Impact of Reference Pricing on Patient Access and Provider Distribution in Urban vs. Rural Health Networks

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ABSTRACT: To examine the reference pricing system, we provide a game-theoretical model. We include a reference price-setting insurer, several price-setting providers in competition with one another, and a patient-facing multinomial logistic regression model for use in choosing a provider. Although reference pricing results in a decrease in profit for the most expensive providers, it surpasses both the two types of payment structures, based on the expected value to patients and the expense to insurers. In addition, we demonstrate that, in most cases, reference pricing results in a greater insurer utility, with the exception of public non-profit insurers, which prioritize the providers' utility above their own cost. People in more remote places had less access to primary care physicians and other health information resources, and they were also less likely to use search engines. physicians, specialists, online journals, periodicals than people living in metropolitan areas. Even after controlling for demography, those Rural residents continued to face a shortage of experts compared to their urban counterparts' cities. People living in rural areas with lower levels of health literacy were less likely to have access to scientific literature and mass media, but they were more likely to utilize businesses and firms than people living in urban areas with greater levels of health literacy or those with acceptable health literacy.

KEYWORDS: healthcare, payment models, reference pricing, patients and Rural

I. INTRODUCTION

Instead of setting patients' out-of-pocket expenses, payers that use reference pricing set a standard price for a medicine, operation, service, or combination of services and then demand that plan members pay any permitted charges above this amount. Hence, the amount that customers pay out of pocket is the disparity, if any, between the reference price and the real cost of the services they obtain. In most cases, the payer will provide customers with a list—possibly via a consumer-focused website—that shows the costs charged by providers and whether or not they are comparable to the reference price. Customers are thus able to make a value-based decision about their treatment by balancing the pros and disadvantages of the provider they want to use with their anticipated out-of-pocket expenses.

Services that are widely believed to have consistent quality yet have large price variations might be subject to reference pricing. Always available from a variety of vendors, these "commodity-like" services never cause an emergency. Lab work, imaging, colonoscopies, magnetic resonance imaging (MRIs), and medication costs can be among them. Some programs include sophisticated, high-cost procedures (such knee and hip replacements), the quality of which might vary, despite the fact that many reference pricing systems are focused entirely on price. By highlighting physicians who satisfy quality standards and provide services at or below the reference price, these initiatives help consumers avoid doctors who have high rates of complications and readmissions. These designs may also ward off people who see reference pricing for what it really is: an effort to put the financial burden of healthcare on individuals. Consumers are strongly encouraged to pick lower-cost service providers via reference pricing, but it does not limit their ability to get treatment from any given provider.

Anyone may get medical treatment from any provider, regardless of how big the gap is between the reference price and the authorized charge; all they have to do is pay the gap. If the payer wants to set a reference price that will work in the market, they should think about how many providers are delivering a certain service at or below that price, so patients can get enough of it. Prompt treatment for patients may be impossible to provide if there are insufficient providers offering services at or below the

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reference price. However, expenditure can be unaffected if the reference price is very high.

Using data collected from the National Health Interview Survey (NHIS) between 2019 and 2021, we investigate three aspects of the high cost of health care. Some of these features include a generalized anxiety about medical costs, a history of having trouble paying bills, and an actual inability to pay bills. These three metrics, when combined, provide light on the reality of health care affordability beyond what is possible with more conventional assessments of medical debt. Using these three indicators of health care affordability, we compared rural and urban dwellers on both broad disparities in reporting and on particular individual traits that may explain why rural dwellers report higher levels of health care affordability. The study years provide a valuable chance to evaluate health care costs during a unique period, made even more so by the advent of the COVID-19 pandemic.

II. LITERATURE REVIEW

Haggerty, Jeannie et.al. (2014). If we want to compare accessibility in rural and urban regions, we need measuring tools that are just as discriminating in both settings. We sought to investigate context-specific accessibility facilitators and obstacles by conducting focus groups to examine and compare care-seeking trajectories. People in rural areas who need medical attention have fewer alternatives, but they are more likely to be accommodated by organizations and depend on telephones. People seeking treatment in urban areas are more likely to use the excuse of physical distance. In order to make reliable comparisons of accessibility, four outcomes of accessibility issues surfaced across contexts: health worsening as a result of delay, utilizing emergency services as primary care, having to start the care-seeking procedure again, or giving up altogether.

