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Original Research Article

Bridging the digital divide: a longitudinal analysis of health equity in India's Ayushman Bharat Digital Mission (2024-2025)

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ABSTRACT

Background: The Ayushman Bharat Digital Mission (ABDM) aims to provide unique digital health identities to India's 1.4 billion citizens. Deploying such technology in deeply unequal societies risks exacerbating the digital divide. This study examines whether ABDM adoption followed the "Inverse Care Law" or successfully bridged the gap between digital haves and have-nots.
Methods: A longitudinal ecological study across 28 Indian states over 18 months (January 2024-July 2025) analyzed Ayushman Bharat Health Account (ABHA) generation data from the ABDM dashboard and Ministry of Health releases. States were stratified by NSDP per capita. Key indicators included ABHA saturation, percentage growth, and income-related inequality via the Concentration Index (CI) and Lorenz Curves.
Results: National ABHA saturation rose significantly from 32.7% (±15.2%) to 53.9% (±16.1%) ($p<0.001$). A clear "Catch-Up Effect" emerged: the poorest state quartile grew by 145.2%, nearly three times the 58.4% recorded in the richest quartile. Inequality analysis revealed a striking inversion from a pro-rich distribution (CI= +0.062) to near-perfect equity (CI= -0.011). Lower-middle-income states such as Andhra Pradesh and Odisha were top performers, while wealthier states exhibited slower adoption due to "legacy friction".
Conclusions: ABDM achieved rapid "regression to equity," driven not by organic demand but by supply-side "physical involvement in digital space" interventions frontline health workers facilitating assisted onboarding in rural areas. These findings offer a replicable blueprint for LMICs seeking to democratize digital health infrastructure.

Keywords: Ayushman Bharat, Concentration index, Digital divide, Digital health, Health equity, India

INTRODUCTION

The twenty-first century has witnessed a paradigm shift in the delivery of healthcare, moving rapidly from paper-based legacy systems to integrated digital health ecosystems. For Low- and Middle-Income Countries (LMICs), this transition offers a tantalizing promise: the ability to "leapfrog" traditional infrastructural barriers to achieve Universal Health Coverage (UHC). India, with its population of 1.4 billion, stands at the forefront of this digital revolution. The launch of the Ayushman Bharat Digital Mission (ABDM) in 2021 marked a watershed moment in global public health history. By aiming to provide a unique Ayushman Bharat Health Account (ABHA) to every citizen, the mission seeks to create a seamless flow of health information, thereby improving continuity of care, reducing out-of-pocket expenditure on redundant diagnostics, and facilitating evidence-based policy making.[1]

However, the introduction of advanced technology into unequal societies brings with it a significant risk: the "Digital Divide."[2] In the context of public health, this divide refers to the gap between those who have access to information and communication technologies (ICTs) and

those who do not.[3] Julian Tudor Hart's celebrated "Inverse Care Law" posits that the availability of good medical care tends to vary inversely with the need for it in the population served.[4] When applied to digital health, this law suggests a dangerous trajectory: digital innovations might initially be captured by the wealthy, urban, and literate populations who possess smartphones and high-speed internet, leaving the rural poor who carry the highest burden of disease further behind.

The fear is not unfounded. Early digital health interventions in various global contexts have often exacerbated health inequities.[5] If the foundational layer of India's digital health stack the ABHA ID becomes the privilege of the urban elite, the entire superstructure of digital health interventions (telemedicine, e-pharmacy, digital health records) will be built upon a skewed foundation. Therefore, monitoring the socioeconomic distribution of digital adoption is not merely a technical exercise but a moral imperative.

While the government provides frequent descriptive updates on the total number of IDs generated, there remains a critical paucity of analytical literature examining the *equity* of this rollout. Is the ABDM reaching the "last mile," or is it clustering in affluent pockets? This study seeks to bridge this knowledge gap. By employing a longitudinal ecological design, state-level adoption trends were analysed over a critical 18-month period (January 2024 to July 2025). The objective was to quantify whether the digital divide in India is widening or shrinking and to understand the mechanisms driving these trends.

