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Safeguarding essential health services during emergencies: lessons learnt from the COVID-19 pandemic

The coronavirus disease 2019 (COVID-19) pandemic has affected all aspects of daily life across all sectors worldwide. The pandemic is nevertheless first and foremost a health crisis, and has severely impacted the health sector. Countries of the World Health Organization (WHO) South-East Asia Region have faced immense challenges in responding to the crisis while maintaining essential health services, owing in part to underprepared medical and public health infrastructures and overwhelmed health workforces. Across the region, countries have experienced shortages of personal protective equipment for health-care workers, ventilators for critical care patients, supplies of essential medicines and even disinfectants for public health measures.

“Restoring and maintaining essential health services and public health programmes throughout the pandemic response and into the recovery and beyond is of paramount importance for the region to strengthen health security and ensure that its progress across all areas of health is protected and built on.”

Between May and July 2020, WHO carried out a rapid situation assessment survey on the impact of the pandemic on the continuity of essential health services during the 3 months prior to the date of survey submission. Across the region, the survey revealed constrained access for pregnant women to antenatal check-ups, delivery and postnatal care, and for children to diarrhoea and pneumonia treatment and routine immunization services. In addition, supplementary polio immunization campaigns and the measles, mumps and rubella vaccination drives were suspended.

These shortfalls in services occurred despite movement to provide or to access health care being exempted from so-called “lockdown” restrictions. Adding to these challenges, misinformation, rumours and the stigmatization of people with COVID-19 have made communities hesitant to use essential health services that continue to function. Upholding and maintaining people’s trust in existing health systems and service delivery provision is as important as ensuring that essential health services remain functional in any disaster or health emergency.

Universal health coverage – now more than ever

Health resilience is strongly promoted by the Sendai Framework for Disaster Risk Reduction 2015–2030, which emphasizes the need for new and existing hospitals and other health facilities that remain safe, effective and operational during and after disasters. In an emergency, it is not sufficient that safe, accessible and affordable health care is available to only that part of the population already served by such facilities and services; these services must also be accessible to the most vulnerable and hard-to-reach populations. Universal health coverage is not only important in its own right but also central to achieving health for all, health security and the health-related Sustainable Development Goals.

As a result of the pandemic, demand will increase for essential health services in the private health-care sector, where price regulation is lacking. This is likely to lead to an increase in out-of-pocket expenditure that will exacerbate financial hardship. The WHO South-East Asia Region will be especially affected, since domestic public spending on health is generally low and out-of-pocket spending is the dominant source of financing – more than 50% of the current health expenditure in five countries of the region.

People in the region are already heavily affected by the double burden of noncommunicable diseases and infectious diseases, in addition to the threat of multiple hazards. They must therefore have equitable and easy access to essential health services at an affordable price, especially in the aftermath of a disaster or in a health emergency situation. Restoring and maintaining essential health services and public health programmes throughout the pandemic response and into the recovery and beyond is of paramount importance for the region to strengthen health security and ensure that its progress across all areas of health is protected and built on. To do that, Member States must adapt, reorient and prioritize investments in the health sector.

Building on commitments to sustain essential health services

The COVID-19 pandemic highlights how an immediate threat to human health can bring entire populations, economies and national systems to an abrupt halt. Among other interventions, national ministries of health both in the region and globally have sought to halt the spread of severe acute respiratory syndrome coronavirus 2 by applying public health and social measures to entire districts or states. The unprecedented action taken to mobilize resources, arrange emergency medical products and organize general logistics – despite several bans on international and domestic travel and the closure of points of entry – reflects Member States’ commitment to protecting the health and well-being of their people. This commitment can also be witnessed in Member States’ resolve to maintain essential health services, which was expressed during the meeting organized by the Regional Director with the ministers of health on 6 August 2020.

Before COVID-19, countries of the WHO South-East Asia Region had some of the world’s fastest-growing economies.
Now, the World Bank estimates a fall in projected average per capita gross domestic product for countries in the region from US$ 4100 to US$ 3800 this year. This unprecedented global downturn has significant implications. Health financing in much of the region relies heavily on government health spending and household out-of-pocket payments. The pandemic has significantly reduced both sources of expenditure and will therefore reduce per capita health spending, substantially jeopardizing efforts to achieve universal health coverage. This underlines the critical need to increase public investment in health as a key determinant of social and economic development.

Considering the increasing vulnerabilities and exposure of people across the region to multiple and diverse hazards, risks and threats, it is crucial that the Member States consolidate, expand and intensify ongoing efforts to strengthen core capacities for health emergencies, as specified in the International Health Regulations, 2005. Accelerated and adequately funded activities to strengthen core capacities, especially at subnational levels, will help to create more resilient health systems that are closer to communities.

It is imperative that Member States develop a roadmap for sustaining essential health services and public health programmes in the context of COVID-19. There is an urgent need to adjust governance and coordination mechanisms to support action in a timely manner and to strengthen coordination and communication among incident managers, programme managers, and public and private sector providers. Continuous monitoring of the delivery of essential services and the provision of timely information to decision-makers – both technical and financial – are vital. An extensive list of sample indicators for monitoring essential health services during the COVID-19 pandemic is available. Indicators should draw on existing ones routinely reported and should be disaggregated if possible (e.g. by age and sex) to aid in addressing vulnerable, underserved and poor populations.

The functional mapping of systems and resources, the harnessing of digital technology such as tele-health service delivery pathways, and the establishment of safe and effective patient flows in health facilities can help optimize essential health services as part of a “new normal” that includes physical distancing, the wearing of masks and avoiding unnecessary journeys. Health authorities should prioritize making timely, clear and appropriate information available to households and communities, especially vulnerable patients with chronic health conditions.

