Risk Adjustment and Primary Health Care in Chile*

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Abstract

Chile´s primary health care (PHC) payment system uses income of the municipalities and the geographic location of health centres (HCs) to adjust current capitation payments. Concerns over the ability of the formula to direct health resources where greater health needs are discussed. We uses a sample of 10,000 individuals was drawn and two years data was collected from a region in Chile. Three models were tested: i) age and gender, ii) age, gender and the presence of two key diagnoses and iii) age, gender and the presence of seven key diagnoses, to estimate how significant their effects were on utilization and per-capita expenditures. Regression analysis was performed to calculate the predictive values of the independent variables and two tests applied to select the best and next best model.

The main results are the following. First, the use of services by age and gender confirmed international trends, where children under five, women and elderly were the main users of PHC services. Second, women consulted twice as much as men. Thrid, clear difference by SES were observed, indigents aged 65+ under-utilised PHC services. From the three models simulated, the major improvement in the predictive power took place from the demographic to the demographic plus two diagnoses model. Improvements were limited when five other diagnoses were added (R-square=28%). The conclusion is that the current normative formula used by the MOH provides little incentives to care appropriately for indigents and people with chronic conditions such as diabetes and hypertension. A capitation payment that adjusts for age, gender, and presence of hypertension and diabetes will better guide resources to those with poorer health and lower SES.

JEL Classification : H51, I11, I18

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Introduction

The objective of this paper is to evaluate the PHC capitation formula for allocating resources using the risk-adjustment conceptual framework and the international evidence. The capitation formula has potential for improvement through the incorporation of individual characteristics, such as age, gender and the presence of selected diagnoses. An improved and feasible formula to facilitate a more equitable distribution of resources is recommended to policy makers.

Background

Chile scores favourably in terms of health indicators, has a life expectancy at birth of 80 years for women, 73 years for men and an infant mortality rate of 8.6 percent. This record, largely stems from better socioeconomic living conditions and strong efforts in preventive care. However, the latest epidemiological data reported diverging health outcomes between socioeconomic groups (Universidad Católica de Chile 2004a), pointing to several causes among them lack of incentives to provide adequate care for chronic diseases particularly in people of low-SES.

Chile is going through an epidemiological and demographic transition. This transition is characterized by a decreasing percentage of the population under the age of 15 and an increase in the percentage of the elderly population. Non-communicable diseases are on the rise in relative and absolute terms (Albala et al. 1997). Several health risk factors, like smoking, high fat diet, and a sedentary lifestyle, acting alone or in combination include the onset of diabetes, coronary disease and hypertension, which are major causes of morbidity and mortality. Since risk factors are synergistic, the relative risk of developing a disease increases when various risks are combined. According to the First National Health Survey (Universidad Católica de Chile 2004b) these risk behaviors do exhibit higher prevalence in lower socioeconomic groups. Therefore, may be necessary to align the allocation of health resources with the new challenges posed by the demographic and epidemiological transition.

Health coverage is largely dominated by the public system. The National Health Fund (FONASA) manages the public insurance. Individuals covered by FONASA may receive health services from either public facilities or from a preferred provider private system. The Ministry of Health (MOH) manages vertical programs, public health interventions and the health personnel from public facilities. The MOH introduced capitation in 1995 at the PHC level, allocating 60% of total funding capitated and 13% in a case-by-case basis. HCs are administrated by the Municipalities, which also fund the remaining. The MOH allocates a prospective capitation rate for all registered beneficiar. The rate covers the full cost of labour, administration, and a percentage of pharmaceuticals. The base capitation rate was about US$20 per year (1999-2000) and was adjusted by two variables: the geographic location of the HC and the income level of the municipality; where a HC located in a rural area received an upward adjustment of 20% and a poor municipality 18% (Vega et al. 2000).

All FONASA-insurees are entitled to participate in the per-capita programme and are required to register with any HC. In the year 2000, 7.5 million people or 74% of FONASA-insurees were enrolled. All FONASA-enrolees (except indigents) have also ccess to a private subsidized system that provides PHC services in fee-for-service basis.

