by Lisa Ng, Benny Chew, Julian Lai and Siti Naqiah Amrun

WHY COMPLEX RISKS DEMAND MULTIDISCIPLINARY ACTION: LESSONS FROM INFECTIOUS DISEASE PREPAREDNESS

The A*STAR Infectious Diseases Labs offers a model for how organisations can move from ad-hoc crisis response to sustained, shared preparedness.

"*Disease knows no borders.*" The phrase sits on the lips of many researchers, politicians and public health professionals that it has become a truism. As true as it is banal, infectious disease outbreaks rarely stay confined to the health sector. They spill over into the workforce at large, inducing supply chain snags, swaying public confidence while serving as a litmus test for institutional coordination, whether regionally or globally.

Such outbreaks also expose systemic risks. Expertise exists, often in abundance, but it is fragmented. For decades, scientific discovery, data analysis, clinical response, policy decisions and industry execution have tended to advance in parallel rather than in tandem. The cost of this fragmentation only becomes clear under pressure. In an interconnected world, the next outbreak is not a question of if, but when. Preparing for this future requires an ecosystem that brings diverse disciplines together before crisis strikes.

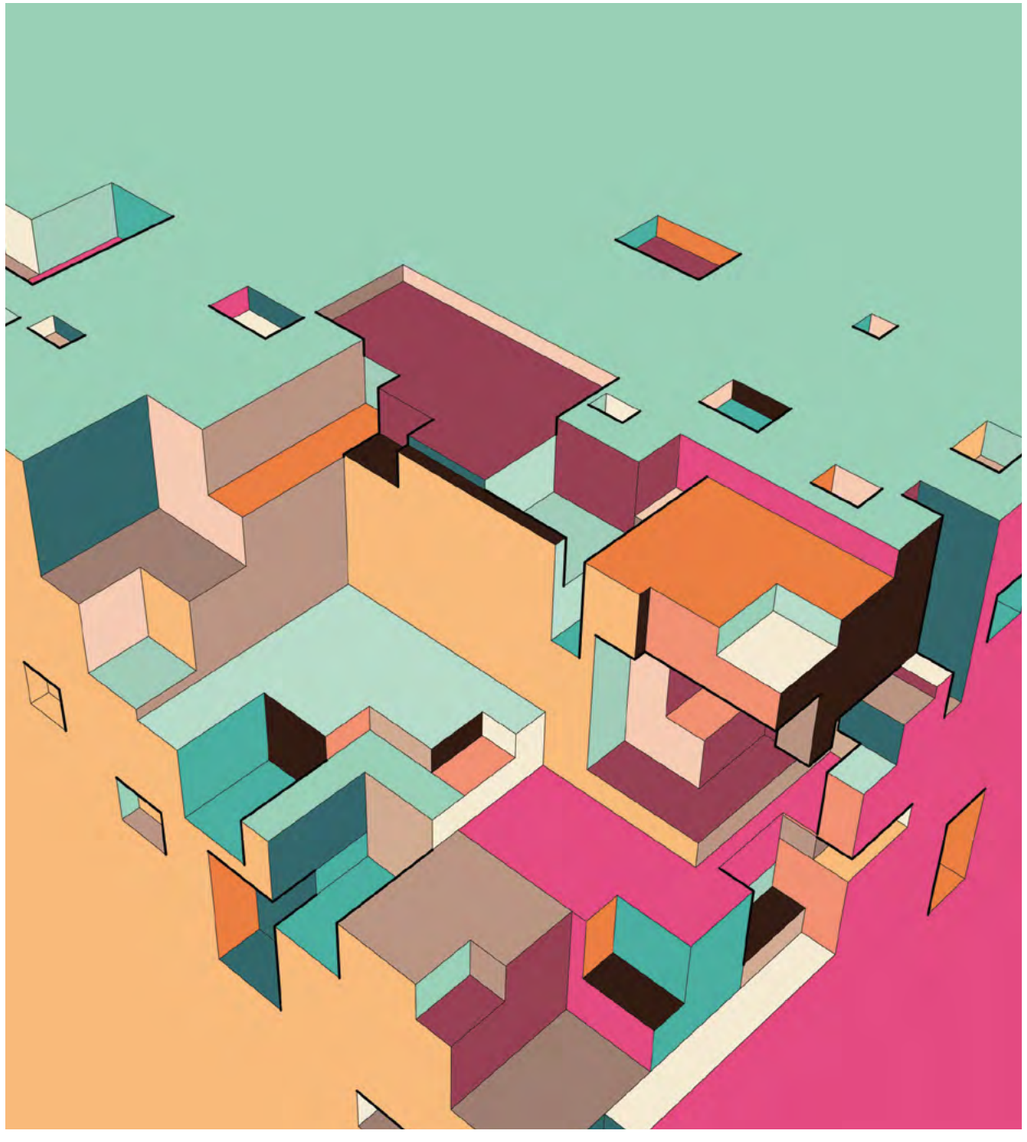
That was the impetus for establishing the A*STAR Infectious Diseases Labs (A*STAR IDL) in April 2021. Set up in the wake of the COVID-19 pandemic, A*STAR IDL was built with a clear mandate—to create pandemic preparedness that is proactive, coordinated and multidisciplinary by default. From the onset, A*STAR IDL integrated capabilities across biological sciences, data and computational methods, clinical research and translational sciences. By working closely with hospitals, industry and public health agencies, it sought to close the gaps that typically emerge when research policy and response efforts are siloed.