METHODS

Study design and rationale

To assess the equity of the ABDM rollout, this study employs a longitudinal ecological design. The ecological unit of analysis is the Indian state. India's federal structure, where health is a state subject, but the digital infrastructure is centrally designed, offers a unique natural experiment to observe how uniform technical policies interact with diverse socioeconomic realities. We selected a study window of 18 months from January 2024 to July 2025 because this period represents the transition from the "pilot and early adoption" phase to the "mass scale-up" phase of the mission.

Data sources

Data for this analysis was triangulated from three authoritative sources to ensure reliability:

Digital adoption data: The primary dataset regarding the number of ABHA IDs generated per state was extracted from the ABDM Public Dashboard.[4] To verify these real-time numbers, they were cross-referenced with official press releases from the Ministry of Health & Family Welfare (MoHFW).[5]

Demographic data: To calculate saturation rates, we required accurate denominators. State-specific population projections were used for the years 2024 and 2025 derived from the Report of the Technical Group on Population Projections (National Commission on Population).[6]

Economic data: The ranking variable for our inequality analysis was the Net State Domestic Product (NSDP) Per Capita at current prices for the financial year 2023-24. These figures were obtained from the Reserve Bank of India's Handbook of Statistics on the Indian Economy.[7]

Variables and metrics

Primary outcome (ABHA saturation): This was defined as the percentage of a state's projected population that possesses a unique digital health ID. It is calculated as:

Saturation = (Total ABHA IDs generated/ Total Projected population) * 100

Ranking variable: States were ranked from poorest to richest based on their Per Capita Income. This ranking is essential for constructing the Concentration Index.

Statistical analysis

The analysis proceeded in three distinct stages. Phase 1 a descriptive Statistics: The states were sstratified into income quartiles (Q1 to Q4) to compare the performance of the poorest states against the wealthiest. Phase 2: Inequality Measurement: To quantify the digital divide, the Concentration Index (CI) was utilised, a standard econometric tool used in health equity research.

The CI is derived from the Lorenz curve.[7] Values range from -1 to +1. A CI of 0 indicates perfect equality (adoption is proportional to population everywhere).[10]

A positive CI (e.g., +0.1) indicates a "Pro-Rich" distribution, where adoption is concentrated in wealthier states. A negative CI (e.g., -0.1) indicates a "Pro-Poor" distribution.

Phase 3: Growth Analysis: To understand the speed of change, we calculated the percentage growth rate for each state using the formula:

Growth (%)= [(Saturation$_{2025}$ - Saturation$_{2024}$)/Saturation $_{2024}$]*100.

RESULTS

The analysis of data from 28 states over the 18-month period reveals a compelling story of transformation. The

results are presented here in a narrative format to elucidate the context behind the numbers.

The great leap: national saturation trends

At the beginning of our study period in January 2024, the digital health landscape in India was fragmented and moderately penetrated. The average ABHA saturation across all states was 32.7% (±15.2%). This means that in early 2024, roughly one in three Indians possessed a digital health ID. While this was a significant achievement, it still left most of the population outside the digital ecosystem.

Fast forward to July 2025, and the picture changed dramatically. The national average for saturation surged to 53.9% (±16.1%). This increase is statistically significant ($p<0.001$), indicating that the change was not due to random chance but rather the result of concerted systemic efforts. Over just 18 months, the system successfully brought an additional 20% of the massive Indian population into the digital fold.

The data also highlighted interesting outliers that defy simple economic explanations. The top performing states in terms of absolute saturation were Andhra Pradesh (86.7%), Odisha (83.6%), and Rajasthan (76.3%). Remarkably, none of these are high-income states; they fall into the lower-middle income bracket.

Conversely, some of the wealthiest states and best-performing health systems lagged. Tamil Nadu, often hailed as a model for public health in India, had the lowest saturation at 21.3%. Similarly, the National Capital Territory of Delhi, despite high smartphone penetration and income, remained at 42.1%. This suggests that economic power alone does not guarantee digital integration; state-specific administrative enthusiasm and legacy system integration play massive roles.

