

Supplier-Induced Demand for Tertiary Healthcare: Evidence from a Public Health Insurance Program in India

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Motivation

- Steep rise in the mortality rates due to non-communicable diseases in India from 37% in 1990 to 61% in 2016 ([MOHFW, Govt. of India](#))
- Developing nations like India are witnessing a shift in the burden of disease ([Dandona et al., 2017](#))
- Consequently, mushrooming of government-financed health insurance schemes to provide tertiary healthcare (not a public bad; costly to treat) using private health facilities
- Problem of [Provider Moral Hazard](#); doctors act as agents for patients to induce demand for state-funded treatments ([van Dijk et al., 2013](#))
- Significant in the presence of high out of pocket expenditure and low insurance cover

'The uterus snatchers of Andhra'

- 'All across Andhra Pradesh, expensive hysterectomies were being performed in private clinics, especially in woman below age of 40 years. And, the city of Hyderabad witnessed mushrooming of new private hospitals, more hospital bed, doctors.' ([Times of India, July 2010](#))
- **The Problem:** Most of the women undergoing the surgery were between 20-40 years of age with adverse health consequences
- **What was happening?** Rajiv Aarogyasri Health Insurance (RACHI), a state insurance scheme, was launched in 2007-08 in the erstwhile Andhra Pradesh
- **Objective of the Scheme:** To deal with catastrophic medical expenditures at tertiary level for poor households.

- The paper broadly addresses **two questions** -
 - ① Are publicly financed health insurance schemes counter-productive, ushering in unnecessary medical procedures with adverse health consequences?
 - ② And, can supplier induced demand be responsible for unfavourable welfare outcomes for the women?
- In particular -
 - Did the **Aarogyasari Health Insurance Scheme** led to unnecessary hysterectomies in the erst-while Andhra Pradesh?
 - And did these indiscriminate hysterectomies increase the likelihood of experiencing **domestic violence** by a woman?

- Empirical literature on supplier induced demand in healthcare
 - Changes in Medicare reimbursement rates affected the intensity & quantity of medical services; more laboratory tests (Rice, 1983)
 - Higher fees & utilisation rates in surgeon-rich areas (inter-regional variation) (Cromwell and Mitchell, 1986)
- Studies on rising hysterectomy cases in India
 - Mushrooming of corporate hospitals in Hyderabad (Mamidi and Pulla, 2013a)
 - 70% of total surgeries in small nursing homes were hysterectomies; more procedures in younger women (Prasad and Raghavendra, 2012)
- Impact of hysterectomy on woman
 - Higher risk of heart-attack; several physical & physiological implications like insomnia, weight fluctuations, depression (Yeh et al., 2013)
 - Higher odds of experiencing domestic violence; over sexual issues, spousal extra-marital affairs (Mamidi and Pulla, 2013a, Loxton et al. (2006))

About the Scheme

- Covers approx. 938 procedures including hysterectomy; based on a Public Private Partnership (PPP) model
- **Aim:** To providing universal, **cashless**, and tertiary care through a network of private-public hospitals empanelled under the scheme
- **Eligibility:** All households with a below-poverty line (BPL) ration card
- **Reimbursements rates** were higher compared to other schemes; private players had incentives to induce demand to earn revenue

Table 1: Variation in Reimbursement Rates for Hysterectomy in India (2009-10)

Scheme Name	(1) State	(2) Package Rate (INR)
Rajiv Aarogyasari Scheme	Andhra Pradesh	20,000
CGHS/ ESIS	India	13,000
RSBY	India	10,000
Yeshasvini	Karnataka	6,000

Source: Report by World Bank; 'Government-sponsored health insurance in India: Are you covered?' (La Forgia and Nagpal, 2012). The rates are shown in INR for the year 2009-10.

