

**Title:** Estimating the Need, Costs, and Access to Essential Surgical Care in India: A Modeling Study

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**Background:** The Lancet Commission on Global Surgical Care (LCGSC) identified India's improvement in surgical care to be crucial for its universal healthcare coverage attainment. Despite agency and advocacy, research on surgical care of 'a billion people' has been limited. We aimed to synthesize national and sub-national estimates for surgical care need, access, and costs for India, particularly rural regions.

**Methods:** Data were acquired from national and international public databases and systematically searched relevant peer-reviewed articles. We adapted the models presented in the LCGSC 2015 report. For estimating essential surgery need, 22 conditions needing surgical care were aggregated for creating the final estimates. Standard rates of operative procedures for estimating the cumulative need were calculated using the average global surgical volumes per condition per 100,000 people. Proportions of met surgical need were calculated for India and rural India. For calculating catastrophic health expenditure (CHE) on essential surgery, cesarean-section was used as an index procedure. Four ordinary differential equation models were solved - rural public, rural private, urban public, and urban private for the proportion at risk for CHE conditional on taking up the c-section surgery. Finally, the access-to-care model for rural areas was built as a tree-based conditional dependencies model using proxies for four factors - timeliness, safety, quality, and affordability.

**Findings:** In 2017, the proportional met surgical care need ranged between 25.77% to 89.95% for India, while being as low as 2.34% - 8.18% for the rural counterpart. C-section recipients at CHE-risk varied across rural private (28.20%), rural public (27.21%), urban private (25.44%), and urban public (16.95%) settings. As of 2017, only 1.41% of the population or 868,459,375 people living in rural India had access to surgical care. Large heterogeneities were observed across states for the surgical workforce, quality, and safety with generally poor care in northern and eastern states.

**Interpretation:** There is a high disparity between rural and urban Indian surgical care necessitating urgent policy attention. The sub-national differences in the surgical workforce and unmet need require decentralized policy implementation. India's new public health insurance can rescue a significant population proportion from catastrophic expenditure on surgery in private-care settings.

# Estimating the Need, Costs, and Access to Essential Surgical Care in India: A Modeling Study

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## BACKGROUND

- The Lancet Commission on Global Surgery- LCoGS (2015) estimated that **5 billion** people lack timely access to safe and affordable surgical care, globally<sup>1</sup>.
- Of these, over 1.6 billion were considered to be residing in South Asia, more specifically, **India**.
- Despite evident need and policy interest, research on surgical care access in India is **negligible**.
- In this study, we –
  - Estimated the timely access, surgical need, and affordability at national and state-levels.
  - Investigated differences between rural and urban regions for surgical volumes and out-of-pocket (OOP) costs

## METHODS

**Surgical Need:** Data for surgical volumes was taken from the *Health Management & Information System (HMIS)* from April 2017 - March 2018, aggregated over months and districts to get annual state-level estimates. State populations for 2017 were aggregated from 1km<sup>2</sup> UN-adjusted unconstrained population counts WorldPop<sup>2</sup> raster for India, cropped by GADM boundaries. Major and minor (without anesthesia) surgeries were used. Rates were defined as 'per 100,000' & proportions as percentages (per 100). Met surgical need was ratio of surgical rate to the threshold<sup>3</sup> - 5000 surgical cases per 100k.

**Surgical Costs:** Data on surgical uptake and expenditures was taken for *National Sample Survey (NSS Round-75 (2017-18))*. Households with at least 1 surgical case (treatment during hospitalization in the past 365 days = surgery) were isolated. Out-of-pocket expenditure (OPE) for these households was calculated as difference between total hospitalization expenditure (direct + indirect costs) and the amount reimbursed from any insurance. Catastrophic health expenditure (CHE) due to surgery was defined as OPE > 40% of household's annual consumer expenditure. State-level values were estimated using sampling weights from the NSS. No error estimation was conducted.

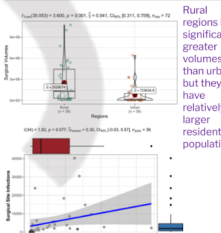
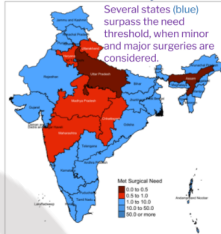
**Timely Access to Surgery:** Data on teaching hospitals (known to provide secondary, tertiary, and super-specialty surgical care for free or reduced costs) were extracted from National Health Profile-2019<sup>4</sup> and manually geocoded by trained medical student in Google Maps. Raster-based analysis of travel-times (using motorized friction surfaces) to these hospitals from all 1 km<sup>2</sup> grid cells in India was conducted as per Weiss et al. (2020)<sup>4</sup>. Travel-times were categorized into 0-30, 31-60, 61-90, 91-120,

## FINDINGS

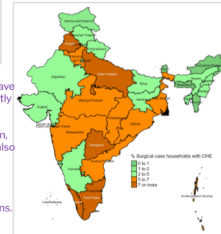
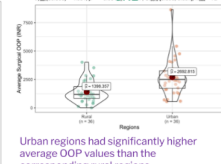
Surgical care attribute	National Estimate
Median time-to-travel to nearest teaching hospital (min, max) in mins.	<b>74.723 [0,000, 18534.820]</b>
Absolute surgical volume (HMIS, April 2017 - March 2018)	<b>117,079,582</b>
Surgical rate (per 100,000 people)	<b>8762.385</b>
Met surgical need (ratio)	<b>1.753</b>
Rate of major surgeries (i.e. that require general or spinal anesthesia)	<b>2385.606</b>
% C-sections out of total institutional deliveries	<b>18.764</b>
Surgical site infections (SSI) rate (per 100,000 people)	<b>14.646</b>
SSI as proportion of total surgeries (%)	<b>0.167</b>
Average OOP surgical expenditure (INR)	<b>1988.694</b>
Proportion of households that faced CHE out of households with surgical cases (%)	<b>19.741</b>
Proportion of households with surgical cases that faced CHE out of all households (%)	<b>5.780</b>

- These are likely **first** such national estimates for India that depict high met surgical need, timely access and overall low CHE with significant rural-urban differences.
- We could **not** conduct rural-urban decomposition for timely access, uncertainty and sensitivity analyses for any estimates.
- The findings are contingent to modeling assumptions and **quality** of the data sources.
- In future, we will include other surgical hospitals for timely access, explore surgical safety in detail, conduct **robustness checks**, and extend the findings to district-level.
- Even so, our estimates could be critical for **National Surgical Planline** for India.

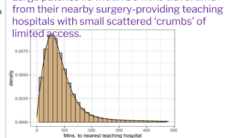
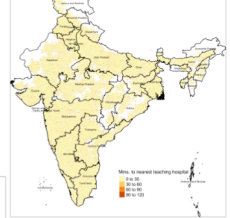
## Surgical Need Analysis – Volumes, Rates & Safety



## Surgical Costs Analysis – OPE & CHE



## Timely Access to Surgery Analysis



## Acknowledgements

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