



Vietnam and innovation in COVID-19 testing

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ABSTRACT

Vietnam made global headlines for its effective management of the first wave of COVID-19. Now, at the time of writing in Spring 2021, although there are occasional instances of imported cases in the headlines, in Vietnam the country's battle with the virus is often spoke of in past tense. After all, the country has responded effectively to each wave, by implementing localised, targeted lockdowns in an effort to quell outbreaks, and through a combination of government, business sector and grassroots innovation that lessened the spread of the virus and ameliorated the impact of the lockdown. To give context to the scale of Vietnam's tremendous response, through June 2020 the country had fewer than 400 cases and 0 deaths. While the ultimate outcome from the pandemic remains to be seen, we believe there are important lessons to be learnt by analysing the determinants of Vietnam's innovative actions to flatten the curve. In this review, we distil five lessons: (1) a shared purpose is an essential motivator, (2) grassroots and small business entrepreneurs are important innovators, (3) multistakeholder collaboration is a powerful force, (4) contextual innovation is essential, and (5) the state is a key enabler of timely innovation. We focus, in particular, on the case of innovation occurring in affordable COVID-19 test kit development in Vietnam.

INTRODUCTION

Vietnam made global headlines for its effective management of the first wave of COVID-19. While the ultimate outcome from the pandemic remains to be seen, we believe there are important lessons to be learnt by analysing the determinants of Vietnam's innovative actions. Thus, in this review we distil lessons from how the Vietnamese society—the state, the social entrepreneurs, the private sector and the society at large—worked in concert, particularly with respect to innovating in affordable COVID-19 testing. The

Summary box

What is already known?

- ▶ Vietnam, an emerging economy, effectively thwarted the spread of COVID-19.
- ▶ Three COVID-19 test kits were approved for use by May 2020, each costing less than US\$25.

What are the new findings?

- ▶ The Vietnamese experience of developing affordable COVID-19 test kits, in particular, offers lessons for all, across emerging and advanced economies alike.
- ▶ In particular, there were five lessons learnt: (1) a shared purpose is an essential motivator, (2) grassroots and small business entrepreneurs are key, (3) multistakeholder collaboration is a powerful force, (4) contextual innovation is essential, and (5) the state is a key enabler of timely innovation.

following are the five lessons: (1) a shared purpose is an essential motivator, (2) grassroots and small business entrepreneurs are key, (3) multistakeholder collaboration is a powerful force, (4) contextual innovation is essential, and (5) the state is a key enabler of timely innovation.

CONTEXT

To begin with, the state acted early, implementing widespread temperature screening, testing, quarantine, targeted lockdowns and public communications. In January 2020, the Vietnamese government shut all schools and locked down an entire village where early cases were confirmed. More stringent measures were adopted until, in March, the whole country was placed in lockdown. As emphasised by Klingler-Vidra *et al*,¹ the Vietnamese government framed COVID-19 as a war and enlisted both propaganda artists and the military, and modernised the fight with a pop song about handwashing



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that ‘went viral’ and used text messaging to communicate details of infected cases to citizens on a daily basis. The effective role of the state in Vietnam was said, by Pollack *et al*,² to have been at least partly enabled by the country’s institutionalised learning from previous experience with virus outbreaks, such as the severe acute respiratory syndrome (SARS) and the avian bird influenza. The resultant swift, and effective, response by the government made international headlines, including those of Allen-Mills and Gregory³ and Taylor.⁴

At the same time, heartening stories of inclusive innovation also emerged from the grassroots level. Vietnamese social entrepreneurs responded to the virus as well as the socioeconomic challenges caused by the national lockdown; Tran and Klingler-Vidra⁵ interviewed the innovators behind the ‘rice ATMs’, which provided up to 3 kg of free rice to those out of work, and the ‘pink bakery’ movement, in which people bought dragon fruit from farmers who could not export and turned it into bread products. An inspiring example comes from the ‘One Egg a Day’ initiative, which strives to help those who are most vulnerable, such as sex workers and those with HIV, seeking out these individuals who may not otherwise be able to access support (KTH Oanh’s interview, 2020). The government and development donors also supported entrepreneurs’ timely development of delivery and disinfection robots in hospitals. These innovative, and grassroots, responses helped to reduce infection and ease the socioeconomic impact of the pandemic by providing sustenance for the marginalised and most at risk. The solutions and resources came from the local communities, for the local communities, rather than waiting on aid or support from elsewhere. According to the United Nations Development Programme Vietnam report,⁶ Vietnam’s COVID-19 response fits with the country’s wider embrace of more inclusive innovation, in which innovation is presumed to be ‘of, by, and for all’.