Risk communication and community engagement strategies should be locally adapted to overcome psychological, social or physical barriers to accessing health services. A whole-of-society approach is required to foster collaboration and partnerships among public, private and civil society stakeholders. Improving health literacy is key to managing any health challenge, including the community response to an outbreak. Special interventions should target vulnerable populations, including people living in urban slums, homeless people, migrant workers, refugees and internally displaced persons, and people in detention centres and prisons.

**Conclusion**

The COVID-19 pandemic has revealed gaps in health system resilience in countries of the WHO South-East Asia Region. In doing so, the pandemic has provided governments with an opportunity to recognize and fill these gaps to better protect against future shocks. The existing core capacities for health emergencies must be more risk-informed, better funded and strengthened through cross-sectoral synergies and linkages. The principles of the right to life, the right to health and universal health coverage must continue to guide efforts to build community and health system resilience. Improving the awareness and health literacy of populations, policy-makers and the health workforce is key to preventing and controlling any disease that threatens the safety and security of populations in the region.

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Mitigating the impact of the COVID-19 pandemic on progress towards ending tuberculosis in the WHO South-East Asia Region

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Abstract
Almost half of the deaths worldwide caused by tuberculosis in 2018 occurred in the World Health Organization (WHO) South-East Asia Region, home to around a quarter of the global population. Maintaining robust progress in this region is therefore essential if the global goal of ending the tuberculosis epidemic is to be realized. Substantial gains have been made in the region, but the threat to health worldwide posed by the coronavirus disease 2019 (COVID-19) pandemic includes not only the direct effects of the pandemic but also the potential eclipsing of the global tuberculosis emergency. The results of modelling studies present stark warnings of a reversal of years of progress and a significant resurgence in deaths from tuberculosis. The COVID-19 pandemic has had variable impacts in the WHO South-East Asia Region to date, but in the countries most affected there has been targeted diversion and repurposing of tuberculosis services, health-care workers and diagnostic equipment. The combined effects of COVID-19, containment measures and fragmentation of tuberculosis services have resulted in delays in diagnosis or non-diagnosis and disruption in treatment resulting in increased morbidity, mortality, transmission and drug resistance. Countries of the region have made attempts to ensure continuity of services and civil society and nongovernmental organizations have instituted a range of innovative mechanisms to support national programmes. However, a comprehensive approach – including scaling up successful initiatives, empowering community leadership, harnessing digital tools, and implementing easily accessible cash transfers and nutrition support – will be critical to success. As COVID-19 recedes, countries will need “catch-up plans” to deploy supplementary measures to address the increased tuberculosis burden. Urgent, targeted and agile responses have the potential to mitigate and reverse the impact of the COVID-19 pandemic on tuberculosis in South-East Asia.

Keywords: COVID-19, health services, South-East Asia, treatment, tuberculosis

Tuberculosis burden in the WHO South-East Asia Region and progress towards ending tuberculosis

The World Health Organization (WHO) South-East Asia Region, with only 26% of the global population, accounted for 44% of the global tuberculosis incidence in 2018. Tuberculosis killed around 650,000 people (or 1800 a day) in 2018 in the WHO South-East Asia Region, which was almost half of global tuberculosis deaths. In 2017, drug-sensitive forms of the disease also caused a loss of more than 8 million disability-adjusted life years among the most economically productive age group (15–49 years) in the region, the highest such figure for any communicable disease. Six countries of the region (Bangladesh, the Democratic People’s Republic of Korea, India, Indonesia, Myanmar and Thailand) are among the 30 countries globally with the highest tuberculosis burdens.

The region has made substantial progress towards ending tuberculosis in recent years, with a 20% increase in treatment coverage since 2015, which has led to the number of cases notified increasing from 2.66 million in 2015 to 3.36 million in 2018. The region needs to continue to build on this momentum and honour the commitments made during the United Nations High-Level Meeting (UNHLM) on the fight against tuberculosis in September 2018 to accelerate progress towards the targets of the 2030 Agenda for Sustainable Development and the WHO End TB Strategy. The Strategy aims to reduce tuberculosis deaths by 95%, reduce new cases by 90% between 2015 and 2035, and ensure that no family is burdened with catastrophic expenses from tuberculosis from 2020 onwards. Some of the targets for the WHO South-East Asia Region established
following the UNHLM commitments are to successfully treat at least 18 million people with tuberculosis, including at least half a million people with drug-resistant tuberculosis, between 2018 and 2022, and to provide preventive treatment to 11 million people from at-risk populations.7

With a high proportion of the world’s tuberculosis burden, the WHO South-East Asia Region determines global progress towards ending tuberculosis. Therefore, any loss of the current momentum would seriously threaten the region’s and the world’s progress towards achieving the goals. The coronavirus disease 2019 (COVID-19) pandemic poses a significant threat to health worldwide not only directly but also by eclipsing the global health emergency of tuberculosis.8 This perspective paper assesses the effects of the early stages of the pandemic on progress towards ending tuberculosis in the WHO South-East Asia Region. Since full data on the impact are not yet available, the unreferenced information provided reflects reports that the authors have received from patients’ groups, civil society organizations (CSOs) and nongovernmental organizations (NGOs), and WHO country offices in the region, through formal and informal communications.

Impact of the COVID-19 pandemic on tuberculosis services

The COVID-19 pandemic has had variable impacts in the region so far, with India, Bangladesh and Indonesia being worst affected in decreasing sequence.9 Accordingly, the countries of the region have taken steps to contain the spread of the disease. Both the fear among people of contracting COVID-19 at crowded health centres and the containment measures taken by governments have led to a change in health-seeking behaviour as well as reduced access to and availability of health services in general. Among the countries with high tuberculosis burdens, the containment measures vary, including strict lockdown in India, restrictions being imposed in Bangladesh, mainly social distancing measures in Indonesia and an emphasis on infection control measures in Myanmar and Thailand.

