



Population-level surgical rates and unmet need in India: a retrospective analysis of districts and states from 2011 to 2019

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Introduction

The Lancet Commission on Global Surgery (LCoGS) recommended a threshold of 5000 surgeries per 100 000 people^[1]. Subnational assessments for low- and lower-middle-income countries (LLMICs), including India, have been limited^[2]. In this India-wide retrospective analysis using data from India's Health Management and Information System (HMIS), we estimated the population-level surgical rates and utilization, and unmet needs at different geographic levels. We also assessed the annual percent changes and the association between surgical and total patient volumes.

Methods

HMIS count data was obtained for major (those requiring anesthesia), minor, and total surgeries (sum of major and minor) for nine financial years (2011–2019) from the National Data and Analytics Platform (NDAP). High-resolution (1 km²) UN (United Nations)-adjusted annual population projection maps were sourced from WorldPop. Shapefiles for district and state-level boundaries of India for 2019 were taken from an open-source repository for 737 districts across 37 state/union territories (UTs).

Annual surgical rates were defined as the number of surgeries per 100 000 residents. Average annual percent changes were computed for surgical rates. The unmet surgical need was defined

by the threshold of 5000 surgeries per 100 000 people^[3]. To understand surgery utilization, we investigated the proportion of surgeries out of total patient volumes. Pearson correlation coefficient assessed the association between surgical and total patient volumes across districts at a 1% significance level. District-level data were aggregated for calculating state and national-level estimates. Analysis was performed in R.

Results

In the financial year 2019, total and major surgical rates were 1385.28 and 355.94 per 100 000 people, pointing to the unmet need of 49 million surgical procedures. The average annual changes were 9.24 and 4.16% for total and major surgical rates, pointing to a greater rise in minor procedures (Fig. 1A). In 2019, five UTs out of 37 states/UTs crossed the LCoGS threshold for total surgeries, while only Chandigarh crossed this threshold for only major surgeries (Fig. 1B). Five states contributed to over 57% of the unmet need. In 2019, total and major surgical rates varied across districts (Fig. 1C, D). Of the 737 districts, 38 and four districts crossed the LCoGS threshold when considering total and major surgeries, respectively. The highest unmet need of 527 201 total surgeries was observed in South Paraganas, West Bengal.

In 2019, 1.08% of the total patients were surgical. There were variations across states/UTs (Fig. 2A) and districts (Fig. 2B). District-level surgical volumes were significantly associated with total patients (Fig. 2C).

Discussion

These district-level surgical rate estimates are novel for India, the most populous country globally. They depict low surgical rates and stagnant changes over time. Several regions need surgical scale-up. Geographic variations point to the scope for localized prioritization and targeted investments. The association between total patient and surgical volumes could be used for predicting the unmet need where data is unavailable. Only a handful of studies with different data sources and methodologies have previously investigated surgical rates in India^[4]. Our national major surgical rate falls much below the modeled rate of 904 per 100 000 people, while the total surgical rate is comparable to the LCoGS estimate^[5].

These estimates may not be comprehensive due to the limited coverage of private facilities in HMIS, data completeness, and quality issues. We did not account for case portability across

