Hospital Variation in Cesarean Delivery: A Multilevel Analysis

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A B S T R A C T

Objectives: To assess the issue of hospital variations in Colombia and to contribute to the methodology on health care variations by using a model that clusters the variance between hospitals while accounting for individual-level reimbursement rates and objective health-status variables. **Methods:** We used data on all births (N = 11,954) taking place in a contributory-regimen insurer network in Colombia during 2007. A multilevel logistic regression model was used to account for the share of unexplained variance between hospitals. In addition, an alternative variance decomposition specification was further carried out to measure the proportion of such unexplained variance due to the region effect. **Results:** Hospitals account for 20% of the variation in performing cesarean sections, whereas region explains only one-third of such variance. Variables accounting for preferences on the demand side as well as reimbursement rates are found to predict the probability of performing cesarean sections. **Conclusions:** Hospital variations explain large variances within a single-payer's network. Because this insurer company is highly regarded in terms of performance and finance, these results might provide a lower bound for the scale of hospital variation in the Colombian health care market. Such lower bound provides guidance on the relevance of this issue for Colombia. Some factors such as demand-side preferences and physician reimbursement rates increase variations in health care even within a single-payer network. This is a source of inefficiencies, threatening the quality of health care and financial sustainability. The proposed methodology should be considered in further research on health care variations.
Keywords: birth procedure, cesarean section, hospital variation, multilevel analysis, small-area variation.

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Introduction

Even when evidence is available, physician's own experience and "word of mouth" rather than evidence determine the performance of multiple health interventions. This behavior is particularly due to lack of complete information on the patient's idiosyncratic response as well as informational asymmetry between health care providers and patients, leaving a gray zone that allows both health services users and providers to respond more freely to pecuniary and nonpecuniary incentives, leading to higher variation in the performance of procedures across geographical regions.

Assuming that procedures and treatments might be fairly standardized for a set of patients with fixed characteristics, the remaining variation (conditional on unobservable variables) in the performance of diagnostic and treatment procedures is often assumed to be caused by differences on the supply side (physician preferences and quality of health care) or the demand side (regional preferences). Even though some variability is acceptable conditioned on disease prevalence, insurance coverage, and availability of resources, systematic variability yields welfare losses in both users and nonusers of health services [1,2]. Consequently, the excessive or deficient provision of a given procedure signals lower quality and inefficient allocation of resources.

"Small-area variation in health care" consists of the systematic variability in the probability of performing a given procedure across "small areas." The concept of "small area" has been used in a wide range of definitions from small geographical regions (such as counties and towns) to entire countries. Some "small areas," however, may not always homogeneously affect the choice of a given procedure because they might not represent legal, financial, or practice-style effects and hence, those "small areas" may not entail a real cluster effect.

Research on "small-area variation in health care" has become a relevant research topic since the Glover's initial article in 1938 [3] when he found that cities in the United Kingdom were performing tonsillectomies "in excess of the essential minimum." Specifically for the case of cesarean sections, two relevant studies [4,5] found no clear patterns in the decision-making process of performing cesarean sections.

Research on variation in health care is especially relevant in developing countries where budget constraints are tighter. After more than 20 years of a health care reform that brought about considerable changes in the national health care market by increasing the coverage and the supply of health services,

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efficiency has become an important issue because the health system financing has grown at a slower pace than the plan of benefits and the increasing technological change, making it a top priority for insurers and governmental entities.

Our case for assessing variation in health care is focused on birth procedure. "Cesarean delivery rate" has been included as one of the "sentinel" quality indicators by the Agency for Health Care Research and Quality in its set of Healthcare Cost and Utilization Project. This evidences that cesarean section represents a real concern because it constitutes a costly procedure and might end up in medical complications including wound infection, respiratory distress, neonatal sepsis, and death for the mother and the child [6,7]. Cesarean sections are rising in developing countries [8,9], and this is particularly worrisome in Colombia, which is ranked the third highest country in performing cesarean sections in Latin America [10], and in which diseases related to pregnancy and delivery are the main nonviolent cause of death among women of reproductive age [11]. All this might be indicating that differences in quality on birth attendance are an important concern in Colombia.