Zhang, Angela et.al. (2020). The government and insurers are interested in pricing transparency tools to assist customers search for services and decrease total healthcare expenditure, due to the rising healthcare expenditures and extensive market price volatility. Nevertheless, the success of pricing transparency in meeting its goals remains uncertain. The purpose of this A scoping review aimed to summarize how price transparency affected the behaviors and results of consumers, service providers, and buyers. Low acceptance meant that price transparency tools had little influence on customers, while providers had varied results. Out-of-pocket and insurance costs went down because budget-conscious individuals opted for less expensive treatments, while overall healthcare expenditure remained flat. pricing for shoppable services decreased when supply-side competition was sparked by the publication of negotiated pricing, as opposed to list prices, which had no impact.

Maganty, et.al. (2023). Common health metrics consistently show that rural communities are in poor health. It is known those living in more remote regions possess challenges when trying to get health care, but what those challenges specifically are is yet unknown. Qualitative research was conducted with primary care doctors who work in rural areas to better understand these obstacles. Using a purposive sample technique, semi-structured interviews were carried out with family practitioners serving patients in remote areas of western Pennsylvania. There are more people living in rural areas here than any other location in the United States. The next steps included data transcription, coding, and theme analysis. The investigation revealed three main themes about the obstacle's issues with access to healthcare in rural areas, including cost and insurance, geographical isolation, and the scarcity and fatigue of providers. Several strategies were proposed or implemented by providers with the intention of benefiting rural communities. These included subsidizing services, constructing mobile and satellite clinics (particularly for specialty care), expanding the utilization of telehealth, enhancing the infrastructure for ancillary patient support (such as social work services), and increasing the number of advanced practice providers.

Denoyel, Victoire et.al. (2017). In an effort to control healthcare costs, insurance companies are looking at programs that would incentivize and educate people to choose the most cost-effective doctors and hospitals. Patients who choose a more expensive provider are responsible for paying the difference under Reference Pricing (RP), which works like this: a payer sets a maximum price that may be paid for a treatment. various out-of-pocket costs are associated with various provider tiers in a Tiered Network (TN), which is based on factors including cost and quality. To address the insufficient quantitative research on these innovative payment policies, we develop an optimization model for payers that incorporates both RP and TN, inspired on a scheme that was recently put into place in California. Picking which doctors and hospitals won't be subject to RP means those patients won't have to worry about paying anything out of pocket. We use a Multinomial Logit model to simulate patient provider choice. The goal is to reduce the cost to the payer as much as possible, and the limitations provide decision-makers tools to strike a balance between reducing costs and maintaining high-quality care. We construct an improved iteration of our model that accounts for variation in the parameters. You can learn more about the distribution of tiers on a price/quality plane using numerical experiments. When it comes to lowering costs, improving patient care, and highlighting high-value doctors, we believe this approach has great promise.

Acheampong, George et.al. (2019). In every country, healthcare is high on the list of priorities. Additionally, some people are unable to get the healthcare they need because of the high expense of using these services. In this chapter, we will discuss healthcare service demand, how to

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forecast it, and the elements that affect it. It delves into the different pricing techniques used in the healthcare industry as well. How much healthcare a patient spends and how a doctor combines different aspects of therapy determine the demand for healthcare. The demand for healthcare services is mostly impacted by factors that affect the demand for treatments from patients, factors that affect the usage of the components of care by physicians, and derived needs for those components. Predictions and techniques for the future demand of healthcare services are examined for the objectives of strategic planning and management. While there are a number of healthcare pricing methods in place, few have proved effective, particularly in less developed nations. In general, healthcare resources are used more by some demographics, such as very young children, women, elderly patients, smokers, high income earners, and patients with more comorbidity. Their healthcare expenses are thus greater.

III. PATIENTS

Each patient chooses the provider that maximizes her utility under a certain payment system after considering the providers' costs and non-price features. Alternative therapies are also available to patients. The patient's utility, which includes both monetary and non-monetary aspects, is represented by the following model:

$$U_{ij} = a_j - \gamma o_j + \eta_{ij}, \quad i = 1, \ldots, m, \ j = 1, 2.$$

Taking pricing into account aside, the parameter depicts the non-idiosyncratic benefit that each patient reaps from receiving treatment from the provider. Consequently, it records broad characteristics including number and quality of personnel and ancillary facilities, availability of cutting-edge technology, degree of comfort, etc. A1 < a2 is assumed to be constant, and we will not lose generality by saying so. The patient's out-of-pocket expenditure while receiving treatment from provider j is denoted as oj. To simplify the explanation, we will not explicitly state that oj is dependent on pricing and the payment system. The price sensitivity γ is the same for all patients. Related literature makes advantage of this assumption. By taking into account different degrees of price sensitivity, we are able to loosen this assumption in.

