



MODELING HEALTHCARE COST FOR NATIONAL HEALTH INSURANCE SCHEME: EXPERIENTIAL ANALYSIS FROM HEALTH MANAGEMENT ORGANISATIONS IN NIGERIA

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Abstract

Healthcare costs in Nigeria have been rising faster than general inflation for many years unlike the growth of health insurance in Ghana and South Africa which was almost hitch free. Nigeria has had many challenges in her health sector. We are in the midst of unprecedented revolution in healthcare hence the need to tame runaway cost-inflation as it is spawning new incentives and payment structure which is democratizing data and empowering consumers. This study explores healthcare utilization data in determining future claims that each enrollee of the Health Maintenance Organizations (HMOs) is entitled to. The data which is made up of 2538 enrollees of the NHIS were analyzed using the Generalized Linear Models (GLM). This model is used to check the significance of the co-variates (age, sex and diagnosis). The results show the age, sex and diagnosis are significant predictors of healthcare costs. It is recommended that healthcare providers and policy makers should take into consideration the effects of these variables as they determine how high or low healthcare costs should be.

Keywords: health cost, NHIS, HMOs, cost-sharing theory, transaction cost theory.

JEL Classification: G04, M06

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I. Introduction

Health insurance in Nigeria has had a difficult historical development from its inception in 1962 up to its amendment by the National Health Insurance Scheme (NHIS) Act 35 Of 1999. Nigeria, as a country, can be boastful of population of not less than one hundred and eighty million (180 million) people with an emerging economy and infrastructural facilities that are needed to be improved. According to Ajemunigbohun et al., (2017), a health population is said to be an indispensable mechanism for prompt sustenance of any country's socio-economic and demographic status. However, most countries have endeavour to realise that healthcare service provision should not solely be seen as part of government policy but also a tool to taking care of the needy who may not be able to finance the cost that is linked with paying for their healthcare needs (Boateng & Awunyor-Vitor, 2013; Meghan, 2010).

According to World Health Organisation (2012), financing healthcare is concerned with the mobilization, accumulation and allocation of money to cover the health needs of the people, individually and collectively in the health system. Thus, many developing countries strive to provide universal healthcare due to insufficient resources or inappropriate use of the existing resources. Sylva (2013) stipulated that health provision is challenging due to costs required as well as social, cultural, demographical, political and economic conditions. According to Swartz (2009), poor people are confronted with barriers to procuring healthcare linked with their inability to afford it. Further, studies (such as Drechster & Jutting, 2007; Pauly et al. 2009) founded that insufficiency in connection with health service accessibility and financial protection encourages out-of-the-pocket contributions to financing healthcare provisions.

The first wealth of a country lies in the health of her citizenry (Sylva, 2013). No where does this globally accepted fact makes more sense than in developing country like Nigeria. The healthcare system is characterized by extensive out-of-the-pocket payments. The government's interventions in healthcare have been abysmally low, which has resulted in Nigeria's out-of-the-pocket expenditure on health being at 95.4% (WHO, 2012). Over the years, evidence suggests that less than 5% of Nigerians mainly federal government workers are insured under this scheme (Onoka et al., 2013; Aregbeshola & Khan, 2018). The need for healthcare is rising but it cannot be met if those ridiculously low percentages of people are insured. Relatively little is known about healthcare cost in developing countries. Many developing countries are just establishing baseline estimates of prevalence of incidence of various diseases and conditions. A large proportion of



healthcare costs associated with advancing aging are incurred in the year or so before death (WHO, 2011). As more people survive to increasingly older ages, the high cost of prolonging life is shifted to even older ages.

The thrust of the present analysis is that aging and uncertainties with respect to future trends in disability across individuals and in cost required catering for future needs are likely to raise significant challenges both for individuals and policymakers in the not so distant future (Piculescu et al., 2012). During the past decade, the cost of healthcare changed in proportion to the size and composition of the world's population and it will continue to change in the coming decades (Adeyemi & Aremu, 2009). A recent World Bank report puts the average life expectancy in Nigeria at 52 years (BRICON, 2015). However, catastrophic expenditures are less frequent in those countries in which there is more prepayment for healthcare due to the adoption of health insurance to reduce out of pocket expenditure.

