

WAVE Model: A Diagnostic Framework for Health-System Collapse Risk

Roozbeh Hojabri
September 25, 2026

The WAVE Model is a conceptual and diagnostic framework developed to understand and assess the progressive risk of health-system collapse. Rather than treating collapse as the direct consequence of a single crisis, shock, or organizational failure, WAVE conceptualizes it as a systemic process in which external pressures interact with internal vulnerabilities, vulnerabilities begin to reinforce and propagate across interconnected domains, and the health system progressively loses its capacity to maintain essential functions, absorb additional shocks, adapt, and recover. See Figure 1.

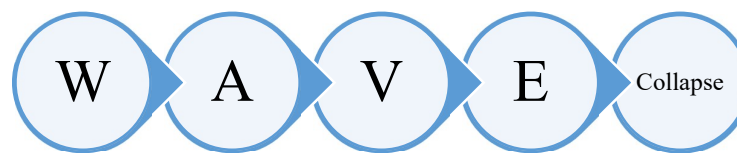


Figure 1. WAVE model (Hojabri, 2026)

The model emerged from a sequential research program integrating findings from ten preceding empirical and conceptual studies. These studies examined external pressures, major internal vulnerabilities, early-warning signals, interactions among vulnerabilities, and deterioration in the functional dimensions of Stability, Efficiency, and Adaptability (SEA). The synthesis identified eight categories of external stressors and six major domains of internal vulnerability, which were subsequently integrated into a single architecture describing the pathway toward systemic collapse risk.

The Four Components of WAVE

W — Wider Environmental Stressors represents pressures originating primarily outside the health system. Eight major categories are considered: wars and armed conflict; changes in disease burden and outbreaks; economic changes and crises; political changes and instability; social, cultural, and demographic changes; natural disasters; climate-related changes; and cross-border and regional crisis spillover. WAVE assesses not merely whether these stressors exist, but their intensity, duration, geographic reach, population exposure, trajectory, persistence, concurrence, and other characteristics that determine the magnitude of pressure imposed on the health system.

A — Activated Internal Vulnerabilities represents weaknesses within the health system that are present or have become sufficiently intensified to affect its capacity to withstand external pressure. Six

major vulnerability domains are incorporated: governance fragmentation and failure; financial and economic vulnerability; workforce vulnerability; digital saturation; infrastructure and capacity vulnerability; and trust erosion. A central feature of WAVE is the concept of activation: the mere existence of a structural weakness is distinguished from a vulnerability that has become functionally consequential under prevailing conditions.

V — Vulnerability Interactions and Cascades captures the critical transition from separate vulnerabilities to interconnected deterioration. Financial pressure, workforce shortages, infrastructure constraints, governance problems, digital dependency, or declining trust may initially exist as distinguishable problems. Systemic concern increases when deterioration in one domain begins to affect another, multiple vulnerabilities reinforce one another, feedback loops emerge, or sequential effects create cascading pathways across the health system. V therefore differentiates a system facing several simultaneous problems from one in which those problems have begun to operate as an interconnected process of deterioration.

E — Escalating Systemic Risk assesses whether deterioration has progressed beyond individual vulnerabilities and their interactions toward system-wide functional consequences. At this stage, attention shifts toward declining reserve and compensatory capacity, disruption of essential-service continuity, reduced shock absorption, weakened recovery capacity, and deterioration in Stability, Efficiency, and Adaptability. SEA therefore complements WAVE: WAVE describes how risk develops and propagates, while SEA helps interpret what functional capabilities the health system is progressively losing.

Table 1 shows a simple illustrative example of applying WAVE to healthcare management.

Table 1. An example of applying WAVE to healthcare management

WAVE stage	Healthcare management example	What happens?
W — Wider external stressors	Flu epidemic, rising patient demand, inflation, staff migration	The hospital faces pressures coming from outside the organization.
A — Activated internal vulnerabilities	Existing staff shortages, limited beds, outdated IT systems, financial constraints	The external pressure exposes weaknesses that were already present.
V — Vulnerability interactions & cascades	Staff shortage → overtime → fatigue → more errors/absences → even greater staff shortage	Different vulnerabilities interact and reinforce each other.
E — Escalating systemic risk	Emergency department overcrowding → delayed treatment → pressure on other departments → deterioration of overall hospital capacity	The problem moves beyond one department and begins affecting the functioning of the wider system.

The conceptual pathway can consequently be summarized as:

$$W \rightarrow A \rightarrow V \rightarrow E \rightarrow \text{Risk of Health-System Collapse}$$

Importantly, this is not an inevitable or strictly linear pathway. A severe external shock does not necessarily lead to collapse, and the presence of multiple vulnerabilities does not automatically produce cascading failure. Reserve capacity, redundancy, effective governance, adaptation, compensatory mechanisms, and recovery may interrupt or reverse the progression. Thus, WAVE is designed to identify the configuration and evolution of risk, rather than assuming that exposure to crisis is equivalent to collapse.

References

Hojabari, R. (2026). A conceptual framework for health system collapse: Linking external stressors, internal vulnerabilities, and cascading risks. *Journal of Saturation Studies*, 1(4, Special Issue), 169–210.

Manafi, M. (2026). The Theory of Saturation, Collapse Model, and Rosetta Stone Model: A Unified yet Modular Meta-Framework. *Journal of Saturation Studies*, 1(1), 10-19.

Manafi, M. (2025). Orientation note: Saturation, collapse, and the Rosetta Stone Model. Manafi Institute for SaturationStudies. <https://manafi-institute.de/Resources>.