HCs provide preventive and curative services, but complex interventions including childbirth are referred to secondary care. Most PHC services are clustered under the following programmes: i) Well-baby and Healthy Children, targeting children from 0-9 years, ii) Maternal Health, encompassing family planning and prenatal care, and a relatively new program iii) Adult Health, preventing and managing risk factors among adults (40-64 year) and elderly (65+) including two programmes dedicated to manage chronic diseases; hypertension and diabetes.

Conceptual Framework

Capitation is becoming increasingly prevalent worldwide as a mechanism for funding prospective budgets. Capitation is a fee paid by a financing agency to a health care provider for each of its registered affiliates for the provision of services for a fixed period, usually one year. The objective of most capitation systems is control of expenditure, so the increasing number of services delivered by health care providers does not lead directly to increased payments by the financing agency (Rice and Smith 2001).

The simple way to design capitation is a uniform flat rate for all clients of a provider and across providers. However, flat capitation rates are likely to overpay or underpay providers for certain patient-groups and may lead to disincentives to provide quality care for chronically ill. The calculation of capitation rates to providers has been the focus of the conceptual and empirical work of the risk-adjustment framework. The principle is that capitation should be adjusted and should reflects beneficiaries relative health needs and expenditures, using variables that help to predict these expenditures. These variables are called risk-adjusters and are used to modify the flat rate, so the differences in the mix of health needs among enrolees are reflected in different revenues of these providers (van de Ven and Ellis 2000).

Several types of models, demographic, socioeconomic and with diagnoses, have been developed and implemented in various health care systems. All models are empirical, but demographic and socio-economic models have also been used under a normative approach, where adjustments to the capitation rate to subsidize disadvantages are based on informed judgement (Rice and Smith 2001).

Demographic models are based on age, gender, and also ethnicity. Most health care systems started risk-adjustment of capitation payments with age and gender. Studies have demonstrated that there are pronounced differences in the average per capita health care expenditures by age groups and gender. Expenditures are higher for infants, women and elderly. Regarding ethnicity, the rationale is that some ethnic groups are vulnerable and may underutilise the system, so a higher capitation payment will make them more attractive to providers (van de Ven and Ellis 2000).

Socio-economic models are based on adjustors such as education, occupation, income and/or area of residence; rural/urban. SES is a good predictor of health needs. It is well established that mortality and morbidity are higher in low socio-economic groups (Mackenbach and Howden-Chapman 2003). However, there are mixed results regarding utilization of health care services. Some studies affirm that socio-economic indicators were good predictors of utilization of health care others were unable to find such a relationship (Hutchison et al. 2000). Regional differences in per-capita expenditures can be observed in many countries caused by differences in input prices or practice patterns (Rice and Smith 2001).

Epidemiological and health status models include mortality, disability and diagnoses as risk-adjustors. Mortality rate, crude and standarized (SMR) is used for capitating regional health authorities, such as those in England. Mortality has been suggested because of the high health care expenditures prior to death, and because it is a good proxy of the population's morbidity. SMR has positive but low correlation with utilization and health need (Bay et al. 1999). Disability and functional health have shown to be relatively good predictors of future expenditures (Rice and Smith 2001). Regarding health status, models have been developed using diseases diagnosed during or prior hospitalization and/or ambulatory consultations, to calculate risk-adjusted capitation payments. The assumption is that certain diagnoses are good predictors of health expenditures. There are pragmatic approaches which identify few diagnoses that are more common and expensive to treat (Brugos et al. 2000). On the other side, there are more elaborated models, which classify the whole spectrum of diagnoses. The two most known classification are the Ambulatory Care Group (ACG) (Weiner et al. 1992), and the Diagnostic Cost Group (DCG) (Ash et al. 2000;Pope et al. 2000).

