Assessing the Impact of Digital Health Interventions on Child Immunization Coverage in India : Insights from NFHS-5 Data

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Background and Rationale

- Why This Study Matters :

  Immunization is one of the most cost-effective public health strategies for reducing child mortality.

  India's UIP has made progress—but gaps persist in urban slums, tribal areas, and low-literacy rural districts.

- Digital Health Interventions (DHIs):

  - eVIN: Tracks inventory & cold chain

  - CoWIN: Digital vaccination scheduling

  - ANMOL: Data entry for ANMs

  - mHealth: SMS/IVR outreach

- DHIs help reduce stock-outs, improve tracking, and engage beneficiaries.
- Limited comprehensive assessment exists despite promising evidence.

Problem Statement

- **What Gaps Does This Research Address?**

  Lack of empirical evidence on how DHIs influence vaccine uptake at the district level in India.

  While national success stories (e.g., CoWIN during COVID) exist, their impact at micro (local) level is underexplored.

- **Key unanswered questions:**

  - How do socioeconomic factors (like female literacy, urbanization, wealth index) interact with DHI effectiveness?

  - Are DHIs equally effective in marginalized regions (e.g., tribal belts, low-income urban clusters)?
  - NFHS-5 data does not directly capture DHI exposure—making evidence-based policymaking difficult.

Research Objectives

- **General Objective**:
- To evaluate how digital health interventions, especially EHR and CoWIN/eVIN platforms, influence child immunization outcomes in India.

- **Specific Objectives**:
- To synthesize existing literature on DHIs and their role in immunization programs in India.
- To analyze NFHS-5 data to detect disparities in immunization rates across socio-economic groups.
- To assess the correlation between digital health adoption (e.g., eVIN presence, mobile reminders) and full immunization rates.
- To provide policy-oriented recommendations for expanding EHR-driven immunization tracking.

Methodology

- **Approach:**

  Secondary research combining literature review, policy analysis, and NFHS-5 data mining.

- **Literature Review:**

  Systematic review from PubMed, Scopus, etc.
  Focus on DHIs and EHR-based immunization tracking.

- **Document Analysis:**

  Reviewed policies (UIP, NDHM, CoWIN, WHO).

  Assessed DHI adoption, challenges, and alignment with SDG 3.

- **Data Mining:**

  Analyzed NFHS-5 data on key vaccines (BCG, DPT, Measles, etc.).

Thematic Analysis of Digital Health Interventions (DHIs)

Key Findings from Research Literature and NFHS-5 Data :

- System-Level Digital Infrastructure (eVIN, CoWIN, ANMOL):
  Platforms like eVIN and CoWIN significantly improved vaccine stock management, cold chain reliability, and real-time beneficiary tracking. High-performing states with full deployment (e.g., Kerala, Himachal Pradesh) reported immunization coverage >90%.

- Mobile Health Interventions (SMS, IVR, Apps):
  SMS reminders and voice campaigns improved DPT3 uptake by up to 11%. However, their effectiveness was amplified when paired with frontline worker (FLW) engagement.

- Equity & Access Disparities (NFHS-5 Evidence):
  GIS and district-level analysis identified critical immunization gaps:
  - 13% zero-dose prevalence in rural Bihar
  - Urban slums in 10 cities showed <50% full coverage
  - 89 districts had <60% full immunization rates