This integrated model offers valuable insights beyond the health sector. A*STAR IDL's experience demonstrates how multidisciplinary collaboration, when embedded in everyday systems, can strengthen readiness long before crisis erupts. For organisational leaders, outbreaks are less a medical problem and more a resiliency stress test of coordination, decision-making and trust. The question, then, is how organisations can design ecosystems where such collaboration is possible before a crisis forces it into being.

Preparedness is an organisational design problem, not a crisis response mode.

Multidisciplinary initiatives only compound when the right enabling conditions are in place.

For organisational leaders, outbreaks are less a medical problem than a resilience stress test.



TACKLING SYSTEMIC RISKS IS INHERENTLY MULTIDISCIPLINARY

While a simplified narrative suggests that a pathogen emerges, spreads, mutates and is eventually contained, the lived reality is far more complex. It interacts with healthcare capacity, economic resilience, public trust, supply chains, information systems and governance structures.

The COVID-19 pandemic demonstrated that outcomes were shaped as much by policy decisions, institutional coordination and communication strategies. Addressing such risks therefore requires an integrated, cross-sectoral approach—one that recognises interdependencies across systems and enables timely, coherent decision-making beyond traditional disciplinary or organisational boundaries.

The pandemic was also a data problem. Case numbers, testing rates, hospital capacity and later vaccination uptake had to be tracked and interpreted in real time. Epidemiological models informed policy decisions on border controls, workplace closures and school reopenings. The usefulness of these models depended not only on technical sophistication, but on data quality, interoperability and the speed at which insights could be shared across agencies and jurisdictions.

Human behaviour quickly proved just as consequential. Most of us are familiar with the fast-changing public health policies enforced during the COVID-19 pandemic: wearing masks, distancing from one another and adhering to vaccination schedules. Misinformation, as well as disinformation, pervaded alongside the disease, infecting risk communication and eroding trust in institutions. Even the most carefully designed interventions faltered when they failed to account for how people perceived risk, authority and fairness.

Policy and governance frameworks influenced every aspect of pandemic response. Governments had to balance public health advice with economic and social considerations. Regulatory systems shaped the speed at which diagnostics were approved, therapeutics and vaccines deployed and international data shared. Businesses, in turn, faced the dual challenge of adapting to evolving regulations while safeguarding workforce well-being, ensuring operational continuity and maintaining stakeholder confidence.

The pandemic underscored how infectious disease risks sit at the intersection of many systems. This complexity is not unique to COVID-19. Other challenges such as antimicrobial resistance, vector-borne diseases and respiratory diseases share the same hallmark. They evolve across biological and social boundaries, and their consequences ripple through healthcare systems, economies and communities.

