, preventive or curative

– presence of the seven selected diagnoses

– number of months registered in the PHCF from January 1st, 1999 until December 31st, 2000.

The number of visits was chosen because it was the only indicator available reflecting use of resources. This information could be transformed into expenditures using an available study that calculates costs per visits for preventive and curative service (23). The number of visits was available in an electronic format from just one of the health centres; for the others the information was drawn manually from the medical records.

With regard to number of visits and presence of selected diagnosis, information from two years has been used in this study. In the case where somebody was enrolled for just one year or a fraction of a year, which happens automatically with births and deaths, the information was annualised and weighted as suggested by van de Ven and Ellis (9):

1. Annualised visits = total number of visits divided by the total number of months enrolled multiplied by 12 months.
2. Weighted = total number of months enrolled divided by 24 months

Visits could be preventive or curative. Primary prevention encompasses measures that comprise of examinations and medical check ups as well as health education. We selected five key preventive intervention categories plus a general category for any other preventive activity. Most of the interventions are linked with an ICD-9 code.

Table 3: Types of Preventive Visits

MOH code	ICD-9 code	Procedures
Well-baby & Healthy Children Programme	V06	Vaccination
	V20.2	Examination health supervision (infant and child) Examination developmental testing (infant and child)
Sexual education	N/A	Sexual education directed to adolescents
Prenatal Care	V22.1	Prenatal care for pregnant women
Adult Programme	V70.0	Routine general medical examination to adults at health care facility (ESPA)
Senior Programme	V70.0	Routine general medical examination to seniors (over 65+) EISAM
Preventive care	N/A	All other preventive interventions

Curative or morbidity consultations are provided as demanded. More complex interventions are referred to at the secondary level, but several chronic stable diseases are treated at the PHC level.

The health centres uses a short-list of around 1,000 ICD-9 diagnoses. Visits related to seven diseases were selected to be included in our study. Our main objective was to include diseases that demanded more resources. We interviewed the health centre directors and agreed to select diagnoses according to some of the following criteria used by the ACG methodology (24): i) recurrent and chronic diseases versus single events of a diseases, ii) within the chronic conditions, diseases which are stable. Stable conditions are more likely to require more resources on an ongoing basis and more likely to require special care, iii) more severe diseases or a disease with higher likelihood to need specialized care, and iv) diseases where a diagnostic evaluation is needed. According to this criteria the following diseases were included; hypertension, diabetes, chronic bronchitis, syndrome bronchitis obstructive, asthma, varicose veins with ulcer and alcohol abuse. Out of these diseases, the health centres manage a subset of diagnoses that are mostly stable and chronic.

Table 4: Types of Curative Visits

CodeICD-9	Label	Characteristics
401.9	Essential hypertension	Chronic, stable
250.0	Diabetes mellitus uncomplicated	Chronic, stable
250.02	Diabetes mellitus II without complications	Chronic, stable
250.03	Diabetes mellitus without complication uncontrolled	Chronic, unstable
491.0	Simple (syndrome) chronic bronchitis	Chronic stable
491.2	Obstructive chronic bronchitis	Chronic unstable
493.1	Intrinsic asthma	Chronic, stable
493.0	Extrinsic asthma	Chronic, stable
493.9	Asthma unspecified	Discretionary
454.0	Varicose veins of lower extremities with ulcer	Likely to recur: discrete
454.9	Varicose veins of lower extremities	Discretionary
303	Alcohol dependence syndrome	Recurrent/unstable Special psychological care needed

4.3 The Model

We have used regression analysis to estimate how significant the effects of (1) the municipality socio-economic status and urbanization level, (2) age and gender, and (3) age, gender and the

presence of hypertension and diabetes and other selected diagnoses are on utilization of health services, or the extent to which these independent variables accounted for increases of utilization of health services. The model is represented empirically by the following equations:

(1) $SPHCV_i = B_0 + B_1 \text{ socio-economic}_i + e$

(2) $SPHCV_i = B_0 + B_1 Age_i + B_2 Gender_i + e$

(3) $SPHCV_i = B_0 + B_1 Age_i + B_3 Gender_i + B_i \text{Chronic diseases}_i + e$

Where:

$SPHCV_i$ Sum of primary health care visits is equal to: annualised and weighted number of preventive and curative visits by a patient *i* to general medical doctors, specialists and paramedics in health centres over a two-year period, 1999-2000.