① National Family and Health Survey-4 (2015-16)

- Sample of approx. 699,000 women between the ages of 15-49
- Survey included a module on hysterectomy, how many years ago the surgery was performed, place and reason for the surgery
- Only a sub-sample of 79,729 women were selected for the domestic violence module and asked questions on physical, emotional and sexual violence

② Patient-level Claims Data under Aarogyasari

- Census of administrative records providing information on the type of surgery, surgery date, claim amount, name of the hospital and district, etc.
- Records all medical procedures financed under the scheme since inception

Summary Statistics

	Mean		Difference
	Underwent Hysterectomy	No Hysterectomy	
Access to State Health Insurance	0.14	0.08	-0.06***
Physical Violence	0.34	0.28	-0.05***
Emotional Violence	0.15	0.13	-0.02**
Sexual Violence	0.07	0.07	-0.00
Education (in yrs.)	3.85	6.81	2.96***
Schedule Caste	0.18	0.19	0.01*
Schedule Tribe	0.11	0.19	0.08***
OBC	0.49	0.41	-0.08***
Witnessed Violence at Home	0.02	0.02	-0.00
Currently Working	0.30	0.23	-0.06***
Rural	0.72	0.71	-0.02***
Household Head is Female	0.14	0.14	-0.00
Current Age	40.64	29.54	-11.10***
Partner Consumes Alcohol	0.34	0.32	-0.02
Has Atleast One Son	0.81	0.53	-0.28***
Husband's Education	7.00	7.90	0.91***
Husband's Age	45.90	37.55	-8.36***
Number of Household Members	5.41	5.80	0.39***
Observations	18,158	681,247	699,405

District-wise Plots

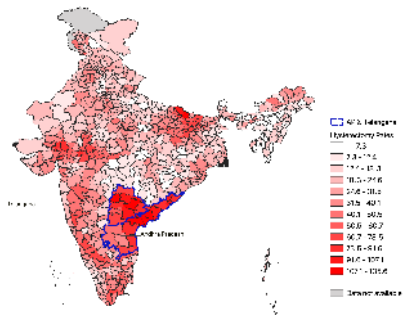


Figure 1: Rates of Hysterectomy

District-wise Plots

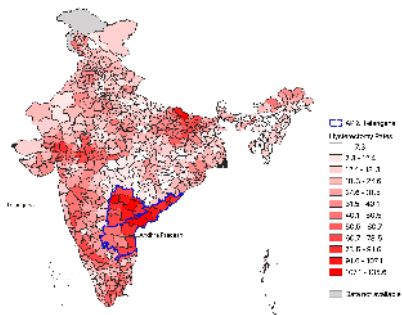


Figure 1: Rates of Hysterectomy

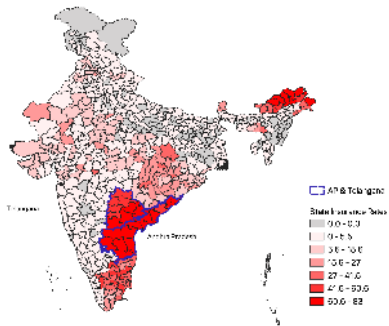
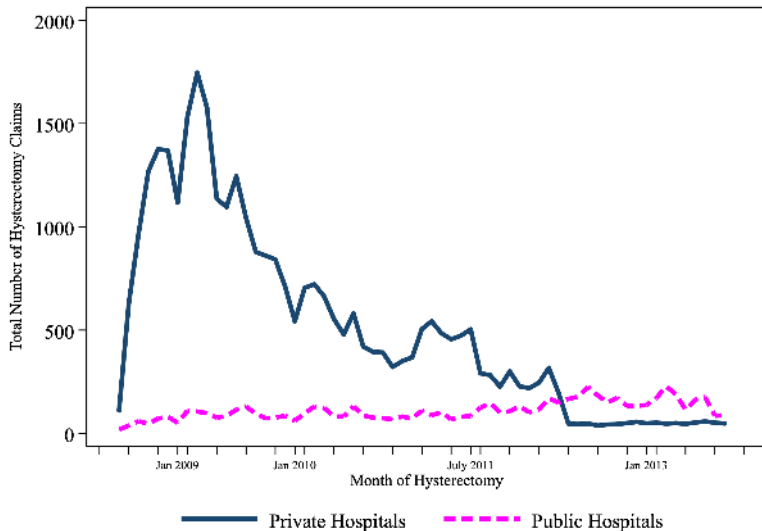
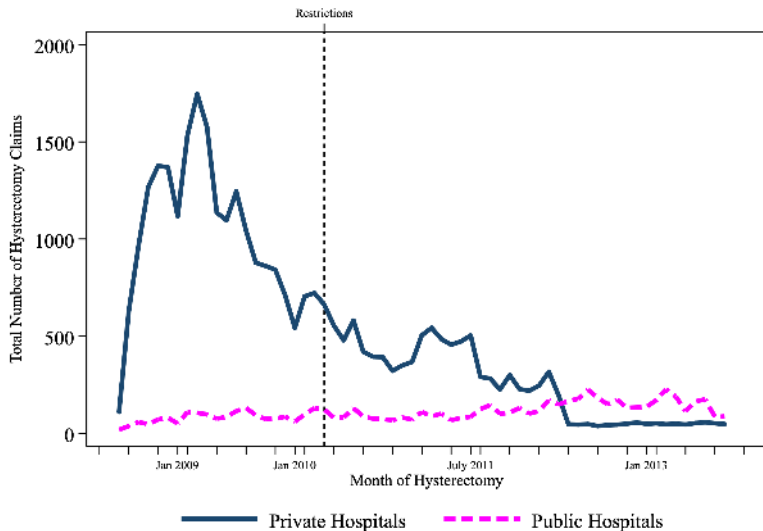


