Aadhaar Ecosystem Analysis: Unlocking Societal Trends in Enrolment and Updates (2025)

UIDAI Data Hackathon (2026) – Final Submission

Team ID: UIDAI_7536

Datasets Used: UIDAI Aadhaar Enrolment, Demographic Update, Biometric Update Datasets

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Executive Summary

India's Aadhaar system has matured beyond mass enrolment and now functions primarily as a **lifecycle identity platform**. Using UIDAI's 2025 enrolment and update datasets, this study analyses how Aadhaar is being used today—who is enrolling, who is updating, where system pressure is concentrated, and when demand spikes occur.

The analysis reveals that:

- Updates vastly outnumber new enrolments, confirming system maturity.
- Children and adolescents dominate new enrolments and mandatory biometric updates.
- Biometric updates form the largest share of Aadhaar activity.
- High-population states account for most service demand, with clear seasonal spikes.

These insights highlight the need for UIDAI to shift from enrolment-centric planning to **update-centric service optimisation**.

The findings can directly support UIDAI in planning update-focused infrastructure, forecasting seasonal service demand, and prioritising biometric update capacity.

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1. Problem Statement and Approach

1.1 Problem Statement

Aadhaar has achieved near-universal coverage in India. However, enrolment statistics alone no longer reflect how the system is actually being used. Citizens frequently update Aadhaar records due to:

- Address and contact changes
- Age-related biometric changes
- Mandatory biometric updates for children
- Authentication failures

Despite this, update behaviour is not analysed systematically.

Problem addressed:

How can Aadhaar enrolment, demographic update, and biometric update data be jointly analysed to uncover societal trends and operational stress points, and how can these insights support informed decision-making by UIDAI?

1.2 Analytical Approach

The study follows a **lifecycle-based analytical approach**:

1. Integrate enrolment, demographic update, and biometric update datasets.
2. Analyse month-wise trends to identify seasonal and policy-driven shifts.
3. Study age-group distributions to understand enrolment saturation.
4. Compare states to identify high-load regions.
5. Use derived indicators such as **Update-to-Enrolment Ratio** to measure system maturity.

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2. Datasets Used

All datasets are official UIDAI datasets provided for the hackathon.

2.1 Aadhaar Enrolment Dataset

Files: api_data_aadhar_enrolment_*.csv
Key Columns:

- date, state, district, pincode
- age_0_5, age_5_17, age_18_greater

Purpose:
To analyse new Aadhaar registrations and age-wise enrolment trends.

2.2 Aadhaar Demographic Update Dataset

Files: api_data_aadhar_demographic_*.csv
Key Columns:

- date, state, district, pincode
- demo_age_5_17, demo_age_17_

Purpose:
To measure non-biometric updates such as address, name, or contact changes.

2.3 Aadhaar Biometric Update Dataset

Files: api_data_aadhar_biometric_*.csv
Key Columns:

- date, state, district, pincode
- bio_age_5_17, bio_age_17_

Purpose:
To capture biometric re-capture activity due to ageing or mandatory updates.

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3. Methodology

3.1 Data Cleaning and Preprocessing

- Combined split CSV files into consolidated datasets.
- Converted date fields into datetime format.
- Created monthly periods (month_year) for time-series analysis.
- Aggregated data from pincode to **state-month level**.
- State-level aggregation was chosen to balance interpretability with scale, ensuring insights remain relevant for national and regional policy planning.
- Used outer joins to maintain continuous timelines.
- Filled missing activity with zero values.
- Noted inconsistencies in state naming as a data quality limitation.

3.2 Feature Engineering

- **Total Enrolments** = age_0_5 + age_5_17 + age_18_greater
- **Total Demographic Updates** = demo_age_5_17 + demo_age_17_
- **Total Biometric Updates** = bio_age_5_17 + bio_age_17_
- **Total Transactions** = Enrolments + All Updates
- **Update-to-Enrolment Ratio** = Indicator of Aadhaar maturity
- **Mandatory Biometric Update Potential** = Focus on 5–17 age group

