A photograph of a desert market scene. In the foreground, two men wearing white thobes and ghutras are talking. One man is standing and the other is partially visible from behind. In the middle ground, several camels are gathered, some standing and some sitting on the sand. The background shows a vast desert landscape with low mountains under a clear sky.

FIND



Because diagnosis matters

**DIAGNOSTICS FOR
EPIDEMIC PREPAREDNESS**

OUTBREAK STRATEGY 2018

ABOUT FIND

FIND was founded in 2003 to bridge existing development gaps for essential diagnostics by initiating and coordinating research and development (R&D) projects in collaboration with the international research community, the public sector and the in vitro diagnostics industry. Today, FIND is a leading partner across the value chain of diagnostics development and delivery. We have programmes in tuberculosis and acute febrile respiratory infections, malaria and acute febrile syndrome, hepatitis C and neglected

tropical diseases. We also have mini-portfolios in areas affecting reproductive and child health: HIV; sexually transmitted infections; and infections and nutritional deficiencies in children less than five years of age. At FIND, we envision a world where diagnostics guide the way to health for all people. We aim to turn complex diagnostic challenges into simple solutions to transform lives and overcome diseases of poverty. To do this we focus on four strategic goals throughout all the disease areas in which we work:

■ Catalyse development

Identify needed diagnostic solutions and remove barriers to their development

■ Guide use & policy

Lead products through the clinical trials pathway to global policy on use and market entry

■ Accelerate access

Support uptake and appropriate use of diagnostics to achieve health impact

■ Shape the agenda

Improve understanding of the value of diagnostics and strengthen commitment to their funding and use

FIND's Vision

A world where diagnosis guides the way to health for all people

FIND's Mission

Turning complex diagnostic challenges into simple solutions to overcome diseases of poverty and transform lives

ABBREVIATIONS

CCHF	Crimean-Congo haemorrhagic fever
CEPI	Coalition for Epidemic Preparedness Initiative
ERPD	Expert Review Panel for Diagnostics
EUAL	Emergency use assessment and listing
FIND	Foundation for Innovative New Diagnostics
Gavi	Gavi, the Vaccine Alliance
MERS-Cov	Middle East respiratory syndrome coronavirus
NGO	Non-governmental organization
POC	Point of care
R&D	Research and development
RFP	Request for proposal
SOP	Standard operating procedure
SARS	Severe acute respiratory syndrome
TPP	Target product profile
WHO	World Health Organization



EXECUTIVE SUMMARY

Infectious disease epidemics – of existing, emerging and re-emerging diseases – imperil life, health and prosperity. Diagnostics are a fundamental component of a successful outbreak containment strategy, enabling evidence-based control strategies to be implemented without delay in order to contain the outbreak, minimize response costs and save lives.

However, 6 of the 10 high-priority “Blueprint” pathogens identified by WHO have significant, unmet diagnostic needs – including Disease X, an as-yet-unknown pathogen that could pose a future risk. Weaknesses in the overall system mean that challenges to diagnostic preparedness are similar, regardless of the pathogen from which the threat originates. To enable both rapid development and deployment of tests when needed, outbreak preparedness must encompass a systems strengthening approach.

Taking into account our experiences in supporting the response to recent outbreaks such as Ebola, and looking to established vaccines preparedness mechanisms including CEPI and Gavi, FIND is advocating for a global diagnostic preparedness forum that will bring together key diagnostics

stakeholders to drive rapid development of tests and surveillance strategies for outbreaks, and support rapid access and market sustainability. FIND volunteers to act as the Secretariat for such a forum.

This Diagnostics for Epidemic Preparedness strategy has been conceived to concretely tackle challenges across the spectrum of diagnostic preparedness. The global forum would amplify its impact.

To deliver on the strategy, priority interventions have been identified in the areas of technical needs (critical assays, comprehensive platforms, and connectivity solutions), response speed (trial sites and regulatory pathways, sample access), and market sustainability (manufacturing and global supply chain).