The variation among patients is caused by parameters. It records the unique characteristics that patients receive from providers, apart from cost, such as how close the provider is to their home and how easy it is for them to get there, whether or not the patient is familiar collaborating with the institution and/or the treating physician, the patient's preconceived notions about the quality of care they will receive, etc. Our approach accounts for patients' diverse choices as parameters differ from one provider to another. The equation for patient i's utility while choosing an alternative therapy (i.e., without picking any provider) is Ui0 = u0 + ηi0. Here, u0 represents the fixed, non-idiosyncratic benefit of choosing an alternative treatment, and ηi0 is the equivalent, patient-specific, idiosyncratic extra utility.

For every j ∈ {0, 1, 2}, we assume that parameters are random variables that are both independent and have the same distribution. Additionally, we assume that it adheres to a standardized Gumbel distribution, often known as type-I extreme value distribution, and that its cumulative distribution function has the form of f(x) = exp(−exp(−x)). Patients using this distribution for error terms in their provider selection process end up with a multinomial logit (MNL) choice model. Take note that the error terms may be removed without affecting the generality of the result since their means are constant. We find that the out-of-pocket costs of the patient, the provider's attributes (via parameter), and the specific mix of the patient and provider all have an impact on the utility that the patient derives from using a particular provider's services. Furthermore, each patient gets to choose the doctor who will help them get the most out of their insurance. Given a random patient selection, the likelihood that provider j will be picked using the MNL model is

$$S_j(P) = \frac{e^{a_j - \gamma o_j}}{e^{u_0} + \sum_{k=1}^{2} e^{a_k - \gamma o_k}} \in (0,1), \quad j = 1, 2,$$

where P is the vector of provider prices, and p1 and p2 are keys. One minus P2 j=1 times Sj(P) is the likelihood of seeking a different therapy. Thereafter, the anticipated usefulness for the patient population is:

$$E[U](P) = m\left(\sum_{j=1}^{2}(a_j - \gamma o_j)S_j(P) + u_0 S_0(P)\right).$$

PROVIDERS

In this analysis, we look at the insurer's network and two rival suppliers who determine prices. In the period that our article is centered on, the provider network remains static; that is, providers do not leave the network during this phase. However, A provider could decide to demand exorbitant prices, causing no patient to pick them, therefore leaving the market. Treatment costs c is the same for providers. Indeed, reference pricing is best used for treatments that follow a standard protocol, since this allows for simpler comparison of prices and less fluctuation in quality. Little variance in delivery cost is guaranteed by uniformity of procedure.

The purpose of reference pricing is also to prevent price discrepancies unjustified by differences in costs. We concentrate in on providers whose treatment costs are same to better examine whether reference pricing gets rid of such unnecessary price fluctuation. Assuming that the non-price qualities (i.e., c1 ≤ c2) are used to rank the provider treatment costs, the majority of our findings remain valid

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for treatment costs that vary among providers. Since it may be costly to improve broad features like facility comfort, personnel level, etc., this ordering property makes obvious sense. Competing providers play a game, trying to predict how patients would behave, given a payment mechanism. The goal of each supplier j is to maximize its profit, which is determined by the following formula:

$$V_j(P) = m(p_j - c)S_j(P), \quad j = 1, 2.$$

PAYMENT SYSTEMS

Three distinct payment methods are examined. We begin with a fixed payment model in which the patient makes a predetermined payment. For the most part, this is the most similar to the way things are right now. When a patient is required to pay a certain amount as their co-payment, this really happens. This situation may also arise if the patient has co-insurance that limits the amount of money you'll have to pay out of pocket expense that she must fulfill each year, regardless of which provider she chooses, due to the large range of rates for the surgery. Secondly, we look at a variable payment model in which the patient pays a certain percentage of the provider's total cost.

This really happens in the real world when patients have to pay a co-insurance amount but do not have a maximum out-of-pocket expense. It can also happen if there's an annual maximum, but only if it's far higher than the anticipated out-of-pocket expenses for the patient, which treatment will lead them to go over their limit. Third, we take a look at the reference pricing plan, where patients pay a certain amount and are then charged the whole amount if they choose a service that surpasses the benchmark pricing. Each of these models has providers setting prices, patients choose a provider, and patients paying the cost-sharing portion out of cash system. We use backward induction to examine the equilibrium choices. Following the steps outlined in the proofs, we determine the provider prices in equilibrium by studying the patient's provider choice for each j = 1, 2 provider prices.