4. Data Analysis and Visualisation

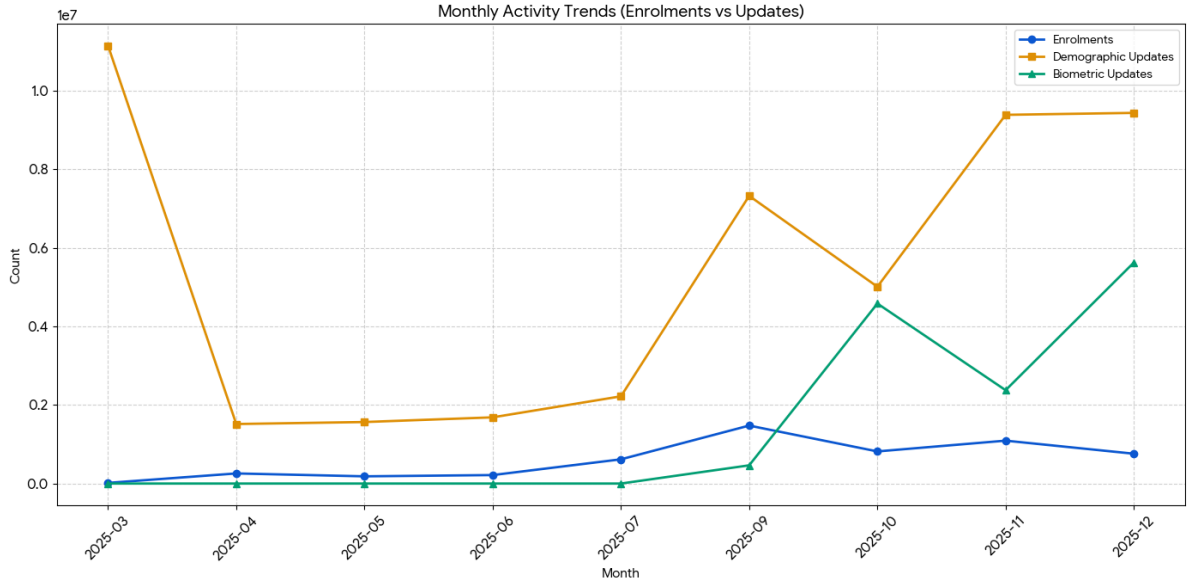
4.1 National Aadhaar Usage Shift

Finding:

- New Enrolments: ~5.4 million
- Demographic Updates: ~49.3 million
- Biometric Updates: ~69.7 million

Insight:
Aadhaar is now overwhelmingly a **record-maintenance system**, not an enrolment system.

Figure 1: Monthly Aadhaar Trend Analysis (Enrolments vs Demographic and Biometric Updates)



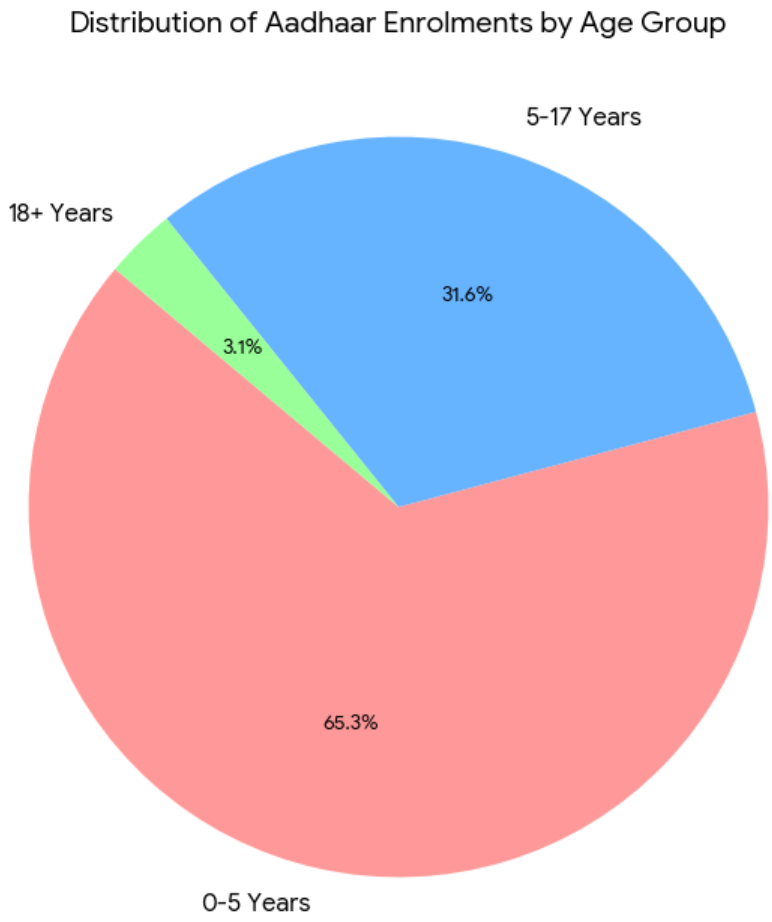
4.2 Age-Wise Enrolment Trends

Finding:

- ~76% of new enrolments come from ages 0–17.
- ~36% are from ages 0–5 alone.

Insight:
Adult Aadhaar enrolment is saturated. Aadhaar now operates as a **birth-to-adulthood identity pipeline**.

Figure 2: Aadhaar Enrolment Age Distribution



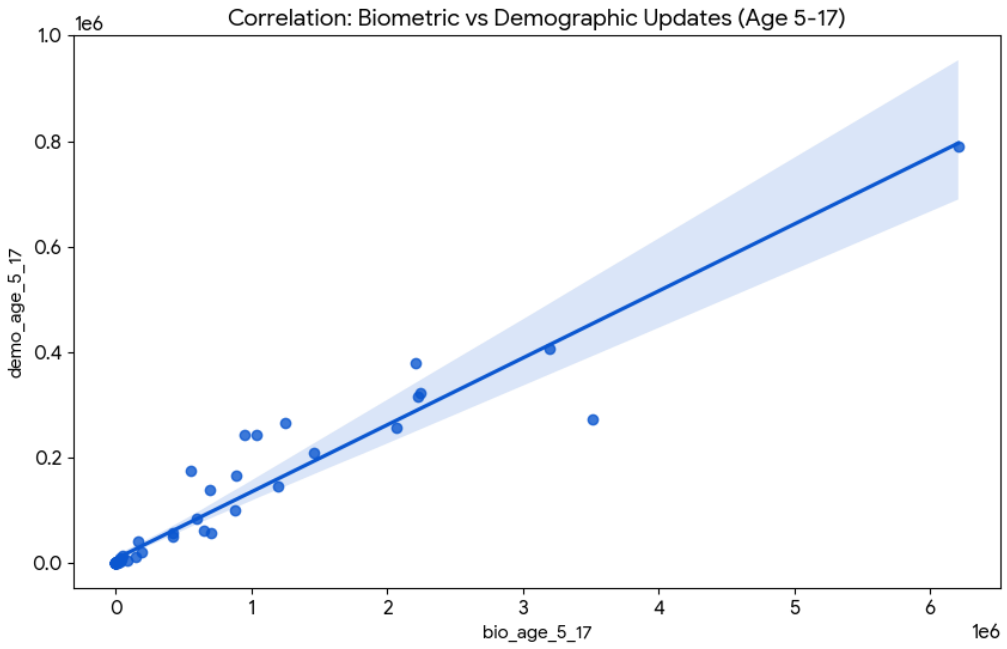
4.3 Biometric Updates as System Load Drivers

Finding:

- Biometric updates exceed demographic updates.
- Strong correlation between child biometric and demographic updates.

Insight:
Mandatory Biometric Updates and biometric ageing are the largest contributors to service load.

Figure 3: Correlation between Biometric and Demographic Updates (Age 5–17)