To our knowledge, this is the first article using multilevel analysis taking hospitals as group of analysis rather than geographic regions. The rationale behind this conceptual model is that hospitals' policy and environment may exert a considerable influence on the choice of the physician in a determined procedure, which we will refer as hospital variations. We isolate the effect of the hospital variation and the regional variation, allowing us to understand the differing effect of each one of both components while controlling for physician reimbursement and clinical data at the individual level. This research attempts to contribute to current research by measuring the extent of the effect of hospital variation on regional variation, by using a hierarchical econometric approach, which defines hospitals as clusters, and by including clinical and physician-reimbursement data. We also aim to highlight the extent to which this constitutes a problem for the Colombian health sector. By studying a single-insurer case, we make a first approach on the broader question of how hospital variations affect health outcomes in developing countries. Because we are using data from a well-regarded insurer in the country, we anticipate our results to provide a lower bound for hospital variation in the national health care market, which underscores the relevance of this issue.

Methods

Data

Despite our efforts in obtaining data at the national level, we faced a trade-off between heterogeneous, low-quality, and incomplete national-level data and homogeneous, high-quality, and reliable information from a single insurer. As a result, we chose to use a single-insurer database. For this reason, our results lack national representativeness, but, at the same time, they also allow us to understand more clearly how users and providers of services might influence the choice of the delivery procedure in a single-payer network. These data come from an insurance company operating at the national level for the contributory regimen Entidad Promotora de Salud del Régimen Contributivo (EPS-C). Data coming from administrative and claim records on all births that took place during 2007 have been obtained (11,768). Births delivered at hospitals with 10 or fewer observations are excluded to ensure the suitability of the model as described in previous studies [12]. During the period of analysis, some hospitals performed either only cesarean sections or only natural deliveries. Because these might be hospitals selectively contracting with the insurer a given procedure, hospitals in which only one type of procedure was observed were also excluded from the analysis. In addition, births delivered in low-complexity facilities were excluded from the study because only vaginal deliveries may take place in them. Our final sample comprises 11,594 births (98.5%) out of the original database. It is important to notice that, in general, the mother can select the hospital in which she wants to be attended as far as the institution is within the network.

Hospital-Level Variables

A variable accounting for complexity of the facility was created. High-complexity institutions (tertiary-care level) provide highly specialized services such as intensive care units and subspecialties, whereas medium-complexity ones have general specialties but are enabled to carry out cesarean sections. *High complexity* is a variable taking a value of 1 if the delivery was attended at a tertiary-care hospital and 0 otherwise (medium-complexity hospital).

All procedures were performed by physicians being paid on a fee-for-service basis. Following previous literature [13,14], a physician reimbursement variable reporting the effect of physician remuneration on the choice of the delivery procedure was designed. This variable accounts for the average difference between the actual and the alternative procedure's fee within each hospital. The rationale for this variable is to describe the opportunity cost in terms of reimbursement fees the physician faces for the chosen procedure; for example, the value for performing a vaginal delivery is the differential fee between performing a vaginal delivery and a cesarean section at that hospital.

Region of the hospital location is categorized as follows: Bogota D.C., Central, Eastern Pacific Ocean, and Caribbean regions. *Public hospital* is a dummy variable taking a value of 1 if the hospital is public and 0 if private. *Teaching hospital* is also a dummy variable that accounts for hospitals that conduct research and have relationships with medical schools on a regular basis [13,15].

Individual Variables

A set of individual-level variables was used. *Mother age* is the mother's age at the time of birth. *Mother income* is the value in hundred thousand pesos of the reported income to the insurer during the last month. *Users per contract* is a variable accounting for the number of people covered under the family group. This variable was included as a proxy for family size, which may play an effect as suggested in previous research [16]. Educational level was controlled using three variables: *primary education accomplished*, *secondary education accomplished*, and *superior education level accomplished*. *Superior level education accomplished* includes technical and professional education. In addition, a variable for *unknown educational level* was included because education information was not provided in 4922 observations.

To control for health factors, some clinical variables were also included. *Previous births* are the number of births a woman had before this delivery. *Type of admission* describes whether the admission was urgent or scheduled. *Female* takes values of 1 if the newborn is female and 0 if male. Even though data on prenatal care and other prevention activities and gestational age were requested, these data were not available.

The last individual variable is *cesarean-section criterion*. The rationale of including this binary variable is to account for risk-adjustment selection on the performance of cesarean sections such that we can control for an objective criterion of the need for a cesarean section [17,18]. The categorization was developed following previous literature and guidelines [19,20]. Because complications are listed in the database as *International Classification of Diseases, Tenth Revision* (ICD-10) codes, the imputation of whether that intervention requires cesarean section or not is based only on the *ICD-10* diagnosis and on the common treatment upon such *ICD-10* diagnosis. The complete list of