http:// health-providers.ir
Letter to Editor (Pages: 19-21)

Health System Resilience in the Digital Era: From Data Repositories to Intelligent, Interoperable Infrastructures

Mahdi Derakhshi[1], *Mohammad Saeedi[2]

[1]Dean of Information and Communication Technology Unit, Mashhad Municipality Fire and Safety Services Organization, Mashhad, Iran.

[2]M.S. in Software Engineering, Information and Communication Technology Unit, Mashhad Municipality Fire and Safety Services Organization, Mashhad, Iran.

Abstract,

Health system resilience increasingly depends on digital architectures that support continuity of care, adaptive decision-making, and sustained performance during crises. Despite the rapid expansion of digital data collection, fragmentation and limited interoperability continue to constrain its utility. Resilient digital health systems require interoperable standards, embedded clinical decision support, distributed computing models, and implementation-ready policy frameworks. Fast Healthcare Interoperability Resources (FHIR) facilitates modular, machine-readable data exchange; clinical decision support systems (CDSS) convert data into timely, actionable insights; and edge computing enhances functionality and equity in low-connectivity settings. The World Health Organization's SMART Guidelines bridge normative recommendations and machine-executable specifications, enabling the translation of policy into deployable digital solutions. Transitioning from passive data repositories to intelligent, interoperable infrastructures enhances system responsiveness, safety, and equity. Ultimately, resilience depends on the integration of standards, algorithms, workflows, and governance within a coherent digital ecosystem.

Key Words: Clinical decision support systems, Digital health, Health system resilience, Interoperability, FHIR.

*Please cite this article as: Derakhshi M, Saeedi M. Health System Resilience in the Digital Era: From Data Repositories to Intelligent, Interoperable Infrastructures. Health Provid 2026; 6(1): 19-21. doi: **10.22034/hp.2026.588523.1084**

Corresponding Author:

Mohammad Saeedi, Information and Communication Technology Unit, Mashhad Municipality Fire and Safety Services Organization, Mashhad, Iran.

Email: msaeedi884@yhoo.com

Received date: Mar. 16, 2026; Accepted date: Jun.22, 2026

Dear Editor,

Recent global disruptions have exposed persistent vulnerabilities in health systems and reinforced resilience as a central policy priority. In this context, digital health should be reconceptualized not as a supportive or archival function, but as a foundational component of resilient health systems. The World Health Organization's Global Strategy on Digital Health 2020–2025 underscores digital transformation as a key driver of system strengthening, improved service delivery, and people-centered care (1).

Despite growing policy emphasis, many health systems remain constrained by fragmented information ecosystems in which data are collected but insufficiently integrated. Resilience requires more than digitization; it demands the capacity to exchange, interpret, and operationalize data across settings and over time. Interoperability is therefore a fundamental prerequisite. Fast Healthcare Interoperability Resources (FHIR) has emerged as a leading standard, enabling modular, machine-readable data exchange and supporting advanced clinical decision support through tools such as Clinical Quality Language, SMART on FHIR, CDS Hooks, and FHIR Clinical Reasoning (2). Recent scoping evidence demonstrates FHIR implementation across diverse domains, including chronic disease management, oncology, acute care, and infectious diseases, while also highlighting persistent challenges related to standardization and scalability (3).

However, interoperable data alone are insufficient to improve outcomes. The value of digital systems lies in transforming data into timely, context-aware clinical actions. Clinical decision support systems (CDSS) integrate patient-specific information with evidence-based guidance to generate recommendations, alerts, and care pathways. When effectively implemented, CDSS can enhance medication safety, adherence to guidelines, and decision consistency. Nonetheless, their effectiveness depends on usability, workflow integration, and the mitigation of alert fatigue—factors that become especially critical under conditions of system stress (4). Accordingly, intelligent decision support should be regarded as a core resilience function rather than an optional feature of electronic health records.

The location of data processing is another critical determinant of resilience. While centralized architectures may offer efficiency under stable conditions, they are vulnerable to disruptions in connectivity and may limit responsiveness in time-sensitive contexts. Edge computing, which processes data closer to the point of care, reduces latency, enhances data privacy, and maintains functionality in low-resource or remote environments. Emerging evidence indicates that intelligent edge computing, particularly when integrated with immersive technologies, can expand remote monitoring capabilities and improve access to specialized care, thereby promoting equity and continuity (5). From a resilience perspective, distributed computational capacity represents a strategic advantage when centralized systems are under strain.

Implementation remains the principal challenge. Even well-established standards and advanced technologies fail to deliver impact without effective translation into usable, context-sensitive systems. WHO SMART Guidelines provide a practical framework by converting narrative recommendations into standards-based, machine-readable, adaptable, and testable digital components that can be embedded within national health systems (6). By aligning policy intent with operational design, SMART Guidelines facilitate the transition from static guidance to executable digital pathways.

In conclusion, strengthening health system resilience in the digital era requires moving beyond basic digitization toward the development of intelligent, interoperable infrastructures. Systems that merely digitize records remain fragmented; those that exchange data without enabling interpretation remain passive; and exclusively centralized architectures are vulnerable under stress. A resilient digital health system integrates interoperable standards, embedded decision support, distributed processing, and implementation-ready governance. Such integration is essential to ensure continuity, safety, equity, and adaptive capacity in contemporary health systems.

CONFLICT OF INTEREST: None.

REFERENCES

1. World Health Organization. Global strategy on digital health 2020-2025. Geneva: WHO; 2021. ISBN: 978-92-4-002092-4. Available from: https://www.who.int/publications/i/item/9789240020924.

2. Strasberg HR, Rhodes B, Del Fiol G, Jenders RA, Haug PJ, Kawamoto K. Contemporary clinical decision support standards using Health Level Seven International Fast Healthcare Interoperability Resources. J Am Med Inform Assoc. 2021 Jul 30;28(8):1796-1806. doi: 10.1093/jamia/ocab070. PMID: 34100949; PMCID: PMC8324242.

3. Tabari P, Costagliola G, De Rosa M, Boeker M. State-of-the-Art Fast Healthcare Interoperability Resources (FHIR)-Based Data Model and Structure Implementations: Systematic Scoping Review. JMIR Med Inform. 2024 Sep 24;12:e58445. doi: 10.2196/58445. PMID: 39316433; PMCID: PMC11472501.

4. Sutton RT, Pincock D, Baumgart DC, Sadowski DC, Fedorak RN, Kroeker KI. An overview of clinical decision support systems: benefits, risks, and strategies for success. NPJ Digit Med. 2020 Feb 6;3:17. doi: 10.1038/s41746-020-0221-y. PMID: 32047862; PMCID: PMC7005290.

5. Lakshminarayanan V, Ravikumar A, Sriraman H, Alla S, Chattu VK. Health Care Equity Through Intelligent Edge Computing and Augmented Reality/Virtual Reality: A Systematic Review. J Multidiscip Healthc. 2023 Sep 21;16:2839-2859. doi: 10.2147/JMDH.S419923. PMID: 37753339; PMCID: PMC10519219.

6. World Health Organization. SMART Guidelines. Available from: https://www.who.int/teams/digital-health-and-innovation/smart-guidelines.