Socio-economic $level_i$ is equal to four categories where: non-poor urban municipalities= Ch$ 817, poor urban municipalities = Ch$946, non- poor rural municipalities = Ch$981, and poor rural municipalities =Ch$1,157.

Age_i is equal to fourteen age-group categories where: 1 = 0-4 years, 2 = 5-9 years, 3 = 10-14 years, 4 = 15-19 years, 5 = 20-24 years, 6 = 25-29 years, 7 = 30-34 years, 8 = 35-39 years, 9 = 40-44 years, 10 = 45-49 years, 11 = 50-54 years, 12 = 55-59 years, 13 = 60-64 years, and 14 = 65+ years.

$Gender_i$ is a dummy variable equal 1 if patient *i* is female, 0 if patient *i* is male.

Chronic $diseases_i$ comprise of seven dummies:

Hypertension, dummy variable = 1 if patient *i* is diagnosed with hypertension, otherwise 0, the same for diabetes, bronchitis obstructive syndrome, chronic bronchitis, asthma, ulcer varicose, and alcohol abuse.

We have estimated a "concurrent" (or "retrospective") model, in which the independent and the dependent variables are from the same, two-year period. We expect higher R-square using two years count of visits rather than a usual one year.

5 Results

In this section we first present some characteristics of the sample of 10,000 registered affiliates. Then we present data on the case-mix between the PHCF. Finally we present the results of the regression analysis.

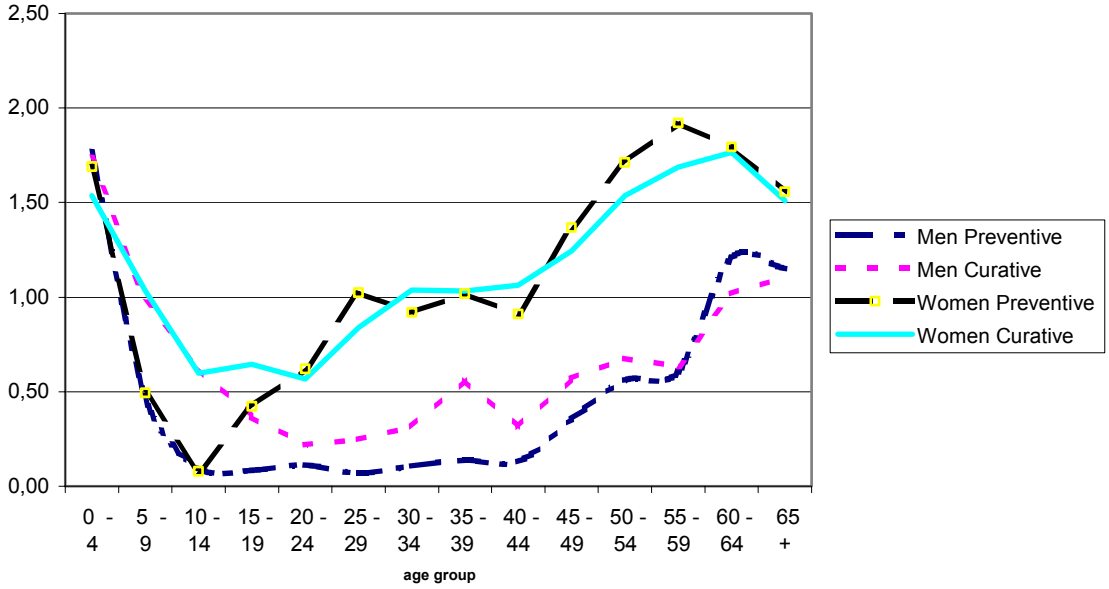
5.1 Sample characteristics

The mean age was 31 years and the median age was 29 years. About 53% of the sample is female, 67% are indigents, compared to 46% of the national population affiliated to the programme, and therefore this subset of the population is poorer than the national average. The population affiliated to the per-capita programme visited primary health centres within the two year period of the study an average 1.59 times per year. The standard deviation was 2.82, therefore the coefficient of variation was 177% (2.82 / 1.59 x 100). From this number of visits 0.72 were for preventive care and 0.87 for curative care. Preventive and curative care makes almost an equal share of the total visits.