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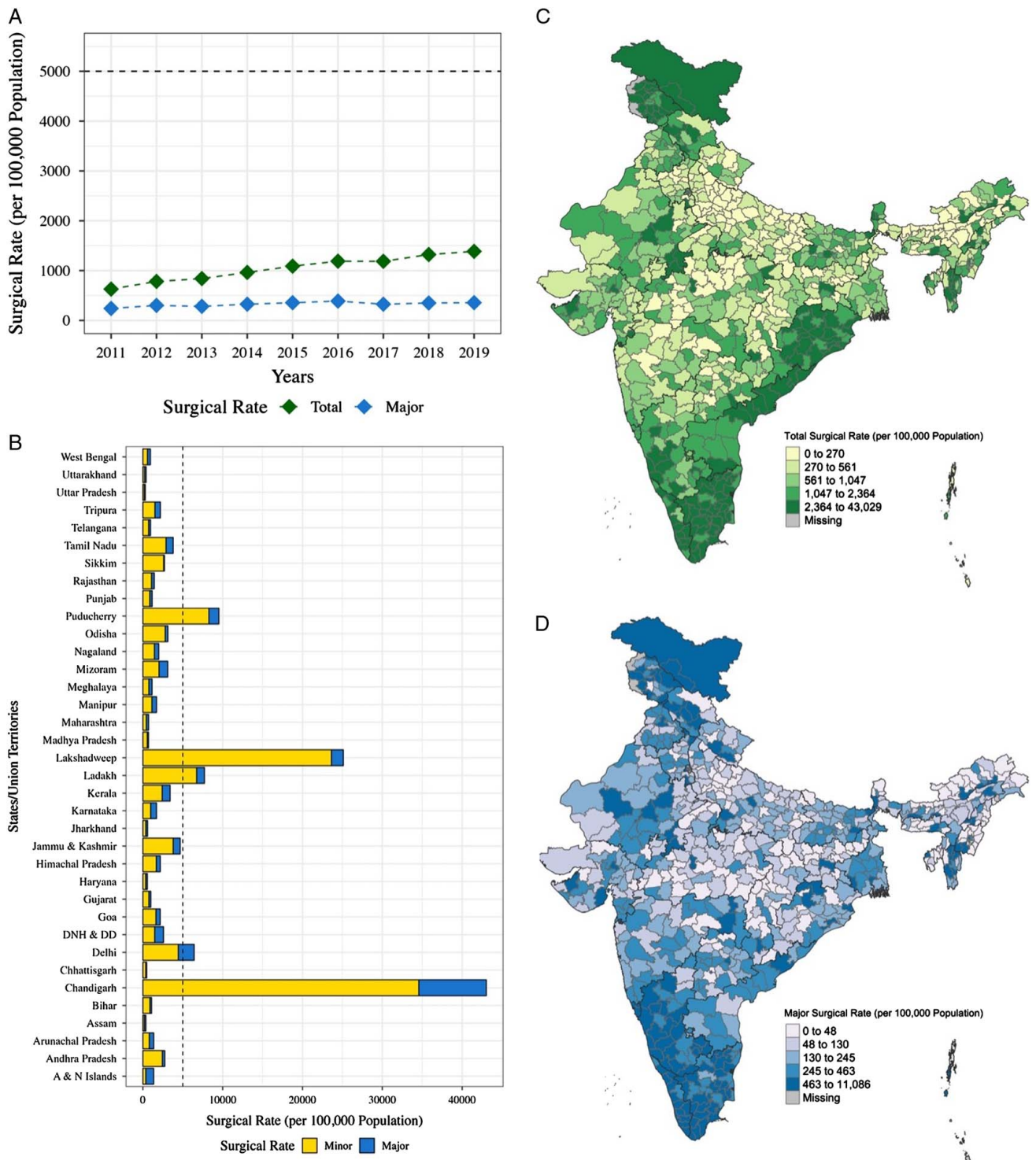


Figure 1. Surgical rates per 100 000 people in India. (A) Total and major surgical rates over nine consecutive financial years (2011–2019) depicted a greater increase in total compared to major surgical rates. Both rates are below the target threshold of 5000 surgeries per 100 000 people (black dotted line). (B) State-wise major and minor surgical rates for 2019. Only a few states cross the target threshold (black dotted line). Geographic variations across 737 districts in 2019 for (C) total surgical rates and (D) major surgical rates distributed by quantile map. Chandigarh district had the highest total surgical rate (43 028.80), while six districts recorded no surgeries. Erode in Tamil Nadu had the highest major surgical rate (11 086.23), while 21 districts had no major surgeries. A & N Islands, Andaman and Nicobar Islands; DNH & DD, Dadra and Nagar Haveli and Daman and Diu.