The containment measures have induced disruption in transport services, and the restriction of health facilities to management of emergency medical conditions is impairing access to and delivery of tuberculosis diagnosis and treatment services. This is primarily because symptomatic people cannot reach health facilities or because cessation of outreach activities means that sputum samples cannot be transported from the field. For similar reasons, it is difficult for patients on treatment to attend a health facility to be monitored through sputum examination. In June 2020, the Global Fund reported that nearly 80% of the tuberculosis programmes it supports globally have experienced disruption in service delivery, with 17% of them reporting high or very high disruption.10 In some countries of the region with high tuberculosis burdens, such as Bangladesh, India and Indonesia, a significant proportion of patients with tuberculosis are notified by private sector health facilities.1 Based on information provided by patients’ groups, the current COVID-19 outbreak has seen a scaling down of medical services provided by the private sector, and therefore tuberculosis case notification has decreased in this sector as well. According to the early data available from Nikshay, India’s online reporting portal with public access, between 1 January and 30 June 2019 nearly 895,000 and 355,000 cases were notified in the public and private sectors, respectively. For the same date range in 2020, the numbers of public and private sector notifications were about 670,000 and 250,000.11

Tuberculosis programmes have contributed significantly to the COVID-19 response, as both diseases present with respiratory symptoms, and similar infrastructure, skills and expertise are needed for containment, diagnosis and management. Therefore, diversion and reprioritization from tuberculosis programmes to the COVID-19 response has been common. In Bangladesh, India, Indonesia and Nepal, health systems structures and health-care workers have been repurposed for or diverted to the COVID-19 response. This effect on tuberculosis service provision is compounded by the fact that health systems in low- and middle-income countries are already under-resourced.

Tuberculosis diagnostic test platforms such as GeneXpert® (Cepheid, United States of America) and TrueNat® (Molbio Diagnostics, India) can also be used to detect the COVID-19 causal agent, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), and their likely diversion to COVID-19 diagnosis may also result in fewer tuberculosis diagnoses and missed opportunities for early detection of drug resistance. According to reports available at the end of May 2020, Bangladesh, India, Myanmar and Thailand had either repurposed a proportion of their equipment or were in the process of doing so while awaiting the cartridges for tests. In Bhutan, India and Indonesia, drug-resistant tuberculosis isolation wards and hospitals that have respiratory isolation facilities are now being reprioritized to treat patients with COVID-19. This could mean fewer patients with drug-resistant tuberculosis starting treatment under appropriate conditions. So far, based on interim tuberculosis notification data available online, reductions of more than 50% in case notification have been recorded in some countries of the region. It is also anticipated that especially vulnerable populations, including migrants, transgender people, elderly people and children, will bear the brunt of the situation resulting from the diversion of qualified staff, further restricted access to health services, and repurposing of the diagnostic and treatment infrastructures for the COVID-19 response. This is also relevant for children in countries of the WHO South-East Asia Region, where the paediatric tuberculosis diagnosis is already low and, as in other low- and middle-income countries, the majority of patients are not seen by dedicated paediatric specialists. Many general physicians and nurses usually available for children’s care will be seconded to dealing with adult patients affected by COVID-19 instead.8

Although investigations of the possible interactions between tuberculosis and COVID-19 are in their infancy, it is reasonable to assume that the diseases may amplify each other if not addressed simultaneously. An observational study conducted in China found that tuberculosis infection and disease may increase susceptibility to SARS-CoV-2 and increase COVID-19 severity.12 The WHO South-East Asia Region has low coverage of tuberculosis preventive treatment: only 15% of people living with HIV newly enrolled in care and 26% of children aged 5 years or younger who were household contacts of people with confirmed tuberculosis received tuberculosis preventive treatment in 2018.1 With outreach activities either stopped
or downscaled, the administration of tuberculosis preventive treatment may be among the most impacted activities that could be useful in preventing the emergence of tuberculosis cases that will be worst affected.

At a much broader level, COVID-19 containment measures have led to loss of earnings specifically for daily wage earners, amplifying poverty and undernutrition. Tuberculosis thrives on poverty. Undernutrition accounted for an estimated 2.3 million cases of tuberculosis globally in 2018. Levels of undernutrition and poverty associated with tuberculosis are already high in the region, and the number of tuberculosis cases in the region will surge with increased poverty and undernutrition.

The net effect of disruption to tuberculosis services will result in delay in diagnosis or non-diagnosis of tuberculosis and in disruption to treatment causing increased morbidity, mortality, transmission of tuberculosis and drug resistance levels. In fact, the results of a mathematical modelling study coordinated by the Stop TB Partnership indicate that a 3-month lockdown plus a 10-month period of gradual restoration of services could see the global tuberculosis incidence and mortality rates resuming to the levels seen during 2013–2016—in other words, in the loss of the progress made in the past 5 to 8 years. The authors of the report also emphasize that any excess tuberculosis burden that is allowed to accumulate during the COVID-19 response could hinder tuberculosis control efforts for at least the next 5 years.

The results of a separate modelling analysis indicate that, if global tuberculosis case detection decreases by an average of 25% over a period of 3 months, an additional 190,000 tuberculosis deaths will occur. Given that the WHO South-East Asia Region accounts for over half of global tuberculosis mortality, even at this minimum level of disruption in tuberculosis case detection an additional 100,000 tuberculosis deaths will occur in 1 year. If case detection drops by 50% over a period of 3 months, the number of tuberculosis deaths could increase by nearly 1 million in the region.

**Preserving progress and mitigating risks to delivery of high-coverage tuberculosis services in the region**

While some disruption to tuberculosis services and consequent decreased access is inevitable, it is important that all countries minimize the impact by providing a basic minimum services package for tuberculosis patients during the COVID-19 outbreak period and that they facilitate access by improving outreach and ensuring that health services have proper infection control measures in place to boost confidence. National tuberculosis programmes will also need to plan for catch-up after the COVID-19 situation normalizes.