FIXED PAYMENT

The fixed payment method allows supplier j to set a price that is not higher than pj. Afterwards, each patient chooses the provider who maximizes her utility, and she pays a set amount independent of her provider choice or the costs (oj = f, j = 1, 2). The insurance sets the maximum price level with all of its network providers because it is price sensitive, but patients aren't. A Nash bargaining model may be used to establish such prices. On the other hand, if the provider were to use reference pricing or variable payment, an exorbitant price would have a detrimental influence on their market share. So, instead of negotiating a limit, the insurer might let market forces dictate the costs that providers charge. Our examination of the fixed payment model is centered on the stage subsequent to the establishment of these limits, and we take the maximum prices pj, j = 1, 2 for granted. What follows is an analysis of how providers establish costs by gauging patients' reactions.

At equilibrium, with j = 1 or 2, providers choose p F P j = pj under fixed payment. The Online Supplement contains proofs. Upon request, the writers may provide detailed proofs. As a consequence of provider's market share is unaffected by patient paying a fixed sum, according to Proposition 1. There is no risk to the provider from charging higher fees as the insurance would pay the difference. Therefore, suppliers are not motivated to set a cap on prices. Patients make choices without facing the financial repercussions of their choices, highlighting the moral hazard problem in this setting. As a result of skewed incentives and the fact that patients have "no skin in the game," costs end up going up.

REFERENCE PRICING

Providers choose their charges once A reference price p ∏ is set by the insurer for the operation under the reference pricing payment system. In contrast to "non-value based" suppliers, "value-based" ones choose to set their pricing higher than the reference price. Ultimately, the provider that maximizes the utility of each patient (oj = ˜c + (pj − p ∏) + = ˜c + max {0, pj − p ∏}) is chosen by each patient, regardless of whether j = 1 or 2. For clarity, if patients choose for a practitioner who is not value-based. Keep in mind that the co-payment has an effect on the patient's incentive to seek care, even if it has nothing to do with the provider they choose. In line with actuality, Presumably, the out-of-pocket expense for treatment will be less than the co-payment. (˜c < c). Our next step is to figure out how providers reach a pricing equilibrium while competing in a non-cooperative game and predicting patients' reactions. We start by formally stating a condition that ensures the exist.

We first establish a formal requirement for the presence provides a study of the reference pricing system leading to a pure Nash equilibrium. Similar to the notations established just before Assumption 1, the next assumption uses them.

Assumption 2. For j equal to 1, 2, S RP j < 50%. What follows is an illustration of how suppliers that base their pricing on value arrive to equilibrium.

Proposition 2A value-based supplier sets their pricing at the reference price, p ■, when the market is in equilibrium.

Both intuition and the fixed payment scenario are supported by this finding. A patient's fixed co-payment remains the same when Regardless of the service's charge, she chooses a provider based on value. The percentage of the market that a supplier controls has zero bearing on the price (below the reference price, anyhow) since patients do not care about it.

Proposition 3. If provider 1 does not base their services on value, then provider 2 will also do the same. With provider

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2 having superior non-price attributes (a1 ≤ a2), Proposition 3 verifies that provider 2 is likely not value-based, since it provides patients with a service that might mitigate the increased expense to them. Our two-step process yields the collection of non-value-based providers and their equilibrium pricing by combining the outcome of Proposition 3 with Theorem 2.

HEALTH LITERACY DISPARITIES BETWEEN RURAL AND URBAN RESIDENTS AS A FUNCTION OF SOCIODEMOGRAPHY

Table 1 displays the non-weighted disparities in health literacy and sociodemographic characteristics between rural and urban areas. Participants from urban areas had a higher level of racial and ethnic variety (P <.001) compared to those from rural areas. Less common among rural residents was the self-identification as non-Hispanic Black, Hispanic, or other; more common was the self-identification as identify as non-Hispanic white, as compared to urban participants. Compared to their urban counterparts, rural individuals had lower income and education levels (P <.001). Health literacy (P =.538) and age (P =.725) were not significantly different between urban and rural residents. The percentage of individuals with sufficient health literacy (NVS score ≥4) was around 83.7% in rural areas and 81.8% in urban areas.

Table 1. Health Literacy and Demographics in Urban and Rural Areas (N = 600)

Demographic	Rural (n = 302)		Urban (n = 298)		χ^2	P
	n	%	n	%		
Race / Ethnicity						
Non-Hispanic white	262	86.3	216	72.5	20.92	< .001
Non-Hispanic black	16	5.3	25	8.4		
Hispanic	12	4.0	36	12.1		
Non-Hispanic Other	12	4.0	21	7.0		
Household Annual Income						
25000	67	22.0	34	11.4	28.80	< .001
25000-50000	70	23.2	63	21.1		
50000-75000	61	20.2	46	15.4		
75000-100000	44	14.6	49	16.4		
100000-125000	27	8.9	31	10.4		
125000 and up	33	10.9	75	25.2		
Education						
Less than high school	27	8.9	21	7.0	23.75	< .001
High school graduate	115	38.1	86	28.9		
Some college	92	30.5	69	23.2		
Bachelor and above	68	22.5	122	40.9		
Health Literacy						
Limited	49	16.3	54	18.2	0.38	.538
Adequate	251	83.7	242	81.8		
Age	M = 51.70, SD = 17.61		M = 52.18, SD = 15.52		t = 0.35	.725