For past epidemics, investments needed to scale and deliver on outbreak response have topped more than US\$3 billion. The priority interventions in this strategy require an investment of US\$65 million to be delivered over the next 5 years. By creating a sustainable market situation that enables timely outbreak response, with the development of appropriate diagnostic solutions, this commitment will allow the global community to act effectively on the epidemics of today while preparing for those of tomorrow.



DIAGNOSTICS HAVE A CRITICAL ROLE IN OUTBREAK PREPAREDNESS AND MANAGEMENT

Diagnostics are a fundamental component of a successful outbreak containment strategy, being involved at every stage from initial detection to eventual resolution (Table 1). They enable evidence-based control strategies to be implemented without delay in order to contain the outbreak, preventing international spread, minimizing the costs of

response – and, crucially, saving lives. Diagnostics are complementary to vaccines and drugs as part of an overall containment strategy, being required for development and validation of vaccines and therapies, for detection of drug resistance, and for determining the most appropriate allocation of resources in the case of short supply.

Table 1. Timescale of an outbreak and role of diagnostics

Prior to outbreak	Acute stage	Late stage	Resolution
To allow surveillance for initial detection of outbreak	To verify cases and determine the extent of the outbreak To identify cases, allowing isolation, hygiene measures and treatment to interrupt transmission	For continued surveillance to detect and anticipate further spread of disease To confirm the efficacy of the measures implemented, and the decrease in number of cases	To confirm that there are no further cases and declare the end of the outbreak To allow continued surveillance for future outbreaks
All stages			
To facilitate vaccine and therapy development, if not already available			
To confirm the relationship between symptoms and pathogen, if unknown			
To collect epidemiological information to inform diagnostic development			
For ongoing research and clinical trials			

Outbreaks generally originate either from resurgence of a known pathogen – one that already occurs at endemic levels, or through accidental or deliberate release of laboratory specimens – or from emergence of a previously unknown pathogen. WHO maintains a list of high-priority “Blueprint” pathogens that could spark a major international public health emergency – including Disease X, an as-yet-unknown pathogen

that could pose a future risk. FIND is collaborating with WHO to develop diagnostic landscapes that evaluate the status of current diagnostic tests for each Blueprint pathogen, and conducting gap analyses to highlight where research strategies should focus. This work has revealed that 6 of the 10 Blueprint pathogens have critical/important unmet diagnostic needs (Table 2).

To enable both rapid development and deployment of tests when needed, outbreak preparedness must also encompass a systems strengthening approach. Past outbreaks have highlighted substantial issues in this respect, including:

- Greater financial risks involved in the manufacture of diagnostics for pathogens with epidemic potential, versus assays with more stable, larger markets

- Funding allocated during high-profile epidemics but not for ongoing, regular outbreaks of endemic diseases that receive less publicity
- Lack of manufacturing and distribution support for companies with low capacity
- Poor surveillance capacity at national level in many countries.

Table 2. 6 of the 10 WHO Blueprint priority diseases have critical/important unmet diagnostic needs

