



# Investigating resilience in essential health services in humanitarian settings: findings from a mixed-methods project on vaccination delivery in Lebanon

## KEY MESSAGES

- Academic engagement with health system resilience is strong but research in this area is emergent. We do not have a clear understanding of how different kinds of shock affect health systems, how essential services may respond to them, nor of suitable strategies for supporting system resilience.
- This brief summarises findings from a mixed-methods research project exploring how the national vaccination delivery system in Lebanon has responded to an overlapping series of shocks – including large-scale population displacement, COVID-19 and an intensifying economic crisis.
- Our findings show that different shocks may give rise to differing risks within health systems, and that these risks are likely to be distributed at multiple levels from national to local. Shock responses are similarly varied. Systems thinking approaches offer considerable potential for mapping out intervention points in a system to support long-term resilience.
- We also show that effective resilience-building depends on portfolio approaches combining packages of interventions in different ways at different times, to respond to changing local conditions.

## BACKGROUND

There is strong research interest in health system resilience, driven in part by experiences during COVID-19, but our understanding of resilience and interventions that may contribute to strengthening it is emergent. We do not have a clear understanding of how different kinds of shock affect health systems, how these systems typically respond to them, and what intervention strategies are likely to support long-term resilience.

Health shocks have also predominantly been studied in isolation, as discrete events. Work in other fields – especially climate and environmental science – has shown how overlapping, or “compound” shocks may amplify systemic risks and cause cascading effects from national to local levels, creating new and unanticipated threats to health service delivery. There is a need for greater understanding of these risks to better support health systems in humanitarian settings and others, where the probability of compound shocks is highest.

In this project, we aimed to [i] explore how external shocks affect health systems, [ii] identify pathways or system constraints that may explain how and why health systems respond to shocks in the ways that they do, and [iii] identify relevant interventions to bolster system resilience. We did so through an in-depth case study on childhood vaccination delivery in Lebanon.

### A primer on the Lebanese vaccination delivery system

Lebanon, unfortunately, offers a rich context in which to study the effects of shocks on health systems. Over the period 2012-22, it experienced a series of shocks including large-scale refugee arrivals from Syria, COVID-19, an explosion in Beirut that had catastrophic effects on the capital city’s infrastructure, and a multi-dimensional political and economic crisis.

The health sector landscape in Lebanon is fragmented. Patients can access vaccination through a multitude of pathways including private clinics (which historically provided the bulk of vaccinations especially to host communities), publicly supported facilities administered by the Ministry of Public Health (MoPH) and Ministry of Social Affairs (MoSA), and third sector facilities.

Historically, primary care facilities offered vaccination on fee-for-service models. A key policy change following the arrival of refugees from Syria was to make childhood vaccines available at nominal cost through publicly supported facilities in the MoPH’s primary care network (PCN).

## OUR APPROACH

We explored system resilience using a mixed-methods approach through a case study on childhood vaccination delivery in Lebanon. We focused on vaccination delivery as an example of an essential health service.

We drew on a conceptual framework originally developed by Donella Meadows (the “iceberg” model) to help identify points or pathways within the system in Lebanon that were likely to amplify risks to vaccination delivery. Meadows’ model classifies these leverage points according to the degree of influence over system structure and behaviour they are likely to have (Figure 1).

We used conventional, thematic qualitative analysis, and a systems thinking approach called system dynamics (SD) involving the production of causal maps (causal loop diagrams), to try to better understand how these shocks have affected the vaccination delivery system, and how this system has responded. Our approach relied primarily on analysis of interviews with stakeholders working at various levels of the vaccination delivery system, from national policy to facility-level service delivery.

Finally, we conducted a realist-informed systematic review to identify system-level interventions to support resilience in vaccination delivery. We focused not just on identifying interventions that work, but also on understanding how they work in different settings.

Across the project, we focused on trends in vaccination coverage across populations as the primary outcome denoting system resilience, with an assumption that continuing ability to maintain or progressively improve vaccination coverage in the face of shocks would be a hallmark of a resilient system.