Figure 2: Access to State Health Insurance

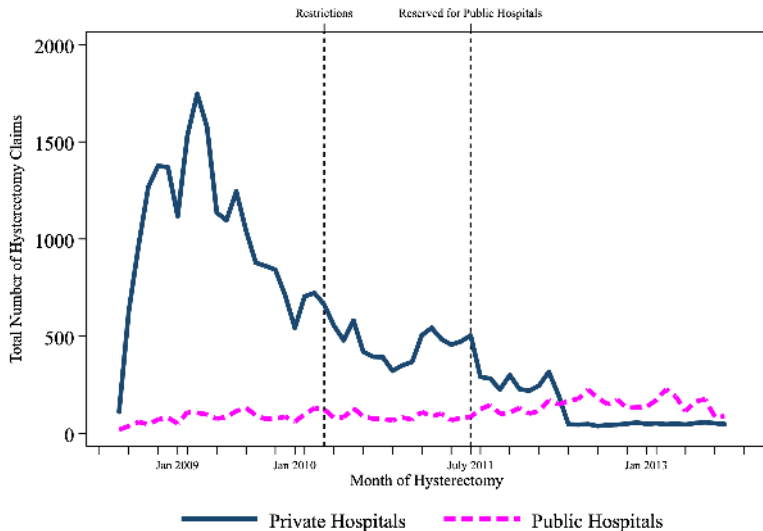
Plot for Hysterectomy using Claims Data



Plot for Hysterectomy using Claims Data



Plot for Hysterectomy using Claims Data



- Model -

$$Hyst_{ij} = \beta_0 + \beta_S SI_{ij} + \beta_{AS}(AP_{ij} \times SI_{ij}) + \mathbf{X}_{ij}\beta_{\mathbf{X}} + Dist_j + \epsilon_{ij}$$

$Hyst_{ij}$: Dummy for a woman i in district j underwent hysterectomy

SI_{ij} : Dummy if woman i has access to state health insurance

AP_{ij} : Dummy if woman i lives in AP (or Telangana)

\mathbf{X}'_{ij} : Control variables at woman level

$Dist_j$: District level fixed effects

ϵ_{ij} : Robust standard errors, clustered at state level

- **Key Variable of Interest:** Interaction term between woman in AP and access to health insurance scheme

Table 2: Impact of *Aarogyasari Health Insurance Scheme* on Hysterectomy

	(1)	(2)	(3)
State Health Insurance	0.005 (0.003)	0.003 (0.003)	0.003* (0.001)
AP × State Health Insurance	0.037*** (0.004)	0.035*** (0.004)	0.033*** (0.002)
Controls	No	Yes	Yes
District FE	No	No	Yes
R Squared	0.004	0.037	0.050
Observations	699,405	509,200	509,200