WHO Blueprint priority disease	Fatality rate	Recent outbreaks	Diagnostic need (red = critical, amber = important; green = remaining)	Diagnostic situation overview
CCHF	10–40%	Pakistan, 2010		<ul style="list-style-type: none"> • No established reference test • Very limited availability of commercial assays, with very low usage and limited performance data • No WHO prequalified diagnostic test
Filoviruses (Ebola and Marburg)	24–90%	West Africa, 2013–2016 and Democratic Republic of the Congo, 2017 & 2018 (Ebola); Uganda and Kenya, 2017 (Marburg)		<ul style="list-style-type: none"> • Recent high-profile outbreaks resulted in international focus and funding, which has enabled the development and introduction of critical diagnostics • Additional work is needed to improve current diagnostics, develop POC tests and ensure reliable availability • Additional work is also needed to ensure regulatory approval beyond WHO EUAL
Lassa fever	1–15%	Annual recurring outbreaks in West Africa		<ul style="list-style-type: none"> • No WHO-approved diagnostics and limited commercially available tests, none of which are easily deployable in the settings needed
MERS-CoV	~35%	Kingdom of Saudi Arabia, 2013–2018; South Korea, 2015		<ul style="list-style-type: none"> • Limited availability of validated assays, restricted to highly complex tests • Lack of POC diagnostics
SARS	~10%	Global, 2003		<ul style="list-style-type: none"> • Recent high-profile outbreaks resulted in international focus and funding, which has enabled the development and introduction of critical diagnostics • Additional work is needed to improve current diagnostics, develop POC tests and ensure reliable availability
Nipah and henipaviral diseases	~30%	Bangladesh, 2004		<ul style="list-style-type: none"> • No WHO-approved diagnostics and limited commercially available tests, none of which are easily deployable in the settings needed
Rift Valley fever	<1%	Republic of Niger, 2016		<ul style="list-style-type: none"> • No WHO-approved diagnostics and limited commercially available tests, none of which are easily deployable in the settings needed
Zika virus disease	Not fatal	South and North America, 2015–2016		<ul style="list-style-type: none"> • Recent high-profile outbreaks resulted in international focus and funding, which has enabled the development and introduction of critical diagnostics • Additional work is needed to improve current diagnostics, develop POC tests and ensure reliable availability • Additional work is also needed to ensure regulatory approval beyond WHO EUAL
Disease X	Not yet known			<ul style="list-style-type: none"> • Need for diagnostic platforms that can rapidly adapt and support diagnostics for unknown pathogens

FIND STRATEGY FOR DIAGNOSTIC PREPAREDNESS AND OUTBREAK RESPONSE

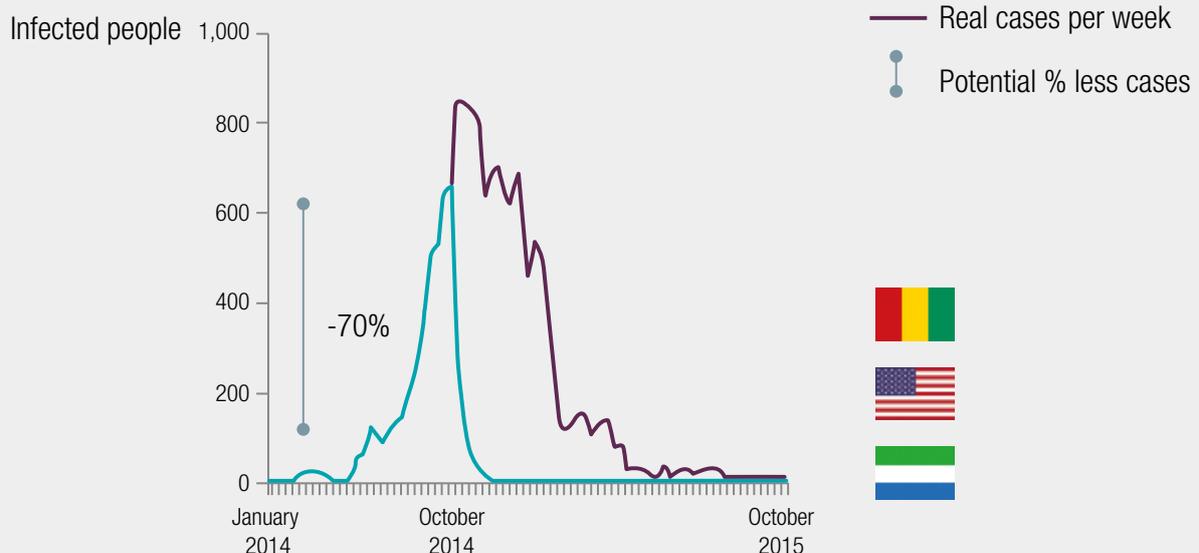
FIND has worked closely with WHO to support response to recent outbreaks including Ebola, Zika and Lassa fever. It has become obvious that weaknesses in the overall system mean that challenges to diagnostic preparedness are similar, regardless of the pathogen from which the threat originates.

