Summer 8-22-2018

Health and Healthcare in Nepal: An Analysis of the Private And Public Sector

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HEALTH AND HEALTHCARE IN NEPAL: AN ANALYSIS OF THE PRIVATE AND PUBLIC SECTOR

By

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B.A. University of Maine, 2016

A THESIS

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Master of Science

(in Economics)

The Graduate School

The University of Maine

August 2018

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Thesis Advisor: Dr. Angela Daley

An Abstract of the Thesis Presented
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Through private and public efforts, there has been considerable improvement in the health and healthcare sector in Nepal. However, the healthcare system in Nepal faces challenges such as limited access and lack of quality healthcare. Although there have been recent efforts to introduce universal healthcare coverage, there is limited evidence on existing systems to properly formulate a policy. To provide a wholistic review of the Nepali health system, we assess both public and private sectors.

In 2005, Nepal introduced a financial incentive, called the Safe Delivery Incentive Program, to increase the use of maternity care with the goal of reducing maternal and neonatal mortality. The program included a cash transfer to help with transportation costs, free delivery for mothers in certain districts and an incentive for healthcare providers to participate in the delivery. In the first paper, we use microdata from the Demographic and Health Surveys (2001 to 2008) and a difference-in-differences model to estimate the effect of free delivery, which was only implemented for mothers in 25 Nepali districts with the lowest Human Development Index. We measure five outcomes: neonatal mortality; prenatal care; prenatal care by doctor; prenatal care by nurse/midwife and immunization against neonatal tetanus. The sample consists of 5,317 live births

between the years of 2001-2008. We find that women are more likely to get prenatal care from a doctor, nurse or midwife and immunization against neonatal tetanus if they reside in districts with free delivery care. Further, neonates born to mothers in the treatment district are more likely to survive, which may have occurred due to increased prenatal care and tetanus vaccines. We provide new evidence that the program did prenatal care, which is contingent on wealth quintile, ethnicity and education.

In the second paper, we address the limited empirical evidence on the relationship between management and performance of private hospitals in Nepal, with emphasis on differences by performance indicator, patient type and analytical approach. We use de-identified inpatient data to assess the relationship between hospital management and performance. We estimate Pabon Lasso and regression models for native-born and foreign-born patients, and for the full sample of patients. Using a Pabon Lasso model, we assess relationship between hospital management and: bed occupancy rate; bed turnover rate; and average length of stay. To complement the Pabon Lasso model, we use a regression analysis to assess the relationship between hospital management and length of stay in a multivariate framework. Our results indicate that separation between the Chief Executive Officer (CEO) and board may promote better performance (except the Pabon Lasso model favors CEO duality for average length of stay among native-born patients). However, results vary by performance indicator, patient type and analytical approach. We provide new evidence on the relationship between management and performance of private hospitals in a developing context. However, when it comes to evaluating management strategies, there are important differences by outcome measure, patient type (i.e. native-born versus foreign-born) and analytical approach.

DEDICATION

To Ma, Papa, Chiran and Chadu

ACKNOWLEDGMENTS

My graduate experience would be incomplete without the guidance, mentorship and unwavering support of Dr. Angela Daley. She promotes curiosity in her students, and has guided me to great heights as researcher, professional and individual. My committee members, Dr. Mario Teisl and Ewa Kleczyk, have dedicated their time and provided me with insightful comments for which I am very grateful. Dr. Teisl has mentored me throughout my undergraduate and graduate experience at the University of Maine and continues to do so. Dr. Kleczyk has taken time from her very busy schedule to share her professional experience, mentor and bring industrial insight to my thesis.

I would also like to thank all my professors at the University of Maine and especially at the School of Economics. Every professor has played a role in defining my career. The School of Economics team is exceptional, humble and kind. Their enthusiasm to impart knowledge is inspiring. Equally inspiring are my colleagues and I thank them for their helpful comments and for their teamwork. My assistantship was supported through the Finance office for the College of Natural Sciences, Forestry and Agriculture. Working with the team for two years has been instrumental in my professional career. They have expressed their compassion and kindness towards me.

The first paper, the Impact of the Safe Delivery Incentive Program on Prenatal Care and Neonatal Mortality in Nepal, was presented in the 2018 Maine Economic Conference, School of Economics Seminar at the University of Maine and University of Maine Student Symposium 2018. I would like to thank all the participants for their comments and feedbacks. The poster for this paper also received a Graduate Student Poster Award at the Maine Economic Conference. Also, we thank Grande International Hospital for providing the data and Dr. Chakra Raj Pandey for contextual information and feedback.

Finally, I would like to thank individuals who have been my foundation not only throughout my graduate experience but also throughout my experience here in Orono, Maine. Without my family's love and support, it would be very hard to fulfil my dreams. My friends have been my family here in Orono and without their humor, kindness and love my education would be incomplete. Lastly if it were not for Karen Moffet and Dr. George Criner's welcoming hug the first time I walked into the School of Economics six years ago, I would not be completing this thesis.

1.1 Conflicts of Interest

Sujita Pandey declares that she has a financial conflict in terms of stock ownership in Grande International Hospital, as well as a personal relationship with the current Medical Director.

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ABBREVIATIONS

ALOS: Average Length of Stay

BTR: Bed Turnover Rate

CCT: Conditional Cash Transfer

CEO: Chief Executive Officer

DHS: Demographic and Health Surveys

GIH: Grande International Hospital

GoN: Government of Nepal

HDI: Human Development Index

NPR: Nepali Rupees

SDIP: Safe Delivery Incentive Program

UNICEF: United Nations Children’s Fund

USAID: United States Agency for International Development

WHO: World Health Organization

CHAPTER 1

THE IMPACT OF THE SAFE DELIVERY INCENTIVE PROGRAM ON PRENATAL CARE AND NEONATAL MORTALITY IN NEPAL

1.1 Introduction

In 2015, the maternal mortality ratio in developing countries was 239 per 100,000 live births, as opposed to 12 per 100,000 live births in developed countries (World Health Organization (WHO), 2018). Maternal mortality is attributed to complications that arise during pregnancy, childbirth and post pregnancy (WHO, 2018). Disparities also exist in child health; children in developing countries under the age of five were ten times more likely to die compared to children in developed countries (WHO, 2011). Moreover, an infant only has a 19 percent chance of surviving if the mother dies (United States Agency for International Development (USAID), 2018). Correspondingly, four major causes of neonatal deaths are infections, prematurity, low-birth weight and birth asphyxia (WHO, 2018). Thus, maternal and neonatal mortality is preventable through low-cost interventions, specifically immunization, prenatal care, skilled birth attendance and postnatal care.

The United Nations and WHO have been collaboratively working towards reducing maternal and child mortality rates to 70 per 100,000 live births and 12 per 1,000 live births, respectively, by the year 2030. Local governments are also working to reduce maternal and child mortality rates, which are predominantly South Asia. For example, in 2013, 24 percent of global maternal deaths occurred in South Asia, which consists of eight countries: Afghanistan; Bangladesh; Bhutan; India; Maldives; Nepal; Pakistan; and Sri Lanka (World Bank, 2015). These countries experienced a 65 percent reduction in maternal mortality between 1990 and 2013 (World Bank, 2015), however challenges continue to exist. In 2016, approximately 1,010,274 newborns died in South Asia compared to 14,842 newborn deaths in North America (UNICEF, 2017). According to the United

Nations Children's Fund (UNICEF), if this trends continues, South Asian countries will not achieve the goal of reducing neonatal mortality ratio to 12 per 1,000 live births by 2030 or UNICEF's South Asian target of saving 500,000 newborns by 2021 (UNICEF, 2015). In 2012, government leaders from 80 countries and partners from various sectors (private, civil and faith-based) convened in Washington D.C. as a 'call to action' to reduce maternal and child mortality worldwide (USAID, 2017). As a result of this meeting, 25 priority countries that account for two thirds of global maternal and newborn deaths were identified. Nepal is one of these priority countries.

Nepal is a landlocked, low-income country in South Asia. Disparities in education, wealth and health exist between 126 ethnic castes, socio-economic classes and residential areas (rural versus urban). Also, with three distinct ecological zones – mountain, hill and terai (lowland region) – some Nepali mothers and children face geographical challenges especially in accessing health care. The Government of Nepal estimated that 23 newborns per 1000 live births died in 2015. (Ministry of Health, 2016). The main cause of death for Nepali mothers and neonates mirrors that experience in other developing countries: lack of access to health care during pregnancy, childbirth and after pregnancy (Ministry of Health, 2016). Relatedly, inequality, poor quality of healthcare facilities, undernutrition of mothers and lack of health care providers in remote areas are detrimental to the health of mothers and children in Nepal (El-Saharty, 2015). Furthermore, inequality is exacerbated by the existing caste system because economic and social well-being is directly correlated with ethnicity (DHS, 2008). Therefore, Janjati, Dalits, Terai/Madhesi and Muslim mothers have limited access to maternal and infant healthcare (DHS, 2008). Despite the challenges there has been a noteworthy reduction in maternal mortality in recent years due to interventions related to family planning, community-based approaches, subsidized or free care and female community health volunteers (USAID, 2017). However, neonatal mortality remains stagnant and a serious concern. According to the Demographic and Health Surveys (DHS) Program, between 2006 and 2010, 26 percent of Nepali mothers between the age of 15 and 49 did not receive prenatal care (DHS, 2011). Moreover, the use of such care increases with education, income and wealth, and is positively associated with living in an urban area. As an important part of prenatal care, mothers typically receive tetanus toxoid vaccinations to prevent neonatal tetanus, which is a major cause of death. Neonatal tetanus is the result of unhygienic birth practices, such as using rusted equipment to cut the umbilical cord after home delivery. This infection affects a newborn between the 3^{rd} and 28^{th} day after birth, and eventually results in arching of the body and painful convulsions (UNICEF, 2000). Described as an 'invisible killer', neonatal tetanus, has a fatality rate of 70 percent, largely infants delivered at home, and deaths often go unreported. However, immunization of mothers protects both mother and child since tetanus antibodies transfer to the fetus (WHO, 2012). Although preventable, worldwide neonatal tetanus was responsible for 14 percent of all neonatal deaths in 1998 (UNICEF, 2000). Despite achieving Maternal and Neonatal Tetanus Elimination in 2005 (less than 50 cases), neonatal tetanus cases in Nepal have sharply increased to over 250 in 2015 (WHO, 2016). To exacerbate this situation, there is a lack of insurance and social security in the country. Therefore, most healthcare costs, are paid out-of-pocket.

Following a series of seven consultation exercises, by the Ministry of Health and Population, called the Nepal Safer Motherhood Project (1998-2004) the Safe Delivery Incentive Program (SDIP) was introduced in July 2005 ((Sharma et al., 2007 and T. Ensor et al., 2009). This policy provided financial incentives to increase the use of maternity care services with the goal of reducing maternal and neonatal mortality (DHS, 2011). The program included a conditional cash transfer to help with transportation costs, free delivery for mothers in the poorest 25 districts and a financial incentive for healthcare providers to participate in delivery. The cash transfer was specific to the geographical regions. Mothers residing in mountain, hill and terai regions received Nepali rupees in quantities of 1,500, 1,000 and 500 respectively (Pradhan et al., 2017). Due to differences in terrain and higher costs of transportation, mothers in the mountain region the largest transfer, and mothers in the hill received more than those in the terai region. Moreover, free delivery for mothers in poorest districts was allocated based on the Human Development Index (HDI). The HDI is the geometric mean of normalized indices for three dimensions: health; education; and standard of living. Therefore, based on the HDI report published in 2004, mothers in the 25 districts with the lowest HDI in 2001 were provided free delivery (Tropp et al., 2004). Thus, mothers in districts with the lowest HDI received free delivery care and a cash transfer for transportation expenses, mothers in the remaining 50 districts only received a cash transfer for transportation expenses. Regardless of geography, skilled birth providers were given a financial incentive (300 rupees) for each delivery they attended.

Due to the changing nature of the program (Table 1.1), this paper focuses on the policy period between 2005 and 2008, during which only women in the lowest HDI districts received free delivery. During this period, eligibility criteria and incentives remained quite stationary. Between 2005 and 2007, women in lowest HDI districts were eligible to receive free delivery care if they resided in an eligible district, delivered in a public facility, had no more than two living children and were not diagnosed with obstetric complications (Pradhan et al., 2017). In 2007, the eligibility criteria were modified to include women with obstetric complications and those with two or more living children (Pradhan et al., 2017). This change has been accounted for during our analysis.

Despite the fact that we focus on the policy period between 2005 and 2008, it is important to be aware of subsequent changes to the SDIP (Table 1.1). In 2009, the program was expanded and renamed the ‘Aama Program’ (Mother Program) (Aryal, n.d.). This program continues to focus on the removal of financial barriers for women seeking institutional deliveries. Unlike previous iterations of the policy, the ‘Aama Program’ removed user fees for all types of deliveries. Furthermore in 2012, women were given cash incentives for completing four antenatal care visits and, in 2016, the program was expanded to include free new born care. Other than these additions, the program continues to provide a cash transfer for transportation costs and a financial incentive for skilled birth providers. A considerable amount of resources – 4.33 billion rupees – has been allocated to this program overall (Aryal, n.d.). Therefore, it is important to understand the impact of this allocation on maternal and child health given the scarcity of resources in a country like Nepal, where purchasing power parity in 2005 was $1,499 (World Bank, 2017).

In this paper we examine the relationship between SDIP on prenatal care (including relevant vaccinations) and neonatal mortality. We do so using a difference-in-differences model, focusing on the free delivery component of the policy, which was implemented for mothers in 25 Nepali districts with the HDI.

Table 1.1 Summary of Changes to the SDIP

Year	Change
2005	Implementation of the SDIP
2007	Removal of parity and obstetric complication restriction
2009	Universal implementation of SDIP
2012	Addition of a cash incentive for four prenatal care visits within first four, six, eight and nine months, and institutional delivery
2016	Addition of free newborn care

1.2 Literature Review

1.2.1 Existing Literature on Safe Delivery Incentive Program

The financial burden of child birth can be immense, particularly in countries like Nepal, where an insurance system is absent, and families are obliged to prepare for a considerable amount of out of pocket expenditures. In Makwanpur district in Nepal, the mean cost of a normal delivery is NPR 4,042 ($ 63.2)[1] and the cost of a caesarean is NPR 22,780 ($356.2) (Powell-Jackson et al., 2009). This is a substantial amount, given that the gross national income per capita in Nepal was $540 in 2010. Limited financial resources and immense costs result in difficult choices for mothers and families. They create barriers for access to care prior to birth, during and after-birth which contributes to high MMR and NMR (DHS, 2016). Several studies indicate that, in Nepal, the decision to seek care is delayed due to costs associated with seeking care (Manandhar, 2000; Borghi et al., 2004; Pradhan et al., 2010). To address such financial barriers and promote healthy behavior, a substantial number of South Asian countries – Nepal, India, Bangladesh and Pakistan – have adopted cash transfers and voucher programs (Jehan et al., 2012). Nonetheless, implementation of these demand-side financial incentives is constrained by lack of awareness and weak governance. The success of similar financial incentive programs in Latin America has influenced countries from other parts of the world to follow suit (Powell-Jackson et al., 2012). The inclusion of various forms of financial incentives such as cash transfer is a key feature of programs trying to address maternal and child health outcomes in South Asia. Particularly, programs in Nepal, India, Bangladesh and Pakistan are based on the idea that financial incentives promote change in health behavior. These programs have been widely attributed to the success in utilization of maternal care (Jehan et al., 2012).

