WESTERN HEMISPHERE READINESS SERIES

HRS Resilience Foundation

TECHNICAL PAPER 01

Building Resilient Health Supply Chains

Risk, Readiness and Continuity in Emergency Preparedness

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Technical Paper 01	André Vieira	HRS Resilience Foundation

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About this series. This Technical Paper is the third publication in the HRS Resilience Foundation's Western Hemisphere Readiness Series. It extends the analytical approach introduced in HRS Strategic Report 01, Health Security and Institutional Resilience in the Americas, by applying the HRS Readiness Cycle's Sustain and Deploy functions specifically to health supply-chain continuity, and complements HRS Policy Brief 01, Strengthening Regional Health Emergency Readiness in the Americas.

EXECUTIVE SUMMARY

Building Resilient Health Supply Chains

Health supply chains are a readiness capability, not merely a procurement function. During an emergency, the availability of medicines, diagnostics, personal protective equipment, devices, laboratory materials and other critical supplies depends on decisions and dependencies that begin well before a crisis and continue through replenishment and recovery.

This paper is published against the backdrop of the Pan American Health Organization's (PAHO) June 2026 Executive Committee session, which approved a new institutional strategy for health emergency and risk management across the Region.[6] It applies that broader regional readiness agenda specifically to the supply-chain layer.

The central technical problem is not simply whether an institution holds enough inventory. It is whether the institution can identify critical dependencies, recognize disruption, make timely sourcing decisions, move material through constrained logistics networks, maintain essential services and restore stock without creating a new vulnerability.

This paper develops an operational framework — the HRS Supply Chain Resilience Framework — around five linked capabilities: visibility, risk segmentation, sourcing resilience, logistics continuity and replenishment discipline. These capabilities should operate within clear governance and decision rights and should be measured using time-based indicators.

> CENTRAL TECHNICAL PROPOSITION
>
> *Resilient health supply chains are designed around the consequence of interruption, not simply the probability of interruption. The appropriate response may be additional stock, alternate suppliers, pre-negotiated contracts, regional reserves, transport contingencies, substitution protocols, or a combination of these measures.*

Key Findings

CAPABILITY	TECHNICAL IMPLICATION
Supply visibility	Link critical-item lists to suppliers, lead times, inventory position, consumption and known single points of failure.
Risk segmentation	Prioritize by consequence, substitutability, lead time and exposure rather than treating every item identically.
Sourcing resilience	Assess supplier concentration, geographic concentration and long replenishment cycles explicitly.
Inventory strategy	Use risk-informed reserves with rotation, replenishment, quality and release procedures.
Logistics continuity	Treat transport, warehousing, customs, cold chain and last-mile delivery as readiness capabilities.
Governance	Define decision thresholds, authorities and escalation paths before disruption.
Performance	Measure time-to-detect, time-to-decide, time-to-source, time-to-deploy and time-to-replenish.

SECTION 01

The Technical Problem

Emergency health supply chains fail at interfaces. A facility may have adequate stock while its regional warehouse is empty; a supplier may have product while transport capacity is unavailable; a purchase order may be approved while customs or regulatory processes delay release.

The WHO's National Health Emergency Alert and Response Framework and its 2026 framework for national public health agencies emphasize coordinated functions, defined capabilities and the ability to act across levels during health emergencies.[1,2] For supply chains, the practical implication is to connect procurement, inventory, logistics, clinical demand, emergency operations, finance, regulatory functions and leadership decisions into one operating picture.

FAILURE MODE	ILLUSTRATIVE MECHANISM
Supplier interruption	Production outage, quality event, insolvency or unexpected demand.
Concentration	Dependence on one supplier, origin, port, route or specialized component.
Demand shock	Emergency consumption exceeds normal replenishment assumptions.
Information delay	Inventory or supplier status is not visible early enough to support action.
Logistics disruption	Route, warehouse, cold-chain or last-mile failure.
Decision latency	Authority to substitute, purchase, allocate or release is unclear.
Replenishment failure	Emergency consumption is met initially but stock is not restored in time.

SECTION 02

End-to-End Supply Chain Architecture

A resilience assessment should map the chain from demand signal to final use and back through replenishment. The objective is to expose dependencies that disappear when procurement or inventory is examined in isolation.

The architecture should be represented as a dependency map rather than a simple vendor list. A single critical component can create a system-wide constraint even when the final product appears to have multiple suppliers. This mirrors the WHO's Emergency Ready Primary Health Care model, which links connect, detect, protect and treat capacities to essential-service continuity[4] — the same logic applied here to the physical supply of critical items.

LAYER	CORE QUESTION
Demand	What essential services must remain operational, at what minimum level, and for how long?
Critical items	Which medicines, devices, diagnostics, PPE and inputs are essential?
Supply	Who produces or supplies them, where, and with what concentration?
Inventory	Where is usable stock held and what coverage does it provide?
Movement	Which transport, warehousing, customs and distribution dependencies must function?
Use	How is material allocated and protected against waste or diversion?
Replenishment	How quickly can inventory be restored after emergency drawdown?