Despite the fact that effective, affordable diagnostics are critical to surveillance and response systems, they are absent in the countries where they are most needed. This was especially pronounced for the

outbreak of yellow fever in Nigeria in 2017; only one diagnostic confirmation facility exists for yellow fever for the whole of Africa – in Dakar, Senegal – and laboratory tests take at least a month.¹

On the R&D side, while extensive efforts are made during an outbreak, these efforts have historically not been well coordinated and thus have not been efficient. Once outbreaks are over, future access to the diagnostics developed cannot be assured, due to factors including a lack of sustainable funding for procurement in down periods.

Case study: Potential impact of earlier availability of a rapid diagnostic test on the 2014–15 Ebola outbreak



In the West Africa Ebola outbreak of 2014–2015, deficiencies in the ability to rapidly detect Ebola cases and initiate patient isolation and contact tracing, especially early in the epidemic, allowed the disease to spread. Although substantial public funding was made available, lack of coordination meant the majority went to small start-up companies with little manufacturing and distribution capacity; without adequate resources or infrastructure, most did not complete development.

The international community donated more than \$3.6 billion by December 2015 to respond to the emergency, including \$2.4 billion allocated by the U.S. government.

Models suggest that early diagnosis could have controlled 30–70% of cases, potentially saving thousands of lives and billions of dollars in the cost of response alone.

Source: <https://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/cost-of-ebola.html>

1. Berkley S. Health security's blind spot. *Science* 2018; 359(6380):1075. DOI: 10.1126/science.aat4714

2. Perkins MD et al. Diagnostic preparedness for infectious disease outbreaks. *Lancet* 2017 (online). Available at: [http://dx.doi.org/10.1016/S0140-6736\(17\)31224-2](http://dx.doi.org/10.1016/S0140-6736(17)31224-2)

Without the infrastructure in place to support an accelerated response to an outbreak of a known pathogen, Disease X poses an even greater challenge, as conducting necessary scientific research into the unknown pathogen adds an additional layer of complication.

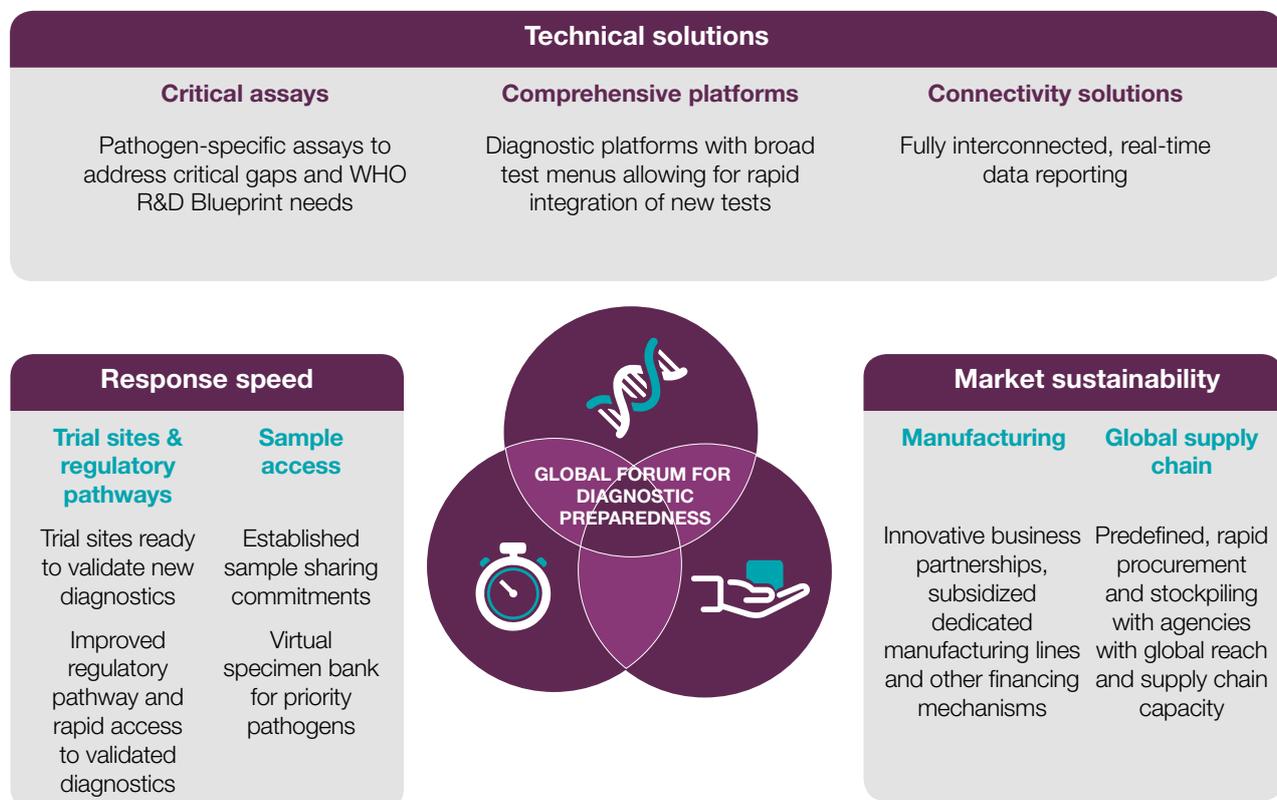
Unlike vaccine preparedness, which is supported by the CEPI to catalyze technical solutions, and Gavi, to address response speed and market sustainability, there is currently no entity that delivers end-to-end support, from rapid R&D to market access, for diagnostics for epidemic preparedness.