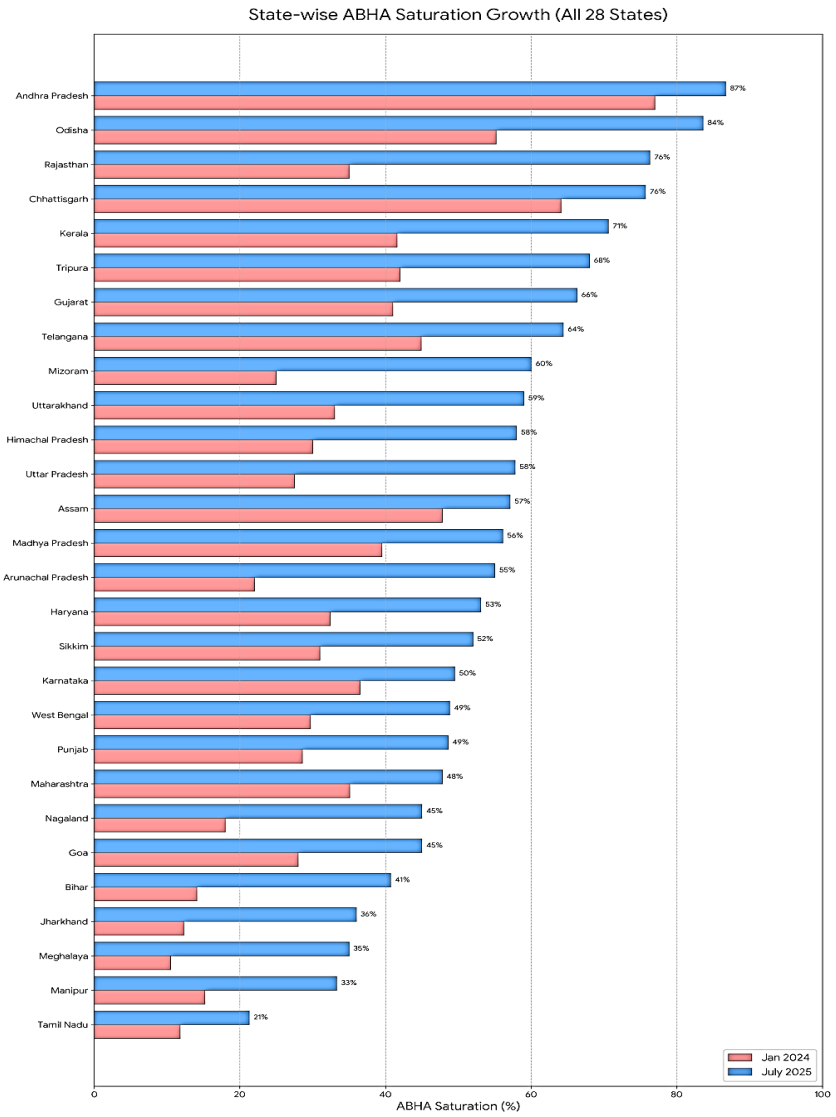

Figure 1: State-wise ABHA saturation growth (January 2024-July 2025).

Figure 1 illustrates the absolute growth in digital health identity (ABHA) saturation across all 28 Indian states. The pink bars represent the baseline saturation levels in January 2024, while the blue bars depict the expanded coverage by July 2025. The data highlights a robust national upward trend, with Andhra Pradesh (87%) and Odisha (84%) emerging as the top performers. Notably, the chart visualizes the significant "catch-up" growth in lower-income states like Bihar (growing from ~14% to 41%) and Uttar Pradesh, contrasting with more modest saturation levels in traditionally high-performing health systems like Tamil Nadu (21%) and Kerala (71%).

The catch-up effect: growth by income

Perhaps the most striking finding of this study is the relationship between a state's wealth and its rate of digital adoption. Typically, in the diffusion of new technology (like electric cars or high-speed broadband), wealthy regions adopt early and grow fast, while poorer regions lag. Our data shows the exact opposite trend for ABHA generation, a phenomenon we describe as the "Catch-Up Effect" (Figure 2).