SECTION 03

Risk Segmentation and Criticality

A uniform resilience standard is inefficient. Criticality should determine the depth of planning, redundancy and management attention applied to an item.

The WHO's 2025 considerations brief on medical countermeasure stockpiling uses a risk-informed approach that considers hazard likelihood and severity, system vulnerabilities and operational capacity.[3] It also distinguishes stockpiling from routine procurement and recognizes different reserve arrangements as potential tools.

DIMENSION	ASSESSMENT QUESTION
Consequence	What essential service is affected if the item becomes unavailable?
Replenishment time	How long would a credible replacement source require under disruption?
Substitutability	Can another product or pathway be used safely and lawfully?
Concentration	How dependent is the institution on one effective source or route?
Storage sensitivity	Does the item require controlled temperature, special handling or limited shelf life?
Demand volatility	Can emergency demand increase rapidly and unpredictably?

SECTION 04

Inventory, Reserves and Stockpile Strategy

Inventory is one resilience mechanism, but excess inventory can create expiry, quality, storage and capital burdens. The technical question is not simply how much to store, but what combination of reserve mechanisms provides the required continuity at acceptable cost and complexity.

PAHO has documented regional procurement mechanisms and prepositioned supplies supporting emergency access — its Regional Revolving Funds delivered over 234 million vaccine doses and other critical health supplies across the Region in 2025.[5,7] These examples illustrate the value of procurement and prepositioned capacity without implying that one model fits every institution.

MECHANISM	POTENTIAL ROLE
Routine inventory	First buffer against short disruptions.
Safety stock	Absorbs predictable variation in demand or replenishment time.
Physical reserve	Immediate availability for high-consequence disruption scenarios.
Contracted reserve	Secures access without requiring all inventory to be stored locally.
Pre-negotiated supply	Reduces procurement latency during emergency demand.
Regional reserve	Provides surge capacity when local stocks are insufficient.
Substitution protocol	Reduces dependence on a single product where safe alternatives exist.

SECTION 05

Supplier and Sourcing Resilience

Supplier diversity is valuable only when alternatives are genuinely independent. Two vendors may provide little redundancy if both depend on the same manufacturer, origin, component, port or specialized input.

ASPR's FY2026–2029 Strategic Plan identifies medical supply-chain resilience as a U.S. strategic objective and highlights concentrated sourcing, shipping delays, geopolitical tensions, trade disruptions and disasters as potential vulnerabilities.[9] It also calls for greater visibility of supply-chain dependencies and more agile manufacturing models.

ASSESSMENT	EVIDENCE TO COLLECT
Supplier concentration	Share of critical volume by supplier and effective alternatives.
Origin concentration	Manufacturing and component locations for critical items.
Lead-time exposure	Normal and stressed replenishment times.
Contract readiness	Emergency terms, allocation, minimum orders and activation conditions.
Quality dependency	Regulatory status, quality history and substitution requirements.
Logistics dependency	Ports, routes, carriers and storage nodes required for delivery.

SECTION 06

Logistics Continuity

A resilient product that cannot move is functionally unavailable. Logistics continuity therefore belongs inside the technical design of emergency preparedness.

The logistics assessment should identify critical nodes and minimum acceptable operating conditions for transport corridors, ports and airports, warehouses, cold-chain facilities, customs interfaces, fuel availability and final-mile distribution. PAHO has documented prepositioned preparedness and rapid deployment of supplies during Caribbean hurricane response, illustrating the value of having both stock and a mechanism to move it quickly.[5]

NODE	CONTINUITY QUESTION
Origin	Can product leave the supplier under emergency conditions?
International movement	Are credible alternative routes or carriers available?
Entry point	Can goods be cleared and released without avoidable delay?
Central storage	Is there adequate capacity, power, security and temperature control?
Regional distribution	Can material reach affected areas if the primary route fails?
Last mile	Are delivery arrangements available when normal routes fail?

SECTION 07

Information, Visibility and Decision Support

Supply-chain resilience depends on knowing what is happening early enough to act. Visibility should therefore be designed around decisions, not data accumulation.

At minimum, decision-makers should know what critical items are available, where they are located, current consumption, expected depletion, supplier status, replenishment time, transport status and which constraints require leadership action. Every high-priority indicator should have an owner, an update interval, a threshold and a named action or decision.

SIGNAL	DECISION ENABLED
Inventory below threshold	Release reserve, accelerate procurement or redistribute stock.
Supplier disruption	Activate alternate source or contingency.
Demand surge	Recalculate coverage and prioritize allocation.
Route disruption	Activate alternative carrier, route or distribution node.
Quality issue	Quarantine affected stock and activate replacement pathway.
Replenishment delay	Escalate before stockout rather than after it occurs.

SECTION 08

Governance and Decision Rights

Emergency supply decisions often fail because authority is ambiguous. Procurement, finance, clinical leadership, logistics, regulatory functions and emergency management may each control part of the process.