[1] Conversion rate based on Powell-Jackson et al., paper. Current rate is 110 NPR per USD (July 11, 2018)

Prior to discussing existing research, it is essential to distinguish between the two components of SDIP: free delivery care and cash transfer. Both components attempt to address financial barriers related to child-birth. Specifically, cash transfer provides a cash incentive to mothers to remove the financial barrier associated with the costs of transportation related to delivery in a health facility. Free delivery care (only provided to 25 districts), removes the financial burden incurred by families at the time of delivery, which allows women to have extra income that would have otherwise been spent on delivery care.

Researchers argue that there is limited evidence on the effectiveness of financial incentives, particularly in countries where government financial systems are weak, and programs are implemented at a large scale (Powell-Jackson et al., 2012). After collecting their own set of data, Powell-Jackson et al., explore the variation in cash transfer between regions and awareness of the program using a propensity score matching methods to conclude that Nepali women who were aware of the program were 4.2 percentage points more likely to deliver with a skilled birth attendant (Powell-Jackson et al., 2012). The treatment effect, however, is positively associated with the amount of cash transfer and quality of care. They also find that slow implementation of the program and lack of awareness has limited SDIP's success. Similarly, in another qualitative study, after a set of interviews in ten districts and researchers find that the implementation of SDIP was challenging for district level authorities (Powell-Jackson et al., 2009). The complexity of the program did not enable smooth transition and the difficulties accessing funds made it challenging. They restate that compared to Latin America, health facilities in South Asian countries like Nepal are inadequate and weak. Apart from Powell-Jackson's study on cash transfer, several researchers have explored the impact of free delivery care on institutional delivery and skilled birth attendance. Ensor et al., use a multilevel logit and the DHS dataset to conclude that the SDIP led to an increase in institutional delivery in the terai and hill regions (Ensor et al., 2017). Likewise, both Pradhan et al., and Lamichhane et al., use DHS and difference-in-differences analysis to provide empirical evidence that the SDIP leads to increased skilled birth attendance (Pradhan et al., 2017 and Lamichhane at al., 2017). Lamichhane et al., also studied the impact of the SDIP on neonatal mortality and found that the policy lead to a decline in neonatal deaths. They attribute this success to increased institutional delivery. Both components of the SDIP has been attributed to the desired outcome of the policy: an increase in the use of maternity services such as skilled birth attendance and institution delivery (Ensor et al., 2017; Lamichhane at al., 2017; Powell-Jackson et al., 2012 and Pradhan et al., 2017;).

A recurring theme in all the studies is the existence of inequality and disparities amongst those who live in rural areas and are in marginalized population. For example, Bhatt et al, (2018) find that wealth had a significant effect in determining antenatal care visits and Pradhan et al., (2017) find that the household's wealth index determined access to delivery care (Bhatt et al., 2018 and Pradhan et al., 2017). Likewise, Deo et al., (2015) identified that ethnic background, limited knowledge and information, women's autonomy and strong beliefs on traditional healers affected the choice to utilize antenatal care. Despite increased enthusiasm for health services, use of the financial incentive provided by the SDIP is limited due to inadequate and inappropriate health infrastructure. In addition, knowledge of the SDIP was limited and especially limited if the women were poorer and from disadvantaged or marginalized populations (Powell-Jackson et al., 2012)

Although several studies have examined the impact of the SDIP on maternal and child health, none have studied the impact of the SDIP on prenatal care. Since the goal of the SDIP is to improve maternal and child health through increased institutional delivery and skilled birth attendance, naturally, the majority of researchers have focused on the direct outcome. We are not aware of any empirical analysis that has assessed the impact of this policy on prenatal care prior to the introduction of cash incentives to promote four antenatal care visits in 2012. Due to the impact of income on maternal and child use, we hypothesize that the SDIP increased the use of prenatal care services.

1.2.2 Literature on Prenatal Care

Finlayson et al., conducted a metanalysis on what affects the use of prenatal services in middle and low-income countries (Finlayson et al., 2013). Among others, the costs associated with utilizing health care services related to maternal care served as a barrier. In the context of Nepal, multiple studies have demonstrated that cost is one of the major drivers in delaying the decision to seek maternal care (Manandhar et al., 2000 and Borghi et al., 2004).

Grossman's theory on the demand for healthcare provides theory and empirical evidence on how people demand medical input to produce health (a capital good) to maximize their utility (Wahyuni, 2015). Age, education, health status and income influence the production of health capital. As such, wage rate and income influence the optimal stock of health capital. This framework has been applied, empirically, towards the production of infant health. One of the goods that enters the family utility function is infant health (Rosenzweig et al., 1983). Thus, an infant's health capital is influenced by several factors such as the mother's age, wage/income, education and knowledge. In congruence with Grossman's theory, higher wages lead to an increased investment in health for both mothers and infants. An increase in income will enable a mother to afford better quality and quantity of health production inputs, such as medical care. Evidence suggests that household wealth does in fact affect prenatal care use from a trained provider (Celik, 2000). Specifically, in Nepal, "the poorest people are twice as likely as those who are least poor to reduce use of child health services in response to an increase in price" (Borghi et al., 2006).

Thus, we hypothesis that the provision of free delivery allows households to invest in other health services, such as prenatal care, due to a relaxed budget constraint and savings that would have otherwise been invested for delivery care. Since households in the 25 districts do not have to spend their limited budget on "deliveries – the single most costly event during pregnancy", they can allocate their resources on the production of health for their mother and infant, i.e. prenatal care (Borghi et al., 2006). Empirical evidence demonstrates that prenatal care has a significant and positive effect on infant health. Thus, we hypothesize that if there is a reduction in neonatal mortality, this may have occurred due to increased prenatal care because of SDIP. Measuring the impact on neonatal mortality has two distinct purposes: first is to measure the intended impact of this policy and second is to use this measurement as a proxy for the quality of care these women receive (Powell-Jackson et al., 2009). If the services are underutilized and if they are inadequate we should expect to see no effect on neonatal health or, worse, an increase in neonatal mortality. Research on the impact of SDIP on one district, Makwanpur, found that SDIP did not have any impact on neonatal mortality (Powell-Jackson et al., 2009). A recent study by Pradhan et al., examined the impact of SDIP on increased skilled birth attendance (Pradhan et al., 2017). However, they mention that their dataset is not adequately powered to detect effects on health outcomes. Another study measures the impact of SDIP on outcomes related to delivery and neonatal death (Lamichhane et al., 2017). They do so by studying two different phases of the policy, where the first phase is the earlier period with parity restriction and the longer phase is without the restriction (Table 1.1). Researchers find a negative and statistically significant effect of SDIP on the probability of neonatal deaths.

Generally, it is difficult to isolate the causal effect on income on the dependent variable due to confounding issues and selectivity issues (Wahyuni, 2015). However, the nature of implementation of SDIP allows us to create a natural experiment where the women in 25 districts, despite their income, can engage in the policy. Due to the universal implementation of the free delivery policy, we do not face a selectivity issue when we conduct this analysis since mothers are not selecting into the treatment group. To my knowledge, there is no empirical evidence in the context of SDIP's impact on prenatal care. Furthermore, due to the maternal and neonatal tetanus elimination status, researchers have not examined the impact of this policy on tetanus toxoid vaccination which is administered during prenatal care. This vaccination is known to be a cost-effective and less expensive prevention for both maternal and neonatal mortality. Additionally, if we study the impact of the SDIP on tetanus vaccination it can serve as a proxy for quality of care. Since this vaccination is required to be administered during the prenatal care period, if mothers are not receiving this service despite increases in prenatal care, we can infer that care for mothers in that area is inadequate.

1.3 Data & Methods

We use cross-sectional microdata from the DHS, which has administered surveys in more than 90 developing countries since 1984. Primarily funded by the USAID, these surveys are dispensed in collaboration with a local government organization and have been acclaimed for collecting nationally representative data related to health and population. The objective of the DHS program is to provide data that is comparable across countries and usually across time (DHS, 2011).

DHS surveys are conducted every five years. Using four types of questionnaires – household, women, men and biomarker – the survey collects data using a stratified two-stage cluster design. The first stage includes enumeration areas drawn from the census files and the second stage includes a sample of households based on an updated list in the enumeration area. To allow for population-level inference, the DHS program uses a probability sampling methodology. Units such as eligible mothers and households are selected randomly, and the goal is to cover the full target population in the country. The questionnaire includes detailed information about socio-economic, demographic characteristics, fertility, family planning, mortality, marriage, reproductive health, child health and nutrition. The data are publicly available, and users must request data with a short description of their intended use.

For this analysis, we use microdata for Nepal from the 2006 and 2011[2] DHS dataset. We focus on 2001 to 2008, which includes the period before and after implementation of the SDIP. Specifically, pre-policy period is 2001 to 2004 and post-policy period is 2005-2008. Our sample includes Nepali mothers between the age of 15 and 49. We focus on married mothers, to whom 98.9 percent of children are born, since the majority of mothers in Nepal are married. We do not include mothers who had more than one live birth during the study period. The unit of analysis is children of eligible women born in the last five years. Our estimating sample includes 5,317 live births (to 5,317 separate women).

We estimate the effect of the SDIP on prenatal care by considering its impact on: immunization against neonatal tetanus; receipt of prenatal care in general; receipt of prenatal care by a doctor; receipt of prenatal care by a nurse or midwife. We also focus on neonatal mortality to determine the overall impact on child health. Our outcome variables are dichotomous, thus we use probit regressions with marginal effects. Immunization against neonatal tetanus is measured as the "number of tetanus toxoid injections given during the pregnancy to avoid convulsions after birth" (DHS, 2016, page 55). There is evidence that pregnant mothers with at least two injections experienced a large reduction in neonatal tetanus (DHS, 2016). Consequently, women who

[2] The 2006 survey covers the period from 2001 to 2005. The 2011 survey covers the period from 2006 to 2010.

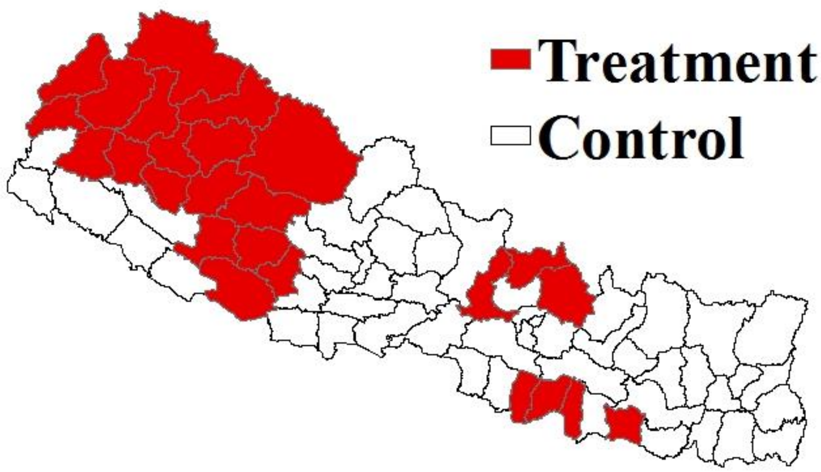
received two or more injections are given a value of 1 and 0 otherwise.

We include a number of controls for household and individual characteristics in our models. Since the use of prenatal care was directly correlated with economic power, in this study we control for household characteristics such as wealth index and region of residence (Sepehri et al., 2008). The DHS generates a wealth index based on a statistical procedure known as principal components analysis. The wealth index is based on a household's ownership of specific assets such as a television, bicycle, house construction materials, types of water access and sanitation. Gabrysch et al., (2009) perform a meta-analysis of over 80 studies on characteristic affecting use of delivery services and determined that among other factors, it is important to control for mother's age, education, ethnicity, religion, occupation and birth order of the child. Appendix A contains a list of my variables, the corresponding DHS variables and how they were coded.

1.3.1 Difference in Differences

Exposure to the SDIP was determined by district of resident and was independent of individual characteristics of mothers therein (i.e. all mothers in selected districts were affected by the policy). The selected districts were determined based on low HDI. Figure 1.1 below illustrates the map of Nepal along with the treatment districts (grey) and control (white) districts.

Figure 1.1 Map of Nepal with treatment (grey) and control (white) districts



We exploit the exogenous variations across groups and time to estimate the impact of the SDIP on prenatal care and neonatal mortality. The following equation summarizes our difference-in-differences model.

$$Y_i = \beta_1 District_i + \beta_2 Post_i + \beta_3 (District_i \times Post_i) + \boldsymbol{\alpha X} + \varepsilon_i \qquad [1]$$

i indexes individuals. Y denotes the respective outcome variable. $District_i$ is a dummy variable to indicate whether a woman resides in the treatment district. $Post_i$ is a dummy variable to indicate whether a woman is observed in the post-policy period. The coefficient on the interaction (i.e. β_3) indicates the impact of the SDIP on the outcome variable in question. β_1, β_2 and $\boldsymbol{\alpha}$, are parameters to be estimated and $\boldsymbol{X}$ is a vector of covariates described above. ε_i is the error term. We estimate Equation 1 using probit regressions, with normalized sampling weights and standard errors clustered by district.

1.4 Results

1.4.1 Descriptive Statistics

Prior to discussing the probit estimates, we describe changes in the outcome variable before and after the SDIP separately for treatment and control groups. Figures 1.3-1.7 illustrate changes in neonatal mortality, prenatal care, prenatal care from a doctor, prenatal care from a nurse/midwife and tetanus vaccination, respectively. The test of whether the percentage change was significant or not between each group is presented in Appendix B. Neonatal mortality (Figure 1.3) declined for the treatment group after implementation of SDIP, as opposed to the control group where neonatal mortality slightly increased. After the SDIP, prenatal care (Figure 1.4), prenatal care from a doctor (Figure 1.5), prenatal care from a nurse/midwife (Figure 1.6) and tetanus vaccination (Figure 1.7) increased in the treatment and control districts. Increases were much larger for the treatment group. As previously states, our goal is to determine whether these changes were plausibly caused by the SDIP, controlling for related factors.