In 2017, FIND joined key stakeholders to call for

a new partnering model that could drive rapid development of tests and surveillance strategies for novel pathogens that emerge in future outbreaks.²

FIND's Diagnostics for Epidemic Preparedness strategy has been conceived with this in mind, and aims to concretely tackle challenges across the spectrum of diagnostic preparedness, by identifying solutions to address technical needs, market sustainability, and response speed (Figure 1). To amplify the impact of this strategy, we are also advocating for a global entity, similar to CEPI/Gavi for vaccines, that will convene stakeholders from across the diagnostics sector.

Figure 1. Unmet diagnostic needs to improve epidemic preparedness that FIND's strategy seeks to address





PRACTICAL IMPLEMENTATION AND EXPECTED OUTPUTS

Global forum for diagnostic preparedness

FIND is advocating for the formation of a global forum for diagnostic preparedness to ensure consensus-driven prioritization and collective implementation of activities, with a particular focus on response speed and market sustainability.

FIND volunteers to act as a Secretariat for the forum, facilitating coordination and communication between stakeholders including country representatives, academia, governments, WHO, regulatory bodies, donors, procurers, NGOs, and industry.

Technical solutions

Given that the majority of the WHO Blueprint pathogens lack critical diagnostic assays, particularly POC diagnostics, the technical component of our strategy seeks to close these gaps by development of solutions that will address pathogen-specific critical assays.

Diagnostic platforms that can accommodate an array of assays avoid the need for many instruments. Single-use assays with the capacity to identify a range of pathogens would be a major breakthrough when paired with such platforms. These solutions would also expand the user base and provide more steady market volumes.

Connected surveillance and decision aid tools help strengthen the link between outbreak management, surveillance, patient diagnosis and treatment. The real-time transmission of geo-tagged test results to national health information systems allows for faster response and containment, particularly if national surveillance programmes include routine hospital and community data. Connectivity can also enable remote monitoring to improve supply chain management and forecasting, and enhance diagnostic device quality assurance. FIND will focus efforts on ensuring diagnostics are connectable to local, national and international databases in order to facilitate surveillance and response networks.

Critical assays

FIND is supporting WHO to conduct disease-specific diagnostic landscapes in order to inform the WHO R&D Blueprint roadmap efforts and the subsequent development of TPPs that address the most critical diagnostics needs.

On the basis of these TPPs, FIND will engage with partners to develop high-priority tests that can be

used on pre-existing platforms, as well as driving the development of new, near-patient, broadly applicable instruments and test menus. This focus on tests that are 'menu expansions' ensures that countries are better equipped for outbreak response by using technologies that have already been successfully implemented and that new technologies provide more than a single pathogen test from the outset.