The distribution of visits to the health centres is not normally distributed, as the data is skewed to the left because of the high proportion of non-users. The non-users that are eligible to use PHC services reached 51% of the population, where men outnumbered women, 83% of men did not make any preventive visit versus 63% of the women and 63% of men did not make any visit for curative treatment versus 50% of the women. The users' visits are distributed as follows: 39% of the population visited the health centre between 1-5 times, 8% between 6-10 times and just 2% visited more than 10 times.

As Figure 1 shows, the average utilization of PHC services varies systematically by age and gender groups and shows a continuous, non-linear pattern. Firstly, differences in the utilization of services by gender occur at all ages. One important reason for this is the extra services needed by women during the reproductive years. Between the ages of 15-49 the female use of primary health services is about 3.6 times higher than that of men. In line with international observations (9), the utilization gap reduces significantly above the age of 50; and in our study sample a positive difference in favour of women persists (37%).

Figure 1: Annualised & Weighted Preventive & Curative Visits by Gender & Age-Group

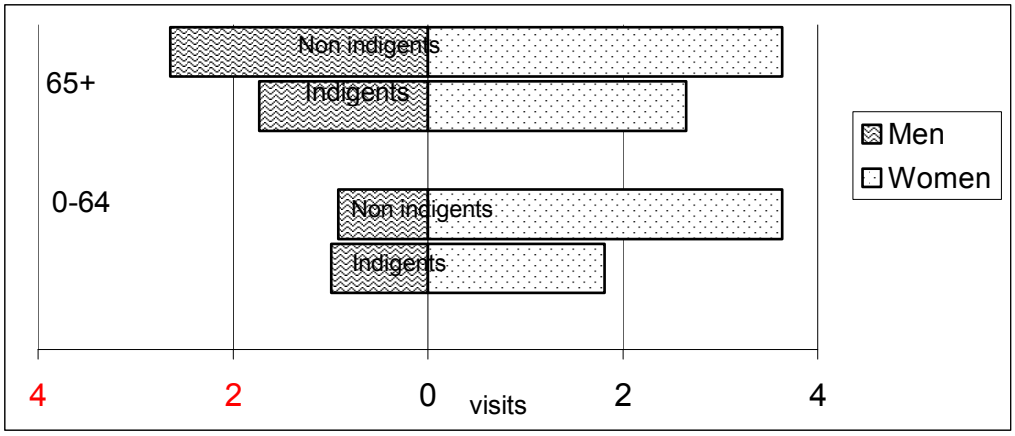


Notes: The lines represent all curative and all preventive visits. Curative or morbidity consultations are provided as demanded. Prevention encompasses the following a) control of children under 6 years old, b) sexual education of adolescents, c) prenatal care for pregnant women, d) preventive adult examination (ESPA), or for the over 65s (EI-SAM) and e) all other preventive visits.
Source: Authors' calculations

Secondly, significant differences occur by age ranges. If we group the sample into two age categories 0-64 and 65+, the result is that the age group 65+ uses primary health services 80% more than the age group 0-64. On the other hand, if we group the sample into 14 age categories by five-years intervals, three major clusters emerge, children 0-4 years use primary health services for prevention and treatment of illnesses more than average, which reflects the special effort from the MOH to provide care to this group-age. This tendency falls for the next age group 5-9, for both genders and maintain under the average, for men until they reach their early 60s and for women until they reach their late 20s. At both points men and women start steadily increasing the use of health services.

Finally, significant differences occur by an individuals' socio-economic status, especially among women where indigents (Category A) use half the services of non-indigent women (Categories B-C-D). The gap among men concentrates in the age group 65+ where indigents men use services about half times that of non-indigents (see Figure 2).

Figure 2: Number of Visits by Two-age Groups, Gender and Socio-economic Status



Source: Authors calculations

As Table 5 shows, if we sort the sample according to the socio-economic status of the municipality, which corresponds to the criteria by which MOH/FONASA allocates their financial resources, a clear difference emerges between poor and non-poor municipalities. Poor municipalities recorded lower numbers of visits than non-poor ones. The difference ranges from 1.00-1.41 visits per year by health centres administered by poor municipalities (urban and rural) to 1.82-1.87 visits per year by health centres administered by non-poor municipalities (urban and rural).

