RADemics

Healthcare Informatics and Decision Support Systems for Public Health

R.J.T Nirmalraj, Mandeep Narang
SRM UNIVERSITY, SHRI GURU RAM RAI UNIVERSITY

Healthcare Informatics and Decision Support Systems for Public Health

[1]R.J.T Nirmalraj, Assistant Professor, School of Management, SRM University, Sikkim. nirmalraj.online@srmus.edu.in

[2]Mandeep Narang, Associate Professor, Department of Hospital Administration, School of Management and Commerce Studies, Shri Guru Ram Rai University, Dehradun, Uttarakhand, India. narangmandeep77777@gmail.com

Abstract

Rapid digital transformation across healthcare ecosystems has redefined the operational landscape of public health governance. Expanding volumes of heterogeneous health data originating from clinical records, surveillance systems, environmental monitoring platforms, and connected devices demand robust informatics infrastructures capable of generating timely and actionable intelligence. Advanced Healthcare Informatics frameworks, coupled with intelligent Decision Support Systems (DSS), enable integration of large-scale datasets into predictive, adaptive, and policy-relevant analytical environments. Artificial Intelligence–driven models strengthen outbreak forecasting, risk stratification, resource optimization, and strategic planning at regional and national levels. This chapter presents a comprehensive examination of digital infrastructure design, interoperable data ecosystems, AI-enabled predictive analytics, explainable modeling strategies, and governance mechanisms within public health contexts. Emphasis was placed on scalable system architectures, real-time surveillance integration, ethical AI deployment, cybersecurity resilience, and regulatory alignment. Sustainable deployment strategies tailored for low-resource settings are also addressed, highlighting modular architectures, open standards, and privacy-preserving analytics frameworks. By synthesizing technological innovation with accountability-driven governance, this work advances a structured research roadmap for resilient, transparent, and equitable public health decision ecosystems suitable for next-generation digital transformation initiatives.

Keywords: Healthcare Informatics; Decision Support Systems; Public Health Analytics; Artificial Intelligence; Interoperability; Ethical Governance.

Introduction

Digital transformation across global healthcare ecosystems has reshaped the operational foundations of public health administration, surveillance, and policy execution [1]. Expansion of electronic health records, laboratory information systems, syndromic surveillance platforms, genomic repositories, environmental monitoring networks, and mobile health applications has generated an unprecedented volume of heterogeneous health data [2]. Such rapid data proliferation demands advanced informatics infrastructures capable of systematic aggregation, semantic harmonization, and high-throughput analytical processing [3]. Public health agencies increasingly rely on computational frameworks that integrate distributed data streams into cohesive intelligence systems supporting disease monitoring, prevention planning, and population-level risk assessment

[4]. Transition from paper-based reporting to interconnected digital environments has enhanced temporal responsiveness and geographic reach, enabling coordinated actions across local, regional, and national authorities [5]. Contemporary public health governance therefore depends upon robust digital architectures that align data engineering principles with epidemiological rigor [6]. Integration of structured clinical datasets with unstructured textual records, geospatial indicators, and behavioral metrics strengthens comprehensive situational awareness [7]. Scalable computing ecosystems, including cloud-native and distributed analytics platforms, support continuous ingestion of high-velocity data streams during dynamic health emergencies [8]. Such transformation signals a paradigm shift from reactive intervention toward predictive and preventive public health management grounded in real-time intelligence generation [9].

Decision Support Systems occupy a central position within modern healthcare informatics by translating complex datasets into actionable policy insights [10]. Early public health information systems functioned primarily as reporting repositories; contemporary DSS architectures incorporate machine learning pipelines, probabilistic modeling engines, and knowledge-based reasoning modules capable of adaptive learning [11]. Integration of artificial intelligence enables detection of subtle transmission patterns, forecasting of hospitalization demand, and identification of vulnerable demographic clusters [12]. Advanced analytical techniques synthesize epidemiological trends with socioeconomic indicators, climate variables, and mobility analytics to support multidimensional risk modeling [13]. Real-time dashboards present predictive outputs in interpretable formats that facilitate strategic planning, emergency preparedness, and resource distribution [14]. Interconnected data infrastructures enhance coordination among hospitals, laboratories, community health centers, and governmental agencies, strengthening collaborative response mechanisms [15]. Incorporation of simulation modeling and scenario analysis tools supports evaluation of intervention strategies under varying transmission conditions [16]. Such computational ecosystems enhance strategic agility and evidence-based governance across diverse public health contexts [17]. Evolution of DSS from static rule-based configurations toward adaptive, self-optimizing intelligence systems represents a significant advancement in population health management capabilities [18].