Impact on Hysterectomy by Place of Treatment

	(1)	(2)
Hysterectomy performed in:	Private Hospital	Public Hospital
State Health Insurance	0.001 (0.001)	0.002 (0.001)
AP × State Health Insurance	0.032*** (0.004)	0.001 (0.003)
Controls	Yes	Yes
District FE	Yes	Yes
R Squared	0.039	0.022
Observations	509,385	509,385

Modelling Hospital Competition

- **Hypothesis** - Regions with greater competition amongst hospitals results in more surgeries undertaken (Cromwell and Mitchell, 1986) .
- To construct a measure of hospital competition -
 - ① Neighbouring districts in AP were clustered to form 6 district markets
 - ② For each hospital, a proportion of patient claims from the total district market claims was calculated
 - ③ A Herfindahl-Hirschman Index(HHI) for a market is the sum of the squares of these shares
 - ④ A higher value of the HHI indicates lower competition amongst hospitals in the district market

$$HHI_{jt} = \sum_i \left(\frac{\text{Hospital claims}_{it}}{\sum_{it} \text{Hospital claims in } j^{\text{th}} \text{ district market}} \right)^2$$

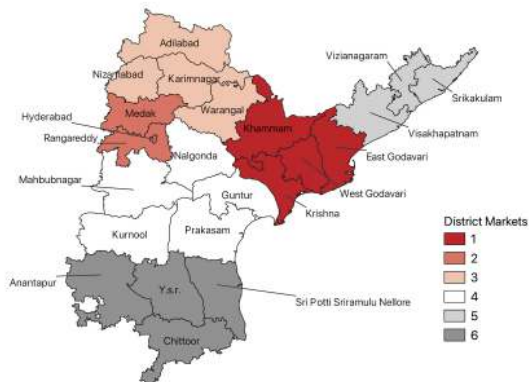
where j refers to district market ($j= 1$ to 6); i : hospital located in the district market j ; t : year of claim

District Markets

- Model -

$$Hyst_{ij} = \alpha_0 + \alpha_S SI_{ij} + \alpha_H (HHI_j) + \mathbf{X}'_{ij} \beta_X + \varepsilon_{ij}$$

ε_{ij} are robust standard errors clustered at the district level



Hospital Competition

The following results are limited to AP & Telangana only.

Table 3: Impact of Hospital Competition on Hysterectomy

	(1)	(2)	(3)
Hysterectomy performed in: (Dependant Variable)	Either Public or Private Hospital	Private Hospital Only	Public Hospital Only
HHI (Year 2010)	-0.631** (0.204)	-0.587** (0.162)	-0.054 (0.060)
State Health Insurance	0.008 (0.006)	0.008 (0.005)	0.001 (0.003)
Controls	Yes	Yes	Yes
R Squared	0.091	0.073	0.018
Observations	14,969	14,971	14,971

Summary So Far

- **Aarogyasari** led to an increase in probability of undergoing hysterectomy by 3.3 percentage points
- More likely in **private hospital** by 3.2 percentage points; insignificant results for public hospitals
- **Higher competition** amongst hospitals (or lower HHI) were 58.7 percentage points more likely to perform a hysterectomy in private hospital

Impact on Domestic Violence

- Medical implications of hysterectomy such as hormonal imbalance, weight fluctuations, insomnia, depression, loss of sexual desire, osteoporosis, especially in younger females (Mamidi and Pulla, 2013b, Yeh et al. (2013))
 - Leads to difficulty in completing household chores or contributing to labor force
 - Post surgery, the woman is unable to reproduce; hence more likely to experience intimate partner violence
- **Empirical Challenge:** Undergoing hysterectomy is endogenous due to omitted variable bias
- We run a **Two-Stage Least Square (TSLS)** to estimate the impact of hysterectomy on the probability of experiencing domestic violence
- **Instrument:** The interaction term between a woman living in Andhra Pradesh and having access to state health insurance

Instrumental Variable (IV) Model

- Structural Equation -

$$DV_{ij} = \beta_0 + \beta_H(Hyst_{ij}) + \mathbf{X}'_{ij}\beta_X + Dist_j + v_{ij}$$