## FINDINGS

### WAYS OF THINKING ABOUT SHOCKS

To better understand resilience, we need to be clear about what we are describing it in relation to – in other words, to clarify what we mean by a “shock”. Using system dynamics, we showed that although each of the shocks that occurred in Lebanon originated outside the vaccination delivery system, they interacted with existing structures in the vaccination delivery system to produce risks which cascaded across multiple levels, from national to local. In Meadows’ framework, almost all of these emergent risks pointed to leverage points affecting patterns of behaviour or system structure (Table 1).

Risks linked to **refugee arrivals** took time to materialise. Most Syrian refugees were not familiar with service access points for vaccination in the Lebanese healthcare system, so demand increased only gradually. System responses were mostly based on anticipated risk, in particular the perceived threat of an outbreak of a high-consequence vaccine preventable disease (polio).

The **economic crisis** had wide-ranging effects on both demand for, and supply of, vaccination. There was a large shift in service access behaviour especially among host communities, moving from the private sector to vaccination uptake through the PCN.

Some common risks to vaccination uptake across the shocks were identified, mostly at **facility level**. These included facility-level crowding, which drove down vaccination uptake because it reduced patients’ confidence in the quality of services. Health worker attrition was another common, and major, risk to resilience in vaccination delivery.

Figure 1: The Iceberg model



Source: The Donella Meadows Project  
<https://donellameadows.org/systems-thinking-resources>

*Table 1: Examples of leverage points in the vaccination delivery system identified using system dynamics, and sample interventions introduced at various points to strengthen system resilience using these.*

Type of lever	Example leverage points identified through the project	Example interventions implemented by leverage point
Events	<ul style="list-style-type: none"> <li>Number of clinic attendances for vaccination</li> <li>Number of vaccine doses available to administer at facility level</li> </ul>	<ul style="list-style-type: none"> <li>Multiple – spanning vaccination campaigns, community engagement activities etc</li> <li>Vaccine procurement and distribution to facility level</li> </ul>
Patterns of behaviour	<ul style="list-style-type: none"> <li>Financial inputs into the system</li> <li>Cost of vaccination to service users</li> </ul>	<ul style="list-style-type: none"> <li>Humanitarian response funding (volume and speed of mobilisation)</li> <li>Policy change to reduce the cost of vaccination to service users through the PCN</li> </ul>
System structures	<ul style="list-style-type: none"> <li>Physical infrastructure supporting cold chain integrity</li> <li>Perception of changing demand for vaccination services at facility level</li> <li>Time delay to distribution of vaccine doses from the national storage warehouse to health facilities</li> <li>Parallel service pathways to maximise opportunities for access to vaccination</li> </ul>	<ul style="list-style-type: none"> <li>Introduction of solar fridges</li> <li>Introduction of new e-record systems to document uptake and identify missed opportunities for vaccination</li> <li>Introduction of electronic stock management system at the national storage warehouse</li> <li>Selective use of Mobile Medical Units; opening of border crossing clinics</li> </ul>
Mental models	<ul style="list-style-type: none"> <li>Strategic orientation regarding the inclusion of refugees as eligible for services through the PCN</li> </ul>	<ul style="list-style-type: none"> <li>Policy change to offer vaccination at nominal cost to Syrian refugees through the PCN</li> </ul>

We also identified parts of the **health system** where different shocks interacted to create escalating risks to vaccination delivery – particularly in the cold chain. The introduction of solar fridges at facility level was an important part of the response to refugee arrivals, to increase cold storage capacity locally. However, this equipment required internationally sourced spare parts which became much harder to obtain as import restrictions tightened during the economic crisis. This coincided with a hike in the price of fuel which made it much more costly for facilities to run back-up electricity generators instead.

#### SYSTEM RESPONSES TO SHOCKS IN LEBANON

We found evidence of a range of system responses to these shocks over time at national, regional and local levels – again focused almost entirely on patterns of behaviour or system structures in Meadows' framework. **At national and regional levels**, most responses focused on governance, financing and to some extent service delivery approaches. At facility level, many of the key response measures addressed workforce issues.

**Facility-level responses** primarily involved coping strategies to help manage changing service demand. These included measures such as temporary clinic

closures, changes to clinic working hours and alterations to staffing levels. A key part of the response to refugee arrivals, however, was capacity building for staff through training. As the strain on facilities intensified during the economic crisis and health worker out-migration become more of a problem, there were also efforts to recruit entry-level health workers and interns to help ensure service continuity.