Table 5: Mean Annualised Visits to PHC in the Period 1999-2000 by Selected Groups

	N	Mean	Standard Deviation	Coefficient of Variation
Age-groups				
0-64	9,055	1.48	2.66	179%
65+	945	2.69	3.89	144%
Gender				
Male	4,740	1.10	2.35	213%
Female	5,250	2.04	3.12	152%
Diagnoses				
Hypertension	674	6.64	4.31	64%
Diabetes	166	8.43	5.47	64%
Syndrome bronchitis obstructive (children)	229	5.60	3.96	70%
Chronic bronchitis (adults)	76	5.17	4.08	78%
Asthma	24	6.31	5.00	79%
Alcohol abuse	21	3.73	2.71	72%
Ulcer varicose	4	10.62	9.92	93%
Municipality socio-economic classification				
Rural poor	1,100	1.41	2.77	196%
Urban poor	2,500	1.00	2.07	207%
Rural non-poor	2,200	1.82	2.82	154%
Urban non-poor	4,200	1.87	3.15	168%
FONASA individual socio-economic classification				
Group A (poorest)	6,738	1.48	2.65	179%
Group B	1,508	2.14	3.40	158%
Group C	782	1.57	2.92	185%
Group D (richest)	972	1.54	2.83	183%

Source: Author's calculation

Using FONASA socio-economic classification of individual beneficiaries, differences in the number of visits to the health centre come into view. The indigent group, and the two top income groups (group C and D) use health services less often than socio-economic group B, going 1.48 (A), 1.57 (C) and 1.54 (D) times to the health centre versus 2.14 (B). Part of this finding is consistent with studies from other countries that show that the indigent population underutilizes

health services even when these are free of charge. However, why the "richest" groups underutilize health services in the health centres has a different explanation, the alternative private FONASA network is probably more attractive for the better-off, so they may use both systems at the same time.

With regard to the seven diagnoses selected because of their high prevalence and unit costs, when ordered according to their prevalence multiplied by the mean number of visits, hypertension, syndrome bronchitis obstructive (children), and diabetes came up to the top of the list. Diabetes and hypertension, in contrast to the other diseases operate under two well-established national programmes that provide guidelines and standardized procedures for the treatment of the diseases. The existence of the programmes and clear guidelines make the diagnostics less subject to intentional or unintentional discretionary coding and treatment by medical doctors. In this matter diabetes is much more straightforward than hypertension. Other diagnoses such as chronic bronchitis in adults could be coded and treated differently according to the caregiver's own judgment.

5.2 Case Mix Across Health Centres

The smallest unit of management of financial resources is the municipality and/or the health centre. Therefore with regard to equity and the issue of cream skimming it is appropriate to present information on how the selected risk adjusters; age/sex, and chronic diagnoses are distributed across health centres. Theoretically, a health centre with a greater proportion of women, seniors (65+) and patients with chronic diagnoses such as hypertension and/or diabetes will have more visits (expenditures) than a health centre with a greater proportion of men, people under 65, and without chronic diseases.

Table 6: Case Mix Across Health Centres

	Health centre 1 (urban)	Health centre 2 (urban)	Health centre 3 (rural)	Health centre 4 (urban)	Health centre 5 (rural)
Age-groups					
65+	10.4%	10.2%	10.0%	7.6%	9.5%
Gender					
Female	53.1%	53.4%	53.0%	52.5%	48.5%
FONASA individual socio-economic classification					
Group A (poorest)	62.6%	59.9%	73.7%	69.7%	75.3%
Weighted income	$34,250	$42,775	$22,950	$37,075	$23,700
Diagnoses					
Hypertension	9.1%	7.4%	7.9%	3.9%	6.5%
Diabetes	2.1%	2.1%	1.7%	0.9%	1.5%
Syndrome bronchitis obstructive (children)	3.6%	3.4%	2.1%	1.0%	1.3%
Chronic bronchitis (adults)	1.7%	0.6%	0.8%	0.7%	0.3%
Asthma	0.5%	0.2%	0.4%	0.1%	0.3%
Alcohol abuse	1.0%	0.1%	0%	0%	0%
Ulcer varicose	0.0%	0.1%	0.3%	0%	0.1%