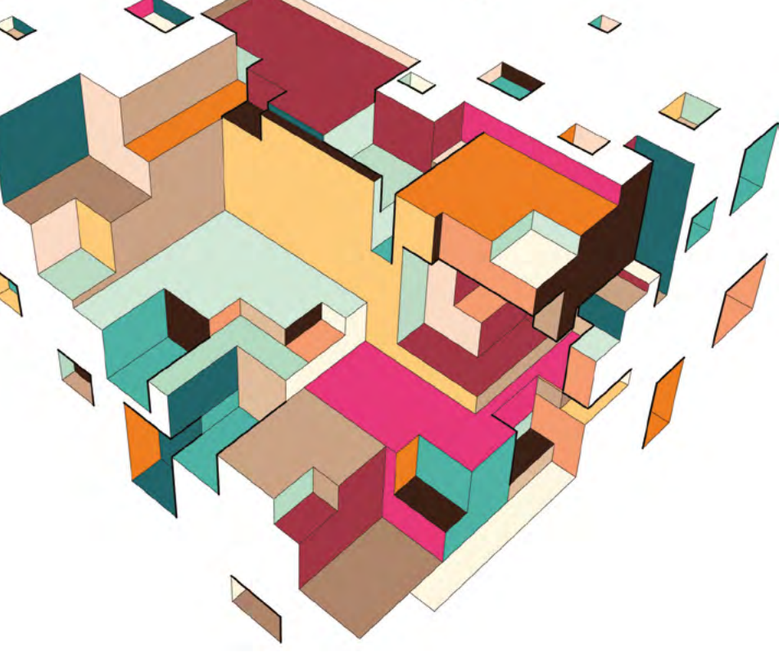
It is this reality that underpins A*STAR IDL's modus operandi. Its core focus areas of respiratory diseases, vector-borne infections and antimicrobial resistance are guided by a cross-cutting emphasis on pandemic preparedness, reflecting problems that cannot be addressed through silos. Each demands collaboration across disciplines and sectors, sustained over time to become effective.

A WINDOW INTO A*STAR IDL'S MULTIDISCIPLINARY ENGINE

A*STAR IDL was established with this clear intent. Infectious disease threats move quickly, cut across domains and demand translation into action. Research capability therefore had to be integrated and not sequential. Decisions about resourcing, infrastructure and partnerships followed from this premise.

A*STAR IDL's research focuses on three main areas: pathogen and disease biology, pathogen evolution and drug resistance, and infection and immunity. These expertise areas are organised around core research themes, allowing teams to address common problems across diseases and methods while reducing handoffs and aligning early on research questions, data needs and downstream use.

Shared infrastructure that links discovery, testing and deployment is a strategic cornerstone of this approach. High containment facilities enable the safe handling of high-risk pathogens and support readiness in both routine and emergency settings. Complementary in vitro and in vivo infection models support the study of disease mechanisms and the evaluation of therapeutic and vaccine candidates. Another key enabler is the pathogen flow platform, connecting discovery, preclinical work and translational development through a coherent pipeline for samples and data. This reduces fragmentation and delays, especially during outbreaks. Together, these platforms and capabilities are designed



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as common infrastructure that multiple teams and partners can access, averting duplication and accelerating progress.

Additionally, A*STAR IDL was structured to treat partnerships as a core capability from the beginning, working closely with academic institutions, clinical institutions, foundations, industry and public sector agencies to achieve common goals. Each player contributes to a piece of the larger puzzle. For instance, industry contributes scale-up and product development capabilities, while clinical partners ensure relevance to patient care and public health. At the same time, public agencies provide pathways into policy and population-level deployment.

These relationships are formalised and long-term. Clear governance, data and material sharing arrangements and intellectual property frameworks allow collaboration to continue beyond individual grants or crisis moments. Over time, this fosters trust, lowers transaction costs and enables faster coordination in moments of urgency, giving first responders a "first mover advantage".

WHAT GETS THE GEARS OF MULTIDISCIPLINARY COLLABORATIONS GOING

Though multidisciplinary collaboration is widely endorsed, many initiatives still struggle to deliver sustained impact even after assembling diverse expertise and securing initial funding. A*STAR IDL's experience shines a light on the modular facets of multidisciplinary work that come together to enable success over time. Across its work, four enabling conditions consistently determine whether multidisciplinary efforts compound—or stall.