So far, countries of the region have made attempts to ensure continuity of tuberculosis services and have issued guidance on carrying out various related activities during the COVID-19 outbreak. Innovative mechanisms are being adopted to ensure continuity of treatment. In some countries, telephone helplines have been established for patients with tuberculosis. In Sri Lanka, patients with tuberculosis treatment cards can use the card as a “pass” to travel through lockdown areas to access health services. During a webinar organized by the WHO Regional Office for South-East Asia, CSOs and NGOs in the region reported the use of various innovative mechanisms to support national programmes (Box 1). The efforts made by programmes and partners are commendable. However, far more needs to be done to ensure that the region with the highest tuberculosis burden continues its progress towards ending tuberculosis. The successful pilot schemes and focused efforts need to be scaled up. A comprehensive approach will be required to strengthen the connection between communities and health services. Community systems must be put in place to ensure rapid screening for people in the community with symptoms such as cough and fever. COVID-19 and tuberculosis may present with similar symptoms, albeit with different durations, and dual screening with universal precautions to address both diseases is going to be critical. Integration of diagnostic processes may help with identification of missing cases of tuberculosis as well as COVID-19. Sputum smear microscopy remains the cornerstone of tuberculosis diagnosis among symptomatic patients and some early evidence indicates that use of sputum, specifically induced sputum, may be a more sensitive method of diagnosing SARS-CoV-2 infection. The path to diagnosis may be stressful physically and mentally for those with symptoms, who may

**Box 1. Examples of civil society activities to support national programmes in the region**

- Various CSOs are mapping patients and available tuberculosis services to help establish contact between patients and health facilities.
- Partners in Jakarta, Indonesia, have ensured that patients with multidrug-resistant tuberculosis can stay connected with services by distributing smart phones.
- Some CSOs have been able to arrange social support for patients with tuberculosis on treatment directly or by connecting them with relevant departments.
- Innovative mechanisms are being used at tuberculosis clinics run by Médecins Sans Frontières, India, to prevent infection transmission, adopt social distancing measures and arrange COVID-19 tests for patients who may be infected. These clinics have established collaborations with other institutes to provide counselling services.
- Teleconsultation for patients on treatment specifically to monitor treatment and identify any adverse events early is being provided by several clinics run by NGOs.
- The international development organization BRAC, Bangladesh, is arranging sputum transportation for diagnosis and monitoring while ensuring proper disinfection of sputum collection places.
- World Vision, Thailand, has been working with vulnerable groups including migrants: the package of services provided includes information dissemination and linking people to health services.
- Save the Children, Nepal, is working with partners to ensure continuity of tuberculosis services, both preventive services and treatment, and monitoring status on a monthly basis. Save the Children has also developed a plan for catch-up in the post-COVID period and enhanced outreach activity.
be apprehensive about being diagnosed with either of the diseases because of the similarities in presentation. Guidance and counselling for those in need of diagnosis are necessary so that people with symptoms are reassured about the diagnosis made and approach treatment accordingly. Community volunteers can provide referral to health facilities for those in need of diagnostic or treatment services. Both tuberculosis and COVID-19 are stigmatized conditions, and avoiding loss of confidentiality and preventing discrimination are important considerations when planning such services for both diseases.

Digital tools such as teleconsultation (and treatment), smart pill boxes and social platforms could also be of help in contacting patients and providing quality care. Digital tools not only help to maintain physical distance, thus preventing transmission, but also provide easy access to health services at a time convenient to the patient. Connectivity among patients and care providers will build confidence in the health system and enable patients' urgent needs to be addressed as and when needed. Some patients may face adverse events during treatment. These can also be suitably monitored and addressed to a large extent if people are connected with healthcare providers through digital platforms. Pill boxes will support patients in regular medicine consumption. The potential for improving tuberculosis care through digital technology is still largely untapped. The COVID-19 pandemic has compelled many sectors to shift rapidly to digital solutions; this should be a catalyst for tuberculosis services to exploit these resources.

To decrease the susceptibility of people with tuberculosis to COVID-19, it is important that preventive tuberculosis treatment is continued even during the COVID-19 outbreak and scaled up considerably once the outbreak is over. Plans for household contact investigations for tuberculosis patients will need to be scaled up.

To minimize the impact of poverty and malnutrition, patient support systems such as cash transfer and nutrition support schemes, which are already part of national tuberculosis programmes, need to be streamlined and made more efficient by identifying and removing any bureaucratic hurdles, which might include, for example, multiple steps required to receive such support. It is reported that streamlining direct benefit transfers through single transfer accounts is being trialled in India.

The WHO Regional Office for South-East Asia has been supporting the region through cross-country learning activities, by sharing literature, guidelines and policy documents, including on continuity of tuberculosis services during the COVID-19 pandemic. The regional office has conducted and facilitated several webinars to build capacity in countries of the region including Bangladesh, Indonesia, Myanmar, Nepal, Sri Lanka and Timor-Leste, with plans for similar activities for other countries of the region. The regional office has also supported countries in developing or updating their national strategic plans for ending tuberculosis, as well as in submitting ambitious proposals to the Global Fund for support for tuberculosis programmes in the region. Remote support through web platforms is likely to continue for several months.

Once the COVID-19 pandemic recedes, the pace of restoration of tuberculosis services will also have a significant bearing on the tuberculosis burden for the next 5 years or so. Supplementary measures will be required to reduce the accumulated pool of tuberculosis cases. Intensifying case finding through community-based outreach activities with a special focus on marginalized and vulnerable groups on a much larger scale may be needed. Each country will have to assess the magnitude of the negative impact and develop appropriate catch-up plans to recover lost ground. To support these catch-up efforts, funding agencies such as the Global Fund might consider “front-loading” some of their grants for tuberculosis programmes. Health systems strengthening will also need a greater focus to create systems that will be sustainable in the long term. Lessons learnt from COVID-19, specifically regarding contact investigations and infection control, will be important for ending tuberculosis and need to be continuously implemented. The catch-up phase will also provide greater opportunities for south–south collaboration through commodity support and technology transfer.