Thematic Analysis of DHIs

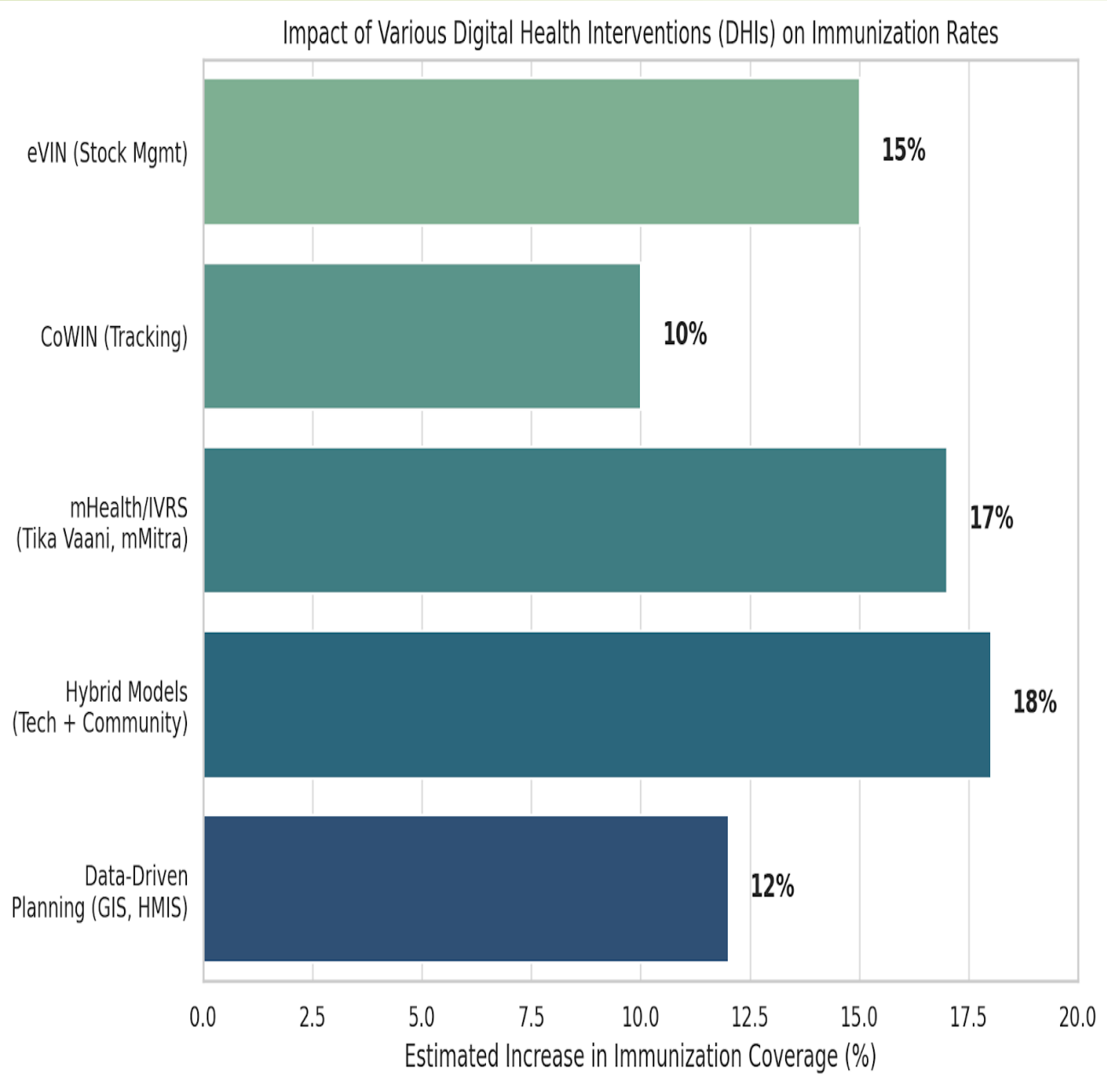
- Policy Integration & Programmatic Alignment:
  DHIs embedded within RMNCH+A and NHM frameworks yielded better results. However, interoperability issues between CoWIN, eVIN, and RCH systems persist in certain regions.

- Human + Tech Hybrid Models:
  Integrated interventions—combining digital tools with ASHA/ANM-led outreach—led to 2.3x higher compliance among parents. Trust and localized follow-ups enhanced effectiveness.