The core objective of this study is to establish a basis for budgeting for healthcare cost thereby evading collapse in Nigeria's healthcare sector due to capitation to the galloping rise in cost. Other specific objectives include projecting (modeling) healthcare cost; getting estimation of health benefits, liabilities and premiums; and establishing reliability and range of uncertainty regarding the projections. For the actualization of the aforesaid objectives, the following relevant research questions were set: How will the health sector fend for rise in the price of healthcare? What will be used as the basis for budgeting for healthcare cost: Will this research be able to give an estimate of health benefits, liabilities and premiums? Will this research put ranges of uncertainties into consideration and establish the level of reliability?

Overview of the National Health Insurance Scheme in Nigeria

In many decades ago, attempts had been made to legislate on health insurance, specifically since 1962. The National Health Insurance Scheme, although established in 1999, came into operation in 2005 to ensure accessibility to qualitative healthcare services, curtail alarming cost of healthcare services, provide pecuniary risk protection, and ensure efficiency in healthcare (NHIS, 2018). NHIS membership is mandatory for workers in the formal sector while it is voluntary for those in the informal sector. States are not lawfully obligated to provide health insurance to the people, but there is a current drive to decentralise social health insurance (SHI) scheme to the states. NHIS has been executed via programmes such as Formal Sector Social Health Insurance Programme (FSSHIP), Mobile Health, Voluntary Contributors Social Health Insurance Programme



(VCSHIP), Tertiary Institution Social Health Insurance Programme (TISHIP), Community Based Social Health Insurance Programme (CBSHIP), Public Primary Pupils Social Health Insurance Programme (PPPSHIP) and the Vulnerable Group Social Health Insurance Programme (VGSHP) which aims to provide healthcare services for children under 5 years, pregnant women, prison inmates, disabled persons, retirees and the elderly.

The NHIS target different population groups including women and those in the informal sector with the aim of working toward UHC (Giedion et al., 2013). Over a decade since its implementation, evidence suggests that the NHIS has provided health insurance coverage to less than 5% of the Nigerian population (McIntyre et al., 2013; Okebukola, & Brieger, 2016). There are indications that NHIS had failed to be made accessible to all population groups especially the needy, vulnerable and informal sector groups. Pertinently, these groups of people have persistently been paying out-of-pocket (OOP) for their healthcare services. Out-Of-Payments continue to be a core source of financing healthcare in Nigeria (World Health Organization, 2018). The poor, vulnerable and informal sector populations are disproportionately exposed to catastrophic and impoverishing effects of high OOP payments. NHIS as an agency of government operate under the Federal Ministry of Health. This agency registers and accredits health maintenance organizations (HMOs) and healthcare providers (HCPs). HMO obtains contributions and pay monthly capitation or fee-for-service (FFS) to HCPs for services provided. HCPs are registered private and public hospitals and clinics at the primary, secondary and tertiary levels that provide healthcare services to NHIS enrollees who are registered through an HMO (NHIS, 2018).

In spite of the detachment of the NHIS (as a regulatory agency), HMOs and HCPs; the NHIS has been criticised with poor governance, fund mismanagement, corruption as well as lack of accountability and transparency. NHIS fund is obtained from general government revenues; premium contributions; returns from investments as well as grants or donations. The NHIS covers over 95% of disease conditions that affect the Nigerian population. The benefit package under the FSSHIP which serve most of the NHIS enrollees includes out-patient services, in-patient services, maternity care for up to four live births, emergencies, preventive care including immunisation, consultation with specialists, eye examination and care, preventive dental care and pain relief as well as a range of prostheses (NHIS, 2018).

Uzochukwu et al., (2015) contended that the policies and plans of the Nigerian government in providing sound health care financing include the National Health Policy, Health Financing Policy, National Health Bill and National Strategic Health Development



Plan (2010-2015). The Federal Ministry of Health (2005) stipulated that the National Health Policy in connection to health financing is to enlarge financial plans for health care and bolster the private sectors' contributions and prepayment based approaches for financing. It thus embodies community-based schemes (CBS) for the financing of primary health care services. Accordingly, this policy supports public-private partnerships (PPPs) at all operating facets for the enlargement of health financing alternatives.

