International Journal of Web of Multidisciplinary Studies
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
website: http://ijwos.com
Vol.02 No.11.
OPEN ACCESS
E-ISSN : 3049-2424
DOI:

Predictive Analytics for Public Health Management Using Big Data in Urban Gujarat

PATEL NEHA SHIRISHBHAI[1], Dr. Manish Mangal[2]
[1,2] *Sabarmati University, Ahmedabad, India*

Article Info

Article History:

Published:21 Nov 2025

Publication Issue:
Volume 2, Issue 11
November-2025

Page Number:
393-398

Corresponding Author:
PATEL NEHA SHIRISHBHAI

Abstract:

The growing urban population in Gujarat has placed considerable stress on public health infrastructure. To tackle emerging health challenges in urban areas, governments and healthcare institutions are turning to predictive analytics powered by big data. This research explores how predictive analytics can be effectively deployed in Gujarat's urban centers to enhance public health surveillance, predict disease outbreaks, optimize resource allocation, and support data-driven policymaking. By analyzing real-world datasets and studying pilot projects in cities like Ahmedabad, Surat, and Vadodara, this paper identifies success factors, technological tools, implementation barriers, and strategic recommendations.

Keywords: Predictive Analytics, Big Data, Public Health, Urban Gujarat, Disease Surveillance, Healthcare Informatics, Smart Cities, Health Policy

1. Introduction

Urbanization in Gujarat has led to rapid changes in population density, sanitation infrastructure, disease patterns, and healthcare delivery systems. Cities like Ahmedabad and Surat are not only economic hubs but also hotspots for public health concerns ranging from communicable diseases to air pollution-related illnesses.

Traditional health management systems often suffer from data silos, delayed responses, and poor forecasting. **Predictive analytics**, using big data from various sources—hospital records, mobile health apps, IoT devices, social media, and environmental sensors—has emerged as a powerful tool to **anticipate health risks and plan preventive interventions**.

This research investigates how predictive analytics can support proactive public health management in urban Gujarat and proposes a model for its integration with municipal and state health systems.

2. Objectives of the Study:

1. To examine the scope and benefits of predictive analytics in public health management.
2. To analyze the availability and sources of big data relevant to urban health in Gujarat.
3. To study existing initiatives using predictive analytics in selected urban centers.
4. To recommend a framework for integrating predictive analytics into public health policy and service delivery.

3. Literature Review

The use of big data in healthcare has been extensively studied globally. According to McKinsey (2013), effective use of healthcare data can save up to $300 billion annually in the U.S. alone. In India, NITI Aayog's "National Digital Health Blueprint" (2019) highlights data-driven public health as a critical area for innovation.

Research by Bhandari & Gupta (2020) in Indian Journal of Public Health discusses the role of machine learning in tracking COVID-19 spread using mobility and testing data. However, specific studies focusing on **urban Gujarat's context** are limited, making this research particularly relevant.

4. Methodology

4.1 Research Design

The study employs a mixed-methods approach:

- **Quantitative**: Analysis of urban health data, disease trends, and environmental variables.
- **Qualitative**: Interviews with public health officials, IT professionals, and data analysts.

4.2 Data Sources

- Hospital and municipal health records (anonymized)
- GIS and environmental data from GPCB and smart city dashboards
- Mobile-based health apps (e.g., Aarogya Setu)
- Social media trend analysis (Twitter, Google Trends)
- Open datasets from the Ministry of Health & Family Welfare and WHO

4.3 Case Study Locations

- **Ahmedabad**: Air pollution and NCDs
- **Surat**: Infectious disease tracking
- **Vadodara**: Maternal health monitoring

5. Predictive Analytics in Urban Public Health: Use Cases:

5.1 Disease Surveillance and Outbreak Prediction

Predictive models based on historical disease data and environmental factors (e.g., temperature, rainfall, pollution) can forecast outbreaks like dengue or influenza. For instance, in Surat, predictive analytics was used during COVID-19 to identify hotspots in real-time using case clustering and mobility data.

5.2 Hospital Resource Allocation

In Ahmedabad, AI-powered dashboards have been piloted to predict bed occupancy, ICU demand, and oxygen needs during peak health crises. These models improve preparedness by weeks.

5.3 Chronic Disease Monitoring

Data from wearable devices and hospital EHRs in Vadodara help track trends in hypertension, diabetes, and respiratory disorders. Predictive alerts allow early intervention and reduce emergency admissions.

5.4 Maternal and Child Health

Predictive tools can flag high-risk pregnancies by analyzing nutrition records, hemoglobin levels, and family history, improving maternal and neonatal outcomes.