Source: Authors' calculation

In this small sample of health centres the demographic adjusters age/gender, varies across the urban/rural divide. The proportion of men in a rural health centre was higher, and this may be associated to structural differences, where rural areas have a greater proportion of men than urban areas (25). In relation to the age structure of the per-capita enrollees this varies across health centres. For example, the proportion of the seniors in health centres managed by "poor" municipalities (4-5) was 7.6% and 9.5% respectively, while in the "non-poor" municipalities (1-3) the

proportion was slightly higher than 10%. This is interesting from two perspectives, health centre 5 with a low proportion of seniors is located in a rural area, where according to the last national census a higher proportion of seniors live. So the question is: why are these people not registered in the programme, i) is this the result of "cream skimming" policy from the health centre considering that seniors are more resource intensive, or ii) seniors are not interested in the programmes offered at the health centres, or iii) both? On the other hand, the higher proportion of senior enrollees in urban health centres runs against the demographic structure of urban areas. This divergence could be explained by a systematic registration of more seniors in urban areas in comparison to younger people, as a result of ISAPRES cream-skimming policy of avoiding the enrolment of people from the age-group above 65, therefore the public system is left as the only alternative, but this can also be result of self-selection by the younger age group.

Another notable difference across health centres is the proportion of people belonging to the poorest segment of the population. According to the results from FONASA income classification, this group varies from 60% to 75%, which are higher than the national average of 46%. After estimating a per-capita weighted income per health centre, -- where average income per category was multiplied by the percentage of people in that category -- the two rural health centres came out in the lower income group with around CH$20,000, and the urban health centres in the higher income range around CH$40,000. This classification disagrees with the municipalities socio-economic classification, used by the MOH/FONASA, where rural health centre 3 was classified as non-poor and urban health centre 4 as poor, which bring us back to the unresolved issue that people and municipality socio-economic status are different issues.

Finally, there are differences across health centres in the proportion of patients with the selected chronic diagnoses. The proportion of patients with hypertension and diabetes across health centres differs by as much as two times, but this difference is consistent with the fact that health centres with a greater proportion of people over 65, reported a higher proportion of hypertension and diabetes cases. On the other hand, for all other diagnoses the difference is greater than two.

5.3 Regression Results

We estimated four regression models: a "socio-economic model" or the MOH/FONASA model (equation 1), a "demographic model" (equation 2), and two versions of a "demographic and diagnoses" model (equation 3), a model with "demographic and two diagnoses" and a "demographic and seven diagnoses" model. The four models are assumed to be linear in the coefficients and include an intercept. It has been assumed to be linear to keep a close relation to the cells model that is commonly used to adjust capitation payments by risk. The regression models are estimated by means of ordinary least squares with the annual and weighted number of visits to a primary health centre in 1999 and 2000 as dependent variables, and socio-economic type, gender, age, and the two sets of diagnoses as independent variables.

Table 7 summarizes the percentage of individual variation in the per-capita visits, predicted by the described four models (R-square):

i) For the socio-economic model used by MOH/FONASA using the given four per-capita payments the R-square is 0.6%.

ii) For the demographic model – age and gender – the R-square is 4.2%, when 28 parameters are use and 6.1% when just 4. In contrast to most studies we distinguish between preventive and curative services and we found that there was a two-fold difference in the predictive power between both types of services.

iii) The R-square rises to 28.5% when the presence of two chronic conditions are added to the demographic model, hypertension and diabetes. Preventive visits reached an R-square of 31.3% vs. 10.6% for curative services, which means that preventive care is driving this result. We think that the reason lies in the fact that PHC centres have two well established programmes for managing hypertension and diabetes, both programmes include a package of well-standardized preventive interventions, that it is not the case for any other diagnoses.

iv) Finally, when adding seven diagnoses to the age/sex model the R-square rises to 34.9% and the power to predict curative care doubles to 20.6%. This model produces the best result but the difference between preventive and curative intervention is not as significant as in the previous model.