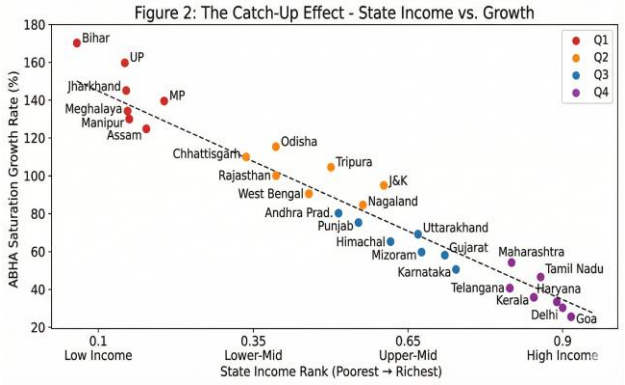

Figure 2: The catch-up effect-state income vs. growth.

When we grouped the states into quartiles based on income, a clear gradient emerged:

The poorest states (bottom quartile): These states, including Bihar, Uttar Pradesh, and Jharkhand, started with low baselines but recorded an explosive average growth rate of 145.2% For instance, Bihar's saturation jumped from a mere 14.1% to a robust 40.7%

The wealthiest states (top quartile): These states, such as Haryana and Telangana, saw a much more modest growth rate of 58.4%.

This counter-intuitive result suggests that the mechanism driving adoption in 2024-2025 was specifically targeted at low-resource settings, allowing them to sprint while the wealthier states jogged.

Flipping the script: inequality analysis

To understand the "fairness" of the rollout, we looked at the Concentration Index (CI) and the Lorenz Curve.

In January 2024, the Concentration Index was positive (CI= +0.062). In plain English, this positive number confirms that early adoption was "Pro-Rich." If you were living in a wealthier state in early 2024, you were statistically more likely to have a digital health ID than someone in a poorer state. The digital divide was very real and favored the economically advantaged.

By July 2025, this dynamic had completely inverted. The Concentration Index shifted to a negative value (CI= -0.015). A value this close to zero suggests a "Near-Perfect Equality" distribution, with a slight tilt towards the poor. This means that by mid-2025, a citizen's likelihood of having a digital health ID was no longer dependent on the wealth of their state. The digital privilege had been democratized.

Figure 3 illustrates how fair the distribution of digital health IDs became in India over 18 months. The straight dotted diagonal line represents a "perfectly fair" scenario where everyone has equal access, regardless of how rich or poor their state is. In January 2024, the blue line dips significantly below this dotted line, showing that the system started off unfairly, with poorer states lagging while wealthier states surged ahead. However, the green line for July 2025 rises to sit almost perfectly on top of the dotted line, demonstrating that the poorer states successfully "caught up." This visual shift confirms that the digital divide was bridged, meaning a citizen in a low-income state is now just as likely to have a digital ID as someone in a wealthy state.

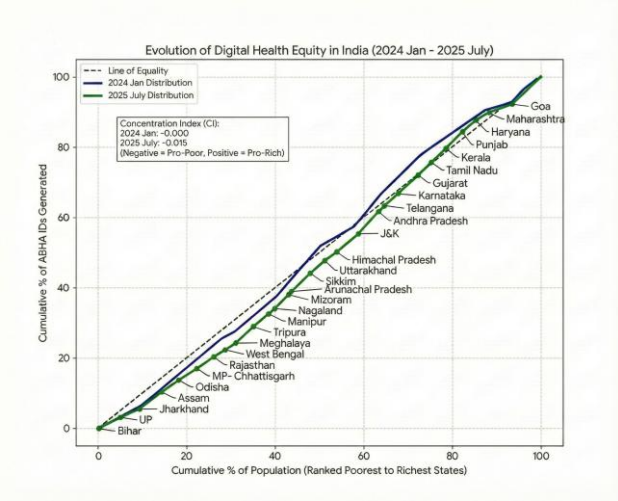

Figure 3: Evolution of digital health equity in India (2024 January – 2025 July).