We identified only a handful of leverage points affecting the values and assumptions underpinning the vaccination delivery system. One important leverage point at this level concerned assumptions regarding whether vaccination delivery should be charged for on a fee-for-service basis or not.

**System delays** were consistently highlighted as important determinants of the timeliness and effectiveness of shock responses. Some of these occurred in predictable areas (e.g., in procurement and delivery of vaccine doses to facilities). Time delays affecting the speed of recognition of emerging humanitarian crisis by government, donors and other international actors, and in mobilisation of funding to implementing partners, also emerged as key points for intervention.

## INSIGHTS ON RESILIENCE BUILDING MEASURES FROM THE WIDER LITERATURE

The central finding from our systematic review – which included 50 studies from countries affected by protracted humanitarian crisis – was that no “silver bullet” solution to supporting resilience in vaccination delivery systems in humanitarian contexts exists. Instead, as implied by analysis from Lebanon above, a **portfolio of approaches** is likely to be needed depending on the nature of the shock, and the phase of the response concerned (onset, shock management, or recovery).

### Vaccination campaigns and supplementary immunisation activities

**immunisation activities** are likely to be mainstay measures in bolstering vaccination uptake in the context of shocks, but we found good evidence supporting the use of multiple service pathways (including mobile health services), better integration of vaccination with other in-demand services (e.g., nutrition).

The most successful interventions relied on **leadership** from domestic ministries of health, **flexible funding and contracting** approaches from donors and other partners, and in particular, close **community engagement**.

## DIRECTIONS FOR FUTURE RESEARCH

This brief reports on results from empirical analysis of a single case, and there is a need for comparative work (focused on vaccination delivery, or other service areas) to better understand the extent to which findings reported here can be generalised. This includes attention both to effects arising from different kinds of shocks (climate-related, disease epidemics and others), and linked to differences in health system context.

Future work may also consider empirically testing our findings through quantitative simulation modelling – and indeed this is planned for follow-on work from this project. Quantitative system dynamics modelling may yield additional insights on the validity of different approaches to resilience measurement and help to inform more robust approaches to risk assessment to support system preparedness to future shocks.

Thirdly, our project focused largely on supply-side behaviours influencing vaccination uptake (i.e., on service delivery). Future work should bridge to the growing literature on community perspectives on system resilience. This is particularly important given evidence both from Lebanon and from our international systematic review emphasising the importance of robust community engagement to resilience in vaccination delivery in humanitarian settings.

Finally, our findings strongly suggest that long-term resilience-building is likely to require portfolio intervention approaches. This is out of step with much of the existing literature on health system support and strengthening, which continues to focus primarily on interventions addressing one or perhaps two of the WHO health system building blocks. Future research will need to consider portfolio design and timing of implementation – suggesting growing space for the use of dynamic methods such as SD.

**About the brief:** Work described in this brief forms part of a wider project exploring resilience in vaccination delivery systems in Lebanon, in response to compound crises. For further information about the research reported in this brief, or the wider project, please contact Dr Sharif Ismail ([sharif.ismail@lshtm.ac.uk](mailto:sharif.ismail@lshtm.ac.uk)) at London School of Hygiene & Tropical Medicine.

**Citation:** Ismail SA, Lam ST, Bell S, Fouad FM, Blanchet K, Borghi J. Strengthening vaccination delivery system resilience in the context of protracted humanitarian crisis: a realist-informed systematic review. *BMC Health Services Research*. 2022 Dec;22(1):1-21.

<https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-022-08653-4>

**Funding:** The research reported in this brief was supported by a Wellcome Trust Clinical Research Training Fellowship [ref no 215654/Z/19/Z (SAI)]

**Study contributors:** Sharif A. Ismail<sup>1\*</sup>, Andrada Tomoaia-Cotisel<sup>2</sup>, Aya Noubani<sup>3</sup>, Fouad M. Fouad<sup>4</sup>, Sze Tung Lam<sup>5</sup>, Sadie Bell<sup>1</sup>, Karl Blanchet<sup>6</sup>, Josephine Borghi<sup>1</sup>

1. London School of Hygiene & Tropical Medicine; 2. RAND Corporation, United States; 3. Independent Consultant, Lebanon;  
4. American University of Beirut; 5. National University of Singapore; 6. University of Geneva

\* Project lead