In terms of the healthcare sector, in particular, Vietnam acted early to build testing capacity, drawing on a combination of antibody and virus tests. By April 2020, Klingler-Vidra and Tran⁷ explained that mass antibody testing was implemented in the capital, Hanoi, while temperature screening and disinfection stations were set up at entrances to all major cities. Virus tests were also increasingly installed at capable facilities across the country. Testing capacity and the use of a tracking system which had been deployed in Vietnam, in collaboration with the Centers for Disease Control and Prevention (CDC), since 2016, according to Pollack *et al*,² helped the state to know where cases were, and as a result the spread of the pandemic could be contained and resources effectively distributed. Underlying any national testing strategies like Vietnam’s is the issue of the cost; only a small per cent of those tested might carry the virus, so the cost–benefit analysis of testing can look bleak on a population-level basis.

The timely development of effective and affordable virus test kits in Vietnam offers especially important lessons, especially with respect to how emerging economies can foster health-focused innovation rather than relying on the diffusion of innovation from abroad. In [table 1](#), we offer a summary of the Vietnam-developed COVID-19 test kits, by (1) the Institute of Military Medicine (IMM) and the biotech company Viet A; (2) the Hanoi University of Science and Technology (HUST), the biotech company Innogenex and the pharmaceutical company Sunstar; and (3) the Vietnam Academy of Science and Technology (VAST).

In the remainder of our review, we distil five lessons from the timely development of three COVID-19 test kits in Vietnam in the first half of 2020.

A shared purpose is an essential motivator

A shared purpose in combating the virus instigated a ‘reflex’ where Vietnamese researchers began working proactively on a test kit on hearing of the new coronavirus in China, for fear that it would spread to Vietnam.

Table 1 Vietnam’s three locally developed, affordable COVID-19 test kits

Teams	IMM and Viet A	HUST, Innogenex and Sunstar	VAST
Technique	RT-PCR	RT-LAMP	RT-PCR
Processing time	60+ min	15–30 min	60+ min
Affordability	US\$19–25	US\$15	Less than US\$21
Key team members	Dr Su and Dr Son (IMM)	Dr Hoa (HUST), Mrs Ha (Innogenex) and Mrs Lien (Sunstar)	Dr Quyen and Dr Khang (VAST)
Date research began	Late December 2019	Late December 2019	7 February 2020
Timing of test kit approval (approver)	4 March (Vietnam’s Ministry of Health)	7 May (Vietnam’s Ministry of Health, of version 1); 25 May (Belgium, of version 2)	April (Vietnam’s Ministry of Health)
Production status	Viet A has led the production and commercialisation and exporting of the test kits.	Sunstar has been working to commercialise and export the test kits to a number of countries.	Status unknown.

HUST, Hanoi University of Science and Technology; IMM, Institute of Military Medicine; RT-PCR, reverse transcription PCR; VAST, Vietnam Academy of Science and Technology.

As an illustration, when Dr Hoa at HUST first heard about a 'strange lung disease in China' in late December 2019, he acted even though there were no cases in Vietnam, because he believed the virus would 'sooner or later spread to Vietnam' given the socio-economic and geographical proximity between the two countries (H Le's interview, 2020). HUST, as well as IMM, initiated efforts in December 2019, in anticipation of needing to respond. These early reflexes ultimately facilitated the early development of test kits than would otherwise have been possible if the teams would have waited until the pandemic was confirmed. In this way, the Communist Party of Vietnam, perhaps paradoxically, produced a permissive innovation environment that enabled this timely, effective development of testing capacity.

Grassroots and small business entrepreneurs are key

The researchers, all of whom were employees of state organisations, did not wait for state directives or funding when beginning their research. They instead used their existing resources and network.

A clear example of entrepreneurship comes from VAST, as Dr Quyen worked to reallocate funds he had gained from other projects in order to undertake initial work on his test kit. In so doing, he showed initiative and creativity. In a similarly entrepreneurial way, Dr Hoa at HUST began developing a test kit without input from institutional leaders nor direct funding from the university. He used his university research facilities and sought out partnerships with private sector collaborators (Innogenex and Sunstar) in order to complete, and then commercialise, the test kits. At IMM, Dr Su's team were also entrepreneurial when they initiated their research before IMM had acted, and when they contacted a private company (Viet A) about collaborating on commercialisation. Thanks to their initiative, they later secured funding from the Ministry of Science and Technology (MOST) for further test kit development on the basis that they had already arranged for commercialisation.