INTERACTION EFFECTS OF HEALTH LITERACY AND RURAL-URBAN ON SOURCE ACCESS AND USE

In order to anticipate which health information sources people would utilize, we examined the correlation between health literacy and whether they lived in an urban or rural area. We found that health literacy, the availability of print and digital media, and the distance between rural and urban areas were all factors interacted with each other in a significant way (P <.001, P =.008, P =.014, P =.003, and P =.021, respectively). The odds of Rural inhabitants with weak health literacy were less likely to obtain health information from newspapers (OR=0.20, P <.001), magazines (OR=0.25, P <.001), books (OR=0.29, P <.001), scientific literature (OR=0.24, P <.001), television (OR=0.41, P =.004), and radio (OR=0.32, P <.001). Books (OR=0.87, P =.674), scientific literature (OR=0.87, P =.643), television (OR=1.39, P =.368), radio (OR=0.89, P =.701), newspapers (OR=1.21, P =.566), magazines (OR=0.81, P =.511), and other print media were not linked with health literacy among urban people. Figure 1 shows that not all rural inhabitants with low health literacy levels have access to health information found in mainstream media such as newspapers, periodicals, scientific journals, and radio. Regardless of their degree of health literacy, many urbanites and many rural inhabitants (ranging from 68% to78%) were able to acquire health information from various media outlets. After controlling for factors like wealth, education level, and race/ethnicity, we still saw significant trends. Interactions have a multiplicative impact rather than an additive one, according to RERI data effect.

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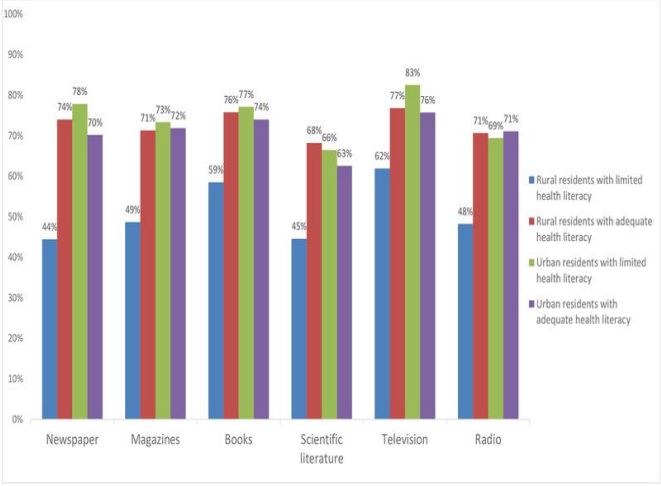

Figure 1. Access to Newspapers, Magazines, Books, and Scientific Literature among Rural-Urban Residents with Adequate/Limited Health Literacy

When we looked at how often people in rural areas and those living in urban areas used "other companies or corporations" (i.e., businesses other than pharmaceutical companies) to get health information, we found that the two variables interacted with one another (P =.99). Among rural residents with low health literacy, there was a higher probability of using health records from "other companies or corporations" (OR=8.22, P <.001). Access to this health information source was unrelated to health literacy among city dwellers (OR=0.73, P =.686).

Although a small percentage Almost a third of rural residents with low health literacy depended on businesses or corporations other than pharmaceutical companies for health information, whereas urban residents and those with adequate health literacy used this source. Adding income, education, and race/ethnicity as factors yielded the same pattern and significant findings once again. A strong multiplicative interaction was also seen in the RERI results, although no significant additive interaction was found.

IV. CONCLUSION

Insurers are paying exorbitant premiums because healthcare providers have amassed enough market power. One tactic used by some insurance companies to combat provider market power is to increase patient cost-sharing or to create restricted provider networks that do not include expensive providers. Although reference pricing isn't a panacea for healthcare's problems, it does have certain obvious benefits over more conventional forms of payment and may work well for some medical issues and treatment episodes. Fewer people in rural areas utilize search engines to get health information, and they have less access to a variety of shared resources, including general practitioners and specialists in the medical field. Small towns and urban populations vary in terms of sociodemographic, which explains in part why they utilize and access health information sources differently.

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