Countries of the region are manufacturers of innovative technology and suppliers of drugs. The availability of cheap technology and commodities will offset some of the costs of the additional investments required and of accelerating the expansion of services. Diversification of sources of funding will be essential, especially for those countries with a heavy tuberculosis burden, although the Global Fund remains the largest international funder of tuberculosis control activities. According to modelling estimates, the existing funding gap for ending tuberculosis in the region is close to US$ 1 billion per year.17 This gap and the additional funds that may be needed could be filled through increased domestic commitments, private sector engagement and innovative funding mechanisms drawing inspiration from successful mechanisms such as GAVI, the Vaccine Alliance, and UNITAID. Social impact bonds, which have been implemented in countries such as the United Kingdom of Great Britain and Northern Ireland and the United States of America, could also be tried in the region as innovative financing mechanisms.

The impact of the COVID-19 pandemic on progress towards ending tuberculosis in the WHO South-East Asia Region may be substantial in the short to medium term if not urgently addressed. However, with resolute action by countries of the region, including a quick assessment of the impact of COVID-19 on tuberculosis programmes, careful planning and prioritization, and ensuring the delivery of quality services, the impact on tuberculosis burden can be minimized and even reversed.

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References


Perspective

Protecting sex workers in Thailand during the COVID-19 pandemic: opportunities to build back better

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Abstract

The Government of Thailand was prompt to launch social and economic measures to mitigate the effects on the general population following lockdown measures to counter coronavirus disease 2019 (COVID-19). However, sex workers were one of the vulnerable groups who were unable to access state support. A rapid survey of sex workers in Thailand showed that almost all had become unemployed and lost their income as a consequence of the lockdown, restrictions on international flights into the country and the closure of entertainment venues. Most were unable to cover the costs of food and shelter for themselves and their dependents. COVID-19 had also disrupted testing and treatment for sexually transmitted infections and HIV services for sex workers. As in other countries, community-based organizations were essential to providing an immediate, short-term COVID-19 response for sex workers. Also as in other countries, the pandemic has demonstrated that many people’s health and well-being depends on very fragile foundations. This presents a clear opportunity to build back better by committing to a longer-term vision for the overall societal inclusion of sex workers. Thailand should advocate for decriminalization of sex work and ensure sex workers are entitled to equal labour rights and inclusion in the government social protection programme. Progress in innovative government initiatives aimed at ending HIV stigma and discrimination show how structural change can come about through harnessing community-based organizations. In turn, HIV services for sex workers need to expand and incorporate targeted interventions to reduce sex workers’ occupational susceptibility to COVID-19.

Keywords: community-based organizations, COVID-19, decriminalization, HIV, sex workers, Thailand

Background

On 14 January 2020, Thailand became the first country outside China to report a laboratory-confirmed case of coronavirus disease 2019 (COVID-19).1 This was followed by sporadic imported cases and then limited local transmission. In mid-March, entertainment venues, pubs and sporting venues were closed, following clusters of cases. By early April, the Government of Thailand had announced a state of emergency and imposed a curfew, with restrictions on travel and movement including suspension of all commercial international flights, and lockdown measures were being implemented to varying degrees throughout the country to curtail transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

Among the most vulnerable groups affected by these measures were sex workers. The most recent estimate of the number of sex workers in Thailand is 144,000, although this is widely regarded to be a significant underestimate, since sex work is illegal in the country.2 The nationwide closure of the estimated more than 23,000 entertainment venues where sex workers work meant that overnight most lost the ability to earn an income.3 The few sex workers who continued to work despite the lockdown did so with very weak negotiating powers, increasing their risk of contracting not only HIV and sexually transmitted infections (STIs) but also COVID-19.4

There are scant data on the effect of COVID-19 on increased risks in sex work, but a rapid online survey of more than 20,000 lesbian, gay, bisexual, transgender and intersex (LGBTI) people in 138 countries carried out during April and May 2020 found that the pandemic had pushed 1% of respondents to start engaging in sex work and that 2% continued to sell sex during the COVID-19 pandemic, risking exposure to the coronavirus.5

In April, a global survey6 to understand the impact of COVID-19...
on sex workers received responses from 55 different countries and found that many social protection and economic support schemes – such as income support, emergency funds, food packages, and rent or mortgage relief – that were in place for members of the general population were not always accessible to sex workers.

The Government of Thailand was prompt to announce a series of stimulus packages to mitigate the negative socioeconomic impact of COVID-19 on the general population. In April 2020, it was announced that 1374288 workers covered by the social security system (SSS) were to receive compensation of 62% of their daily wage for a period of 3 months. Furthermore, 15.1 million workers not covered by the SSS and not in the agricultural sector and another 7.1 million workers not covered by the SSS and in the agricultural sector were to receive a direct transfer of 5000 baht per worker per month for 3 months. However, since commercial sex is illegal in Thailand, sex workers unable to access the SSS were left to fend for themselves.7 Sex workers who are migrants or from tribal communities and have no Thai ID are formally undocumented; they therefore not only lack access to government support but also risk being arrested because of their illegal status in the country.8

Assessing and addressing the immediate impact on sex workers

A rapid, community-led survey of sex workers carried out shortly after the national lockdown illustrated the impact of the measures on sex workers.9 The survey was prompted when Service Workers in Group (SWING), a Thai national organization providing HIV services and advocating for sex workers’ rights, began to receive requests from sex workers for help with the most basic of needs, such as food, housing and medicine. The survey was carried out in collaboration with the Planned Parenthood Association of Thailand (PPAT) and Dannok Health and Development Community Volunteers, with support from the Joint United Nations Programme on HIV/AIDS (UNAIDS). Respondents were from the cities of Bangkok and Pattaya and the town of Dannok, on the Thai–Malaysia border. There were 255 respondents in total: 234 sex workers (170 female, 38 male and 26 transgender; 207 Thai and 27 non-Thai) and 21 community-based organizations. The survey was carried out using an online self-administered questionnaire during 13–26 April 2020. There was no compulsion to respond, and responses were anonymous.9

COVID-19 and the limits of social protection for sex workers

Almost all respondents (232, or 91%) said that they had become unemployed and lost their income as a consequence of the lockdown, restrictions on international flights into the country and the closure of entertainment venues. Of the respondents, 191 (75%) could not make enough money to cover daily expenses and 154 (66%) could no longer cover the cost of food, daily necessities and housing/accommodation, both for themselves and for their dependents. Owing to interprovincial travel restrictions, 100 of the respondents (43%) were not able to travel to their home town; disturbingly, 47 (18%) reported that they had had to move out of their accommodation or had nowhere to live.