Additionally, various criteria for selecting the best empirical model for capitation payments have been established: statistical performance, administrative feasibility, simplicity, and robustness against manipulation. The measure of the predictive power at the individual level 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 model. Age and gender can explain about 1%-4% of the variance. The percentage of the individual variation that can be predicted by prospective models using diagnoses has been estimated to reach about 20%. The remaining percent is subject to random fluctuation (van de Ven and Ellis 2000). At the group level "predictive ratios" are used to test the model accuracy. Thus, coefficients from the regression analysis are used to predict the probability of individuals in different risk-groups to use health services or to predict their per-capita expenditures. The mean predicted expenditures is divided by the mean of actual expenditures, and predictive ratios for different groups are estimated. A ratio of 1.0 indicates accurate prediction, less than 1.0 under prediction and more than 1.0 over prediction (Bluhm et al. 1999).

Model and Data

From the literature review it is clear that the predictive power increases as diagnoses of medical conditions are use in addition to demoghaphics variables. Therefore, our empirical model uses diagnoses in addition to age and sex .

Study population

The study was carried out in five HCs and 24 sub-centres located in south Chile (Valdivia and Temuco). The HCs covered 110,000 individuals in 1999 and 123,000 in the year 2000. In the selected region about 65% of the population was affiliated to the public insurer FONASA and about 35% were living in rural areas; both percentages were consistent with FONASA´s national average.

A random sample of HCs affiliates, who were registered in the per-capita programme of FONASA was drawn. The selected sample comprised 10,000 affiliates and was the result of a multi-stage stratified sampling design. First, to obtain correct estimates for the overall population, the following sampling weights were used based on the proportion of the FONASA affiliates residing in urban/rural areas and in poor and non-poor municipalities: 11% rural poor municipalities, 22% rural non-poor, 25% urban poor municipalities, and 42% urban non-poor.

Second, HCs were selected accordingly and their population age and gender structure used to estimate sampling weights. Third, a dataset of individuals was constructed; i) registered completely or partially from 1 January 1999 until 31 December 2000, and ii) born before 31 December 2000. Finally, the dataset was sorted by gender and five-year interval age-groups. A random sample was drawn from each age-gender group by HC.

From each individual, identified by a unique personal number, medical records were audited and the following information was collected: number of months registered in the HCs from 1 January 1999 until 31 December 2000, date of birth, gender, income level (FONASA classification), number of consultations to the HCs, and the presence of any of the seven selected diagnoses. The number of consultations was chosen as indicator of consumption of health resources (physicians, nurses and pharmaceuticals) because patients expenditures data were not available. Consultations were grouped in preventive and curative because of their variations in costs related to differences in the use of drugs and medical and non-medical personnel. Cost series available of the selected preventive and curative consultation were used (Balic 1999). Preventive consultation included five key interventions: vaccination (ICD-9 V06), infant and children examination (ICD-9 V20.2), sexual education for adolescents, prenatal care (ICD-9 V22.1), general medical examination to adults and elderly (ICD-9 V70) and other preventive activities. Curative consultations associated to the selected diagnoses or any other disease were recorded. HC directors were interviewed and agreed to select diseases based on the following criteria used by the Johns Hopkins ACG methodology i) recurrent and chronic diseases, ii) within the chronic conditions, diseases which are stable and likely to require resources on an ongoing basis, iii) disease with higher likelihood to need specialized care, and iv) diseases where a diagnostic evaluation is needed. Accordingly, the following diseases were selected: hypertension (ICD-9 401.9), diabetes (ICD-9 250.0), chronic bronchitis (ICD-9 491.0), syndrome bronchitis obstructive (ICD-491.2), asthma (ICD-9 493), varicose veins with ulcer (ICD-9 454) and alcohol abuse (ICD-9 303). Depression was not included because treatment was not available at PHCs at the time.

Consultations were available in electronic-format for 3,000 people. The remainder information was drawn manually from the medical records and then converted into electronic- format.

The model

Regression analysis was performed to estimate how significant the effects of i) age and gender, and ii) age, gender and the presence of two or seven diagnoses were on utilization and expenditure of PHC services, or the extent to which these independent variables accounted for increases of utilization or expenditures of PHC services*. A prospective model was estimated, in which adjustors or individual characterists from year 1 (1999) seeks to predict year 2 (2000) per-capita consultations or expenditures.