II. Literature review

II.1. Concept of Health Insurance

Health insurance, according to Vaughan & Vaughan (2014), is defined as insurance against loss by sickness or accidental bodily injury. Thus, the loss may be the loss of wages caused by the sickness or accident or it may be expenses for doctor bills, hospital bills, medicine or expense of long-term care. Health insurance, according to the Health Insurance Association of America (2014), is defined as coverage that provides for the payments of benefits as a result of sickness or injury; which include insurance for losses from accident, medical expense, disability, or accidental death, injury and dismemberment. It includes insurance for losses from accident, medical expense, disability, or accidental death and dismemberment. Health Insurance can be defined as a system of advance financing of health expenditure through contributions, premiums or taxes paid into a common pool to pay for all or part of health services specified by a policy or plan (National Health Insurance Scheme, 2012). It is thus described as any program that assists payment for medical expense, whether through privately purchase insurance, social insurance or a social welfare program funded by the government (Bhargava & Loewenstein, 2005).

II.2. Healthcare Insurance Costs and Choices: Public versus Private

According to Bovbjerg & Hadley (2007), procuring health insurance is vital due to the fact that coverage assists people with accessible timely medical care and enhances their lives and health. Demchak (2006) earlier mentioned that the instant growth in healthcare cost produced innovations concerning gains designed and cost-sharing provisions as payers attempt to temper healthcare cost increase. More so, potential tools often employed by insurers and payers in confronting challenges that may spring rising healthcare costs include: prior approval, tiered pricing, second opinions, lowest cost alternative, consumer-directed packages with high cost-sharing and value based insurance



design. According to Arnold & Austin (2009), consumer-driven health plans and value based insurance designs (VBID) are major directions that have caused consumers to focus on value and may serve to extract value (.e.g. high quality at low cost) from the healthcare system. Earlier submission of Sherry (2003) stipulated that the ability of individual consumers to shop for low-priced services is often cramped because some medical markets are characterised by a degree of market power, either as a consequence of government restrictions on entry or because the protection process is characterised by high fixed costs and low marginal costs.

Paradigm shift from purely public insurance plans to a choice of private option raises a number of pertinent economic matters. Thus, moving from privatised system of insurance choice can be divided into the allocative and production side. From the allocative side, individuals differ in their demand for insurance for a number of reasons, ranging from demographic characteristics to tastes for risk (that is, forcing individuals into a plan that doesn't reflect their preference imposes an allocative cost). From the producer side, the standard economics arguments is obvious; that is, permitting choice across options will put competitive pressure on those options to deliver care efficiently, whereas a monopolistic public insurer faces no such pressure (Gruber, 2017). Therefore, having choice across healthcare plans invokes two choice costs: adverse selection and choice frictions. According to Finkelstein & McGarry (2006), adverse selection does not necessarily doom an insurance markets but it hinges on the nexus between tastes for risk and health status. While Einav & Finkelstein (2011) found that adverse selection exists across insurance plans choice with evidence of relatively modest welfare costs, Handel, Kolstad & Sinnewijn (2015) evident how choice frictions impact the demand side of insurance market with the ideology that more is not achieve when it comes to decisions facing choice frictions.

In a bid to critically examine consumers' choices across the numerous healthcare options or plans that are available, the study of Abaluck & Gruber (2011) and Heiss et al., (2012) earlier submitted that large number of enrollees do not choose the cost-minimizing plan. More specifically, Abaluck & Gruber (2011) contended that there exist two major choice inconsistencies under healthcare components: individuals are much more sensitive to premium differentials across plans than to out-of-pocket cost differentials; and consumers consistently overweight salient plan characteristics based on their overall impacts, not their impacts on those specific consumers. Abaluck & Gruber (2016) found that choice inconsistencies grow overtime with little individual or cohort learning. In health insurance market, choice adequacy impacts plan enrollment, which invariably



determines average cost, subsequent premiums and thus have positive welfare impact (Handel, 2013).

According to Starc & Town (2018), the welfare generated by private health insurance fervently dependent upon the structure of benefit packages offered by insurers. The welfare impact these benefit design decisions are potentially astronomical, as the level and composition of consumption of healthcare services depends on insurer benefit design. Indeed, an optional insurance option must balance these gains from risk protection against inefficiencies due to asymmetric information.