Less than one third of the respondents stated that they were seeking access to government relief measures. Overall, 183 respondents (72%) reported that, because their occupation was illegal, they would not be eligible for any government assistance. Of the respondents, 102 (40%) felt that they could not ask their employer to vouch for them as an employee so that they could access the 5000 baht per month in financial aid, and a further 102 (40%) were not registered with the SSS and could therefore not seek compensation from it for lost income.

COVID-19 and access to STI and HIV services

Lack of access to STI testing and treatment (reported by 122 respondents, or 48%) was the most common difficulty encountered in terms of access to health services as a consequence of the COVID-19 situation. Although the survey was not designed to assess differences, difficulty in accessing STI services was more common among female sex workers and non-Thai sex workers. A separate analysis in seven STI sentinel clinics in Thailand found that COVID-19 coincided with a 90% reduction in sex workers presenting for screening for STIs (Dr Rossaphorn Kittiyawamarn, Department of Disease Control, Ministry of Public Health, personal communication, 13 May 2020). The other main problems encountered were lack of access to condoms, pre-exposure prophylaxis (PrEP), and harm reduction and drug treatment services. Sex workers living with HIV also reported difficulties accessing antiretroviral therapy (ART).9 This reflected the finding that, between March and June 2020, 40% of 86 UNAIDS country offices reported that HIV services for sex workers had been disrupted by COVID-19 lockdown measures.10

Emergency responses led by community-based organizations

As in other countries, community-based organizations were essential to providing an immediate, short-term COVID-19 response for sex workers. Box 1 provides examples of various forms of rapid assistance for sex workers in Thailand provided or coordinated by community organizations.

Committing to longer-term initiatives to protect sex workers

Opportunities for structural change: social protection and decriminalization

In the longer term, the lack of social protection for sex workers in Thailand will need to be resolved. Social and structural interventions require a long-term vision for the overall societal inclusion of sex workers.11 Decriminalizing sex work is not a new topic of discourse in Thailand or globally. In Thailand, entertainment venues earn around US$ 6.4 billion a year in revenue, and sex workers create roughly 4–10% of the kingdom’s gross domestic product.12 Thailand should advocate for decriminalization of sex work and ensure sex workers are entitled to equal labour rights and inclusion in the government social protection programme. The impetus for such reform could be catalysed by political will and structural change, by a grass-roots movement – or by both in combination.

Recent innovations in Thailand’s health sector provide lessons on how structural change can come about through harnessing community organizations. The nationwide 3-by-
4 package for stigma-free health facilities was designed to address stigma and discrimination within and beyond the health system, with one stigma-free health facility in each province as a catalyst “node” for expanding facility–community linkages. Led by the government body that coordinates Thailand’s multisectoral HIV response, this initiative involves key government officials, civil society advocates and development agencies. It is anticipated that one of the outcomes, as the initiative continues to evolve and innovate, will be an online community-led crisis response and reporting system on HIV-related human rights violations. Similarly, the newly established Thailand Partnership for Zero Discrimination brings together stakeholders from justice, education and the workplace with the Ministry of Public Health and civil society and international development partners to build a strategic alliance to implement and scale up programmes aimed at ending HIV stigma and discrimination.14

The COVID-19 pandemic may therefore present an opportune time to reconsider social protection and decriminalization, with the involvement of sex worker-led organizations. Such an approach would accord with WHO guidance stating: “Laws, legal policies and practices should be reviewed and, where necessary, revised by policy-makers and government leaders, with meaningful engagement of stakeholders from key population groups, to allow and support increased access to services for key populations.”15

Opportunities for enhancing holistic services for sex workers

On 10 July 2020, the UNAIDS Interagency Working Group on Key Populations released a statement underscoring the needs to (i) make quality, non-discriminatory HIV prevention, treatment, care and support services, and health services in general, available to vulnerable populations and (ii) rapidly adapt HIV service provision to take into account the new realities of the COVID-19 pandemic.16

Sex workers and their clients account for around 10\% of new HIV infections in Thailand;17 therefore, it is essential that sex workers are able to access the HIV services that have been reconfigured as a result of COVID-19. Various changes to services have been implemented to date. A new policy was endorsed by the National AIDS Commission in March 2020 that aims to reinforce adherence to existing guidance to ensure ART continuity and minimize the risk of COVID-19 exposure in health facilities by recommending rescheduling hospital visits, dispensing antiretroviral drugs by post and using multi-month dispensing.18 Although there has been progress, with major health insurance schemes – the Universal Coverage scheme and the SSS – offering patients a stock of at least 3–6 months’ supply, efforts need to be made to ensure that sex workers can also benefit from these changes. As recommended by the UNAIDS working group, HIV service provision also needs to take into account the new realities of the COVID-19 pandemic, by enabling safe access to home HIV testing or self-testing and remote counselling.

Changes made to HIV prevention services to mitigate the overall impact of COVID-19 should also be incorporated into targeted interventions to reduce sex workers’ occupational susceptibility to SARS-CoV-2. Prevention packages that have proven to be useful in Thailand in the initial months of the COVID-19 pandemic and could perhaps be improved and scaled up have included an emphasis on personal hygiene, with provision of condoms, masks, sanitizers, etc. A full package of services should include interactive messaging with sex workers, clients and advice providers; education and training for sex workers on the proper implementation of prevention measures; and, of course,
unrestricted provision of PPE and related material. These new prevention packages must also cater for and be available to non-Thai sex workers.