The dependent variable was the sum of preventive and curative PHC consultations ($SPHC_i$) or the sum of PHC expenditures ($SEPHC_i$) by a patient *i* to general practitioners, specialists and paramedics in HCs over year 2 (2000). The information was annualised and weighted to adjust for enrollment for one year or a fraction of a year, which happens automatically with births and deaths.

The independent variables were: i) age_i equals fourteen categories: 0-4 years, 5-9, 10-14, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-65, 65+, or two age-

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* The model is represented by the following equations:

(1) $SVPHC_i = B_0 + B_1\ age_i + B_2 gender_i + e$

(2) $SEPHC_i = B_0 + B_1\ age_i + B_2 gender_i + e$

(3) $SVPHC_i = B_0 + B_1 Age_i + B_3 gender_i + B_i chronic\ diseases_i + e$

(4) $SEPHC_i = B_0 + B_1 Age_i + B_3 gender_i + B_i chronic\ diseases_i + e$

groups: 0-64 and 65+, ii) $gender_i$ a dummy variable equals 1 if patient *i* is female, 0 is male, iii) Chronic $diseases_i$ comprised of seven dummies: hypertension = 1 if patient *i* is diagnosed with hypertension in year 1 (1999), otherwise 0. The same for diabetes, bronchitis obstructive syndrome, chronic bronchitis, asthma, ulcer varicose, and alcohol abuse.

Results

Sample characteristics

The mean age was 31 years and the median 29 years. About 53% of the sample was female, 67% were indigents compared to 46% of the national population affiliated to the programme at the time. Therefore, this subset of the population was poorer than the national average.

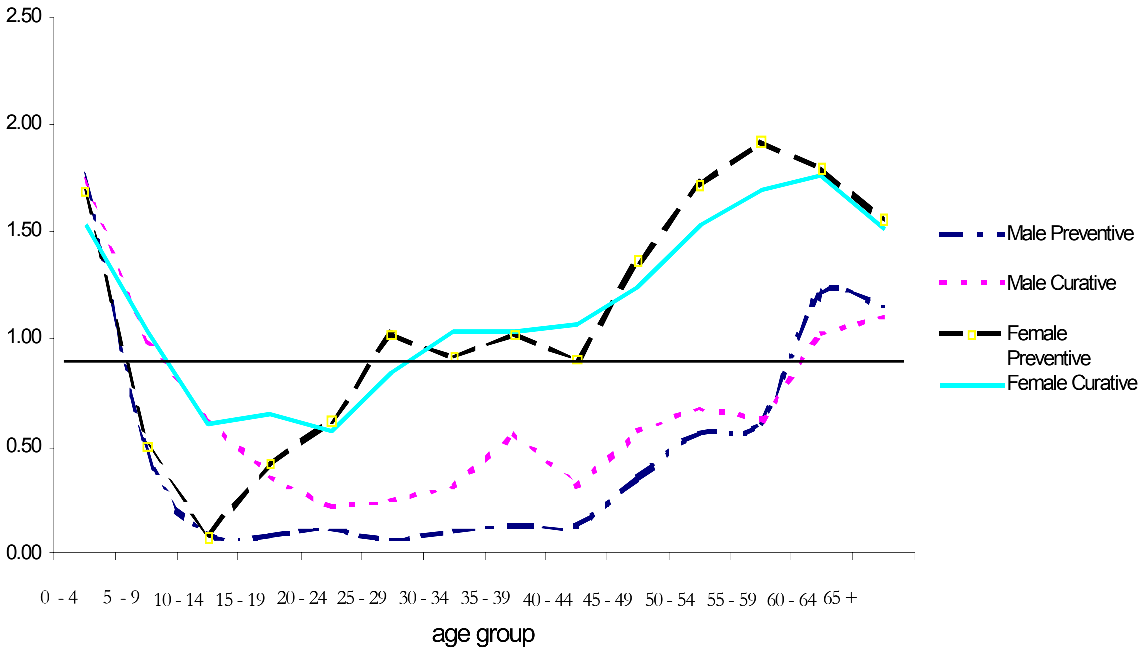
Table 1 PHC per-capita consultations and expenditures by selected groups, 2000