Gruber (2017) mentions two issues which involve the capabilities of public and private insurers. One issue is the ability of public versus private insurers to reduce unit prices for healthcare, which turns on the dynamics of competitive bidding versus regulatory price arrangement. The other issue is the ability of private insurers to impose care management limitations that probably influence politics alongside public insurance. On the one hand, Einav et al., (2016) opine that public insurance option typically embodies uniform cost-sharing across prescription drugs, private prescription drug plans differentiate cost-sharing across categories of drugs that are differentially price-elastic, which is more efficient. On the other hand, Geruso et al., (2016) document that within private options on the state-level health insurance, prescription drug cost sharing is designed in a manner to discourage enrollment among less-healthy enrollees. This explains that plan benefits design help promote virtuous selection in that efficiency will be defined relative to observable health outcomes such as measuring for the rate at which deaths occur in a given population.

II.3. Theoretical Frameworks

This study takes cognizant of two major theories supporting the healthcare cover. These theories are cost-sharing theory, and transaction cost theory. The cost-sharing theory, according to Krutilova (2013), is an arrangement that require contributions from patients even if health goods or services are (partly) pre-paid or insured. The direct cost sharing comprises copayment, coinsurance and deductible (Swartz, 2003). Cost sharing unarguably arose from the existence of moral hazard (Osterkamp, 2003). According to earlier submission by Holmstrom (1979), the presence of moral hazard leads optimal insurance contracts to be incomplete, striking a balance reducing risk and sustaining incentives. Brot-Goldberg et al., (2017) noted that a declining out-of-pocket price schedule is a natural way of optimally trade off the goal of combating moral hazard through higher consumer cost sharing with the goal of providing risk protection through



lower consumer-cost sharing. Then, the existence, magnitude and nature of the moral hazard response is thus key input into the optimal design of private or public health insurance contract. However, consumer cost-sharing is the typical name exerted for determining the out-of-pocket price the consumer has to pay for healthcare. Due to potential variation between healthcare and price, insurers often specify coverage as a percentage share of the total healthcare spending (Einav & Finkelstein, 2018).

Transaction cost economics focuses on the cost of market transaction to explain the existence of the firm. The transactions referred to in theory are carried out under conditions of uncertainty associated with the risk (Suska, 2016). As a theory and methodology, transaction cost economics is designed to compare evidence of the cost-effectiveness of alternative organization arrangement (Williamson, 2000). According to Tadelis & Williamson (2012), the theory of transaction gains predictive content by naming the key ways in which transactions differ, describing the economic properties of alternative structures of governance, and measuring the costs that parties experienced as they carried out transaction.

According to earlier submission by Fink (2006), two major drivers of transaction cost economics are uncertainty cause by the external environment and costs, which consist of coordination costs and transaction costs. However, transaction costs are generated due to information asymmetry, inducing the parties into negotiation, and because of the high risk associated with them, also to insuring the contract, under which they arise (Zbroiska, 2013). This theory may be particularly relevant to the healthcare providers interested in determining the relative costs and consequences adopt health technology (Theodore et al., 2015).

II.4. Modeling Healthcare Cost Trend

Healthcare trends permeate throughout the entire industry, so employers in a similar geographical location may experience very similar annual trends, even with occupational profile that could be very different. This occurs because healthcare trend is the expected change in claims cost before any employer initiatives, such of plan design changes or health and productivity programs. According to Adeyemo (2005), factor that could drive trend, they include: price inflation or deflation, healthcare service utilization, aging of the covered population, and difference in provider treatment patterns.



III. Methodology

The study uses data of healthcare claims from record of healthcare providers and health maintenance organizations (HMOs). The data set includes the medical claims cost for in-patient diagnoses, age, sex, policy plan and provider payments for over 974 enrollees from a private health maintenance organization (HMO). Generalised linear models are fitted to the data. The fitted models are used to compute the future healthcare costs of the enrollees and also risk score so as to compute capitation. The estimation method used in this study is the normal distribution and gamma distribution of the exponential family. A distribution for a random variable Y belongs to an exponential family if its density has the following form:

$$f(y; \theta, \phi) = \exp\left(\frac{y\theta - b(\theta)}{a(\phi)} + c(y, \phi)\right) \quad (1)$$

There are two parameters in the above density. θ which is called the “natural” parameter, is the one which is relevant to the model for relating the response (Y) to the covariates, and ϕ is known as the scale parameter or dispersion parameter. We shall see in the study exactly how θ is used to relate the response to the covariates. Note that $E(Y) = b'(\theta)$ and $Var(Y) = a(\phi) b''(\theta)$. Statistical tests can be used to determine the acceptability of a particular model, once fitted. The standard criterion refers to Akaike Information Criteria and the Bayesian Information Criteria. The Lower the AIC and BIC, the better the performance of the model.