Figure 1.3 Percent of Neonatal Mortality in Control and Treatment Districts, Before and After SDIP

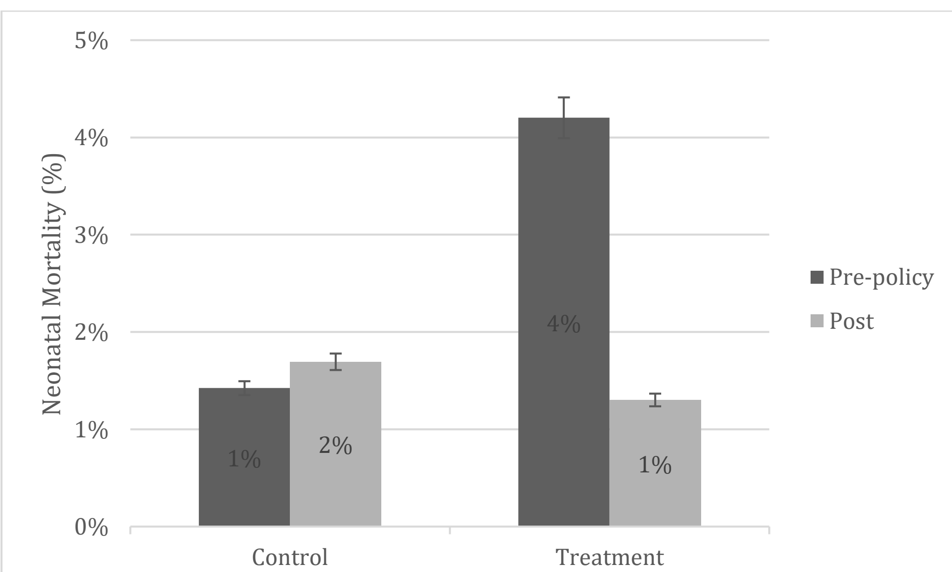


Figure 1.4 Percent of Mothers that Received Prenatal Care in Control and Treatment Districts, Before and After SDIP

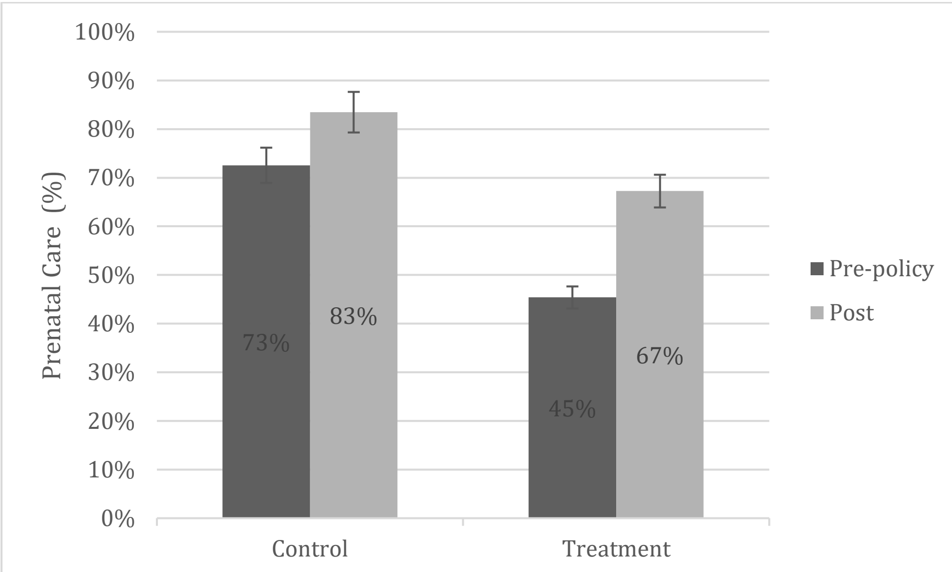


Figure 1.5 Percent of Mothers that Received Prenatal Care from a Doctor in Control and Treatment Districts, Before and After SDIP

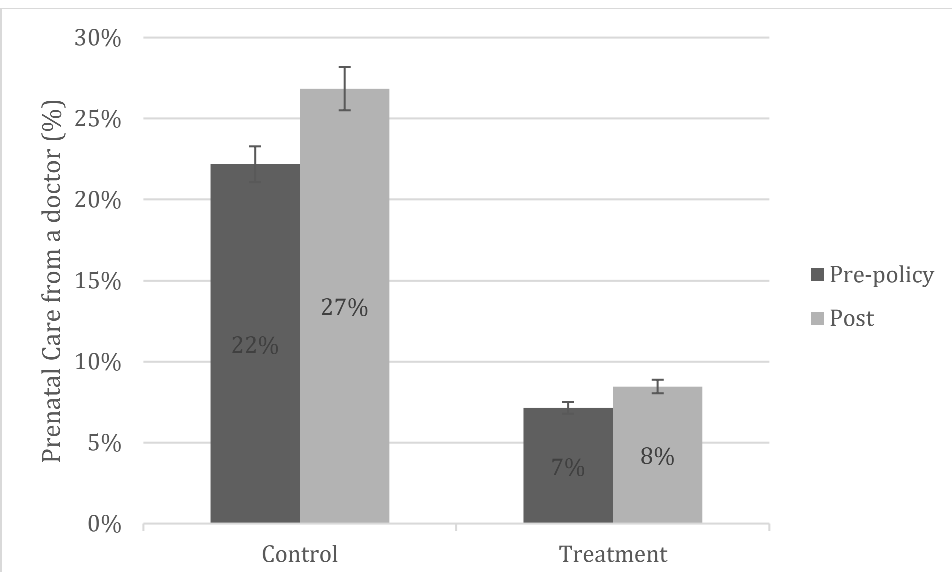


Figure 1.6 Percent of Mothers that Received Prenatal Care from a Nurse/Midwife in Control and Treatment Districts, Before and After SDIP

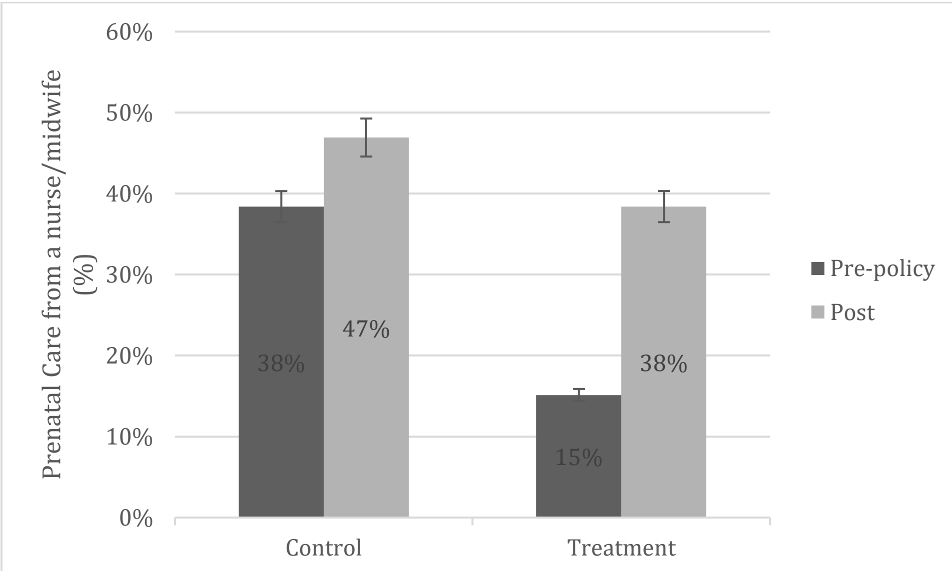
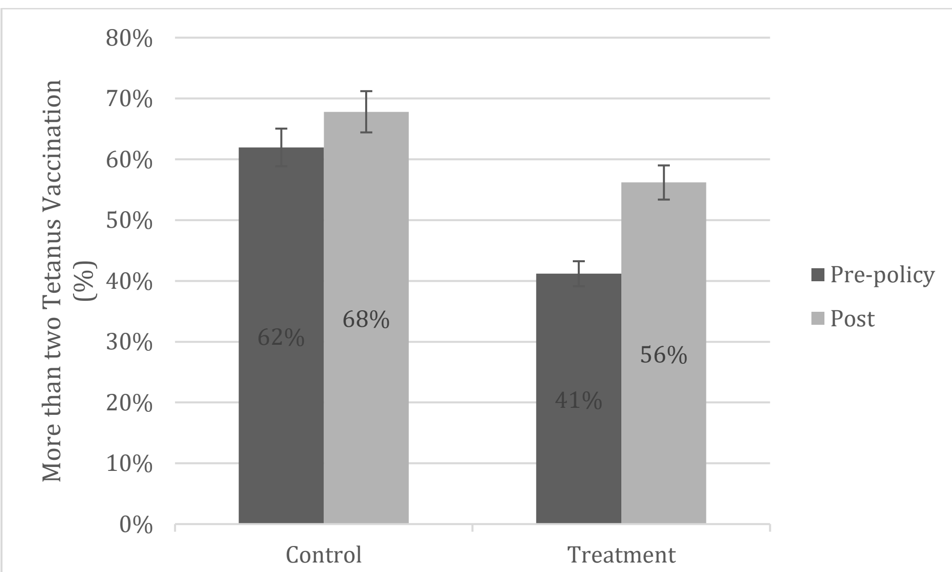


Figure 1.7 Percent of Mothers that Received Tetanus Vaccinations during Prenatal Care in Control and Treatment Districts, Before and After SDIP



Covariates listed in table 1.2 pertain to the mother's socio-demographic characteristics. The table contains means of covariates before and after SDIP in treatment and control groups. In the control group approximately, 75 percent of mothers are from a rural area versus 89 percent of mothers in the treatment group were from rural areas. In terms of ecological geography, 44 percent are from the terai region, 40 percent from the hills and 15 percent from the mountains. Between treatment and control group, pre and post SDIP, there seems to be no or very low statistically significant difference in terms of mothers' ecological region. Average age varies from 23 is 28 years between the subgroups. While a higher percentage of mothers are non-Hindu (Buddhist, Christian, Kirati and Muslim) in the treatment group (13 percent), post SDIP, less mothers in treatment groups were non-Hindu (5 percent). Percentage of mothers with no education remains consistent in treatment group before and after the policy, however, in the control group less mothers have no education after the SDIP. Approximately, 13 percent of mothers in all sub groups have some primary education. There is a big jump in percentage of mothers with complete primary education in the control group between the policy period. However, there is no statistically significant difference in the treatment group for mothers with complete primary education in the treatment group. In terms of secondary education, higher percentage of mothers were getting secondary education in both treatment and control group, pre and post SDIP. Also related to socio-economic status, less mothers in the control district were employed in a non-agriculture occupation post policy. However, in the treatment group more mothers were employed in a non-agriculture occupation post-policy. Non-agricultural occupation is an aggregation of professional, clerical, sales, services and manual labor (Appendix B). Higher percentages of mothers in the control group post-policy were unemployed compared to the treatment group where less mothers in the treatment group were unemployed. Given that lower percentages of mothers in the control group are from rural areas compared to mothers in the treatment group, percentage of mothers in the agriculture occupation did not change post-policy in the treatment group. Finally, in terms of ethnicity there were statistically significant difference in all subgroups, beside Brahmin.

Table 1.2 Means of covariates in treatment and control group, pre and post SDIP

	Control Group			Treatment Group		
	Pre	Post	Difference	Pre	Post	Difference
Mountain	0.1426	0.1249	0.0177*	0.2500	0.2941	-0.0441
	(0.0068)	(0.0075)	(0.0102)	(0.0280)	(0.0213)	(0.0357)
Hill	0.3903	0.3967	-0.0064	0.4542	0.4619	-0.0077
	(0.0094)	(0.0111)	(0.0146)	(0.0322)	(0.0233)	(0.0398)
Terai	0.4671	0.4784	-0.0114	0.2958	0.2440	0.0518
	(0.0097)	(0.0113)	(0.0149)	(0.0295)	(0.0201)	(0.0350)
Mother's age	28.2380	27.4466	0.7915***	23.5167	27.7386	-4.2219***
	(0.1254)	(0.1397)	(0.1892)	(0.2544)	(0.2938)	(0.4461)
Poor	0.4517	0.4440	0.0077	0.7083	0.7102	-0.0019
	(0.0096)	(0.0113)	(0.0148)	(0.0294)	(0.0212)	(0.0362)
Middle	0.1770	0.1840	-0.0069	0.1792	0.1765	0.0027
	(0.0074)	(0.0088)	(0.0115)	(0.0248)	(0.0178)	(0.0305)
Rich	0.3713	0.3720	-0.0008	0.1125	0.1133	-0.0008
	(0.0093)	(0.0110)	(0.0144)	(0.0204)	(0.0148)	(0.0253)
Unemployed	0.1632	0.2055	-0.0424***	0.1792	0.1089	0.0702***
	(0.0071)	(0.0092)	(0.0115)	(0.0248)	(0.0146)	(0.0270)
Ag Work	0.6557	0.6202	0.0354**	0.7625	0.7691	-0.0066
	(0.0092)	(0.0110)	(0.0143)	(0.0275)	(0.0197)	(0.0337)
Non-Ag Work	0.1811	0.1742	0.0069	0.0583	0.1220	-0.0637***
	(0.0075)	(0.0086)	(0.0114)	(0.0152)	(0.0153)	(0.0238)
No education	0.5883	0.4584	0.1299***	0.6875	0.6972	-0.0097
	(0.0095)	(0.0113)	(0.0147)	(0.0300)	(0.0215)	(0.0368)
Some Primary	0.1287	0.1387	-0.0100	0.1375	0.1002	0.0373
	(0.0065)	(0.0078)	(0.0101)	(0.0223)	(0.0140)	(0.0252)
Complete Primary	0.2081	0.2785	-0.0704***	0.1542	0.1438	0.0104
	(0.0079)	(0.0102)	(0.0126)	(0.0234)	(0.0164)	(0.0283)
Secondary	0.0749	0.1244	-0.0495***	0.0208	0.0588	-0.0380**
	(0.0051)	(0.0075)	(0.0087)	(0.0092)	(0.0110)	(0.0166)
Rural	0.7433	0.7508	-0.0075	0.8875	0.8911	-0.0036
	(0.0085)	(0.0098)	(0.0130)	(0.0204)	(0.0146)	(0.0250)
Brahmin	0.1246	0.1249	-0.0002	0.0875	0.0784	0.0091
	(0.0064)	(0.0075)	(0.0098)	(0.0183)	(0.0126)	(0.0218)
Chhetri	0.0329	0.1552	-0.1223***	0.0375	0.3660	-0.3285***
	(0.0035)	(0.0082)	(0.0081)	(0.0123)	(0.0225)	(0.0324)
Dalit	0.1471	0.0668	0.0803***	0.1958	0.0458	0.1501***
	(0.0069)	(0.0057)	(0.0094)	(0.0257)	(0.0098)	(0.0229)
Newar	0.0404	0.1310	-0.0906***	0.0208	0.2113	-0.1905***
	(0.0038)	(0.0077)	(0.0079)	(0.0092)	(0.0191)	(0.0272)
Janjati	0.5269	0.2158	0.3111***	0.4875	0.1046	0.3829***
	(0.0097)	(0.0093)	(0.0138)	(0.0323)	(0.0143)	(0.0306)
Muslim	0.0371	0.2523	-0.2153***	0.0625	0.1852	-0.1227***
	(0.0037)	(0.0098)	(0.0094)	(0.0157)	(0.0182)	(0.0275)