If these gaps are not addressed, sex workers will continue to be left behind in the global response and the world will not meet the goals it needs to achieve to end the HIV epidemic and the COVID-19 pandemic. Community-led organizations must take a holistic and comprehensive approach, providing for immediate basic needs and implementing an integrated package covering COVID-19 prevention, HIV health services and mental health support for sex workers. It is important to bear in mind that the need for assistance will remain long after the COVID-19 situation has eased, and long after the bars and restaurants have reopened.

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References


Community action for people with HIV and sex workers during the COVID-19 pandemic in India

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Abstract

Sex workers have been one of the marginalized groups that have been particularly affected by India’s stringent lockdown in response to the coronavirus disease 2019 (COVID-19) pandemic. The sudden loss of livelihood and lack of access to health care and social protection intensified the vulnerabilities of sex workers, especially those living with HIV. In response, Ashodaya Samithi, an organization of more than 6000 sex workers, launched an innovative programme of assistance in four districts in Karnataka. Since access to antiretroviral therapy (ART) was immediately disrupted, Ashodaya adapted its HIV outreach programme to form an alternative, community-led system of distributing ART at discreet, private sites. WhatsApp messaging was used to distribute information on accessing government social benefits made available in response to the COVID-19 pandemic. Other assistance included advisory messages posted in WhatsApp groups to raise awareness, dispel myths and mitigate violence, and regular, discreet phone check-ins to follow up on the well-being of members. The lessons learnt from these activities represent an important opportunity to consider more sustainable approaches to the health of marginalized populations that can enable community organizations to be better prepared to respond to other public health crises as they emerge.

Keywords: antiretroviral therapy, community, emergency response, India, sex workers

Background

On 25 March 2020, India went into lockdown in the first phase of government-imposed public health measures to curb coronavirus disease 2019 (COVID-19). The health system in the country suffered a major resource crisis arising from the tremendous burden of the urgent care needs of those presenting with the disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). While the country mourned the lives lost to COVID-19, the everyday lives of citizens changed profoundly under public health measures intended to mitigate the impact of the pandemic. The pandemic and the lockdown in particular have had myriad social and economic effects.

For society’s most vulnerable, in terms of socioeconomic status, the unintended consequences of these restrictions have been devastating. A recent article by Lucy Platt and colleagues underscored the importance of reaching sex workers, a severely marginalized population vulnerable to the HIV epidemic, the effects of which have been accentuated during the COVID-19 pandemic. In this perspective paper, we describe the response of a sex worker organization based in Mysore, Ashodaya Samithi, which is known for its community-driven health interventions. Ashodaya has restructured its HIV health service delivery approaches while addressing the basic needs of sex workers amid the disruptions wrought by COVID-19. In particular, we highlight the innovative strategies that Ashodaya has cultivated.

Ashodaya is a well-established organization of more than 6000 female, male and transgender sex workers across four districts of Karnataka. Ashodaya’s leadership works with key stakeholders, including the police, the media, health-care providers, government authorities, political leadership and several others, to address violations of the human rights of sex workers and to advocate strongly for the decriminalization of sex work. With respect to health care, Ashodaya advocates for access to health services, including primary health care, HIV services, and sexual and reproductive health services.

India’s particularly tight lockdown, intended to slow the spread of COVID-19, has posed a major challenge to the daily functioning of Ashodaya and has had severe consequences for the lives of its members, who derive much of their income from sex work. Loss of livelihood and lack of access to health care and social protection have intensified their vulnerabilities, dramatically impacting their lives to the extent that many are unable to sustain themselves and their families. Based on their experiences of implementing community-led HIV programmes, Ashodaya community leaders have redesigned their approaches in response to the following crucial
questions: (i) What are the community’s imminent needs and how can we meet them? (ii) What social protections does the government provide and how can we enable timely access to these benefits? (iii) How can we dispel circulating myths, address discrimination and violence, and raise awareness in the community around health protection?

Responding to the imminent needs of sex workers

For people living with HIV, the lockdown of Mysore city immediately disrupted antiretroviral therapy (ART) access, as the majority of ART dispensation takes place through the government-run district hospital, although there are two private hospitals that are part of the government ART programme. Between 200 and 250 people per day collect their medication from the district hospital. With the onset of COVID-19, and the lockdown, the district hospital initially became the only designated testing and treatment centre for SARS-CoV-2 in the city, which effectively halted regular ART distribution.

Ashodaya had already established strong linkages with the district hospital, having built a system of “community health-care navigators” (CHCNs) within the ART centre. CHCNs are part of the Ashodaya community and offer support to patients visiting the ART centre, the counselling and testing centre, and other departments in the district hospital. They assist patients in navigating the complex health-care system and provide ongoing peer support. They also provide support to the staff at the centre by assisting with various administrative tasks. Thanks to this existing relationship, Ashodaya was able to garner support from the ART centre and soon set up an alternative, community-driven ART distribution system.

Amid the COVID-19 restrictions, community leaders adapted a community network-based strategy successfully utilized in their HIV outreach programme to form a community-led ART distribution system for sex workers. Although Ashodaya’s response was initiated in Mysore, it was quickly adopted by Ashodaya teams in the other districts where they work.

Establishing this alternative system involved gaining the necessary district-level authorization and securing the necessary resources (including ART stockpiles), collating the available information on members living with HIV and receiving ART, geomapping discreet distribution sites and ensuring privacy at those locations. CHCNs helped in the distribution of ART, as they were already known to those individuals accessing the ART centre. As Ashodaya initiated its new delivery programme amongst sex workers living with HIV, it began to grow in popularity among other groups of people living with HIV, who started to request Ashodaya’s discreet ART delivery service.