Table 7: R-square[a] of Four Models to Predict Visits to PHC Based on N = 10,000

Models & parameters		Both	Preventive	Curative
Socio-Economic MOH/FONASA [b]	4=(2x2)	0.3	-	-
Age/Sex[c]	4=(2x2)	4.3	3.9	2.2
	28=(28x2)	4.2	4.2	1.8
Age/Sex plus two diagnoses[d]	8=(2x2x2)	28.1	31.0	10.3
	56=(14x2x2)	28.5	31.3	10.6
Age/Sex plus seven diagnoses[e]	28=(2x2x7)	34.8	32.5	20.6
	196=(14x2x7)	34.9	32.4	20.6

Source: Authors' calculations

[a]Percent of individual variation in use of services explained

[b]The socio-economic model contains two categories for income level of the municipality and two categories for degree of urbanization.

[c]The demographic model contains age and sex. Age is broken down in two and fourteen age-categories.

[d]The demographic & two-diagnoses model contains age, sex, and the dummies, presence of hypertension and diabetes.

[e]The demographic & seven-diagnoses model contains age, sex and the dummies, presence of hypertension, diabetes, syndrome bronchitis obstructive, chronic bronchitis, asthma, alcohol abuse and ulcer varicose.

In conclusion, about 35% of the variance in the use of health services among all individuals is explained by means of factors reflected in the past two-years service utilization. When only curative visits were included the R-squares were closer to results reported in the international literature that generally covers only curative care. Finally, the most important finding is the major improvement in the predictive power took place from the age/sex model to the two diagnoses model, with an average seven fold and being even stronger for preventive care. The improvement from the two to the seven models is modest, just one-and-half-times.

5.4 Predictive Ratios

Table 8 compares the predictive ratios for four municipalities. Since municipalities are the unit responsible of managing the financial resources allocated by MOH/FONASA to the health centres we want to know how different models will better predict the total utilization of services at this level. It is surprising to find that the MOH/FONASA model perform as well as the age sex model, however both underestimate and overestimates more than the other models. The seven and the two diagnoses models reach the best level of accuracy for predicting use of health services.

Table 8: Predictive Ratios (predicted/actual) by Municipality Under Four Models

Municipality	Models			
	Socio-economic MOH	Age/Sex	Age/Sex plus two diagnoses	Age/Sex plus seven diagnoses
Urban non-poor	0.93	0.86	0.89	0.92
Urban poor	1.44	1.48	1.32	1.25
Rural non-poor	0.82	1.09	0.91	0.91
Rural poor	0.87	1.09	1.10	1.06

Source: Authors' calculations

The following Table 9 compares the predictive ratios of two different age/sex groupings. The first set has four age/sex categories and the second set 28 age/sex categories. The model with seven diagnoses has the best explanatory accuracy. There is just one age/sex cell where the two diagnoses model underestimate the number of visits and is in the male group 65+.

In the second set, broken down into 28-age/sex cells, we have mixed results. Predictive accuracy for users of PHC is better under the seven diagnoses model, especially for men. The other models overestimate and underestimate significantly the utilization of services.

Table 9: Predictive Ratios for Age/Sex Groups Under Four Models

	Models			
	Socio-economic MOH	Age/Sex	Age/Sex plus two diagnoses	Age/Sex plus seven diagnoses
Four age/sex categories				
0-64 male	1.62	1.06	1.03	1.01
65+ male	1.70	0.76	0.89	0.95
0-64 female	0.82	1.02	1.00	1.00
65+ female	0.52	0.86	0.99	1.03
28 age/sex categories				
0-4 male	0.45	0.17	0.31	0.48
5-9 male	1.11	0.49	0.73	0.81
10-14 male	2.20	1.09	1.37	1.29
15-19 male	3.51	1.95	2.08	1.64
20-24 male	4.81	2.90	2.66	2.15
25-29 male	5.12	3.38	2.70	2.25
30-34 male	3.78	2.69	2.00	1.71
35-39 male	2.27	1.72	1.14	1.04
40-44 male	3.61	2.95	1.95	1.81
45-49 male	1.72	1.50	1.10	1.09
50-54 male	1.28	1.19	1.07	1.08
55-59 male	1.28	1.25	1.05	1.04
60-64 male	0.71	0.73	0.95	1.03
65+ male	0.70	0.76	0.89	0.95
Total male	1.44	1.00	1.00	1.00
0-4 female	0.49	0.48	0.58	0.71