Table 1.2 Continued

Terai-Madhesi	0.0909	0.0540	0.0370***	0.1083	0.0087	0.0996***
	(0.0056)	(0.0051)	(0.0078)	(0.0201)	(0.0043)	(0.0157)
Non-Hindu	0.1317	0.1377	-0.0060	0.1000	0.0523	0.0477**
	(0.0065)	(0.0078)	(0.0102)	(0.0194)	(0.0104)	(0.0201)
Birth order	3.1995	2.7996	0.3999***	1.7042	3.0153	-1.3111***
	(0.0402)	(0.0419)	(0.0591)	(0.0518)	(0.0908)	(0.1311)
N	2672	1946	4618	240	459	699

1.5 Probit Results

Table 1.3 contains baseline probabilities marginal effects from the probit models assessed at sample means with dichotomous variables set to zero. Again, the difference-in-differences ($District_i \times Post_i$) estimator here represents the average causal treatment effect of SDIP on: neonatal mortality; prenatal care in general; prenatal care from a doctor; prenatal care by a nurse or a midwife; and tetanus vaccination. Note that causal inference relies on a number of assumptions, which are assessed in a later section.

Table 1.3 Probit marginal effect estimates for equation 1

	Neonatal Mortality	Prenatal Care	Doctor	Nurse/ Midwife	Tetanus Vaccines
Baseline	0.0104	0.8528	0.1655	0.3666	0.6850
$District_i$	0.0193*	-0.2329***	-0.1291***	-0.2232***	-0.1601**
	(0.0111)	(0.0572)	(0.0249)	(0.0419)	(0.0628)
$Post_i$	0.0081***	0.0543***	0.0083	0.0497**	-0.0150
	(0.0030)	(0.0184)	(0.0207)	(0.0251)	(0.0224)
$District_i \times Post_i$	-0.0098***	0.0792**	0.1158*	0.2322**	0.1453***
	(0.0034)	(0.0308)	(0.0700)	(0.0907)	(0.0387)
Mountain	-0.0013	0.0127	0.0006	0.0755	-0.0390
	(0.0035)	(0.0256)	(0.0309)	(0.0565)	(0.0400)
Terai	-0.0072**	0.1025***	-0.0280	-0.0313	0.1793***
	(0.0031)	(0.0271)	(0.0279)	(0.0328)	(0.0403)
Age	-0.0018	0.0114**	0.0132*	0.0051	0.0213**
	(0.0016)	(0.0055)	(0.0077)	(0.0106)	(0.0105)
Age^2	0.0000	-0.0002*	-0.0001	-0.0001	-0.0003*
	(0.0000)	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Poor	-0.0029	-0.0764***	-0.0582***	-0.1014***	-0.1139***
	(0.0044)	(0.0250)	(0.0221)	(0.0287)	(0.0255)

Table 1.3 Continued

Rich	0.0033	0.0324	0.1250***	0.1299***	-0.0107
	(0.0047)	(0.0218)	(0.0290)	(0.0304)	(0.0309)
Unemployed	0.0040	-0.0083	0.1210***	0.0059	-0.0151
	(0.0051)	(0.0288)	(0.0306)	(0.0307)	(0.0276)
Non-Ag Work	0.0148**	0.0056	0.0655**	0.0180	-0.0368
	(0.0068)	(0.0194)	(0.0270)	(0.0315)	(0.0274)
No Education	0.0075	-0.1008***	-0.0907***	-0.0634*	-0.1090***
	(0.0051)	(0.0197)	(0.0212)	(0.0330)	(0.0271)
Some Primary	0.0051	-0.0335	-0.0439**	0.0247	-0.0515*
	(0.0076)	(0.0276)	(0.0213)	(0.0281)	(0.0299)
Secondary	-0.0118***	0.1559***	0.0889**	-0.0408	0.0943***
	(0.0020)	(0.0163)	(0.0424)	(0.0401)	(0.0309)
Rural	0.0052	0.0028	-0.1251***	-0.1001**	0.0105
	(0.0036)	(0.0182)	(0.0278)	(0.0497)	(0.0252)
Chhetri	-0.0017	-0.0126	-0.0443**	-0.0096	-0.0131
	(0.0062)	(0.0439)	(0.0225)	(0.0397)	(0.0514)
Dalit	0.0139	-0.0958**	-0.0309	-0.0758*	-0.1639***
	(0.0139)	(0.0447)	(0.0305)	(0.0447)	(0.0518)
Newar	-0.0026	-0.0615	-0.0198	-0.1081***	-0.0779*
	(0.0071)	(0.0425)	(0.0292)	(0.0418)	(0.0462)
Janjati	0.0040	-0.1316***	-0.0344	-0.1569***	-0.1800***
	(0.0065)	(0.0422)	(0.0222)	(0.0377)	(0.0443)
Muslim	0.0025	-0.1131**	-0.0395	-0.1546***	-0.1472***
	(0.0072)	(0.0521)	(0.0272)	(0.0422)	(0.0517)
Teraimadh	0.0047	-0.1272*	-0.0196	-0.1351***	0.0010
	(0.0096)	(0.0737)	(0.0376)	(0.0522)	(0.0441)
Non-Hindu	-0.0029	-0.0352	-0.0239	-0.0320	0.0165
	(0.0035)	(0.0289)	(0.0188)	(0.0337)	(0.0353)
Birth order	-0.0011	-0.0372***	-0.0526***	-0.0286***	-0.0412***
	(0.0012)	(0.0048)	(0.0096)	(0.0087)	(0.0075)
N	5,317	5,317	5,317	5,317	5,317

Robust standard errors clustered by district are reported in parentheses unless otherwise indicated. Statistical significance is given by: * ten percent; ** five percent; and *** one percent.

1.5.1 Neonatal Mortality

First, we examine the relationship between SDIP and neonatal mortality. We find that, after the SDIP was implemented in the treatment districts, there was a lower probability of neonatal mortality by about 94 percent (i.e. 0.0098 on the baseline probability of 0.0104).

In terms of the covariates, neonates born to mothers in the terai region were less likely to die compared to those born to mothers in the hill region. Neonatal mortality in the mountain versus hill region, however had no statistically significant difference. Next, we examine the relationship between socio-economic characteristics of mothers and neonatal mortality. Neonates born to mothers with higher levels of education were less likely to die by one percent compared to neonates born to mothers who completed primary education. However, neonates born to mothers employed in non-agricultural sectors were more likely to die by one percent relative to mothers employed in the agricultural sector. The difference between neonates born to unemployed mothers versus those employed in the agriculture sector is not statistically significant. The relationship between neonatal mortality and the remaining covariates – age, wealth quintile, ethnicity, religion and birth order – is not statistically significant.

1.5.2 Prenatal Care

Our results indicate that the SDIP increased the likelihood of getting prenatal care – overall, as well as from a doctor, nurse/midwife and tetanus vaccination respectively – for mothers in the treatment districts in the post-policy period. Precisely, the policy increased the probability of getting prenatal care by nine percent (i.e. 0.079 on the baseline probability of 0.852). Similarly, the SDIP improved the probability of receiving prenatal care from a doctor and a nurse/midwife by 70 and 63 percent respectively. Consistent with the increased utilization of prenatal care mothers' vaccination against tetanus toxoid increased by 21 percent.

In terms of covariates, we find that mothers in the terai region are more likely to access prenatal care by 10 percent compared to mothers in the hill region. Furthermore, if mothers reside in a rural area, they are less likely to get prenatal care from a doctor or nurse/midwife by 13 and 10 percent respectively. While mothers in the poorest wealth quintile were less likely to access prenatal care – overall, as well as by a doctor, nurse/midwife and tetanus vaccination– mothers in richest wealth quintile were more likely to receive prenatal care from a doctor or a nurse/midwife, compared to those in the middle wealth quintile. Similarly, mothers with higher levels of education were more likely to access prenatal care, prenatal care from a doctor and tetanus vaccination by 16, eight and nine percent, respectively, compared to mothers with complete primary education. Conversely, mothers with lower levels of education (some primary) were less likely to get prenatal care from a doctor. Furthermore, mothers with no education were less likely to get any kind of prenatal care, from a nurse/midwife as well as tetanus vaccination by ten, six and 11 percent, respectively. Indigenous mothers (Janjati, Dalit, Muslim and Terai Madhesi) were less likely to get prenatal care overall, prenatal care from a nurse/midwife and immunization against tetanus, as opposed to Brahmin mothers. Finally, older mothers were more likely to get all components of prenatal care; however, higher birth orders were associated with lower levels of prenatal care (DHS, 2011). It is possible that higher birth orders are attributed with unwanted pregnancy, therefore mothers are less likely to seek prenatal care (DHS, 2011).

1.6 Robustness

Table 1.4 reports difference-in-differences estimators for various robustness checks compared to that reported earlier. We control for time trends, access to radio, mother's literacy, parity, exclusion of Kathmandu and father's education.

Table 1.4 Difference-in-differences Estimators for Robustness Checks

Robustness Model	Neonatal Mortality	Prenatal Care	Doctor	Nurse/ Midwife	Tetanus shots	N
Baseline	-0.0098***	0.0792**	0.1158*	0.2322**	0.1453***	5,317
	(0.0034)	(0.0308)	(0.0700)	(0.0907)	(0.0387)	
Time Trends	-0.6118*	0.3691**	0.4240*	0.5487**	0.4228***	5,310
	(0.3335)	(0.1859)	(0.2193)	(0.2358)	(0.1442)	
Radio	-0.0097***	0.0790**	0.1177*	0.2320**	0.1447***	5,317
	(0.0033)	(0.0310)	(0.0705)	(0.0908)	(0.0389)	
Literacy	-0.0112***	0.0837**	0.1054	0.2341***	0.1421***	5316
	(0.0036)	(0.0348)	(0.0686)	(0.0896)	(0.0390)	
Parity	-0.0100***	0.0894***	0.1015	0.2354**	0.1679***	5,317
	(0.0029)	(0.0282)	(0.0760)	(0.0988)	(0.0374)	
Exclude KTM	-0.0105***	0.0806**	0.0984	0.2249**	0.1395***	5,187
	(0.0036)	(0.0329)	(0.0644)	(0.0922)	(0.0394)	
Father's Education	-0.0098***	0.0826***	0.1174*	0.2324**	0.1420***	5,302
	(0.0032)	(0.0285)	(0.0674)	(0.0911)	(0.0384)	
Parallel Trends	0.0777	0.0343	-0.0674	0.0112	0.0496	2,536
	(0.0603)	(0.0413)	(0.0421)	(0.0890)	(0.0486)	

1.6.1 Time Trends

First, we add time trends. The purpose of this robustness check is to ensure that our base model is not only reporting general improvements in health outcomes over time, but also the impact of the SDIP. When we include year controls, signs remain consistent for all five outcomes. Significance changes to ten percent for neonatal mortality and remains consistent for others. The size of the effect of SDIP increases for all outcomes. We conclude that SDIP did have an impact on prenatal care and neonatal mortality.

1.6.2 Radio

Anecdotal evidence in Powell-Jackson et al (2012) suggests that radio was the primary means of disseminating information about the SDIP. Radio communication about SDIP leaves behind those who do not have access to radios. In this case, 47 percent of Terai/Madhesi women listened to radios compared to 67 percent mountain and hill mothers. Therefore, we hypothesize that mothers with a radio were more likely to hear about the policy, which could affect utilization of prenatal care and neonatal mortality. Compared to our base model, a control for radio has no impact on the size, sign and significance of the difference-in-differences estimator.

1.6.3 Literacy

Evidence suggests that, in developing countries, it is challenging to compare educational attainment since there is considerable variation in quality and access across regions: ‘completion of primary education’ does not have consistent meaning (Smith-Greenaway, 2015). Several researchers have recommended that ‘literacy’ is a more effective control (Smith-Greenaway, 2015 and Miller et al., 2017). Usually, information regarding policies are disseminated in pamphlets or posters, making the ability to read important. Thus, as a robustness, we replace educational attainment (main model) with literacy and we find that SDIP had no impact on prenatal care. We can infer that, as a result of unawareness, there were no significant effects of SDIP on prenatal care when we include literacy as a covariate. This result is particularly important in the context of mothers in marginalized group since they tend to have lower literacy rates (DHS, 2008).

1.6.4 Parity and Birth Complication

Lamichhane et al., (2017) present anecdotal evidence that the parity and birth complication restrictions were lifted, “precisely to ensure women with high parity can also utilize health services” (S Aryal, personal communication). They hypothesize that mothers with obstetric complications are highly price elastic to maternal care services. In this section, we assess the impact of the SDIP on our outcomes prior to the implementation of the parity restriction. We find that results are consistent besides the impact of SDIP on prenatal care from a doctor. Weak results in relation to a mother's access to prenatal care from a doctor is not surprising. Recall that Powell et al., (2012) and Witter et al., (2011) address the issue of weak governance and inadequate resources. Although women are eligible to receive free institutional and skilled birth delivery, slow implementation and lack of doctors had no effect on prenatal care.

1.6.5 Exclusion of Kathmandu

Given huge disparities in access to healthcare in Kathmandu versus the rest of the country, we exclude the capital as a robustness check (Lamichhane et al., 2017). This allows us to ensure that our control group is not conflated due to the inclusion of Kathmandu. While the impact of SDIP on neonatal mortality, prenatal care overall, from a nurse/midwife and tetanus vaccination remains consistent, the result is quite different for prenatal care from a doctor. There were no statistically significant differences between treatment and control groups post-policy in terms of prenatal care provided by a doctor. Also, other researchers find that SDIP had no impact on institution delivery when they performed a robustness check by excluding Kathmandu district (Lamichhane et al., 2017). Consequently, other researchers have found that access to roads had a significant effect in access to skilled birth attendance (Pradhan et al., 2017). This result validates our concern with SDIP regarding the persistent inequal provision of healthcare.

