Title: Assessing Population-level Accessibility to District Hospitals in India: A Geospatial Modeling Study of 36 States and Union Territories

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Conflicts of Interest: None

Background:
In 2021, the topmost government think tank in India - NITI Aayog published a report compiling key performance indicators for District Hospitals (DHs). Notably, the report overlooked a crucial aspect: timely access to DHs. Our study focuses on addressing this gap by examining the geographical distribution of DHs across India's states and union territories (UTs) and developing models to assess timely access to these healthcare facilities.

Methods:
The NITI Aayog address data was geocoded using machine techniques, and then manually verified using Google Maps. We incorporated 2020 motorized and walking travel-time friction surface rasters from the Malaria Atlas Project. Population estimates for India at a 1-square-kilometer resolution were sourced from WorldPop. Additionally, we conducted an examination of the number of DHs per million inhabitants across 36 states and Union Territories (UTs). We introduced the concept of Healthcare Access Coverage (HAC), representing the population proportion residing within specified time thresholds (30 and 60 minutes) from the nearest DH, considering both walking and
motorized travel modes. We categorized the travel friction rasters based on the defined time thresholds using a raster-based analytical approach. Then, we overlaid these categorized rasters with the population raster to derive population estimates for regions where healthcare accessibility fell within the timeframes.

Findings:
In 2021, India had 707 DHs and a density of 0.51 DHs per million people. Uttar Pradesh had 150 DHs while small UTs of Chandigarh, Lakshadweep, Dadra and Nagar Haveli and Daman and Diu had 1 DH each. Across states, densities ranged from 0.15 for Telangana to 25.34 per million for Lakshadweep. Nationally, only 4.11% of people were within 30 minutes of walking from their nearest DH. Puducherry (28%), Chandigarh (29%), and Delhi (35%) were the only regions with >20% HAC for walking. For motorized transport, nationally, only 78.83% of people were within 60 minutes from their nearest DH by motorized travel. Among states/UTs, 31 regions had >50% HAC with UTs of Chandigarh and Delhi depicting 100% access coverage.

Interpretation:
These results emphasize the importance of incorporating factors like timely access into policy frameworks for a more comprehensive evaluation of health system performance in a country as geographically vast as India. This type of geospatial analysis can provide useful information for identifying the optimal locations for building new facilities.

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Background

- In 2021, a collaboration between Niti Aayog, the Ministry of Health and Family Welfare, the World Health Organization, and key stakeholders undertook the first-ever comprehensive assessment of India's district hospitals, a critical step towards achieving "Health for All" objective.
- The report evaluated hospitals on various key indicators, but its aspect - timely access to these facilities - remained unaddressed.
- Our study aimed to address this critical gap. We analyzed the geographical distribution of district hospitals across Indian states and union territories (UTs) and developed models to assess the timeliness of access to these healthcare facilities.

Findings

Table 1. States with the highest CPM Rate

<table>
<thead>
<tr>
<th>State/UT Name</th>
<th>DH Count</th>
<th>Population</th>
<th>CPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odisha</td>
<td>15</td>
<td>664,498</td>
<td>6.002</td>
</tr>
<tr>
<td>Ladakh</td>
<td>2</td>
<td>306,326</td>
<td>5.530</td>
</tr>
<tr>
<td>Nagaland</td>
<td>3</td>
<td>36,140</td>
<td>3.200</td>
</tr>
<tr>
<td>Gujarat</td>
<td>21</td>
<td>317,564</td>
<td>12.086</td>
</tr>
<tr>
<td>Lakshadweep</td>
<td>1</td>
<td>20,452</td>
<td>25.340</td>
</tr>
</tbody>
</table>

Table 2. States with the lowest CPM Rate

<table>
<thead>
<tr>
<th>State/UT Name</th>
<th>DH Count</th>
<th>Population</th>
<th>CPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jharkhand</td>
<td>19</td>
<td>96,264</td>
<td>0.931</td>
</tr>
<tr>
<td>Himachal Pradesh</td>
<td>11</td>
<td>52,613</td>
<td>0.539</td>
</tr>
<tr>
<td>Odisha</td>
<td>32</td>
<td>126,116</td>
<td>0.524</td>
</tr>
<tr>
<td>Telangana</td>
<td>6</td>
<td>18,632</td>
<td>0.311</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>25</td>
<td>88,164</td>
<td>0.312</td>
</tr>
</tbody>
</table>

Fig 1. Flowchart for timely access

We defined a metric called the Healthcare Access Coverage (HAC), representing the population proportion residing within specified time thresholds (30 and 60 minutes) from the nearest DH, considering both walking and motorized travel mode.

Fig 2. Centers Per Million

India has 707 District Hospitals, serving as critical access points for healthcare. However, disparities exist in their accessibility; the HAC W varies significantly, ranging from 0.87% in Andaman & Nicobar to 35.07% in Delhi. Similarly, the HAC M fluctuates between 3.12% in Andaman & Nicobar and 100% in Delhi and Chandigarh. Compared to the national average, HAC W stands at 4.11%, while HAC M reaches 78.83%.

Methodology

Conclusion

Integrating timely access alongside other metrics provides a more comprehensive picture of the existing healthcare facilities, particularly in a geographically diverse nation like India. This type of geospatial analysis not only contributes to comprehensively assessing existing facilities but also offers valuable insights for strategically establishing new sites, ensuring equitable access for all.

References