Multistakeholder collaboration is a powerful force

Collaboration, across the public and private sector, as well as community action and international links, provided the research teams with technical know-how, resources and commercial prospects.

In particular, collaboration with private sector partners proved crucial for translating the test kits from innovation into certified products for use in Vietnam and in foreign markets. For the HUST-initiated test kit, collaboration with two private entities, Innogenex and Sunstar, offered essential funding, access to clinical validation, and ultimately production capacity. In the case of IMM's kit, commercialisation by a private company, Viet A, was crucial to the test kits, ultimately being available for widespread use.

In addition, Vietnamese researchers benefited from international collaboration, which provided information about state-of-the-art approaches to testing for SARS-CoV-2. Two of the test kits referenced (and adapted) the WHO and the American CDC test kits. Further engagement with the international research community was underscored by the actions of Dr Su at IMM, as early communications with a German researcher helped him develop the detection protocol for the virus. He was also able to stay current with the latest data given membership in the Global Initiative on Sharing All Influenza Data.

Contextual innovation is essential

The test kits were contextually innovative, as each team adapted existing approaches for COVID-19 and the Vietnamese context. VAST's Dr Quyen and IMM's Dr Su based their test kits on the ones by WHO and the American CDC. However, they introduced their own modifications. The WHO's reference test kit first screens for gene E of the coronavirus family; IMM and VAST researchers found that this alone would take 80 min to process (Q Dong's interview, 2020). Afterwards, it screens for two more genes, the RdRp and the N gene, to detect SARS-CoV-2, specifically. The VAST and IMM's test kits skip the first step, because the Vietnamese research teams found that the other members of the coronavirus family, such as SARS and Middle East respiratory syndrome, were not present in Vietnam, and so this step was unnecessary. Thus, the one-step testing protocol brings crucial time and cost savings; their kits produce results in just over an hour.

In a similarly contextually relevant way, at HUST, Dr Hoa developed his RT-LAMP test kits based on work he had done to develop RT-LAMP kits for other viruses in Vietnam. He knew that the RT-LAMP technique was cheap to produce and easy to conduct, and as such could be widely deployed in a country like Vietnam.

The state is a key enabler of timely innovation

Last but not least, in different ways the state enabled the timely innovation by the three research teams. The Vietnamese government acted early to bring together relevant groups and direct resources to key tasks. At the end of January, Vietnam's MOST organised a meeting on COVID-19 with virologists around the country; it was in this meeting that IMM was commissioned with developing a test kit within 2 weeks. They were able to advance on the work because the National Institute of Hygiene and Epidemiology (NIHE), a public entity, had successfully isolated and grown COVID-19 from patient samples in laboratories. In March 2020, the Ministry of Health issued a decision on temporary guidance on COVID-19 testing, which enabled multiple laboratories (22 at the time) to carry out COVID-19 testing. This allowed companies like Viet A to have samples for validating the kits' effectiveness.

The Communist Party of Vietnam demonstrated flexibility and responsiveness in its provision of funding and support for each team's test kit innovation. Atypically, it authorised financial support for two teams to work on similar projects: VAST could spend state money on its own test kit even though IMM had already been developing theirs with funding from the MOST. Also, the state provided non-financial support for the third set of researchers, as the Ministry of Health agreed to meet the HUST–Sunstar–Innogenex team and organised a committee of leading medical experts from the NIHE and the National Institute for Control of Vaccine and Biologicals to assess their prototype kit.

CONCLUSION

In the early days of 2020, Vietnamese researchers, entrepreneurs, grassroots innovators and policymakers were already working to develop ways to identify the new virus. Through the combination of the society's shared purpose, the initiative taken by grassroots and small business entrepreneurs, multistakeholder collaboration, an emphasis on *contextual* innovation, and with the adaptable and enabling role of the state, Vietnam was able to effectively identify the early cases of the virus. Although the first case of COVID-19 would not be found in Vietnam until late January, state, industry and society were already vigilant and collaborating. As a result of early testing capacity, along with the other decisive actions, Vietnam's healthcare system, and society more generally, were never overwhelmed by the virus in the way that many countries around the world have been. For emerging and advanced economies alike, the Vietnamese case serves as an important one to study, to understand ways in which affordable innovation can help thwart the devastation of pandemics.

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