- First Stage Regression -

$$Hyst_{ij} = \beta_0 + \beta_S SI_{ij} + \beta_{AS}(AP_{ij} \times SI_{ij}) + \mathbf{X}_{ij}\beta_X + Dist_j + \epsilon_{ij}$$

DV_{ij} : Binary variable for a woman i in district j if she has experienced domestic violence at home

$Hyst_{ij}$: Dummy if woman i in district j has undergone hysterectomy

\mathbf{X}_{ij} : Control variables at woman level

$Dist_j$: District level fixed effects

v_{ij} : Robust standard errors, clustered at state level

Table 4: First Stage IV: Impact of Hysterectomy on Domestic Violence

	(1)	(2)	(3)
Hysterectomy performed in: (Dependant Variable)	Either Private or Public	Private Hospital	Public Hospital
AP × State Health Insurance	0.028* (0.010)	0.039*** (0.009)	-0.012*** (0.002)
Controls	Yes	Yes	Yes
District FE	Yes	Yes	Yes
First-stage F Statistic	48.418	56.382	27.277
Kleibergen-Paap rk F stat	7.290	20.029	46.045
R Squared	0.061	0.051	0.034
Observations	56,948	56,962	56,962

TSLs - Second Stage Results

Table 5: Second Stage IV: Impact of Hysterectomy on Domestic Violence

	(1)	(2)	(3)
	Physical	Sexual	Emotional
Hysterectomy (Private Hospital)	0.716*** (0.092)	-0.049 (0.095)	0.649* (0.254)
Controls	Yes	Yes	Yes
District FE	Yes	Yes	Yes
Non-Hysterectomised Woman (Average)	0.28	0.07	0.13
Observations	56,962	56,962	56,962

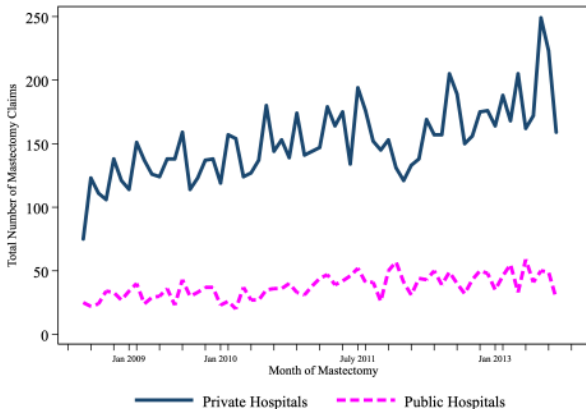
- Results are insignificant for **sexual violence** by partner as women are unable to reproduce, and might face medical side-effects due to the procedure (Mamidi and Pulla, 2013a)

Validity of the Instrument

- **Relevance Concerns:** Interaction term is significantly correlated with the dependant variable
- **Weak Instruments:** The first stage F-statistic and the Kleibergen-Paap rk Fstatistic are substantially larger than 10 for hysterectomies performed in the private hospitals only
- **Exogeneity Concerns:** We provide a list of arguments to establish validity
 - ① Access to Aarogyasari did not affect other treatments exclusive for women. Number of claims for mastectomy (using Claims Data)
 - ② Placebo treatments using the Non-equivalent Dependent Variable (NEDV) approach

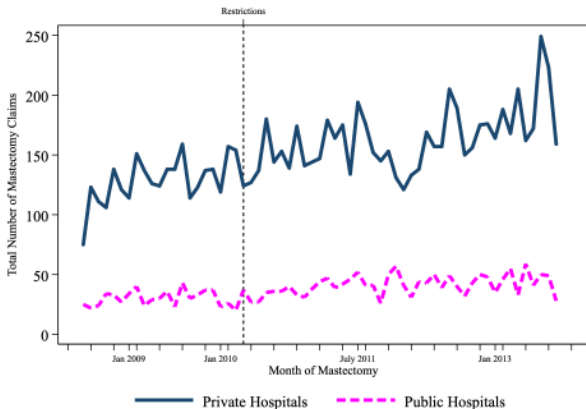
Plot for Mastectomy

- Mastectomy is the surgical removal of one or both breasts, partially or completely; covered under Aarogyasari
- Being a cosmetic and invasive procedure; it is difficult to induce demand