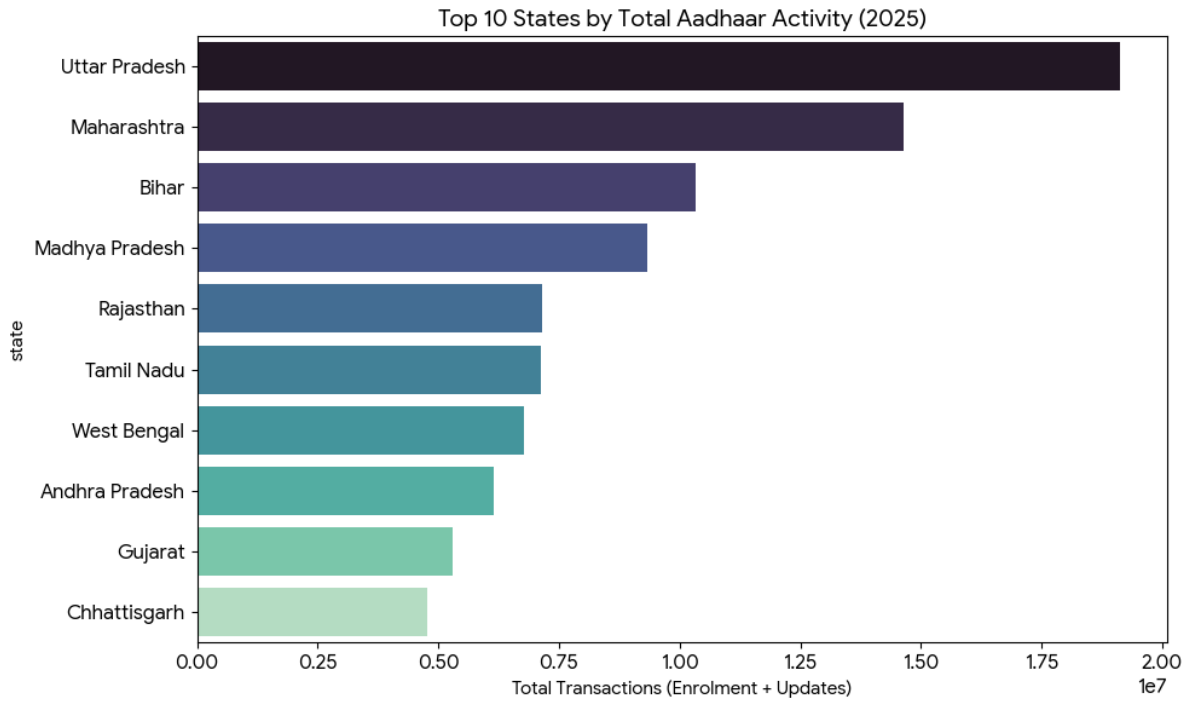
4.4 Regional Activity Concentration

Finding:
Top states by total Aadhaar activity:

1. Uttar Pradesh
2. Maharashtra
3. Bihar
4. Madhya Pradesh
5. Rajasthan

Insight:
Population size, rural outreach, and compliance cycles drive sustained Aadhaar demand.

Figure 4: Top 10 States by Total Aadhaar Activity



4.5 Seasonal Demand Patterns

Finding:
Biometric updates spike sharply in Q4 2025.

Insight:
Likely driven by school admissions, year-end documentation, and compliance requirements.

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5. Code and Reproducibility

- Analysis performed using **Python, Pandas, Matplotlib, and Seaborn**.
- A single Jupyter Notebook documents:
    - Data loading and merging
    - Aggregation logic
    - Feature engineering
    - Visualisations

Reproducibility:
Notebook can be rerun using UIDAI datasets placed in a local data/ directory.

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6. Limitations

- Aggregated data limits individual-level interpretation.
- The analysis reflects transaction volumes and does not distinguish between first-time updates and repeat updates by the same individual.
- State naming inconsistencies may affect precise aggregation.
- Migration and policy impacts are inferred, not directly measured.

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7. Conclusion and Recommendations

Conclusion

Aadhaar in 2025 reflects a mature digital identity ecosystem where **updates, not enrolments**, define operational reality.

Recommendations for UIDAI

1. Reallocate Aadhaar centre capacity based on update volume rather than enrolment counts.
2. Increase biometric update infrastructure and staffing in high-activity states during Q4 to handle predictable seasonal surges in update requests.
3. Track the size of the 5–17 age group to estimate upcoming Mandatory Biometric Updates. This allows UIDAI to plan staffing and biometric infrastructure in advance instead of responding after service congestion occurs.
4. Ensure consistent state and district naming across all Aadhaar datasets before deploying dashboards or automated alerts. This will prevent duplicate records, incorrect aggregations, and misleading regional insights.
5. Monitor sudden rises in demographic or biometric updates at the state level as early warning signals of service pressure. These trends can help UIDAI proactively adjust centre capacity and scheduling before delays build up.

Final Remark

Aadhaar transactional data offers a clear view of societal mobility, ageing, and compliance behaviour. Using these signals can help UIDAI move from reactive service delivery to proactive, data-driven governance.