Expected output

2022: Two new pathogen-specific assays to address critical gaps in diagnostics for priority pathogens available on existing platforms

Comprehensive platforms

FIND will accelerate the R&D of multi-pathogen response systems by issuing RFPs to establish partnerships that will address the need for diagnostic platforms that can accommodate an array of assays, as well as single-use assays with the capacity to identify a range of pathogens.

We will work towards a long-term goal (beyond 2022) of developing several outbreak response platforms capable of simultaneously testing multiple sample types, multiple analytes and multiple biomarkers to critically transform preparedness capacity.

Expected output

2022: Two response systems allowing quick adoption of novel assays onto existing platforms

Additional activities will be considered based on the results from the disease landscapes and technical and partner assessments.

Connectivity solutions

FIND will establish connectivity solutions for diagnostics and decision aid tools.

Expected output

2022: Fully interconnected, real-time data reporting solutions for outbreak pathogens embedded into current and newly developed diagnostics; local and national databases capable of real-time connection to diagnostics and reporting systems

Response speed

Our strategy recognizes that a fast response depends on readiness to conduct robust clinical trials at short notice, supported by regulatory pathways that can expedite approval of successful diagnostic candidates.

Access to specimen samples can also be a key bottleneck for companies working to develop and validate new tests, particularly

for uncommon pathogens. Countries need to collect, analyze, store, share and ship specimens in order to ensure diagnostics can be evaluated using relevant samples, and validated as quickly as possible. Many countries have yet to define how their patient samples will be made available to the research, industry and regulatory communities.

Trial sites & regulatory pathways

FIND will work with partners to identify and establish trial sites that can rapidly evaluate new diagnostics, vaccines and treatments appropriate to the country context.

FIND will also advocate for clear, expedited regulatory pathways, which are needed to allow

validation of new diagnostics in a timeframe that means they can have impact during (rather than after) an outbreak. FIND will support WHO in expanding the Expert Review Panel for Diagnostics as one mechanism to bring change to the regulatory pathway for diagnostics for priority pathogens.

Expected output

2020: One fully operational clinical trial site established in West Africa; two priority pathogen diagnostics validated and approved through the WHO ERPD pathway; clear proposal for additional regulatory changes and options to support broader introduction of diagnostics

Sample access

FIND will establish a virtual sample repository that provides information on specimens collected, including storage locations and acquisition processes. This project will ensure sufficient sample access during development and validation phases to drive regulatory approvals. FIND also plans to support the development of standards for sample

collection, storage and qualification in order to ensure they are of sufficient and reliable quality.

Additionally, FIND will support ongoing global efforts to establish in-country diagnostics champions at Ministry of Health level to define in-country sample sharing agreements.

Expected output

2019: Online virtual specimen bank and formalized SOPs for at least four priority pathogens

Market sustainability

The unpredictability of outbreak situations makes it a challenging market environment. Manufacturers of diagnostic tests are often unable to meet urgent demands to produce relatively small volumes of products and frequently withdraw from the market after long

periods of unsustainable losses during non-outbreak years. Thus, innovative new financing solutions, procurement and supply mechanisms are needed to ensure ongoing affordability and availability of critical diagnostics once they are developed.

Manufacturing

FIND will advocate for novel, partner-based financing, to help companies provide guaranteed product access to global health entities in the event of an emergency, without negatively impacting other business commitments. Novel mechanisms

may include capital investments in manufacturing lines, advanced market commitments, and other mechanisms to ensure that validated, high-quality diagnostics remain readily available for procurement and use.

Expected output

2021: One outbreak preparedness manufacturing improvement partnership in place

Global supply chain

FIND will advocate for industry and global procurers (e.g. World Bank, Gavi) to develop push and pull incentives to offset manufacturer opportunity

costs and improve supply chain and procurement pathways.