A first building block is a clear and shared purpose. At A*STAR IDL, pandemic preparedness and outbreak response function as organising goals that guide decisions from research priorities to platform investment and partnerships. This framing helps align contributors from different disciplines and sectors around outcomes that matter beyond individual projects.

Purpose, however, needs an operating environment. Shared, integrated platforms—such as high-containment laboratories, infection models and pathogen flow systems—give teams a common way of working. They reduce duplication, standardise workflows and allow partners to plug in without renegotiating foundational capabilities each time. For collaborators, this lowers the cost of engagement and shortens the path from idea to execution.

The third condition is governance and trust. Formal agreements on data and material sharing, intellectual property and decision rights create clarity and reduce friction. At A*STAR IDL, memoranda of understanding (MoUs) and strategic partnerships are designed to sustain collaboration in the long run. Gradually, this consistency fosters trust, which can make all the difference when speed and collective response are paramount.

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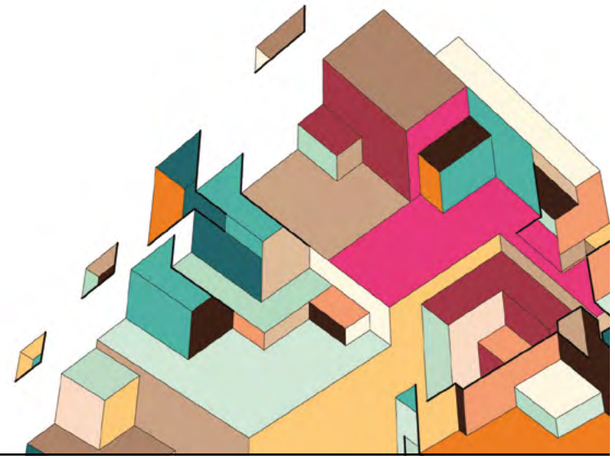

A fourth enabler is talent pathways that keep expertise moving across boundaries. Joint training programmes, visiting appointments and academic ties allow talent to move between institutions and disciplines. A*STAR IDL's partnerships with local institutions such as the Duke-NUS, National University of Singapore (NUS) and Nanyang Technological University (NTU), as well as international universities such as Zhejiang University, Tsinghua University, Institut Pasteur, Oxford University and The Rockefeller University, support this exchange, ensuring that skills and perspectives circulate and flourish.

Just as important is recognising what does not work. Collaborations built solely around short-term grants often prioritise outputs over outcomes. Without aligned incentives or shared ownership, partners revert to familiar silos once funding cycles end. The result is activity without continuity and impact—and progress that does not compound.

The experience of A*STAR IDL demonstrates preparedness as an ongoing, shared responsibility through its investments in multidisciplinary teams, shared platforms and long-term partnerships.

Anticipating influenza through AI and RNA platforms

Seasonal influenza vaccines are typically developed based on predictions of which strains will circulate months later. When these predictions fall short, vaccine effectiveness wavers. The problem is structural—influenza evolves rapidly, while vaccine design, testing and manufacturing remain predominantly reactive.

How can vaccine development move upstream, from reacting to dominant strains to forecasting how the virus is likely to evolve? Doing so requires computational analysis at scale to pinpoint conserved viral targets, while biological systems are required to rapidly test and translate those insights into viable vaccine candidates.

A*STAR IDL's partnership with Apriori Bio brings these capabilities into a single workflow. Apriori Bio contributes its Octavia™ AI platform, which analyses extensive viral sequence data to predict evolutionary trajectories and identify stable antigenic targets. A*STAR IDL provides self-amplifying RNA vaccine technologies, high-containment laboratory infrastructure and expertise in virology and immunology to rapidly test and refine these AI-designed antigens.

The work is integrated in nature, merging computational design, biological validation and translational considerations from the outset to reduce delays and redesign later in the process.