A resilient model defines decision rights before disruption. This requires pre-agreed thresholds at which specific authorities become active, together with documentation, segregation of duties, auditability and post-event review.

DECISION	PRE-DEFINED GOVERNANCE ELEMENT
Reserve release	Who can authorize it, under what threshold and for which priorities?
Emergency purchase	What conditions activate expedited procurement and who approves it?
Supplier substitution	Who determines technical and clinical acceptability?
Allocation	Who sets priorities when demand exceeds supply?
Route change	Who can authorize alternative logistics arrangements?
Replenishment	Who owns restoration of stock after emergency use?
Escalation	What event requires executive or emergency-operations review?

SECTION 09

Performance Measurement

Traditional measures — purchase price, inventory value, fill rate and procurement cycle time — remain useful, but they do not fully describe emergency readiness.

Technical readiness should be measured in terms of time, continuity and exposure. Metrics should be tested in exercises as well as real events.

INDICATOR	WHAT IT MEASURES
Time to detect	Time from disruption signal to institutional recognition.
Time to decide	Time from recognition to authorized response decision.
Time to source	Time required to secure alternative or emergency supply.
Time to deploy	Time required to move critical material to the point of need.
Time to replenish	Time required to restore reserve or operational inventory.
Critical-item availability	Share of priority items available at required service points.
Single-source exposure	Proportion of critical demand dependent on one effective source.
Coverage	Expected days or service units supported by usable inventory.
Continuity performance	Extent to which essential services remained operational.

SECTION 10

Implementation Framework

Implementation should begin with the highest-consequence dependencies rather than attempting to redesign the entire supply chain simultaneously. The framework should be adapted to national laws, institutional structures, geography, financing and available infrastructure. It is an operating logic, not a fixed procurement prescription.

> **MINIMUM VIABLE RESILIENCE PACKAGE**
>
> *A prioritized critical-item list; a dependency map; reliable inventory visibility; defined emergency decision rights; at least one tested continuity mechanism for major supply risks; and a replenishment plan after emergency drawdown.*

PHASE	PRIORITY ACTIONS
0–90 days	Define essential services; establish critical items; map high-risk dependencies; assign owners; establish baseline metrics.
90–180 days	Segment critical items; assess supplier and route concentration; review reserves; define decision thresholds; validate data flows.
180–365 days	Activate alternate sourcing and logistics; test reserve release and replenishment; conduct simulations — regional platforms such as PAHO's SIMEXamericas illustrate how such exercises can be run in virtual or hybrid environments[8]; close identified gaps.
Beyond 12 months	Institutionalize annual risk review, supplier reassessment, stress testing, exercises and continuous improvement.

SECTION 11

Technical Design Checklist

The following checklist can be used as a practical readiness review. A "yes" answer should be supported by evidence, not only by a policy statement.

CONTROL	EVIDENCE OF READINESS
Critical-item definition	Approved list linked to essential services and operational requirements.
Dependency mapping	Supplier, origin, component, logistics and regulatory dependencies documented.
Inventory visibility	Reliable current position, usable stock and consumption data.
Risk segmentation	Documented criteria and classification of critical items.
Supplier resilience	Effective alternatives or documented rationale for single-source exposure.
Emergency sourcing	Pre-defined procurement or contractual mechanisms with activation authority.
Reserve management	Release, rotation, quality and replenishment procedures tested.
Logistics continuity	Alternative route, carrier, warehouse or delivery arrangements assessed.
Decision rights	Named authorities and thresholds for release, purchase, substitution and allocation.
Performance metrics	Time-based indicators measured during exercises or events.
After-action learning	Formal process converting findings into corrective actions.

> ASSESSMENT PRINCIPLE
>
> *Readiness is demonstrated by the ability to perform under stress. Documentation is necessary, but testing, measurement and corrective action are what turn a plan into an operational capability.*

SECTION 12

Conclusion

Health supply-chain resilience is ultimately a continuity problem. The objective is not to eliminate every disruption; it is to prevent predictable or manageable disruptions from becoming failures of essential services.

The Americas already possess substantial health-system capabilities, procurement mechanisms, logistics networks and emergency preparedness structures. The technical opportunity is to connect those capabilities through stronger visibility, risk-based prioritization, diversified sourcing, resilient logistics, clear decision rights and disciplined replenishment.

A resilient supply chain is therefore not defined by the size of its inventory or the number of suppliers alone. It is defined by how reliably the institution can detect a problem, understand its consequences, make a decision, secure an alternative, move critical resources, sustain essential services and restore capacity.

FINAL TECHNICAL PROPOSITION

The most useful resilience investment is the one that reduces the time between a disruption signal and a reliable operational response — and reduces the probability that a temporary shortage becomes a prolonged service failure.

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André Vieira, MD

FOUNDER & CHAIRMAN, HRS RESILIENCE FOUNDATION