IV. Data Analysis

This chapter deals with the analysis of the data collected. This include the exploratory data analysis of healthcare claims cost and predicting future healthcare cost with respect to the socio demographic characteristics of the enrollees using GNL (Generalized Linear Models).



Table 1- Exploratory data analysis of healthcare claims cost by socio demographic

Demographic Variables		Mean	N	Std. Deviation	Kurtosis	Skewness
Age	Children (0 - 9 years)	18196.2500	20	55143.03534	19.250	4.357
	Adolescent (10 - 19 years)	7624.7500	36	22850.85619	34.784	5.853
	Adult (20 - 45 years)	6269.5897	39	8083.89197	11.112	3.225
	Middle age (46 - 60 years)	7407.3090	741	13888.55492	93.413	8.399
	Old (Above 60 years)	8506.1159	138	19351.20062	46.824	6.353
	Total	7747.0123	974	16811.93934	91.889	8.555
Sex	Male	6202.8484	475	12074.54446	102.357	9.070
	Female	9216.9078	499	20224.27424	71.587	7.642
	Total	7747.0123	974	16811.93934	91.889	8.555
Diagnosis	Endocrinology	4753.1667	12	5073.98645	5.172	2.152
	Respiratory	5001.1111	9	2409.59252	.523	.550
	Gastroenterology	11099.5417	48	27611.08739	36.075	5.737
	Cardiovascular	3166.6667	3	665.83281		1.056
	Musculoskeletal	10107.3171	41	27497.83748	34.936	5.783
	Neurology	6450.0000	8	7257.77613	5.539	2.237
	Nephrology	5263.1750	80	9767.18245	41.571	5.931
	Ophthalmology	6650.0000	17	5138.70120	-.151	.805
	Infectious disease	6118.4508	528	8009.81437	42.642	5.772
	Obstetrics/Gynecology	17434.0168	119	34341.38577	24.891	4.660
	Dermatology	3128.6538	26	1757.03532	.117	.830
	Dental	5477.9167	12	4395.33919	.847	1.113
	Urology	6273.1250	8	4097.81905	1.451	1.132
Rheumatology	3476.0714	14	2522.38454	1.680	1.315	
Age	Children (0 - 9 years)	18196.2500	20	55143.03534	19.250	4.357
	General Surgery	44354.6667	3	57468.33568		1.664
	Burns & Plastics	2568.5000	8	2849.03207	.938	1.140
	Others	5169.1579	38	4267.71408	.795	1.199
	Total	7747.0123	974	16811.93934	91.889	8.555
Policy plan	Micro Plan	6213.7940	738	9154.51209	92.840	7.583
	Standard	3353.6852	54	4057.27400	19.296	3.983
	Executive	15267.6429	182	33183.08069	24.581	4.726
	Total	7747.0123	974	16811.93934	91.889	8.555
Admission	0-3	6430.9843	958	9273.08735	73.340	6.687
	4-7	85650.7857	14	77425.12677	-.199	.996
	8 and Above	92798.0000	2	117023.3438		6
	Total	7747.0123	974	16811.93934	91.889	8.555

Source: researchers' computation, 2017



The exploratory data analysis of healthcare claims cost by socio-demographic characteristics of the enrollees was displayed in Table 1 as the children (0-9years) account for an average cost of 18196.25, adolescents (10-19years) account for an average cost of 7624.75, adults (20-25years) account for an average cost of 6269.59, the middle ages (46-60years) account for an average cost of 7407.31, while the olds (above age 60years) account for an average cost of 8506.12. It was observed that on the average, the highest cost according to the age classification was observed in the children group.

Also, the highest cost observed according to sex classification was observed in the female group, the highest cost observed according to diagnosis classification was observed in the obstetrics/gynecology group, the highest cost according to policy plan classification was observed in the executive plan and the highest cost according to admission classification was observed from 8 and above group. Also, from the exploratory data analysis displayed in Table 1, positive skewness were observed all through and heavy tailed claims were majorly observed as well Modelling of Healthcare Cost.