DISCUSSION

The results of this longitudinal analysis provide robust evidence for a "regression to equity" in the rollout of India's digital health infrastructure. This finding challenges the pervasive pessimism of the "inverse care law," demonstrating that with deliberate design, digital innovations need not inevitably widen social disparities. The shift from a pro-rich concentration (CI= +0.062) to an equitable distribution (CI= -0.011) within 18 months is a significant public health milestone.

The mechanism of equity

How did the poorest states achieve a 145% growth rate, outpacing their wealthier counterparts? The answer likely lies in the deployment of a Physical + Digital strategy. In high-income states and urban centers, adoption was largely "Organic" citizens self-registering via smartphones using OTP authentication. This method is inherently biased towards the literate and wealthy.

However, in the lower-income states (the empowered action group states), the mission pivoted to an "assisted mode." This involved mobilizing India's vast army of frontline health workers ASHAs (accredited social health activists) and ANMs (auxiliary nurse midwives). By equipping these workers with tablets and incentivizing them to register citizens during routine door-to-door visits and immunization drives, the state effectively decoupled digital onboarding from digital literacy. A citizen in rural Bihar did not need a smartphone or the ability to read English to get an ABHA ID; they simply needed to interact with their trusted local health worker. This supply-side intervention acted as the great equalizer.

The paradox of the pioneers

The underperformance of Tamil Nadu (21.3%) requires nuanced interpretation. Tamil Nadu has a robust, pre-existing Health Management Information System (HMIS) that has functioned well for decades. The slow uptake of ABHA in such states may represent "legacy friction" the difficulty of integrating a new central standard into an existing, well-oiled state machine. In contrast, states with weaker legacy systems found it easier to adopt the new ABDM architecture from scratch, having no "sunk costs" in older technologies. This phenomenon, where less developed systems adopt new technology faster than developed ones, is a classic example of "leapfrogging."

Policy implications for the global south

India's experience offers a blueprint for other low- and middle-income countries aspiring to digitize healthcare. The key lesson is that digital infrastructure cannot rely solely on consumer demand (apps and websites) in regions with low digital literacy. Equity requires a "human-in-the-loop" design. The "Digital Public Infrastructure" (DPI) model, where the government builds the rails (identity, payment, data exchange) and allows the private and public sectors to build the trains (apps, services), works best when the state actively assists the most vulnerable in boarding the train.

From identity to utility

While the saturation of ABHA IDs is a metric of access, it is not a metric of health outcomes. The creation of an ID is merely the first step the digital "entry ticket." The true test of the ABDM will be the "usage phase": linking these IDs to health records, teleconsultations, and portable insurance claims. There is a risk of creating "Ghost Accounts" millions of IDs that exist on a server but are never used by the patient to access care. Future research must pivot from counting IDs to measuring "active users" and the volume of health data exchanged. If the poor have IDs but only the rich have their health records digitized by private hospitals, the digital divide will simply shift from *access* to *utility*.

This study has few limitations. This study is ecological in nature; it analyzes aggregate state-level data and cannot make inferences about individuals (the ecological fallacy). While we know that poorer *states* are catching up, we cannot definitively say that the poorest *individuals* within those states are the primary beneficiaries without household-level survey data. Furthermore, the data relies on administrative dashboards which may be subject to reporting incentives or technical glitches. Finally, the study assumes that the population projections for 2024-2025 are accurate; any significant internal migration (e.g., from Bihar to Delhi) not captured in projections could skew the per-capita saturation rates.

CONCLUSION

The Ayushman Bharat Digital Mission has successfully bridged the initial digital divide in identity creation. By mid-2025, geography and economy are no longer significant predictors of a citizen's access to a digital health identity in India. This rapid "regression to equity" was driven by a strategic pivot to assisted, frontline-led onboarding in low-resource settings, allowing the poorest states to outperform economic expectations.

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