Title: Assessing Population-Level Access to Cardiac Care across Health Centres: A Geospatial Modeling Study in Vadodara District of Gujarat, India

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Abstract Topic/Track: Non-Communicable Diseases, Health Systems, Public Health, Primary and Surgical Care

Keywords (3 max from the options given): Health systems, Non-communicable diseases, Public health

Background:
Cardiovascular diseases (CVDs) are the leading cause of death in India and majorly contribute to premature death in Gujarat. Primary and Community Healthcare Centres (PHCs and CHCs) act as the first points of contact for those needing primary/secondary prevention. The Cardiac Care Centres (CCCs) provide specialized care. Timely access to healthcare can help reduce CVD mortality through early diagnosis and treatment. Our study investigates accessibility to cardiac care for seven subdistricts in Vadodara, Gujarat, India.

Methods:
We obtained PHC, CHC, and CCC geolocations for 2022 from a Google Maps search, accessibility motorized friction surface raster from the Malaria Atlas Project, and 1 sq

km population counts from WorldPop. We looked at two outcomes a) the density of health facilities per million population and b) the proportion of the population within a certain time threshold from the nearest health facility to them timely. This was analyzed for PHCs/CHCs and CCCs. The density was calculated as the number of centers per million people in the subdistrict. For timely access, the Dijkstra algorithm was implemented for two modes of transport i.e. walking and motorized transport. For PHCs/CHCs, 30 and 60 minutes were used as thresholds for walking and motorized travel. For CCCs, 60 and 120 minutes were used as thresholds for walking and motorized timely access.

Findings:
Vadodara district had 33 PHCs/CHCs and 4 CCCs. The densities of PHCs/CHCs and CCCs were 9.8 and 1.19 centers per million (CPM). The density of PHCs/CHCs was highest for Sinor (31.60 CPM) and least for the Vadodara subdistrict (3.15 CPM). Proportion within 30 minutes of walking from PHCs/CHCs varied from 9% in Kajran to 24.57% in Sinor. Across all subdistricts, 97% of people were within 60 minutes of their nearest PHCs/CHCs by motorized travel. Two subdistricts (28.6%) had CCCs. 60.75% of people in the Vadodara subdistrict could reach their nearest CCC within 60 minutes by walking. Four subdistricts have 0% access to CCCs by walking. Across all subdistricts, >97% of people could access the nearest CCC within 120 minutes via motorized travel.

Interpretation:
There is a dearth of health facilities that gravely limit access to appropriate cardiac care in Vadodara district, Gujarat, India. Future policy interventions should aim to address disparities in access to cardiac care across subdistricts. Such geospatial analyses can help inform appropriate locations for planning new centers.

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BACKGROUND

- Cardiovascular diseases (CVDs), the leading cause of death in India, particularly affect premature mortality in Gujarat.
- Primary and Community Healthcare Centres (PHCs and CHCs) offer first-line prevention, and Cardiac Care Centres (CCCs) specialize in cardiac treatment.
- The study explores access to cardiac care in Vadodara, Gujarat's seven subdistricts, underlining the role of timely healthcare in reducing CVD deaths through early intervention.

METHODOLOGY

Data Sources

- WorldPop, the Malaria Atlas Project for motorized and walking travel friction surface, and Justin Meyer's shapefile for population estimation through raster-based analysis.

Data Analysis

- **Healthcare access coverages (HAC)** were defined as the proportions (%) of the population within 60 and 30 minutes for PHCs/CHCs facility by motorized (HAC-M) and walking (HAC-W) modes of transport, respectively. For CCC these thresholds were extended to HAC-M 120 and HAC-W 60.
- **Centers per million (CPM)** focused on calculating the density of health facilities, which was determined by the number of centers per million people within a subdistrict. This metric was assessed for both PHC/CHCs and CCCs.

FINDINGS

Vadodara district has **33** PHCs/CHCs and **4** CCCs. HAC-W 30 for PHCs/CHCs varied from **9%** in Karjan to **24.57%** in Sinor. For HAC-M 60, **97%** of the population had access to the nearest PHCs/CHCs. Only 2 out of 7 subdsitricts have CCCs resulting in **0%** HAC-W 60 in 4 subdistricts and **97%** HAC-M 120 across all subdistricts. PHCs/CHCs density peaks at **31.59 CPM** in Sinor and drops to **3.15 CPM** in Vadodara. A summary of the findings can be seen below.

Centers Per Million

Sub_District	CCC	Population	CPM_CCC	PHC_CHC	CPM_PHC_CHC
Dabhoi	0	191266.1719	0	5	26.1415
Karjan	0	191764.375	0	5	26.0736
Padra	0	280378.7813	0	6	21.3996
Savli	0	207813.5781	0	4	19.24801
Sinor	0	94942.125	0	3	31.5981
Vadodara	3	2220969.75	1.35	7	3.1517
Waghoriya	1	169541.7969	5.89	3	17.6947

Table 1. *Summary of Centers per million for PHC/CHC and CCC*

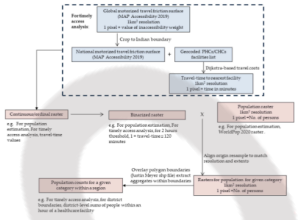

Fig 1. *Flowchart for timely access analysis*

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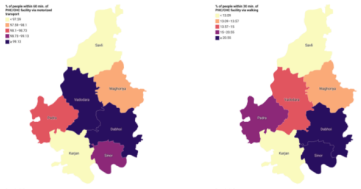

Fig 2. *Population estimates for PHC_CHC for HAC-M 60 and HAC-W 30*

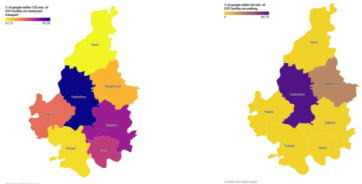

Fig 3. *Population estimates for CCC for HAC-M 120 and HAC-W 60*

CONCLUSION

The lack of health facilities severely restricts access to cardiac care in Vadodara district, Gujarat, India. Future policies must focus on reducing these disparities across subdistricts, using geospatial analyses to identify strategic locations for new centers.