5-9 female	1.03	1.06	1.19	1.25
10-14 female	2.32	2.52	2.61	2.42
15-20 female	1.48	1.68	1.61	1.45
20-24 female	1.34	1.59	1.40	1.28
25-29 female	0.86	1.05	0.89	0.82
30-34 female	0.82	1.05	0.84	0.81
35-39 female	0.78	1.04	0.82	0.81
40-44 female	0.81	1.12	0.94	0.92
45-49 female	0.61	0.88	0.85	0.86
50-54 female	0.48	0.73	0.91	0.91
55-59 female	0.44	0.68	0.89	0.93
60-64 female	0.45	0.71	0.84	0.89
65+ female	0.52	0.86	0.99	1.03
Total female	0.78	1.00	1.00	1.00
Total both	1.00	1.00	1.00	1.00

Source: Authors calculations

The following Table 10 compares the predictive accuracy of four models; socio-economic MOH/FONASA, age/sex, age/sex with hypertension and diabetes and age/sex with seven diagnoses for the subset of people presenting any of these diagnoses during the period of the study; hypertension, diabetes, syndrome bronchitis obstructive (children), chronic bronchitis (adults), asthma, alcohol abuse and ulcer varicose.

Table 10: Predictive Ratios for Diagnoses Groups Under Four Models

	Models			
	Socio- eco-nomic MOH	Age/Sex	Age/Sex plus two diagnoses	Age/Sex plus seven diagnoses
Hypertension	0.24	0.33	1.00	1.00
Diabetes	0.19	0.25	1.00	1.00
Bronchitis Obs. Syn.	0.29	0.19	0.25	1.00
Chronic Bronchitis	0.31	0.40	0.50	1.00
Asthma	0.25	0.23	0.38	1.00
Alcohol abuse	0.44	0.37	0.62	1.00
Ulcer varicose	0.16	0.19	0.30	1.00

Source: Authors' calculation

The age/sex model underestimates the utilization of health services by beneficiaries with chronic diseases, even for hypertension and diabetes that are associated with age. The model that include hypertension/diabetes came out with a predictive ratio of 1 indicating accurate prediction in the case of both diagnoses. Additionally, it improves the explanatory accuracy for all other diagnoses probably because of co-morbidity. The model with the seven diagnoses predicts with perfect accuracy the utilization of services by people with all these diagnoses.

5.5 Weights by Age, Gender and Key Diagnoses

We use the observed utilization of health services results to suggest weights per risk group. Weights serve as expected value for a risk group and suggest the level of given resources considered appropriate for individuals who are assigned to that risk group category. Weights are expressed as relative values, where the population average number of visits equals 1.

Table 11: Weights by Age/Gender and Key Diagnoses (sample average = 1)

	Weight1	Weight2
Young Female (0-64)	1,2	1,0
Senior Female (65+)	2,0	0,7
Young Male (0-64)	0,6	0,5
Senior Male (65+)	1,5	0,5
Presence of Hypertension	-	4,0
Presence of Diabetes	-	4,6
Presence of Hypertension & Diabetes	-	5,8

Source: Authors' calculation

We anticipate that in a first-phase, considering information constrains, only a simple model could be implemented. We present two alternative set of weights for two models; the first uses only age (with two categories) and gender as risk adjusters; the second set includes the presence of hypertension and/or diabetes as well as age and gender.

The utilization of services due to the presence of the both diagnoses are implicit in the age/sex model, and are expressed with higher weights for seniors as the conditions cluster in this age-group. In contrast, as we take apart people with these two diagnoses, weights for the seniors decrease, and the weights for people with these diagnoses reach 5-6 times the reference value.

6 Discussion and Conclusions

6.1 Discussion of the Results

In the previous sections we have analysed different models for calculating capitation rates to public primary health care facilities in Chile. Although the sample on the facilities level (5 health centres, 24 health posts) is not representative of the nationwide public system, we are convinced that

the main findings at the individual level (10,000) can be generalized and should initiate a discussion among policy makers from MOH/FONASA.