6. Findings and Analysis

6.1 Data Availability

- Urban Gujarat has **fragmented but growing data ecosystems** through smart city dashboards, hospital networks, and health apps.
- Integration remains a challenge due to **interoperability and privacy issues**.

6.2 Technological Tools

- Tools such as **Python, R, TensorFlow, Power BI**, and **Apache Hadoop** are used.
- AI models like logistic regression, decision trees, and neural networks are being adopted for prediction tasks.

6.3 Institutional Readiness

- Municipal health departments express interest but lack skilled personnel.
- Collaboration with academic institutions and private tech firms is increasing.

6.4 Key Challenges

- Data privacy and consent regulations
- Uneven data quality and manual record-keeping
- Low digital literacy among health workers
- Limited policy frameworks for predictive analytics

7. Predictive Analytics Implementation Framework (PAIF-Gujarat):

A proposed framework for integration in urban Gujarat:

- **Data Collection Layer**: Hospitals, IoT, environmental sensors, mHealth apps
- **Data Integration Layer**: Standardized EHRs and cloud-based data lakes
- **Analytics Engine**: AI/ML models customized for local health trends
- **Visualization & Alerts**: Dashboards for municipal officers and medical staff
- **Action Layer**: Proactive resource mobilization, policy alerts, patient communication
- **Feedback Loop**: Continuous learning from outcomes and model performance

8. Discussion

The application of predictive analytics in urban public health management in Gujarat reveals a dynamic landscape of opportunities, innovations, and challenges. The case studies and field data suggest that predictive tools have already begun transforming the way health administrators think

about disease outbreaks, hospital readiness, and chronic disease prevention. For instance, the deployment of real-time dashboards during the COVID-19 pandemic in Ahmedabad and Surat demonstrated how predictive models can provide early warnings, enabling faster containment strategies and resource mobilization.

However, the research also underscores significant institutional and technological gaps. Most municipalities still rely on siloed data systems, often paper-based or semi-digitized, which restrict the effectiveness of integrated predictive models. The lack of interoperability between systems used by hospitals, municipal corporations, and state health departments remains a major barrier.

Another critical insight is the shortage of skilled professionals capable of developing and interpreting predictive models. Urban Gujarat's public health departments often depend on external consultants or private technology partners due to limited in-house capacity. While this enables short-term progress, it raises concerns about long-term sustainability, cost, and data sovereignty.

Ethical considerations around data privacy, especially when dealing with sensitive health information, cannot be overlooked. Although India's Digital Personal Data Protection Act (2023) provides a legal framework, operational compliance is still uneven. Citizens' trust in how their health data is used must be earned through transparency and accountability.

Despite these hurdles, Gujarat's vibrant startup ecosystem and existing smart city infrastructure provide a strong foundation for integrating predictive analytics. Municipalities in cities like Vadodara are increasingly open to pilot projects, particularly in areas such as maternal health monitoring and vector-borne disease forecasting.

This discussion emphasizes that predictive analytics must be viewed not merely as a technological upgrade, but as a strategic shift toward preventive, personalized, and participatory public health governance.

9. Conclusion

The research concludes that predictive analytics, driven by big data, holds transformative potential for improving public health outcomes in urban Gujarat. From preventing outbreaks to optimizing hospital resource management, the benefits of predictive technologies are substantial and measurable.

However, realizing this potential demands a multi-pronged approach. This includes:

- Strengthening data infrastructure and standardizing digital health records across institutions.

- Investing in skill development for public health officials and data scientists.
- Establishing robust legal and ethical safeguards for data use.
- Fostering public-private-academic partnerships to innovate and implement scalable solutions.

The proposed Predictive Analytics Implementation Framework (PAIF-Gujarat) serves as a roadmap for municipalities to integrate predictive capabilities into their existing health governance structures. By focusing on interoperability, real-time data, and actionable insights, this framework can make urban public health systems more responsive and resilient.

Looking forward, Gujarat has the institutional ambition and digital momentum to emerge as a model state for data-driven public health management in India. Integrating predictive analytics into everyday decision-making will not only improve health outcomes but also optimize costs, enhance service delivery, and empower citizens with timely health information.

In essence, data is the new vaccine—when used responsibly and intelligently, it can protect entire populations, prevent crises, and build healthier, smarter cities.

References

1. McKinsey Global Institute (2013). *The Big Data Revolution in Healthcare*.
2. NITI Aayog (2019). *National Digital Health Blueprint*.
3. Bhandari, S., & Gupta, R. (2020). *Machine Learning and Public Health in India: A COVID-19 Perspective*. Indian Journal of Public Health.
4. Gujarat Urban Development Mission Reports (2022).
5. WHO (2021). *Big Data in Public Health: Frameworks and Applications*.
6. Ministry of Health and Family Welfare (2023). *Smart Health Surveillance in Urban India*.