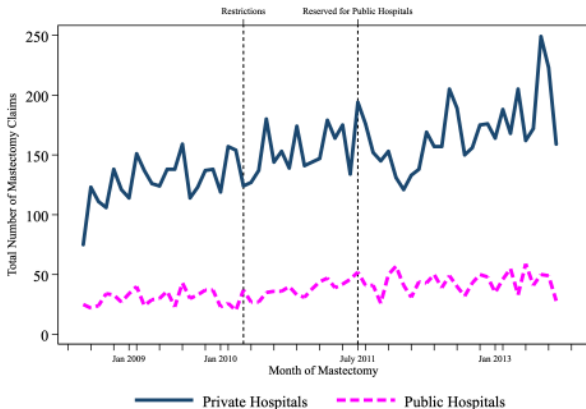
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Placebo Checks

- Non-equivalent dependent variable consists of similar latent constructs that are predicted 'not' to undergo any changes due to the treatment variable (Coryn and Hobson, 2011; Shadish et al., 2002)

Table 6: Placebo Checks: Impact of *Aarogyasari Scheme* on Other Treatments

	(1)	(2)	(3)	(4)	(5)
	Cancer	Asthama	Diabetes	Heart Disease	Thyroid
State Health Insurance	0.001 (0.000)	0.001 (0.001)	0.002 (0.002)	0.001 (0.001)	0.001 (0.001)
AP × State Health Insurance	-0.001* (0.001)	-0.002 (0.002)	-0.009** (0.003)	0.002 (0.001)	-0.006* (0.003)
Controls	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes
R Squared	0.004	0.010	0.022	0.014	0.024
Observations	506,792	506,841	501,323	506,841	506,251

Key Takeaways

- Our results motivate the need for audits and monitoring under health insurance programs without co-payments; especially for private hospitals
- Possibility of adverse health as well as social consequences due to supplier induced demand
- Need to enforce medical ethics; conduct clinical audits by government; increase in awareness among public for better implementation of such schemes
- Gains significance in the face of new *Ayushman Bharat Health Insurance Schemes* that provides medical coverage to poor households

Thank You!

Appendix - I

- We estimate a multivariate probit model using simulation maximum likelihood method (Cappellari and Jenkins, 2003)
- Similar results to IV using the linear probability method

Table 7: (Multivariate Probit) Second Stage: Effects on domestic Violence

	(1)	(2)	(3)
Hysterectomy in private Hospital			
AP × State Health Insurance	0.751*** (0.090)	0.751*** (0.089)	0.753*** (0.090)
Physical Violence			
Private Hospital	0.142** (0.051)		
Sexual Violence			
Private Hospital		0.066 (0.070)	
Emotional Violence			
Private Hospital			0.140** (0.053)
Controls	Yes	Yes	Yes
Observations	56,962	56,962	56,962

Appendix - II

	(1) Undergone Hysterectomy below 40 years	(2) Reported Year of Hysterectomy (2008-11)
State Health Insurance	0.003** (0.001)	0.000 (0.001)
AP × State Health Insurance	0.033*** (0.003)	0.008*** (0.002)
Controls	Yes	Yes
District FE	Yes	Yes
R Squared	0.035	0.015
Observations	505,007	509,200

- *Similar result are observed using HHI calculated for years between 2007-2012, when hysterectomy was open to private hospitals.*

Table 8: Robustness Check: HHI calculated using years 2007-12

Dependant Variable:	Hysterectomy Performed in a Private Hospital					
HHI calculated in:	2007	2008	2009	2010	2011	2012
HHI	-0.053 (0.064)	-0.352** (0.101)	-0.563*** (0.145)	-0.587** (0.162)	-0.773* (0.312)	-0.781 (0.405)
State Health Insurance	0.007 (0.005)	0.008 (0.005)	0.008 (0.005)	0.008 (0.005)	0.007 (0.005)	0.007 (0.005)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
R Squared	0.070	0.072	0.073	0.073	0.072	0.071
Observations	14,971	14,971	14,971	14,971	14,971	14,971

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