The focus of this paper was a comparison of the present formula used by MOH/FONASA with the alternatives we developed out of the risk adjustment conceptual framework. The analysis produces mixed results. On the one hand, the current formula is a good principle for matching those funds made available by municipalities with different financial power. Also – at least for the PHCF included in the sample – the predictive ratio on the level of the municipalities was acceptable. On the other hand, the present formula neither was a good predictor for individual socio-economic status (when compared to FONASAs classification based on income level) nor, and more important, for health status of the individuals. The model performs extremely badly in explaining the utilization of health services. According to our results, the MOH/FONASA variables predict just 0.3 percent of the annual utilization of health care at the individual level. The present formula therefore gives strong incentives to PHCF not to enrol and/or treat people with a bad health status.

Three alternative models were tested, i) demographic: age and sex, ii) demographic plus two key diagnoses, hypertension and diabetes and iii) demographic plus seven of the most common and expensive diagnoses. The empirical analysis demonstrated that moving from the existing model to a demographic model already improves the R-square significantly. However, as the international discussion over the last 15 years has shown as well, much more progress can be achieved if diagnostic information is included. The R-square rises from 4.2% in the demographic model to 28.5% when the presence of two chronic conditions are added to the model, and finally to 34.9%. The R-square was larger for preventive than for curative services, which is likely to be explained by the high level of standardization of preventive services. With regard to "predictive ratios" on group level, age and gender severely underestimate the number of visits (and use of resources) for people with bad health and overestimate the number of visits for people with good health, whereas models which include diagnostic information perform much better.

6.2 Policy Implications

According to our data, there are significant differences across this small sample of health centres in the proportion of beneficiaries with chronic conditions. This leads to, for example, large variations in visit rates and costs across health centres, and disputes between health centres and municipalities about the fairness of the budgets. Hence, methods of funding that take into account differences in the case mix are needed.

The difference in the case mix, probably is not a result of differences in the prevalence of chronic conditions by geographic area, but i) the intended or unintended "discrimination" against people with chronic diseases, ii) self-selection, where people with chronic diseases choose not to enrol in the health centre, or iii) both. If the formula to calculate capitation rates would take into account the predictable larger use of resources by the chronically ill, the chances would increase that PHCF will not discriminate against these people.

We propose that MOH/FONASA continue to adjust the base capitation rate by socio-economic indicators, considering that "rich" municipalities have better possibilities to give discretionary funds to their health care facilities, but improve the formula by taking case-mix, measured by demographic and diagnostic information into account as well. With regard to demographic information, a simple distinction of two age groups (0-64, and 65+) and gender is recommended, as the predictive ratio shows mix results when using 14 age groups

In relation to health status, we recommend the inclusion of two key diagnoses, hypertension and diabetes, as the R-square and predictive ratio show limited improvement when seven diagnoses are included. The treatment of hypertension and diabetes, in contrast to other diseases, operates under two well-established national programmes and clear guidelines that make the diagnostics less subject to intentional or unintentional discretionary coding and treatment by medical doctors. Also, the use of two diagnostics versus seven makes the model easier to "feed" in administrative terms. Finally, we suggest to discuss the inclusion of "syndrome bronchitis obstructive" (children), that is the second most resource-intensive diagnosis . The MOH, has been redirecting resources from the capitation programme into the control of respiratory infections, under the correct "intuition" that the current capitation system does not offer the incentives to provide extra services for this intervention.

Due to the under-utilization of health services by the indigent group we recommend "positive selection". The per-capita programme has reached about 78% of the indigent group in 2000, so there is still room for expansion. In addition, on average as a group, indigents underused health

services in comparison to the other three income groups, especially the age group 65+. They are also underrepresented in the group of beneficiaries with hypertension and diabetes, which runs against results from population-based studies where people belonging to low-income group have a higher prevalence of risk conditions such hypertension than people of a higher-income. Therefore, it is recommended, that the capitation subsidy should be more than the actual present expenditures for these groups or "normative risk adjustment". The health centres should have incentives to "positively select" these groups and to spend more resources on them. The payment

of the subsidy could also be linked to evidence that the health centres are reducing underutilization of the indigents.

Finally, we suggest two sets of weights for key risk groups. The first set distinguishes four groups of enrollees and the second seven groups. The evaluation of the most appropriate set could include some pilots' experiences as well a discussion of health needs of men, that presently underuse health services.

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