1.6.6 Father's Education

Finally, we control for the impact of father's education. Researchers have indicated that it is important to account for mother's autonomy since it affects her decision to seek medical care (Deo et al., 2015). Thus, we include father's education as a covariate to control for his influence and social status. We find the effect of the SDIP on our outcomes is consistent with the base model.

1.6.7 Assumptions of the Difference-in-differences Model

A difference-in-differences model allows us to examine average treatment effect of the SDIP on the outcomes of interest. It requires that the following assumptions hold: policy should not be determined by the outcome; composition of treatment and control group is consistent pre-policy and post-policy intervention; and treatment and control groups exhibit parallel trends prior to the intervention. We test the parallel trends assumption (Table 1.4). To do so, the period prior to the SDIP (2001-2004) was tested using equation 1. We conclude that there were no statistically significant differences between the treatment and control group prior to the implementation of SDIP.

1.7 Discussion

The SDIP program has been assessed by several researchers and there is empirical evidence on SDIP's relationship with institutional delivery and skilled birth attendance. Yet, there is limited empirical evidence on SDIP's relationship with prenatal care and neonatal mortality. Specifically, there is no evidence regarding the impact of SDIP on tetanus vaccination. This paper addresses the current gap in literature by providing empirical evidence on the effect of SDIP on prenatal care and neonatal mortality. Moreover, there have been expansions to the SDIP with limited empirical evidence therefore it is important to address the existing gaps (Aryal, n.d.).

We exploit the exogenous financial shock, the availability of free delivery to all mothers in the treatment district, to assess the impact on the use of prenatal care and on the impact on neonatal mortality. In this paper, we find that free delivery improved mothers' chances of receiving prenatal care and decreased the likelihood of neonatal deaths. As such, this paper adds to prior evidence that SDIP not only increased skilled birth attendance and institutional deliveries but also improved average mothers' likelihood of getting prenatal care (supported by this study). Perhaps mothers' first point of contact, prenatal care, further influences mothers to go back for an institutional delivery. Agglomeration of these choices by mothers influence the reduction of neonatal mortality.

Also, vaccinations against tetanus provided during prenatal care is instrumental for the survival of both mother and neonates. This paper provides evidence that SDIP increased the likelihood of a mother's immunization against tetanus, thus decreasing the likelihood of neonatal mortality caused due to neonatal tetanus. Furthermore, we can speculate that those who get vaccinated during prenatal care are also motivated to come back for an institutional delivery. Thus, fewer mothers deliver at home, which is usually where they are exposed to rusted equipment and unsanitary delivery condition.

In congruence with existing literature, our model also demonstrates that mothers from poorer households were less likely to receive prenatal care as well as its components (Deo et al., 2015 and Finlayson et al., 2013). Therefore, free delivery care removed a substantial financial burden associated with institutional delivery costs. Recall that poorer households are highly price elastic to child healthcare costs. As such, this 'extra' income relaxes the household's budget constraint, which allows mothers to seek prenatal care to produce health for herself and for her infant. Therefore, SDIP has not only increases institution delivery (Pradhan et al., 2017 and Lamichhane at al., 2017) but also increases prenatal care (as per this study). However, there is a caveat to the success of SDIP.

Past studies have demonstrated that inequality continues to exist in Nepal (Borghi et al., 2006; Powell-Jackson et al., 2012; Deo et al., 2015; Bhatt et al., 2018 and Pradhan et al., 2017). Marginalized and vulnerable populations face the highest mortality and healthcare access challenges. Furthermore, our model also demonstrates that neonatal deaths are higher among women who are less educated, employed in nonagricultural industries and among those that do not live in the terai. Prenatal care is challenging for those who are less educated, are from the poorest wealth quintile, reside in a rural area, or belong to an Indigenous group. Policy makers should be aware of such inequalities especially at the prenatal care stage because as we progress through the maternal care process – prenatal care, delivery and postnatal care – we lose mothers' participation and neonates born to mothers from marginalized populations along the process. If policy makers do not address issues of limited access to prenatal care, especially for those in marginalized ethnic groups, lower income families, mothers with lower levels of education and those that reside in regions with challenging terrain, inequality will continue to grow. A study reports that although SDIP addresses financial barrier as a major constraint for mothers, if implementation of the SDIP is not improved, women in excluded groups will continue to be left behind due to economic barriers. Further, the excluded groups face challenges such as illiteracy and lower social status besides just income barriers, which continues to create inequality (DHS, 2008).

As other researchers have mentioned in previous studies, our model is based on 'intent to treat estimates' (Lamichhane et al., 2017 and Pradhan et al., 2017). We do not capture whether a mother got free delivery care because of SDIP. However, researchers can use propensity score matching to generate the probability of being treated given the pre-treatment characteristics of mothers. The slow nature of implementation of the SDIP with bureaucratic and practical difficulty is not reported in these estimates. Slow implementation also means mothers in treatment districts may not have accessed free delivery care immediately after the policy was implemented.

We are especially unaware about the quality of care received by those that are in disadvantaged populations. Although mothers receive prenatal care, we do not have adequate information to make conclusions about where she received the care. As such, we cannot provide recommendations on which districts require more quality care; for instance, some districts may require more doctors or more hospitals. Further, in this study we do not estimate the direct impact of prenatal care on neonatal mortality. This could be addressed in future work.

Another limitation of this study is migration. Unfortunately, we do not observe the birthplace of the child. Thus, our estimates are based on mother's residence district. Treatment districts have very low HDI; it would therefore be unconventional for mothers to migrate to difficult terrains with poorer living conditions for free delivery care. But we can expect outmigration from the treatment districts to urban areas. Therefore, our results may underestimate the effect of this policy since we do not observe if the mother received free delivery and if she migrated. Additionally, we are unable to measure the impact on this policy on maternal mortality due to the constraints of the dataset. Finally, if we test for statistically significant difference between our main estimates and robustness checks, it will allow us to make stronger conclusions about the effect of controlling for radio, literacy, parity, Kathmandu, father's education.

1.8 Conclusion

Despite several limitations, this study addresses an existing gap in literature: the impact of SDIP on prenatal care. While we have been attributing the success of decline in neonatal mortality to institutional delivery and skilled birth attendance, it is critical to pay attention to the potential impact of prenatal care on neonatal mortality, especially because majority of neonate deaths are attributed to infections such as neonatal tetanus. Although Nepal reached neonatal tetanus elimination status, a recent study demonstrated that in recent years deaths due to neonatal tetanus has indeed increased. Therefore, immunization against tetanus, which is provided to mothers during prenatal care, is equally important. In this study we provide evidence that SDIP led to an increase in prenatal care utilization and decrease in neonatal mortality. We infer that decreased neonatal mortality is a product of increase in institutional delivery as well as increased prenatal care.

There are several implications to this result. First, we find that after certain financial barriers are removed, Nepali mothers opted to consume maternal care (prenatal care) to produce health for both mother and infant. This result leads us to our second conclusion: given multiple South Asian countries are attempting to change mothers' behavior through various cash incentives, the removal of financial barriers seems to be effective. However, a blanket policy will not help address global and national issues of maternal and neonatal mortality. If global actors and nations hope to see a sustainable change in neonatal and maternal mortality, policy makers must not only address existing financial barriers but must also pay special attention to barriers that affect marginalized populations. Therefore, policy-makers ought to address other barriers and incorporate policies that address inequalities in the society for a sustainable and substantial decline in neonatal and maternal mortality.

CHAPTER 2

ASSESSING PERFORMANCE OF A PRIVATE HOSPITAL IN NEPAL: EVIDENCE FROM PABON LASSO AND REGRESSION MODELS

2.1 Introduction

In developing countries, such as Nepal, many people believe the private (versus public) sector delivers better health care (Andaleeb, 2000). Indeed, the majority of health expenditures in Nepal come from private households (RTI International, 2010). This is consistent with a shift in the public-private mix of hospitals across time. For example, the share of private hospitals in Nepal increased from 23 to 78 percent since 1995. Moreover, the private sector now provides many services that were historically public, such as maternal and child care and infectious disease control (RTI International, 2010). Nevertheless, there is limited empirical evidence on the performance of private hospitals in Nepal, especially as related to management.[3] This is despite the fact that evidence-based decision making is important for the efficient delivery of health care (Liang et al., 2017). We address this gap in the literature by examining the relationship between management and performance using Grande International Hospital (GIH) as a case study.

Established in 2010 (and providing inpatient services since 2013), GIH is part of the large and growing share of private hospitals in Nepal. It is located in Kathmandu and offers multi-specialty preventative and curative health care services. GIH complies with the Joint Commission International patient safety goals and, as such, has forged a new standard of care in Nepal in terms of improved sanitation, technology and accessibility. For example, compared to public hospitals where the use of new technology is lagging, GIH uses advanced sterilization techniques and a

[3] There is evidence that management strategies affect hospital performance in other contexts (Gholipuri et al., 2013; Kalhor et al., 2014; Aij et al., 2015). For example, Gholipour et al. (2013) assess this relationship across gynecology teaching hospitals in Iran. They find that hospitals run by a board of trustees performed better [3].

reverse osmosis water purification system (The Himalayan Times, 2017). Moreover, along with ten operating rooms and 50 critical care units, it has a four-dimensional cardiovascular ultrasound, digital broadband magnetic resonance system, bone densitometer and catheterization laboratory. In terms of accessibility, GIH has an emergency medical team to rescue patients from any part of the country with an air and road ambulance service. It also provides preventative care, a help desk for foreign-born patients (i.e. for help with insurance and paperwork) and free clinics for those who cannot afford health care. In 2016, Frost & Sullivan named GIH as 'Hospital of the Year' (Business360, n.d.). Given the importance of GIH to health and health care in Nepal, it is important to assess its performance and drivers thereof. Moreover, as a leading private hospital in Nepal, it is well-positioned to establish best practices for other private hospitals in the country and similar contexts.

Our objective is to examine the relationship between management and performance of private hospitals in Nepal using GIH as a case study. To do so, we compare the performance of GIH across five management strategies, ranging from January 2013 to August 2017. The strategies are summarized in Table 2.1. The first (S1) was an extreme case of Chief Executive Officer (CEO) duality where the CEO was the Chairperson of the board of directors and a major shareholder. Under the second and third management strategies (S2 and S3, respectively), GIH had an independent board. In both cases, the CEO was an outside contractor, however the S2 CEO had 20 additional years of management experience compared to the S3 CEO. Under the fourth management strategy (S4), the Medical Director, who was also a member of the board, managed GIH without a CEO. Finally, under the fifth management strategy (S5), the CEO was independent from the board of directors as in S2 and S3. However, in this case, two CEOs shared the position, and both simultaneously managed other hospitals.

We use a Pabon Lasso model to compare hospital performance under these very different strategies via bed occupancy rate (BOR), bed turnover rate (BTR) and average length of stay (ALOS) (Lasso, 1986). To complement this analysis, we estimate the effect of each strategy on LOS in a regression framework (Aij et al, 2015; Tripathi et al., 2016; Lotfi et al., 2014). Using this multifaceted approach, our goal is to support evidence-based decision making and best practices for private hospitals in Nepal and similar contexts.

Table 2.1: Management Strategies

Management Strategy	Start Date	End Date	Description
S1	January 3, 2013	April 1, 2014	CEO duality; CEO was Chairperson of the board
S2	April 1, 2014	June 30, 2014	Independent board Outside CEO with 20 additional years of management experience compared to S3
S3	July 15, 2014	April 25, 2015	Independent board Outside CEO with 20 fewer years of management experience compared to S2
S4	April 25, 2015	June 24, 2016	GIH managed by Medical Director, who was also a member of the board
S5	June 24, 2016	August 2, 2017	Independent board Two CEOs simultaneously managed other hospitals

2.2 Methods

GIH provided us with inpatient data ranging from 2013 to 2017. To our knowledge, we are the only researchers who have access to these data, which contain information about the patient's country of origin, age, gender, admit and discharge dates, treatment department, diagnosis and surgery procedure. The timeline also includes two external shocks: a major earthquake and a political blockade.[4]

To assess the performance of GIH across management strategies, we use a Pabon Lasso model to simultaneously analyze three indicators: BOR; BTR; and average LOS. This graphical approach has been used largely in developing countries such as Iran, Malawi and Philippines (Gholipuri et al., 2013; Kalhor et al., 2014; Aeenparast et al., 2015). For example, Kalhor et al. (2014) use a Pabon Lasso model to assess the performance of six public hospitals in Iran (Kalhor et al., 2014). According to Lasso (1986), researchers should compare across a homogenous group of hospitals since size may affect all three performance indicators (Lasso, 1986). Following this recommendation, we focus only on GIH and compare across the five management strategies.

In our model, BOR is represented on the x-axis and measures the percentage of beds filled during the strategy. The value is derived by taking the ratio of inpatient days and bed days available (i.e. number of hospital beds × number of days the strategy was in place). BTR is represented on the y-axis and measures the number of times each bed changes occupants. The value is derived by taking the ratio of the number of discharges during the strategy and the number

[4] A blockade imposed by India impacted the transportation of supplies including medicine, fuel and equipment to Nepal, which made it difficult to provide quality health care [12].

of bed available, which is 200. The graph is divided into four quadrants where the borders are defined by average BOR and average BTR.[5] The four quadrants are characterized as follows:

- Quadrant I – low BOR and BTR, indicating underutilization of hospital resources;
- Quadrant II – low BOR and high BTR;
- Quadrant III – an ideal situation in which BOR and BTR are both high;
- Quadrant IV – high BOR and low BTR, representing longer hospital stays with limited changes in bed occupants.

In addition to BOR and BTR, we present average LOS in a separate bar graph. It measures how many days a patient spends in the hospital, on average.[6]

To complement the Pabon Lasso model, we estimate the effect of each management strategy on LOS in a regression framework as outlined in Equation 1. Y is LOS in days. β_j captures the effect of management strategy S_j on LOS for j= [2, 3, 4, 5]. The base group is S1, however we explore alternate base groups in the Appendix C. **X** is a vector of controls for country of origin (i.e. native-born or not), dummy variables for age compared to the base group of 25 to 58, gender, whether the patient had surgery and treatment department compared to general surgery. We also control for the earthquake and political blockade, as well as time via dummy variables for month and year. α consists of parameters to be estimated and ε is the error term. We estimate Equation 1 using Ordinary Least Squares.