	N	Total visits	Preventive visits	Total per-capita expenditure	Preventive per-capita expenditure
Age-groups					
0-4	620	3.41	0.51	$20,172	$2,217
5-44	6823	1.07	0.39	$10,097	$2,780
45-64	1611	2.47	1.27	$27,706	$11,840
65+	945	2.69	0.62	$44,515	$13,778
Total	10,000	1.59	0.62	$16,817	$5,244
Gender					
Male	4,748	1.05	0.32	$11,062	$2,856
Female	5,252	2.07	0.90	$22,020	$7,402
Gender, age and SES					
Women 0-64	4,745	1.98	0.84	$18,909	$6,547
Women indigent 0-64	3,264	1.84	0.76	$17,134	$5,750
Women non-indigent 0-64	1,481	2.29	1.03	$22,822	$8,303

Women 65+	507	2.98	1.48	$51,131	$15,400
Women indigent 65+	269	2.51	1.18	$42,549	$12,095
Women non-indigent 65+	238	3.52	1.82	$60,831	$19,136
Men 0-64	4,310	0.94	0.23	$8,440	$1,937
Men indigent 0-64	2,994	0.96	0.22	$8,433	$1,784
Men non-indigent 0-64	1,316	0.89	0.26	$8,458	$2,287
Men 65+	438	2.12	1.11	$36,857	$11,900
Men indigent 65+	211	1.77	0.98	$30,283	$10,471
Men non-indigent 65+	227	2.44	1.25	$42,697	$13,228
Diagnoses					
Hypertension	541	6.92	4.33	$90,190	$43,836
Diabetes	135	8.11	5.55	$101,778	$56,798
Syn bronchitis obstructive	149	4.75	0.87	$32,189	$4,716
Chronic bronchitis	43	5.44	2.30	$77,257	$22,530
Asthma	16	5.81	2.25	$70,578	$17,306
Alcohol abuse	15	2.40	0.66	$30,429	$6,228
Ulcer varicose	3	8.66	2.66	$124,227	$27,268

The population affiliated to the per-capita programme consulted PHCs in the year 2000 an average of 1.59 times per year; where 0.72 were for preventive and 0.87 for curative care (Figure 1). Average per-capita expenditure was $16,817. As Figure 1-2 shows, the utilization and expenditures of PHC services varies systematically by age-group and gender. Per-capita expenditure increase with age, children (0-4 years) spent 1.2 times the average, adults (45-64) 1.6 times and people aged 65+ spent 2.6 times the average. The principal users of PHC were children under 5, women and seniors. Women visited the PHC approximately twice per year, while men in the same age group just once a year mainly for treatment of illness. Women received more preventive care in absolute and relative terms.

Figure 1 Preventive & curative consultations by age and gender (curative average=0.89)



Prevention includes: vaccination, sexual education of adolescents, antenatal care, children under 6, adult and elderly health examination and others. Curative includes any consultation demanded for treatment of illness.

In addition to the significant differences in utilization associated to age and gender there was a gap in the use of health services associated to SES. The SES gap emerged predominantly in the aged 65+, where per-capita expenditure of non-indigent was around 40% higher than indigents, owing to a higher coverage of non-indigents for the treatment of chronic diseases such hypertension and diabetes, (55% vs 33% of the sample).

There were no significant differences by SES in the use of services and expenditures of male aged 0-64. In contrast, non-indigent females in this age-group, presented 30% higher expenditures than non-indigents. Besides, the non-indigents had access to publicly subsidize private providers as well, so these figures were a partial count of their use of PHC services. In conclusion, differences of expenditure at the individual level were associated largely to age, then gender and to some extent to SES among aged 65+.

The annual distribution of consultations and expenditures was skewed because of the high-percentage of non-users, about 62.3% of total beneficiaries. In the year 2000, users' consultations were distributed as follows: 25.0% visited the HC between 1-4 times per year, 10.3% between 5-10 times and just 2.7% more than 11 times. Health expenditures were concentrated, people diagnosed with any of the seven diseases represented 9% of the sample but their per-capita expenditure was 2-7 times above average and were responsible for 43% of the total expenditures. In the same line, hypertensive and diabetics patients represented 7% of the sample, their per-capita expenditure was 5-6 times the average, and their expenditures amounted to 38% of the total.