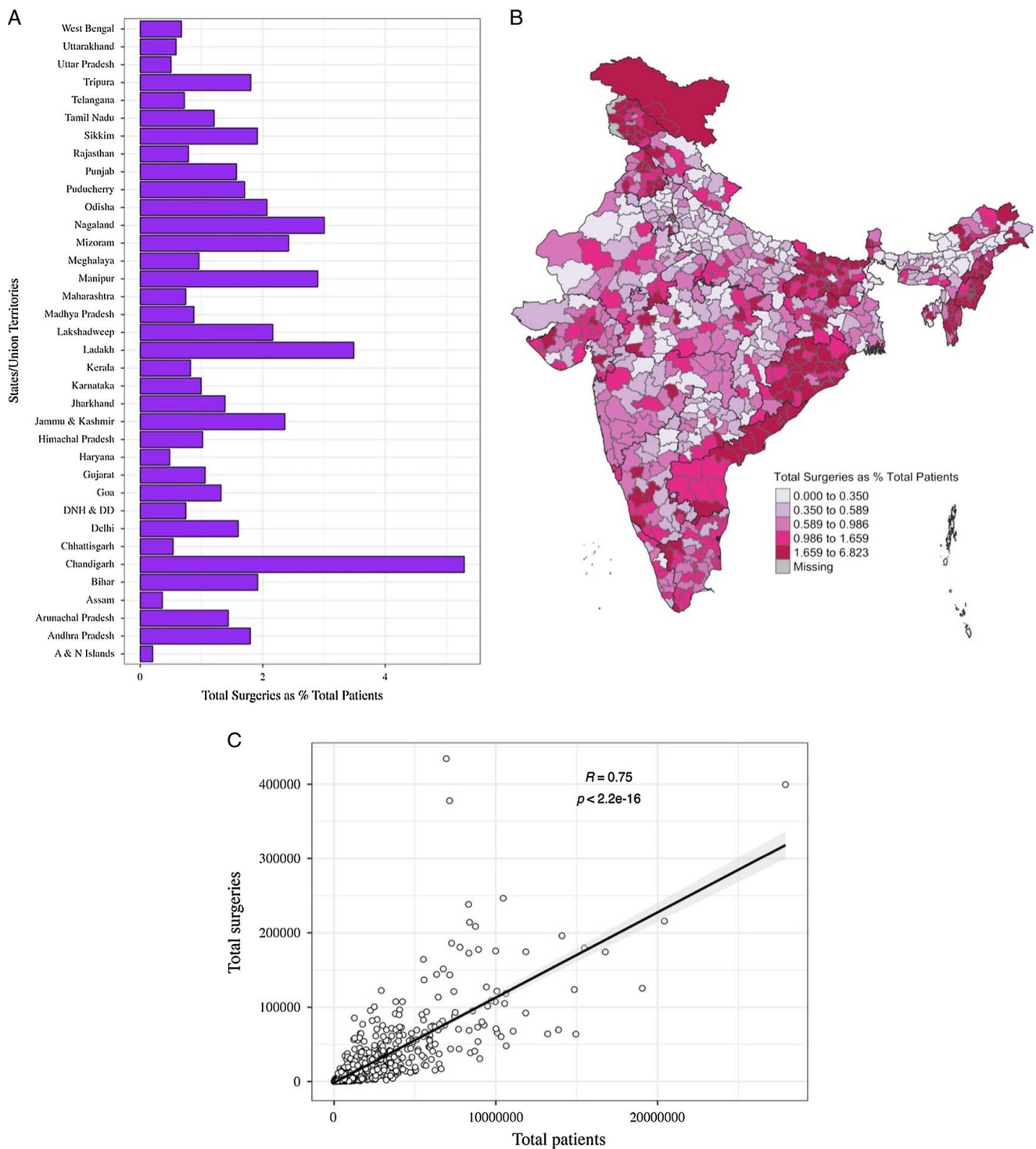


Figure 2. Surgeries as a percentage of total patients including inpatient admissions and outpatient visits recorded for allopathic treatments. (A) State-wise values varied from 5.29% in Chandigarh to 0.20% in Andaman and Nicobar Islands in 2019. (B) Geographic variations across 737 districts for 2019. Among districts, Rajouri and Jammu and Kashmir had 6.82% surgical patients, while Nicobar Islands showed a null value. (C) Correlation between surgical and total patient volumes across districts for 2019. *R* depicts Pearson’s product–moment correlation coefficient. A & N Islands, Andaman and Nicobar Islands; DNH & DD, Dadra and Nagar Haveli and Daman and Diu.

districts. NDAP–HMIS does not provide disaggregation by rural–urban areas, public–private sectors, and diseases or procedures for granular analyses. The large unmet need should not be perceived as a lack of efficiency on the part of the workforce.

Rather, it reflects the burden on the surgical systems of the country despite the overworked surgical, obstetric, and anesthesia personnel. These findings provide insights for local planning with high acceptability among policymakers and present the

potential utility of HMIS data for promoting LCoGS indicators in LLMICs.

Ethics approval

It is not applicable since the study involves analysis of publicly available aggregate data.

Consent

Not applicable.

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Duke Global Health Institute.

Author contribution

S.Z.: conceptualization, methodology, formal analysis, data curation, writing – original draft, writing – review and editing, and project administration; E.R.S.: writing – review and editing; C.A.S.: writing – review and editing; T.N.F.: writing – review and editing; J.R.N.V.: project administration, supervision, and writing – review and editing.

Conflicts of interest disclosure

The authors declare no conflicts of interest.

Research registration unique identifying number (UIN)

Not applicable.

Guarantor

Siddhesh Zadey.

Data availability statement

Data used in the manuscript is available at the NDAP – datasets 7067 (<https://ndap.niti.gov.in/dataset/7067>) and 7068 (<https://ndap.niti.gov.in/dataset/7068>), WorldPop (<https://hub.worldpop.org/geodata/listing?id=75>), and Git repository for shapefiles (https://github.com/justinelliottmeyers/India_Official_Boundaries_2019) platforms. Data generated in this manuscript can be requested from the authors.

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