[5] Lasso (1986) cautions researchers about using means to create the quadrants when comparing across hospitals as they may be skewed by high BOR in single-specialty hospitals, such as psychiatric hospitals [9]. We argue this is not an issue in our work since we are comparing across management strategies in a single hospital.
[6] In variations of the Pabon Lasso model, average LOS can be represented by diagonal lines passing through the origin of the BOR/BTR graph (Kalhor et al., 2014).

$$Y = \sum_{j=2}^{5} \beta_j S_j + \boldsymbol{\alpha X} + \varepsilon \qquad \text{Equation 1}$$

In both the Pabon Lasso and regression models, we focus on patients who stayed at GIH for less than or equal to 38 days (Appendix D) since this is the 99th percentile of LOS.[7] While doing so, we drop 228 observations. The majority of these dropped observations were native-born (226) male (168) patients who were treated in the Orthopedics department (84) followed by Department of Neuro Sciences (37). We also drop observations for whom there was an obvious data entry error (e.g. a 300-year-old individual) or missing key information (e.g. age, gender, treatment department). Our sample consists of 23,081 observations, of whom 22,698 are native-born and 383 are foreign-born. We perform all analyses separately for these groups, as well as for the full sample of patients. It is important to distinguish between native-born and foreign-born patients because there are likely differences in the nature of care received. For example, foreign-born patients may be visiting Kathmandu and are more likely to seek emergency versus preventative care.

2.3 Results

2.3.1 Pabon Lasso Model

Figures 2.1, 2.2 and 2.3 contain results of the Pabon Lasso model, which we use to compare BOR and BTR across management strategies. We find that, under S1, GIH was in Quadrant I for all patients. This is characterized by low BOR and BTR, indicating underutilization of hospital resources. BOR increased and BTR declined under S2. Specifically, GIH moved to Quadrant IV, which is characterized by longer hospital stays with limited changes in bed occupants. Under S3,

[7] As a robustness check, we estimated Equation 1 with different censors on LOS. The narrative was unchanged. Results are available upon request.

GIH remained in Quadrant IV for native-born patients, but moved to Quadrant III for foreign-born patients. As described above, this is efficient with high BOR and BTR. Next, we find a reduction in BOR under S4, especially for foreign-born patients. Specifically, GIH moved to Quadrant II, which is demonstrative of "unnecessary hospitalization, an oversupply of beds or the use of beds for simply observing patients" (Tripathi et al., 2016). Finally, we find that GIH operated efficiently under S5, especially for native-born patients. BOR and BTR were both high, indicating fewer unused beds and unnecessary hospitalizations.

Figure 2.1 BOR and BTR by Management Strategy – All Patients

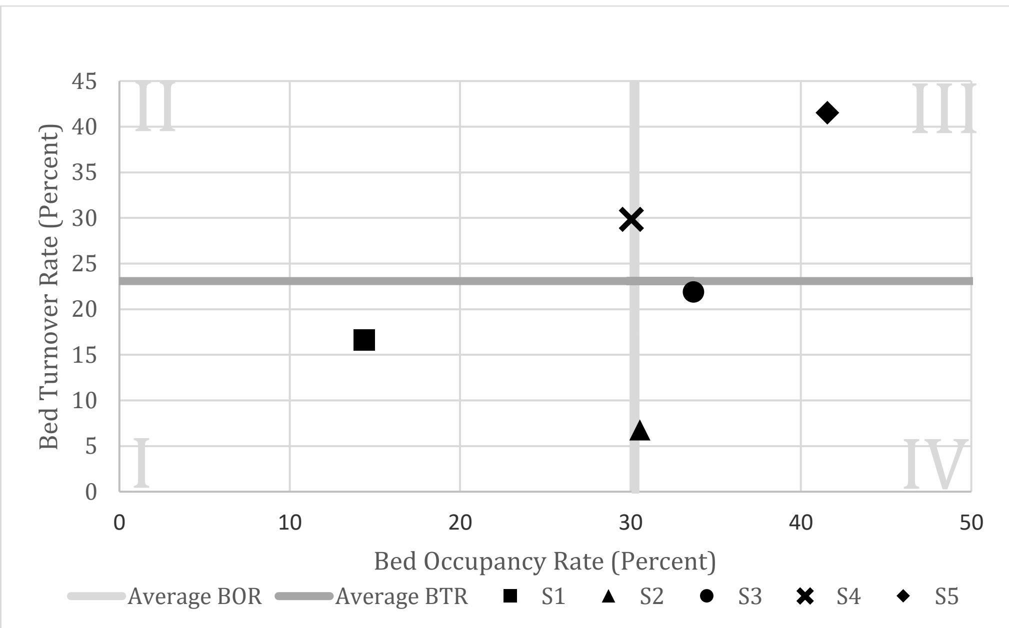


Figure 2.2 BOR and BTR by Management Strategy – Foreign-Born Patients

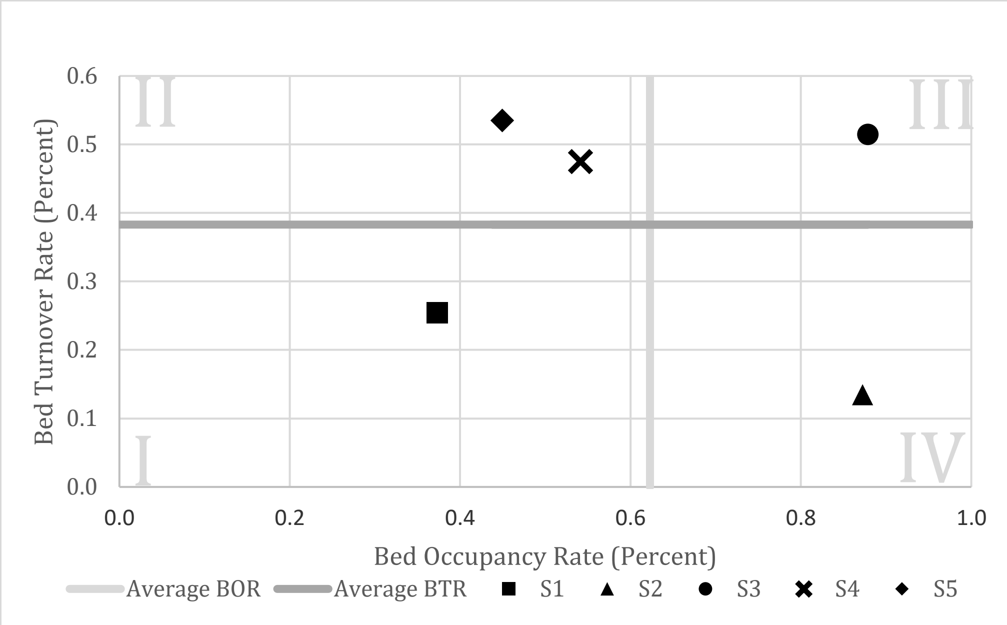
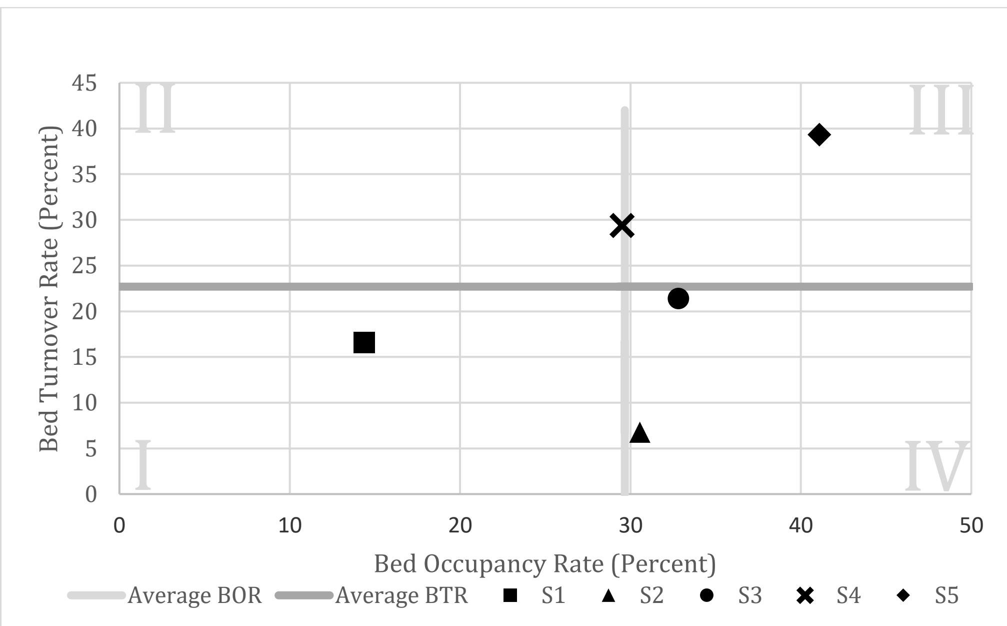
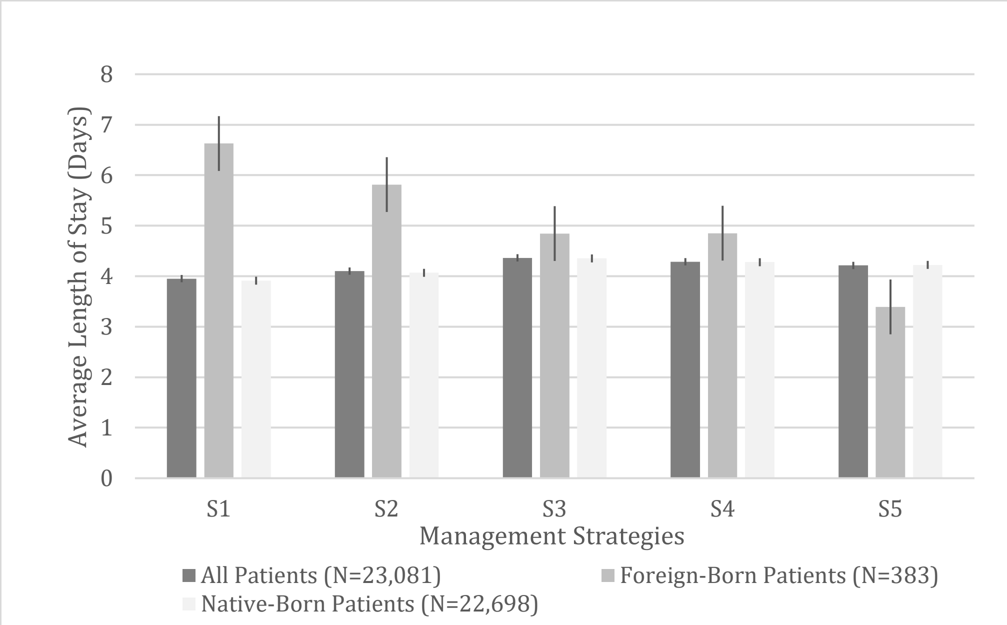


Figure 2.3 BOR and BTR by Management Strategy – Native-Born Patients



In addition to BOR and BTR, we consider how average LOS varies by management strategy in Figure 2.4. For native-born patients, it was lowest under S1 and highest under S3. For foreign-born patients, average LOS was lowest under S5 and highest under S1.

Figure 2.4 Average LOS by Management Strategy – All, Foreign-Born and Native-Born Patients



2.3.2 Regression Model

Table 2.2 contains selected Ordinary Least Squares estimates of Equation 1, by which we examine the relationship between management strategies and LOS in a multivariate framework (Appendix E contains the full regression results). Unlike the Pabon Lasso model, this approach allows us to control for other factors that affect LOS (i.e. patient characteristics, treatment department, earthquake, political blockade and time).

Table 2.2: Ordinary Least Squares Estimates of LOS – All, Foreign-Born and Native-Born Patients

	All Patients	Foreign-Born Patients	Native-Born Patients
Mean (Standard Deviation)	4.216	4.747	4.207
	(4.801)	(4.737)	(4.802)
Strategy 2	-4.801***	-3.786*	-4.675***
	(1.506)	(2.232)	(1.541)
Strategy 3	-3.783***	0.0419	-3.681**
	(1.436)	(2.085)	(1.472)
Strategy 4	-0.715	-3.383*	-0.540

	(0.719)	(2.020)	(0.737)

Table 2.2 Continued

Strategy 5	-0.273	-2.613	-0.0845
	(0.851)	(2.364)	(0.868)
Native-Born	-0.224	_	_
	(0.245)		
Age ≤ 5	-0.694***	-7.704***	-0.614***
	(0.193)	(1.979)	(0.193)
6≤ Age ≤17	-0.720***	-2.832*	-0.738***
	(0.112)	(1.491)	(0.113)
18≤ Age ≤24	0.00418	1.879*	-0.0366
	(0.115)	(1.032)	(0.115)
Age >58	1.258***	1.994**	1.234***
	(0.0810)	(0.770)	(0.0815)
Female	-0.362***	0.266	-0.369***
	(0.0666)	(0.478)	(0.0673)
Surgery	0.157*	1.974***	0.127
	(0.0806)	(0.697)	(0.0813)
Cardiology and Cardiac Surgery	-1.283***	1.697	-1.305***
	(0.146)	(1.244)	(0.148)
Cardiothoracic and Vascular Surgery	0.957***	1.958	0.993***
	(0.370)	(1.665)	(0.376)
Critical Care Medicine	2.101***	_	2.077***
	(0.240)		(0.240)
Dentistry and Dental Surgery	1.571**	7.436	1.306*
	(0.750)	(5.394)	(0.733)
Department of Neuro Sciences	2.661***	5.386***	2.634***
	(0.186)	(1.464)	(0.188)
Ear, Nose, Throat, Head and Neck Surgery	-1.539***	2.181	-1.538***
	(0.103)	(1.567)	(0.103)
Emergency Medicine	-4.391***	2.466	-4.085***
	(0.620)	(1.523)	(0.469)
Endocrinology and Diabetology	-0.0737	6.994***	-0.118
	(0.236)	(1.128)	(0.235)
Gastroenterology and Hepatology	-0.312***	1.272	-0.322***
	(0.121)	(1.159)	(0.122)
Geriatric Medicine	-1.457***	_	-1.458***
	(0.217)		(0.220)
Infectious Diseases	2.670	_	2.648
	(1.952)		(1.949)
Internal Medicine	0.446	1.473	0.843**
	(0.333)	(1.200)	(0.379)
Neonatal Critical Care	0.964*	_	0.850
	(0.555)		(0.558)
Nephrology and Transplant Medicine	0.802***	3.061**	0.781***

	(0.152)	(1.422)	(0.153)
Obstetrics and Gynecology	-0.274***	2.314*	-0.327***
	(0.101)	(1.250)	(0.100)
Oncology	-0.215	_	-0.226
	(0.236)		(0.236)
Ophthalmology and Vision Sciences	-2.286***	_	-2.287***
	(0.324)		(0.323)
Orthopedics and Traumatology	1.430***	2.458**	1.443***
	(0.124)	(1.158)	(0.126)
Pediatrics and Neonatology	1.427***	10.89***	1.292***
	(0.196)	(2.146)	(0.195)
Plastic, Reconstructive and Cosmetic Surgery	2.093***	3.200	2.112***
	(0.571)	(1.944)	(0.588)
Psychiatry	0.359	-1.690	0.340
	(0.335)	(2.315)	(0.338)
Pulmonary Medicine	0.968***	2.544*	1.170***
	(0.323)	(1.355)	(0.350)
Radiology and Interventions	-2.493***	_	-2.488***
	(0.174)		(0.179)
Urology and Kidney Transplant Surgery	-0.979***	0.956	-0.978***
	(0.103)	(1.734)	(0.104)
Earthquake	-0.543	_	-0.547
	(0.622)		(0.623)
Political Blockade	-0.344	2.456	-0.370
	(0.316)	(3.752)	(0.318)
N	23,081	383	22,698
R-Squared	0.089	0.358	0.090

We also control for time via dummy variables for month and year. Robust standard errors are reported in parentheses unless otherwise indicated. Statistical significance is given by: * ten percent; ** five percent; and *** one percent.