Expected output

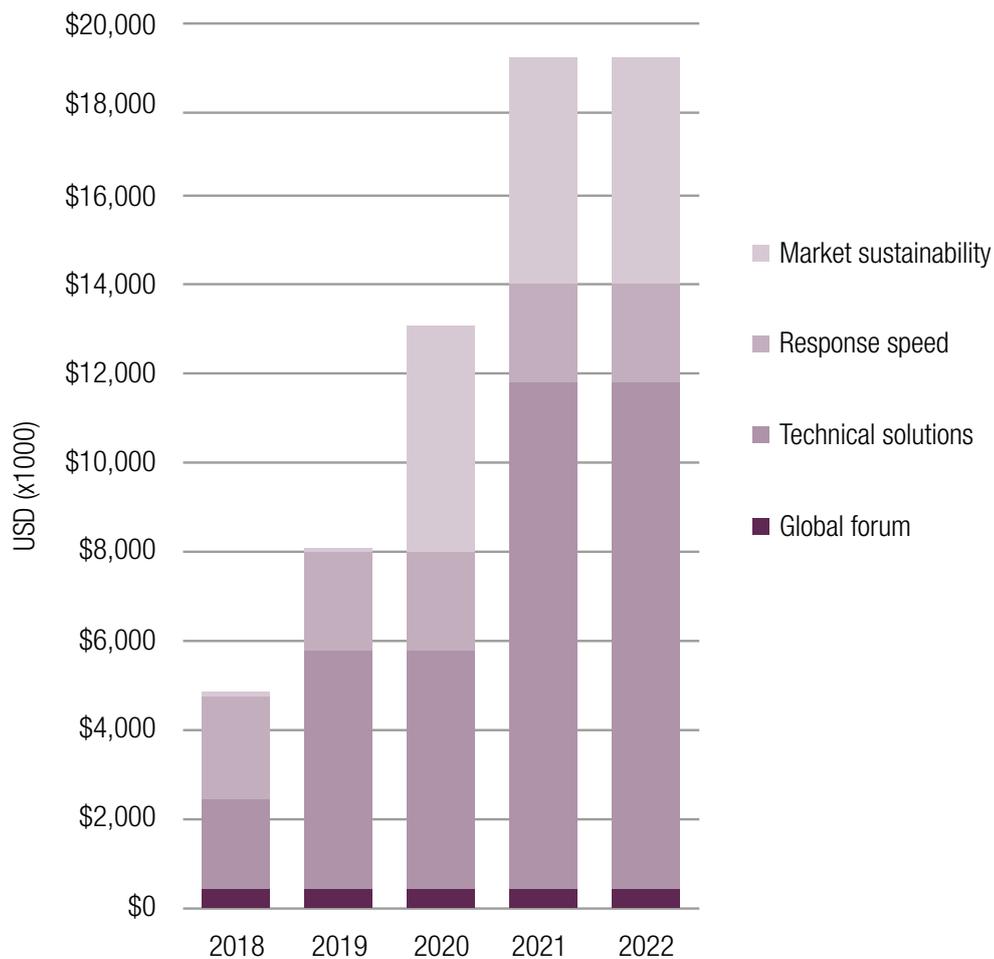
2022: One/two new global financing mechanisms to ensure sustainable access to diagnostics



INVESTMENT & NEXT STEPS

Investments needed to scale and deliver on outbreak response have topped more than US\$3 billion in past epidemics. To deliver on the priority interventions identified, investment of US\$65 million over the next 5 years is required. This estimate includes R&D costs

for new diagnostics, staff and consultants and project costs. It does not include in-kind co-investments by partners, such as laboratory capacity at academic institutions or R&D personnel housed with industry partners.



The budget will be updated after the disease and technical landscape assessments have been completed in 2018 to more accurately reflect what is needed to overcome the development, regulatory

and access challenges for priority pathogens. Further fundraising may be required to support additional activities that are initiated based on the market assessments.

FIND welcomes partnership inquires, which can be directed to Catharina Boehme, CEO, at catharina.boehme@finddx.org or to Cassandra Kelly-Cirino, Director of Emerging Threats, at cassandra.kelly@finddx.org

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