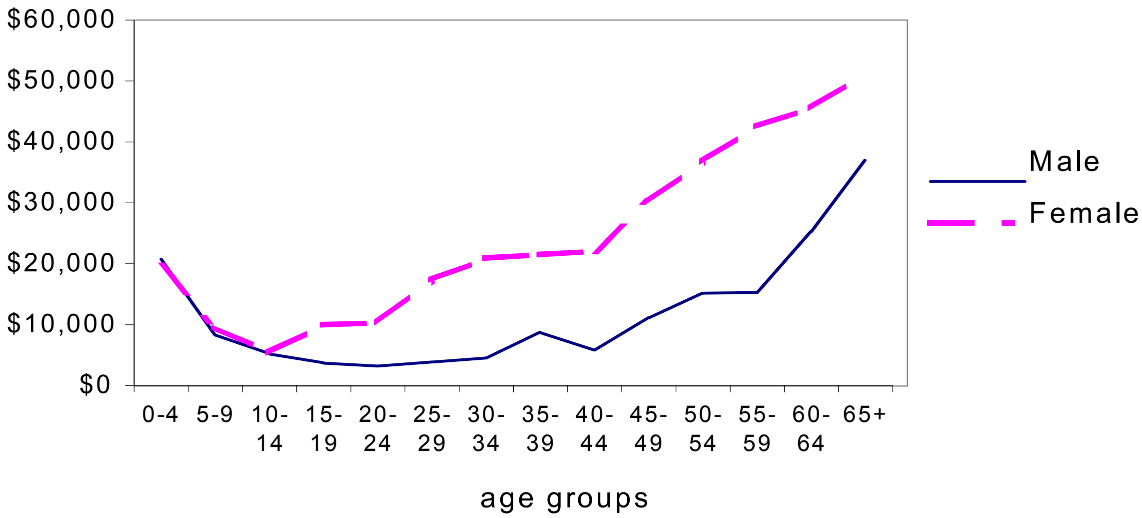


Figure 2 Per-capita expenditure by age-gender groups (average = $16,817)

Regression results

Three regression models by means of ordinary least squares were estimated. The models were assumed to be linear in the coefficients and include an intercept. The dependent variable is the number of consultation to a PHCS by each individual in the year 2000 and independent variables were gender, age, and seven diseases diagnosed in 1999.

Table 2 R-square[a] of three alternative models predicting PHC consultations and expenditures prospectively based on N 10,000

Models	Visits	Expenditures
Age/gender[b]	3.9	8.9
Age/gender plus two-diagnoses[c]	20.0	26.7
Age/gender plus seven-diagnoses[d]	22.0	28.1

[a]Percent of individual variation in use of services explained. [c]The demographic & two-diagnoses model includes age, gender, and dummies, presence of hypertension and diabetes. [d]The demographic & seven-diagnoses model includes age, gender and dummies; presence of hypertension, diabetes, syndrome bronchitis obstructive, chronic bronchitis, asthma, alcohol abuse and ulcer varicose.

1. The demographic model explains 4% to 9% of variation in individual resource use.
2. Adding two-diagnoses, hypertension and diabetes to the demographic model increase the explanatory power to 20%-27% of individual resources use and
3. Finally, the demographic plus seven-diagnoses model explains 22%-28% of variation in the use of resources.