Compared to the base group of S1, S2 had the lowest LOS.[8] For example, being treated under S2 reduced LOS by 4.8 days, on average. The effect is slightly larger for native-born versus foreign-born patients. Interestingly, LOS was also shorter under S3 compared to S1 for native-born patients (i.e. 3.7 days), but there was no effect on foreign-born patients. On the other hand, LOS was shorter under S4 versus S1 for foreign-born patients (i.e. 3.4 days), but there was no

[8] The Appendix C contains estimates with alternate base groups, and the narrative is largely unchanged. For example, compared to the base group of S2, LOS is longer under all other strategies.

effect on native-born patients. The difference between S5 and S1 is not statistically significant, regardless of patient group.

In terms of control variables, Table 2.2 indicates that children and youth (i.e. those younger than 18) stayed in the hospital for fewer days compared to those aged 25 to 58. On the other hand, LOS is 1.25 days longer for older patients, on average. We also find that LOS is marginally shorter for females and longer for individuals who had surgery. Moreover, patients in the following departments had a shorter LOS compared to general surgery: Cardiology and Cardiac Surgery; Ear, Nose, Throat, Head and Neck Surgery; Emergency Medicine; Gastroenterology and Hepatology; Geriatric Medicine; Obstetrics and Gynecology; Ophthalmology and Vision Sciences; Radiology and Interventions; Urology and Kidney Transplant Surgery. Conversely, LOS is longer for patients in: Cardiothoracic and Vascular Surgery; Critical Care Medicine; Dentistry and Dental Surgery; Department of Neuro Sciences; Neonatal Critical Care; Nephrology and Transplant Medicine; Orthopedics and Traumatology; Pediatrics and Neonatology; Plastic, Reconstructive and Cosmetic Surgery; and Pulmonary Medicine. Finally, coefficients related to the earthquake and political blockade are not statistically significant, but remain in the analysis because, if omitted, may bias coefficients on management strategies (i.e. these events are plausibly related to both management strategies and LOS).

2.4 Discussion

2.4.1 Statement and Interpretation of Principal Findings

Health care has been changing in Nepal, with a large and growing share of private hospitals (RTI International, 2010). Yet, there is limited empirical evidence on the relationship between management and performance of these organizations. We address this gap in the literature using

GIH as a case study. Our goal is to support evidence-based decision making and best practices for private hospitals in Nepal and similar contexts.

Using a Pabon Lasso model, we find that BOR and BTR were low under S1 (i.e. CEO duality), perhaps reflecting the challenges of starting inpatient services. Under S2, in which the board was independent from an experienced CEO, GIH had a high BOR and low BTR. However, with a less experienced CEO under S3, GIH performed better for foreign-born patients. This may be attributed to surrogate mothers from India, a large number of whom came to GIH for labor and delivery and then were discharged during this period. Under S4, during which GIH was managed by the Medical Director, it experienced low BOR and high BTR. This is likely due to the major earthquake and political blockade that occurred during the period (e.g. GIH was unable keep adequate records during the earthquake, which could mirror "unnecessary hospitalization" and an "oversupply of beds"). Finally, we find that GIH performed best under S5, during which there were two CEOs who were independent from the board of directors. This is consistent with evidence that autonomy allows for expedient decision-making in allocating resources (Gholipuri et al., 2013). However, it is important to note that, while GIH faced challenges under other strategies (i.e. first year of inpatient services, earthquake, political blockade), it did not under S5. These differences cannot be addressed in the Pabon Lasso model. Given this limitation, we compare findings from the Pabon Lasso model to those of a regression analysis, in which we control for other factors that affect hospital performance. We find that LOS was lowest under S2. This is inconsistent with the Pabon Lasso model, which suggests it was lowest under S1 for native-born patients and S5 for foreign-born patients.

Taken together, our results suggest important differences in hospital performance by indicator (i.e. BOR, BTR versus LOS), patient type (i.e. native-born versus foreign-born) and analytical approach. In terms of the latter, both models are consistent with agency theory, which suggests that separation between the CEO and board promotes better performance. However, results from the Pabon Lasso model also support stewardship theory, which suggests that CEO duality is essential to "unify and to remove ambiguity from firm leadership" (Ramdani et al., 2010). We argue that, when it comes to evaluating management strategies, private hospitals in Nepal and similar contexts should consider evidence from more than one analytical approach, as well as important differences by performance indicator and patient type.

2.5 Strengths and Weaknesses

A strength of this work is that we use unique data (to our knowledge, we are the only researchers with access) to inform an issue that is not well-understood. This is important for the efficient delivery of health care in Nepal and other developing countries where private hospitals are increasingly influential. Another strength is that we consider contextual differences (e.g. native-born versus foreign-born) and use more than one analytical approach. The latter is important because we cannot control for confounding factors in the Pabon Lasso model. In other words, the Pabon Lasso model is useful for describing differences, but we cannot infer whether they are attributable to management strategies or coinciding factors (e.g. patient characteristics, time, earthquake, political blockade). This is possible, to some extent, in the regression analysis. Nevertheless, our results are correlational and should be interpreted as such.

In terms of weaknesses, we cannot assess quality of care and are missing data related to costs, readmissions and deaths. The latter are required for data envelopment analysis, which is a more common approach to assessing hospital performance; it is used by 48 percent of studies (Hollingsworth, 2008). This technique would allow us to understand the "complex nature of the relations between the multiple inputs and multiple outputs involved in many activities" (Cooper et al., 2007). Also, the inclusion of financial metrics might change our conclusion on the best strategy for the hospital. For example, length of stay for foreign-born patients and native-born patients would affect hospital income differently. Perhaps, for financial advantage, the hospital might target certain patient-types based on a profit motive. Specially, medical tourism has gained popularity in recent years, researchers should be aware of the impact of medical tourism, financial gain received from medical services to foreign-born patients and length of stay (British Broadcasting Corporation, 2010). However, in the absence of financial metrics, we refer to past Lasso studies and make appropriate conclusions solely based on BOR and BTR (Gholipuri et al., 2013; Kalhor et al., 2014; Aeenparast et al., 2015). Also, we our sample size for foreign-born patients is very low compared to native-born patients which bias our regression results. Another limitation is that we are missing inpatient data due to the earthquake. This distorts our results. For example, GIH had a low BOR under S4, but the reality was likely quite different. Finally, our analysis pertains to inpatients at a leading hospital in Kathmandu, Nepal. Readers should keep this in mind when generalizing results to other patient groups (e.g. outpatients), in less established hospitals, more rural areas and/or other developing countries.

2.6 Meaning and Future Research

Our results indicate that separation between the CEO and board may promote better performance (except the Pabon Lasso model favors CEO duality under S1 for average LOS among native-born patients). Perhaps more importantly, we provide evidence that more than one analytical approach should be used to assess hospital performance. For example, although the Pabon Lasso model is useful for describing differences, we cannot infer whether they are attributable to management strategies or coinciding factors. This is addressed by the regression analysis, to some extent, and hospitals might consider collecting data on confounding factors (i.e.

those that are related to both hospital management and performance) and other missing information described above. They might also consider standardization (e.g. current procedural terminology) to enhance the external validity of the analysis.

2.7 Conclusion

The importance of private hospitals in Nepal and other developing countries has been growing in recent years. However, there is limited empirical evidence on their performance, especially as related to management. Our results indicate that separation between the CEO and board may promote better performance, but there is variation by indicator (i.e. BOR, BTR versus LOS), patient type (i.e. native-born versus foreign-born) and analytical approach. We argue that, when it comes to evaluating management strategies, private hospitals in Nepal and similar contexts should consider these important differences.

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APPENDIX A
LIST OF VARIABLES AND RECODING

Covariates	DHS Variable	Coding
$District_i$	sdist	Control District=0 and Treatment District=1
$Post_i$	-	Pre-policy=0 and Post-Policy=1
$District_i \times Post_i$	-	Interaction between $District_i \times Post_i$
Mountain	sreg	Mountain=1 if sreg=1, Mountain==0 otherwise
Hill	sreg	Hill=1 if sreg=2, Hill==0 otherwise
Terai	sreg	Terai=1 if sreg=3, Terai==0 otherwise
Age	v012	v012
Age^2	v012	$(v012) \times (v012)$
Wealth Index:Poor	v190	Poor=1 if v190==1 | v190==2, Poor==0 otherwise
Wealth Index:Middle	v190	Middle=1 if v190==3, Middle==0 otherwise
Wealth Index:Rich	v190	Rich=1 if v190==4 | v190==5, Rich==0 otherwise
Unemployed	v717	Unemployed=1 if v717==0 , Unemployed==0 otherwise
Agriculture	v717	Agriculture=1 if v717==4, Agriculture==0 otherwise
Non-Ag Work	v717	Non-Ag Work=1 if v717==1 | v717==2| v717==3 | v717==5| v717==6 | v717==7| v717==8 | v717==9| v717==10, Non-Ag Work==0 otherwise
No Education	V149	No Education=1 if V149==0, No Education==0 otherwise
Some Primary	V149	Some Primary=1 if V149==1, Some Primary==0 otherwise
Complete Primary	V149	Complete Primary=1 if V149==2 | V149==3, Complete Primary==0 otherwise
Secondary	V149	Secondary=1 if V149==3, Secondary==0 otherwise
Rural	v025	Rural=1 if v025==2, Rural==0 otherwise
Brahmin	v131	Brahmin=1 if v131==2 | v131==27, Brahmin==0 otherwise
Chhetri	v131	Chhetri=1 if v131==1|v131==14|v131==20| v131==48|v131==51|v131==73, Chhetri==0 otherwise
Dalit	v131	Dalit=1 if v131==8|v131==12|v131==15|v131==17 |v131==22|v131==23| v131==54|v131==75|v131==79| v131==84|v131==39|v131==40|v131==41, Dalit==0 otherwise
Newar	v131	Newar=1 if v131==6, Newar==0 otherwise
Janjati	v131	Janjati=1 if v131==3| v131==4|v131==5|v131==10 |v131==11 |v131==13 |v131==1 |v131==21 |v131==24 |v131==29 |v131==45 |v131==46 |v131==52 |v131==61 |v131==62 |v131==67 |v131==86 |v131==32 |v131==35 |v131==36 |v131==42, Janjati==0 otherwise
Muslim	v131	Muslim=1 if v131==7, Muslim==0 otherwise
Teraimadh	v131	Teraimadh=1 if v131== 9 |v131==18 |v131==19 |v131==25 |v131==26 |v131==28 |v131==30 |v131==31 | v131==33 |v131==34 |v131==37 |v131==38 |v131==43 |v131==44 |v131==47 |v131==50 |v131==55 |v131==56 |v131==58 |v131==59 |v131==64 |v131==72 |v131==76

	|v131==90 |v131==91, Teraimadh==0 otherwise
Non-Hindu	v130	Non-hindu=1 if v130==2 | v130==3 | v130==4 | v130==5, Non-Hindu==0 otherwise
Hindu	v130	Hindu=1 if v130 ==1, Hindu==0 otherwise
Birth order	Bord	Bord
No Read	v155	No Read=1 if v155==0, No read==0 otherwise
Some Read	v155	Some Read=1 if v155==1, Some Read==0 otherwise
Read	v155	Read=1 if v155==2, Read==0 otherwise
Radio	v120	Radio=1 if v120==1 | v158==1 | v384a==1 | s1010aa==1 | s1010ad==1, Radio==0 otherwise
Fathers_No Education	v729	Fathers_No Education=1 if v729==0, Fathers_No Education==0 otherwise
Fathers_Some Primary	v729	Fathers_Some Primary=1 if v729==1, Fathers_Some Primary==0 otherwise
Fathers_Complete Primary	v729	Fathers_Complete Primary=1 if v729==2 | v729==3, Fathers_Complete Primary==0 otherwise
Fathers_Secondary	v729	Fathers_Secondary=1 if v729==3, Fathers_Secondary==0 otherwise

List of treatment districts: Mugu; Bajura; Kalikot; Bajhang; Jajarkot; Jumla; Achham; Humla; Dolpa; Dailekh; Rolpa; Rukum; Baitadi; Rasuwa; Salyan; Doti; Mahottari; Sarlahi; Rautahat; Dang; Dhading; Sindhupalchok; Pyuthan; Darchula; Siraha

APPENDIX B
T-TEST FOR PERCENTAGE DIFFERENCES IN OUTCOME VARIABLES BETWEEN CONTROL AND TREATMENT, PRE AND POST SDIP

Table: Percentage point difference in outcome variables for each subgroup. **S**tandard errors are reported in parentheses unless otherwise indicated. Statistical significance is given by: * ten percent; ** five percent; and *** one percent.