The collaboration enables faster prototyping of vaccine candidates against likely future influenza variants, shortening response times when new strains emerge. For preparedness, this is a shift from reactive to anticipatory design. When risks evolve faster than traditional development cycles, resilience depends on multistakeholder partnerships that combine advanced analytics, deep domain expertise and execution capabilities within shared platforms.

Building regional capacity through shared networks

Pathogens circulate through travel, trade and migration, often emerging in one setting before spreading rapidly across regions. For those operating in Asia, preparedness therefore depends not only on domestic capabilities, but on the strength of regional surveillance, research and response networks.

However, many parts of the region face uneven access to advanced research infrastructure, genomic surveillance and specialist training. This creates blind spots in the early detection of threats such as antimicrobial resistance and vector-borne diseases. Addressing these gaps requires sustained capacity building and trusted partnerships that enable data, skills and insights to flow freely across borders.

A*STAR IDL has pursued this through long-term collaborations with regional and global partners. An MoU with Oxford University Clinical Research Unit (OUCRU) Nepal in 2025 focuses on joint work in antimicrobial resistance, respiratory and vector-borne diseases. The partnership emphasises shared training, talent exchange, workshops and collaborative research, strengthening local and regional capabilities. In parallel, A*STAR IDL's MoU with the Wellcome Sanger Institute (Parasites and Microbes Programme), also established in 2025, connects Singapore-based research to global expertise in genomics and AI-driven pandemic preparedness, addressing health challenges from antimicrobial resistance to genomic influences on respiratory tract infections. A Master Research Collaboration Agreement with the Institut Pasteur, signed in 2025, underscores a shared commitment to tackling global infectious disease challenges, including the roles of ageing and the microbiome in infection. Complementing this collaboration, a Joint Forum convened in 2024 strengthened ties with the Institut Pasteur and regional members of the Pasteur Network, including Hong Kong, Cambodia, South Korea and New Caledonia. More recently, a research collaboration agreement signed in 2026 with The First Affiliated Hospital, Zhejiang University aims to enhance preparedness for emerging vector-borne diseases through the application of artificial intelligence.

These collaborations improve early detection, data sharing and scientific readiness across regions. Beyond public health, stronger regional health systems contribute to the stability of supply chains, labour markets and cross-border operations, underscoring the importance of investing in shared capacity and networks as a strategic necessity.

THE CASE FOR ACTION

Infectious disease risk is multidimensional and involves various stakeholders. Treating it as a specialist issue, addressed only during crises, can leave organisations exposed to disruptions that would quickly compound.

One implication is the value of integrating diverse expertise earlier in decision-making. Leaders that rely on escalation under pressure often discover that coordination costs are highest when time is most constrained. Embedding multidisciplinary perspectives into planning, risk assessment and scenario development creates space for alignment before uncertainty becomes urgent.

Another implication concerns how organisations approach external relationships. Transactional engagements may suffice when conditions are stable, but they offer limited flexibility when circumstances change. The experience of A*STAR IDL suggests that longer-term partnerships, anchored in shared infrastructure, data and governance, offer greater resilience. These relationships allow organisations to adapt together rather than negotiate from scratch amid disruption.

Preparedness is not a technical problem to be delegated; it is a leadership choice about how an organisation is designed, governed and connected. It is rarely the result of a single initiative or the responsibility of any one actor. Taking a page out of the infectious diseases book, organisational leaders who treat preparedness as part of core risk management are better positioned to navigate crises with greater finesse—drawing on multidisciplinary capabilities to anticipate uncertainty, absorb shocks, adapt to change and steer their organisations through periods of volatility. ANI

A*STAR INFECTIOUS DISEASES LABS (A*STAR IDL), established in April 2021, aims to be a leading research institute of infectious diseases in antimicrobial resistance, respiratory and vector-borne diseases. A*STAR IDL brings together multidisciplinary infectious disease expertise to drive cutting-edge translational research for Singapore's national preparedness and defence against emerging infections. Building on strong biomedical research capabilities and a globally connected scientific network, A*STAR IDL focuses on innovative technologies in infectious disease detection, intervention and prevention with a pathway to impact on health and economic outcomes.

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