Predictive ratios

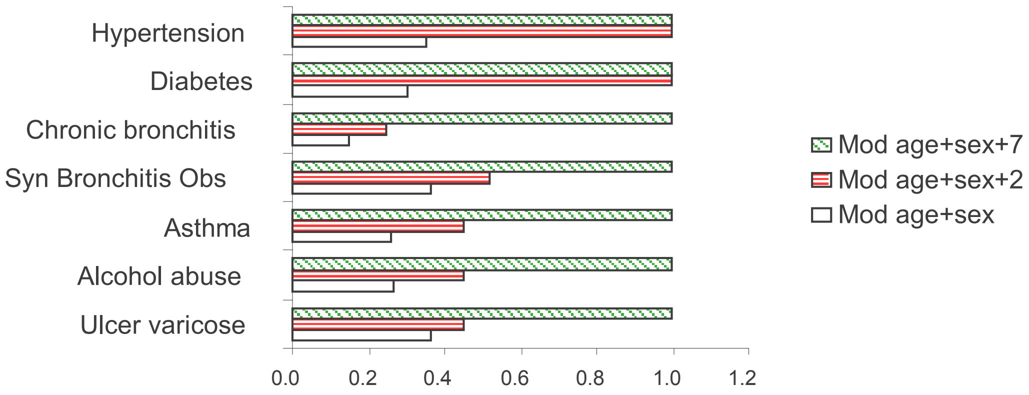
Table 3 shows the predictive ratios test for four age-gender groups. The models with seven and two diagnoses provide the best and next best prediction. In contrast, the use of just age and sex as adjustors underestimate the per-capita expenditures of aged 65 and over.

Table 3 Predictive ratios for age-gender groups under three models (1=perfect accuracy)

	Age/gender	Age/gender plus two-diagnoses	Age/gender plus seven-diagnoses
Age-gender groups			
0-64 male	1.06	1.03	1.01
65+ male	0.76	0.89	0.95
0-64 female	1.02	1.00	1.00
65+ female	0.86	0.99	1.03

Figure 3 compares the predictive accuracy of three models for the subset of people presenting any of these diagnosesd. The demographic model underestimates the utilization of health services by beneficiaries with chronic diseases, even for hypertension and diabetes that are associated with aging. The model that includes hypertension and diabetes accuratelly predicted expenditures when any of these two diagnoses were present. Additionally, it improved the prediction all other diagnoses, probably because of co-morbidity. The model with the seven diagnoses predicted with perfect accuracy the utilization of services by people with any of these diagnoses.

Figure 3 Predictive ratios for selected diagnostic groups under three models



Capitation formula and relative prices

In order to operationalize the model into a capitation formula of use at the MOH, weights for two models were estimated as an example. Total expenditure per-capita of PHC services were use to estimate weights per risk group, where the average per-capita expenditure equals 1. Weights indicate the relative level of resources considered appropriate for individuals who belong to that risk- group. The first set uses age and gender as risk-adjusters; the second set add the presence of hypertension and diabetes.

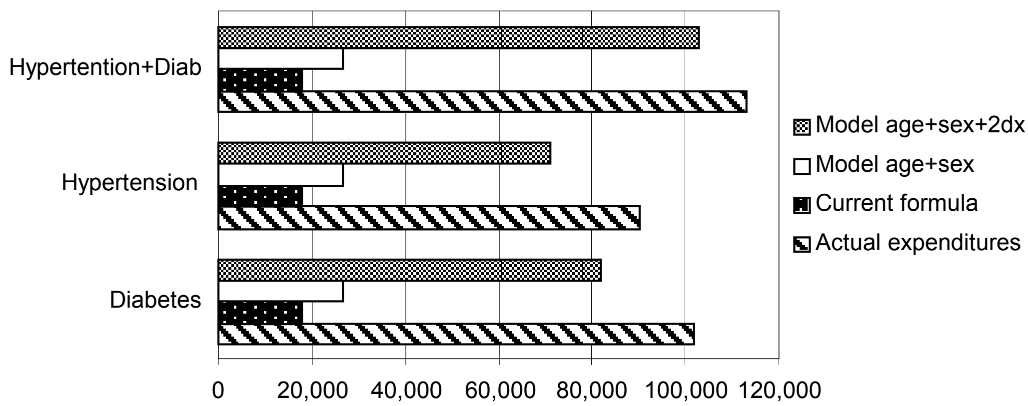
Table 4 Weights by age, gender and key diagnoses (average = 1)