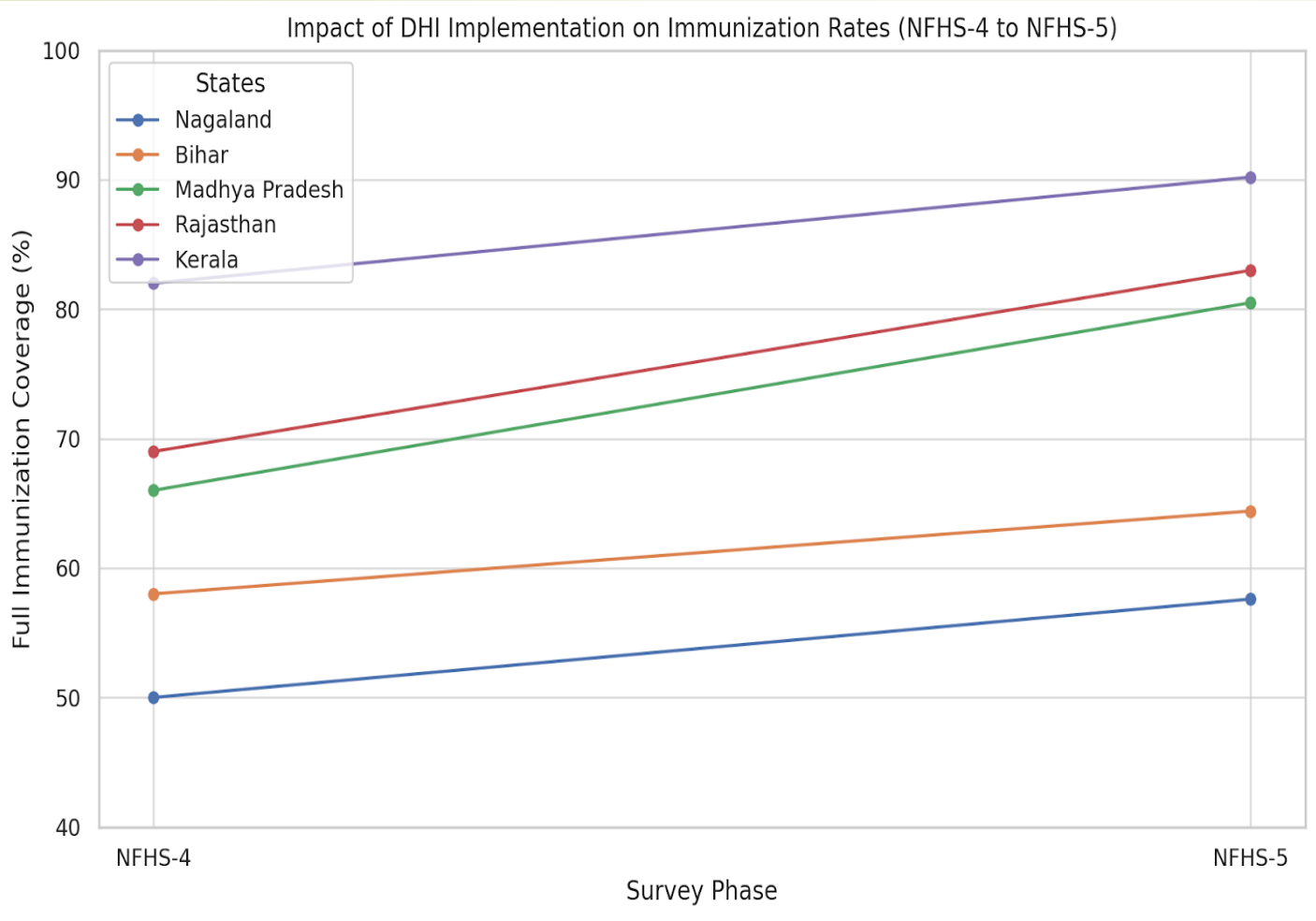
- Data-Driven Surveillance & Microplanning:
  Platforms like DHIS2 and GIS-enabled NFHS dashboards enabled district health officials to identify zero-dose clusters, reduce vaccine wastage (by 70% in eVIN pilots), and guide targeted interventions.

Findings from research

- Full immunization coverage in India increased from 62.0% (NFHS-4) to 76.4% (NFHS-5), showing a 14.4% national improvement.States with full DHI adoption (e.g., Kerala – 90.2%, Rajasthan – 83%) outperformed others like Bihar (64.4%) and Nagaland (57.6%). eVIN rollout reduced vaccine stock-outs by over 80%, improving cold chain management and session planning.
- In Rajasthan and MP, stock-out rates fell by 15–17% post-eVIN deployment. CoWIN adaptation for child immunization in Maharashtra led to an 8–12% increase in vaccine coverage and 25% drop in missed appointments.
- mHealth and IVRS tools (e.g., Tika Vaani, mMitra) raised awareness by up to 19% and improved coverage by 15–18%.
- Urban immunization rates (80.1%) were higher than rural (74.3%), though the gap is narrowing due to mobile interventions.
- Overall, integrated digital platforms, when combined with community outreach, significantly improve child immunization outcomes.



- The graph showing the estimated increase in immunization coverage due to different **Digital Health Interventions (DHIs)**:
- **eVIN**: ~15% increase from improved stock management.
- **CoWIN**: ~10% increase through scheduling and tracking.
- **mHealth/IVRS (e.g., Tika Vaani, mMitra)**: ~17% boost via reminders and awareness.
- **Hybrid Models**: ~18% improvement by combining tech with human outreach.
- **Data-Driven Planning**: ~12% increase by using GIS, HMIS for microtargeting.



This line graph illustrates the **change in full immunization coverage from NFHS-4 to NFHS-5** across five states, highlighting the role of **DHI implementation**:

- **Kerala**, **Rajasthan**, and **MP** (with strong DHI adoption) show sharp increases.

- **Bihar** and **Nagaland** (with partial or no DHI) show smaller improvements.

Challenges & Barriers

- Infrastructure gaps in tribal/rural regions
- Digital literacy among ASHAs/ANMs is low
- Data fragmentation: CoWIN, eVIN, RCH not fully integrated
- Policy gaps: No unified standards, privacy protocols missing
- DHIs often unsustainable post-pilot/donor phase

Recommendations & Conclusion

- Policy Recommendations:
- Expand ABDM-compliant DHI integration
- Incentivize mHealth use by FLWs
- Use AI dashboards to monitor dropout risk
- Target zero-dose clusters using GIS + NFHS overlays

- Conclusion:

  DHIs are powerful enablers when tech is integrated with human outreach, policy support, and equity goals.

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Thank You