Neonatal mortality

		-3.3066*** (1.4537)	
		Treatment-Pre	Treatment-Post
0.2748 (0.3719)	Control-Pre	3.1798*** (1.3746)	-0.1268 (0.5734)
	Control-Post	2.9050*** (1.3867)	-0.4016 (0.6018)

Prenatal care

		22.1983*** (3.8872)	
		Treatment-Pre	Treatment-Post
-10.9680*** (1.2063)	Control-Pre	-27.3314*** (3.3331)	-5.1330** (2.3437)
	Control-Post	-38.2994*** (3.3275)	-16.1010*** (2.3358)

Prenatal care from a doctor

		1.3104 (2.1049)	
		Treatment-Pre	Treatment-Post
4.7393*** (1.2874)	Control-Pre	-15.0510*** (1.8467)	-13.7407*** (1.5205)
	Control-Post	-19.7903*** (1.9432)	-18.4800*** (1.6364)

Prenatal care from a nurse/midwife

		23.3822*** (3.2349)	
		Treatment-Pre	Treatment-Post
8.5244*** (1.4717)	Control-Pre	-23.2749*** (2.4976)	0.1072 (2.4487)
	Control-Post	-31.7994*** (2.5757)	-18.4800*** (1.6364)

Number of tetanus vaccinations

		15.1513*** (3.9293)	
		Treatment-Pre	Treatment-Post
5.8740*** (1.4163)	Control-Pre	-20.9202*** (3.3173)	-5.7689** (2.4901)
	Control-Post	-26.7942*** (3.3533)	-11.6428*** (2.5379)

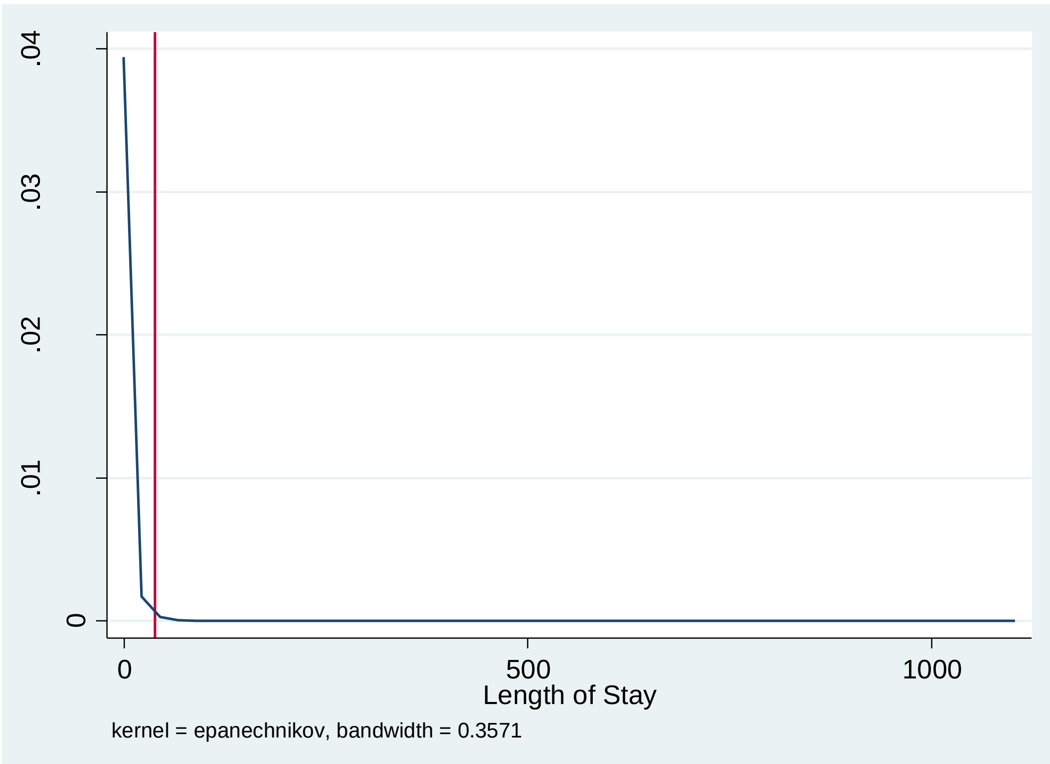
APPENDIX C
ORDINARY LEAST SQUARES ESTIMATES OF LOS WITH ALTERNATE BASE GROUPS – ALL PATIENTS

	Base Group				
	Strategy 1	Strategy 2	Strategy 3	Strategy 4	Strategy 5
Strategy 1	–	4.801***	3.783***	0.715	0.273
		(1.506)	(1.436)	(0.719)	(0.851)
Strategy 2	-4.801***	–	-1.018**	-4.086***	-4.528***
	(1.506)		(0.451)	(1.325)	(1.401)
Strategy 3	-3.783***	1.018**	–	-3.067**	-3.510***
	(1.436)	(0.451)		(1.245)	(1.325)
Strategy 4	-0.715	4.086***	3.067**	–	-0.442
	(0.719)	(1.325)	(1.245)		(0.455)
Strategy 5	-0.273	4.528***	3.510***	0.442	–
	(0.851)	(1.401)	(1.325)	(0.455)	
N	23,081	23,081	23,081	23,081	23,081
R-Squared	0.089	0.089	0.089	0.089	0.089

We include all relevant control variables. Robust standard errors are reported in parentheses. Statistical significance is given by: ** five percent; and *** one percent.

APPENDIX D

KERNEL DENSITY OF LENGTH OF STAY WITH TRUNCATION AT 38 DAYS



APPENDIX E
FULL TABLE FOR ORDINARY LEAST SQUARES ESTIMATES OF LOS – ALL, FOREIGN-BORN AND NATIVE-BORN PATIENTS

	All-Patients	Foreign-Born	Native-Born
Strategy 2	-4.801***	-3.786*	-4.675***
	(1.506)	(2.232)	(1.541)
Strategy 3	-3.783***	0.0419	-3.681**
	(1.436)	(2.085)	(1.472)
Strategy 4	-0.715	-3.383*	-0.540
	(0.719)	(2.020)	(0.737)
Strategy 5	-0.273	-2.613	-0.0845
	(0.851)	(2.364)	(0.868)
Native-Born	-0.694***	-7.704***	-0.614***
	(0.193)	(1.979)	(0.193)
Age ≤ 5	-0.720***	-2.832*	-0.738***
	(0.112)	(1.491)	(0.113)
6≤ Age ≤17	0.00418	1.879*	-0.0366
	(0.115)	(1.032)	(0.115)
18≤ Age ≤24	1.258***	1.994**	1.234***
	(0.0810)	(0.770)	(0.0815)
Age >58	-0.224		
	(0.245)		
Female	-0.362***	0.266	-0.369***
	(0.0666)	(0.478)	(0.0673)
Surgery	0.157*	1.974***	0.127
	(0.0806)	(0.697)	(0.0813)
Cardiology and Cardiac Surgery	-1.283***	1.697	-1.305***
	(0.146)	(1.244)	(0.148)
Cardiothoracic and Vascular Surgery	0.957***	1.958	0.993***
	(0.370)	(1.665)	(0.376)
Critical Care Medicine	2.101***		2.077***
	(0.240)		(0.240)
Dentistry and Dental Surgery	1.571**	7.436	1.306*
	(0.750)	(5.394)	(0.733)
Department of Neuro Sciences	2.661***	5.386***	2.634***
	(0.186)	(1.464)	(0.188)
Ear, Nose, Throat, Head and Neck Surgery	-1.539***	2.181	-1.538***
	(0.103)	(1.567)	(0.103)
Emergency Medicine	-4.391***	2.466	-4.085***
	(0.620)	(1.523)	(0.469)
Endocrinology and Diabetology	-0.0737	6.994***	-0.118
	(0.236)	(1.128)	(0.235)
Gastroenterology and Hepatology	-0.312***	1.272	-0.322***
	(0.121)	(1.159)	(0.122)
Geriatric Medicine	-1.457***		-1.458***

	(0.217)		(0.220)
Infectious Diseases	2.670		2.648
	(1.952)		(1.949)
Internal Medicine	0.446	1.473	0.843**
	(0.333)	(1.200)	(0.379)
Neonatal Critical Care	0.964*		0.850
	(0.555)		(0.558)
Nephrology and Transplant Medicine	0.802***	3.061**	0.781***
	(0.152)	(1.422)	(0.153)
Obstetrics and Gynecology	-0.274***	2.314*	-0.327***
	(0.101)	(1.250)	(0.100)
Oncology	-0.215		-0.226
	(0.236)		(0.236)
Ophthalmology and Vision Sciences	-2.286***		-2.287***
	(0.324)		(0.323)
Orthopedics and Traumatology	1.430***	2.458**	1.443***
	(0.124)	(1.158)	(0.126)
Pediatrics and Neonatology	1.427***	10.89***	1.292***
	(0.196)	(2.146)	(0.195)
Plastic, Reconstructive and Cosmetic Surgery	2.093***	3.200	2.112***
	(0.571)	(1.944)	(0.588)
Psychiatry	0.359	-1.690	0.340
	(0.335)	(2.315)	(0.338)
Pulmonary Medicine	0.968***	2.544*	1.170***
	(0.323)	(1.355)	(0.350)
Radiology and Interventions	-2.493***		-2.488***
	(0.174)		(0.179)
Urology and Kidney Transplant Surgery	-0.979***	0.956	-0.978***
	(0.103)	(1.734)	(0.104)
January /2013	-3.343***		-3.304***
	(0.447)		(0.447)
February /2013	-1.900***		-1.858***
	(0.433)		(0.435)
March /2013	-2.079***		-2.035***
	(0.382)		(0.383)
April /2013	-0.609		-0.562
	(0.451)		(0.452)
May /2013	-0.935***	-1.375	-0.873**
	(0.362)	(2.091)	(0.365)
June /2013	-0.656*		-0.603*
	(0.345)		(0.346)
July /2013	-0.322		-0.273
	(0.381)		(0.382)
August /2013	-0.132		-0.0809
	(0.344)		(0.345)
September /2013	-0.729**	-1.736	-0.664**

	(0.332)	(1.982)	(0.334)
October /2013	-0.635*	-1.982	-0.564
	(0.353)	(2.120)	(0.357)
November /2013	-0.0948	-3.157	0.000203
	(0.417)	(2.462)	(0.422)
December /2013	-0.691**	8.561	-0.740**
	(0.311)	(6.217)	(0.304)
January /2014	-0.0595	1.482	-0.179
	(0.352)	(3.044)	(0.339)
February /2014	0.0497	-0.919	0.0145
	(0.367)	(2.191)	(0.372)
March /2014	-	-	-
April /2014	4.594***	3.714**	4.440***
	(1.501)	(1.853)	(1.536)
May /2014	4.718***	4.505***	4.608***
	(1.511)	(1.529)	(1.546)
June /2014	4.851***	-0.313	4.797***
	(1.509)	(1.419)	(1.544)
July /2014	4.058***	-1.297	4.013***
	(1.465)	(1.085)	(1.501)
August /2014	3.460**	1.357	3.383**
	(1.427)	(3.258)	(1.462)
September /2014	3.608**	-3.101**	3.583**
	(1.434)	(1.464)	(1.468)
October /2014	4.489***	-0.0922	4.434***
	(1.442)	(1.356)	(1.479)
November /2014	4.522***	-0.745	4.509***
	(1.434)	(1.156)	(1.470)
December /2014	3.396**	-1.482	3.320**
	(1.425)	(1.185)	(1.460)
January /2015	3.611**	-2.173	3.563**
	(1.432)	(1.329)	(1.468)
February /2015	3.503**	-1.238	3.446**
	(1.442)	(1.578)	(1.477)
March /2015	4.498***	0.471	4.409***
	(1.452)	(1.810)	(1.488)
April /2015	3.194**		3.086**
	(1.401)		(1.437)
May /2015	1.973**	2.381	1.872*
	(0.972)	(1.985)	(0.986)
June /2015	0.741	3.085	0.622
	(0.946)	(2.507)	(0.961)
July /2015	0.756	3.434	0.633
	(0.889)	(2.372)	(0.903)
August /2015	0.450	4.167**	0.309

	(0.724)	(1.840)	(0.742)
September /2015	0.204	2.967	0.0988
	(0.766)	(4.401)	(0.783)
October /2015	5.833***	2.408	6.133***
	(1.630)	(4.200)	(1.785)
November /2015	1.457*	2.289	1.339
	(0.809)	(4.654)	(0.826)
December /2015	0.753	-0.584	0.669
	(0.783)	(3.919)	(0.801)
January /2016	1.433*	1.318	1.340*
	(0.783)	(4.184)	(0.800)
February /2016	0.992	1.101	0.895
	(0.745)	(2.810)	(0.763)
March /2016	0.281	5.243**	0.109
	(0.705)	(2.565)	(0.723)
April /2016	-0.00547	1.738	-0.121
	(0.699)	(1.088)	(0.719)
May /2016	0.965	3.407*	0.824
	(0.712)	(1.978)	(0.731)
June /2016	0.553	2.425**	0.429
	(0.709)	(1.150)	(0.727)
July /2016	0.0359	2.146	-0.0913
	(0.834)	(1.849)	(0.851)
August /2016	0.197	2.193	0.0562
	(0.833)	(1.938)	(0.850)
September /2016	0.0351	1.209	-0.0931
	(0.834)	(1.568)	(0.852)
October /2016	0.118	0.961	0.00899
	(0.835)	(1.626)	(0.853)
November /2016	-0.0295	0.438	-0.152
	(0.831)	(1.664)	(0.848)
December /2016	0.404	0.703	0.290
	(0.842)	(1.797)	(0.860)
January /2017	0.212	1.902	0.0783
	(0.841)	(1.723)	(0.859)
February /2017	0.371	0.804	0.249
	(0.837)	(1.555)	(0.855)
March /2017	0.0709	0.607	-0.0554
	(0.833)	(2.029)	(0.850)
April /2017	-0.227	-0.282	-0.339
	(0.830)	(1.520)	(0.848)
May /2017	-0.205	1.092	-0.336
	(0.831)	(1.799)	(0.849)
June /2017	-1.319	-0.767	-1.411*
	(0.829)	(1.565)	(0.847)
Political Blockade	-0.344	2.456	-0.370

	(0.316)	(3.752)	(0.318)
Earthquake	-0.543		-0.547
	(0.622)		(0.623)
Constant	4.161***	1.651	3.928***
	(0.351)	(2.041)	(0.257)
Observations	23,081	383	22,698
R-squared	0.089	0.358	0.090

BIOGRAPHY OF THE AUTHOR

Sujita was born in Ankara, Turkey on December 5, 1993 to Nepali parents and grew up in Kathmandu, Nepal, where she graduated from Ullens School in 2011. In 2016, she graduated *magna cum laude* from the University of Maine with a Bachelor of Arts in Economics. Sujita was a recipient of the full international tuition scholarship, member of the Omicron Delta Epsilon and the International Students' Association. She is a candidate for the Master of Science degree in Economics from the University of Maine in August 2018.