	Demographic	Demographic & two-diagnoses
Young female (0-64)	1.2	0.4
Senior female (65+)	2.4	0.9
Young male (0-64)	0.5	1.0
Senior male (65+)	1.8	1.5
Presence of hypertension	n/a	5.0
Presence of diabetes	n/a	3.6
Both, hypertension & diabetes	n/a	7.6

Expenditures associated with any diagnoses were implicit in the demographic model, and manifested in higher weights in the elderly as chronic diseases tend to cluster in this age-group. In contrast, when people with either or both diagnoses were sorted out, weights of the elderly decreased and weights of individuals with both diagnoses rose to 7.6 times the average. In conclusion, the use of age and gender can identify a five fold-difference in expected cost prospectively (R^2 =8.9) and the use of the demographic plus two-diagnoses model can distinguish a 19 fold-difference in expected cost prospectively (R^2 = 26.7).

Figure 4 illustrates the difference between actual per-capita expenditure, predicted and current payments for the subset of people with hypertension and/or diabetes in a HC that serves the urban poor. Hypertensives and diabetics represent a significant share of a HC's expenditures at about 38% of the total. While current per-capita payment grossly underestimate actual per-capita expenditures, new models with either two and seven diagnoses would predict expenditures much more accurately.

Figure 4 Actual per-capita vs current payments and estimated values (Chilean pesos)



Policy Implications and Conclusions

An examination of the appropriateness of the present normative formula used by the MOH at PHC level and an analysis of alternatives models of capitation payments developed out of the risk-adjustment conceptual framework was the focus of this study.

The current normative formula is a good principle for allocating funds to municipalities with different financial power, and to compensate HCs located in rural areas where distance increases costs. This formula does not adjust for individual differences in SES but public HCs clientele were predominantly the poor and people of low-SES.

However, much progress can be achieved, as the international experience and the risk-adjusting methodologies have shown, if demographic and diagnoses information is included. The proposed formulas can identify five to nineteen fold-difference between the high and the low cost, compensating the higher costs of people with chronic conditions, in contrast to the just one-third-fold difference of the current payment formula.

There are some limitations in the present study that must be taken into account when interpreting the results for policy purposes. First, the sample of two regions is non-representative of the nationwide PHC system, however results at the individual level were consistent with international findings allowing valid comparisons for age, gender, diagnoses and SES. Second, the per-capita expenditure of the non-indigent group was a partial count of the total expenditures because they have also access to a private network of care. Finally, regarding the demographic model the predictive ratio shows that the use of four age-sex categories underestimate the utilization of services by the elderly therefore this model would requires further refinement.

Even given these limitations, the empirical analysis confirmed the results from risk-adjusting studies, diagnoses such as hypertension and diabetes, improves significantly the predictive power of the demographic model. In contrast, the R-square showed limited improvement when five other diagnoses were added. Additionally, the treatment of hypertensive and diabetics patients function under programmes with clear protocols, which make the diagnoses less subject to discretionary coding and treatment by medical doctors.

In summary, it is recommended to adjust the base capitation rate combining a normative and an empirical approach; normative to adjusting for municipality´s financial power and for rural/urban location and an empirical approach to adjusting for demographic charactheristics and the presence of key diagnoses. The formula does not need to include the whole spectrum of diagnoses but select the subset that predicts the larger use of resources by the chronically ill. Therefore, a demographic or demographic and two diagnoses model easier to administrate it is recommended. Thus, an effective capitation formula can be constructed by incrementally adding variables, and balancing added statistical power and accuracy against practical concerns such as data availability and administrative burden.

The formula with two diagnoses will compensate and create incentives for HCs to provide better care for chronic and indigent patients. In the group of people with chronic diseases such as hypertension and diabetes, indigents were underrepresented, probably because of undiagnosed and untreated cases. Therefore, providing an special rate for chronic conditions could create incentives to diagnose and to treat them and compensate HCs for the extra resources needed as this may entail difficult behavioural changes.

A capitation payment that adjusts for age, gender, hypertension and diabetes, in the long run will save resources from fewer hospital admissions as access to care is inversely associated with hospitalization rates for these chronic medical conditions and will advance equity in health re-directing health resources to those with greater health needs.

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