Table 2- Generalized Linear Model for Healthcare Cost

Variables	Generalized normal model				Generalized gamma model			
	Full model		Reduced model		Full model		Reduced model	
	B	P-value	B	P-value	B	p-value	B	P-value
(Intercept)	-64519.258	0.000			5.059	0.000		
Age	-102.273	0.880			.141	0.003	.110	0.011
Sex	2260.675	0.009	2293.688	0.008	.351	0.000	.352	0.000
Diagnosis	36.694	0.830			.018	0.123		
Policy Plan	2725.819	0.000	2728.688	0.000	.180	0.000	.179	0.000
Admission days	63852.414	0.000	63839.748	0.000	2.180	0.000	2.155	0.000
Goodness of fits								
Log Likelihood	-10638.663		10638.724		-9501.382		-9502.559	
AIC	21291.325		21287.448		19016.764		19017.118	
BIC	21325.495		21311.855		19050.933		19046.406	
Consistent AIC	21332.495		21316.855		19057.933		19052.406	
Likelihood Ratio	439.504	0.000	439.381	0.000	389.538	0.000	439.381	0.000

Source: Researchers' computation, 2017



The modelling of healthcare cost is presented in Table 1 using the generalized Normal and generalized Gamma models. The result shows that both the generalized Normal and generalized Gamma models fits the data well. Although using the model performance criteria, the result shows that the Gamma model is a better model for modelling healthcare cost. Also the result revealed that covariates such as sex, policy plan and admission days significantly influences healthcare cost using the generalized Normal Gamma models but age, sex, policy plan and admission days significantly influences healthcare cost using the generalized Gamma models.

Table 3. Summary of Prediction

Age	Sex	Diagnosis	Policy Plan	Admission days	Normal	Gamma
Children (0 - 9 years)	Male	Cardiovascular	Executive	0-3	9815.79	4204.68
Middle age (46 - 60 years)	Male	Musculoskeletal	Executive	0-3	9545.66	6536.02
Middle age (46 - 60 years)	Male	Nephrology	Executive	0-3	9619.05	6775.54
Old (Above 60 years)	Male	Endocrinology	Standard	0-3	6570.8	5847.16
Middle age (46 - 60 years)	Female	Musculoskeletal	Standard	0-3	9080.52	7751.61
Middle age (46 - 60 years)	Male	Nephrology	Standard	0-3	6893.23	5656.92
Adult (20 - 45 years)	Male	Infectious disease	Executive	0-3	9794.71	6099.84
Old (Above 60 years)	Female	Ophthalmology	Executive	0-3	11814.15	11283.81
Adult (20 - 45 years)	Female	Infectious disease	Executive	0-3	12055.39	8664.84
Children (0 - 9 years)	Female	Others	Executive	0-3	12553.48	7546.94
Old (Above 60 years)	Male	Infectious disease	Executive	0-3	9590.17	8087.78
Old (Above 60 years)	Male	Neurology	Executive	0-3	9480.08	7662.74
Middle age (46 - 60 years)	Female	Obstetrics/Gynecology	Executive	0-3	11989.81	10158.53
Middle age (46 - 60 years)	Female	Infectious disease	Standard	0-3	9227.29	8330.13
Middle age (46 - 60 years)	Male	Nephrology	Executive	0-3	9619.05	6775.54

Source: Researchers' computation, 2017



V. Conclusion and recommendations

This research has shown the application of the Generalized Gamma and Normal regression to model healthcare cost given the characteristics of enrollees of Health Maintenance Organizations (HMOs) under the National Health Insurance Scheme (NHIS) in Nigeria. The result revealed that covariates such as age, sex, policy plan and admission days significantly influences healthcare cost. Conclusively, it is very important to consider socio demographic factors of the HMO enrollees as they have a significant influence on healthcare costs.

On recommendations, age must be given ample consideration when embarking on [policies that relates to healthcare matters. This is because the research discovered age, to be statistically significant on visits. Consequently, sex of the person taking up the policy is of utmost significant to the healthcare cost. Consumers' perceptions of pricing fairly the healthcare policy must be given utmost priority when determining healthcare cost. Lastly, insurance companies should review, at regular interval, their rating system in order to avoid under/over rating of premium.

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