Ashodaya’s approach was aligned with the recommendations of the National AIDS Control Organization (NACO) issued on 23 March 2020. NACO, the central governmental agency for India’s HIV programme, produced advice recommending the dispensation of 3-month supplies of ART to all stable patients and supported community-based ART distribution, in principle. On 14 April 2020, the Ministry of Health and Family Welfare, Government of India, produced guidance identifying essential services to be prioritized. This noted that states should ensure an uninterrupted supply of ART to people living with HIV, through decentralized drug dispensation. It stated that 3-month supplies of ART could be dispensed through ART centres. In updated guidance issued on 1 June 2020, the World Health Organization (WHO) recommended dispensing supplies for up to 6 months, to limit the potential for disruption to supplies of ART and other essential medicines, and promoting community dispensing points. The guidance also noted that, as soon as movement restrictions are relaxed, catch-up campaigns should be considered to improve the coverage of testing, prevention and treatment interventions.

Ensuring access to social protection and confronting discrimination

Owing to the COVID-19 pandemic, government at both national and state levels has begun to roll out a number of social benefits and protections that include food, shelter homes, and financial benefits for individuals and families. Ashodaya leaders created several WhatsApp groups through which they disseminated information on various social benefits and how and where they could be accessed. Community leaders ensured that the information reached many hard-to-reach members through their networks and by word of mouth. This was followed by regular check-in calls to further support access. Local philanthropists were mobilized to provide groceries, sanitizer and masks to the members who remained unreached by the government.

The emergence of the COVID-19 pandemic generated numerous myths and propagated harmful misinformation, giving rise to new forms of stigma and discrimination. Furthermore, there were growing reports of domestic violence faced by sex workers in Mysore. Ashodaya aimed to raise awareness, dispel myths and mitigate violence by posting advisory messages in WhatsApp groups and through regular (and discreet) phone check-ins to follow up on the well-being of members. Counselling services provided as part of HIV services have now been redesigned to meet the growing demand for COVID-19-related psychosocial support.

The way forward

In the period between the beginning of the COVID-19 pandemic and May 2020, Ashodaya was able to provide ART to 1065 people, provide nutritional supplements to 270 people and ensure access to social protection for approximately 3800 sex workers, and it was in regular contact with over 5500 sex workers through calls and individual meetings. Unfortunately, the COVID-19 pandemic continued to progress, as did the challenges faced by the community. Ashodaya continued to find ways to assist its members in the face of tremendous financial losses. In addition, Ashodaya initiated tele-support services to members through its network of allied health-care providers, many of whom had partnered with the organization over the years. Importantly, this tele-support included counselling services intended for those experiencing emerging psychological issues, violence or stigma and discrimination. Ashodaya was also exploring ways of delivering nutritional support alongside ART, organizing ambulance services to
respond to emergencies and providing medical support as required by its members.

Ashodaya also planned to reactivate its crisis response system, which used to respond to adverse situations (e.g., violence, incidents of stigma and discrimination, etc.) faced by the community members and created by various perpetrators such as the police, local goons, neighbours, shopkeepers, clients, etc. This system had been disbanded because of a lack of funding from the State AIDS Control Programme.

Ashodaya has drawn on its vast experience in community mobilization and outreach to swiftly respond to emerging issues and challenges resulting from the COVID-19 pandemic, helping to ensure continued access to treatment, social entitlements, psychosocial counselling, and accurate and up-to-date information. Ashodaya's community-led response, while initiated to address imminent and emerging community needs, has been in line with WHO guidance on action related to COVID-19, contextualized for its community and setting. Over the past decade, Ashodaya has been actively working to create an enabling environment for its community. It has established strong relationships with various district departments, including the Department of Women and Child Development; the district legal services authority; the police; local politicians (e.g., members of the legislative assembly); and journalists working in print and electronic media. Ashodaya’s strategic advocacy with different constituencies has significantly contributed to its success in HIV prevention.

These emergency responses provide us with important lessons on how to restructure HIV programmes for key populations during the time of a pandemic. Moreover, these lessons present an important opportunity to consider more sustainable approaches to the health of marginalized populations that can enable community organizations to be better prepared to respond to future pandemics and other public health crises as they emerge.

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References


Perspective

Migration health research and policy in south and south-east Asia: mapping the gaps and advancing a collaborative agenda

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Abstract

Migrant health has been the subject of various international agreements in recent years. In parallel, there has been a growth in academic research in this area. However, this increase in focus at international level has not necessarily strengthened the capacity to drive evidence-informed national policy and action in many low- and middle-income countries. The Migration Health South Asia (MiHSA) network aims to challenge some of the barriers to progress in the region. Examples include the bias towards institutions in high-income countries for research funding and agenda-setting and the overall lack of policy-focused research in the region. MiHSA will engage researchers, funders and policy-makers in collectively identifying the most pressing, yet feasible, research questions that could help strengthen migrant and refugee health relevant to the region’s national contexts. In addition, policies and provisions for different migrant populations in the region will be reviewed from the health and rights perspectives, to identify opportunities to strategically align research agendas with the questions being asked by policy-makers. The convergence of migration policy with other areas such as health and labour at global level has created a growing imperative for policy-makers in the region to engage in cross-sector dialogue to align priorities and coordinate responses. Such responses must go beyond narrow public health interventions and embrace rights-based approaches to address the complex patterns of migration in the region, as well as migrants’ precarity, vulnerabilities and agency.

Keywords: health policy, migration, research priorities, south Asia, south-east Asia

Background

Migration is a global phenomenon. Alongside the significant benefits migration offers to individuals, societies, states and economies, it also presents critical public policy, humanitarian and human rights challenges. The health and well-being of migrants and refugees is a public policy issue and an emergent field of scholarship and advocacy. Migrant health has been the subject of various international consultations and agreements in recent years, such as the Global compact for safe, orderly and regular migration1 and the Global compact on refugees in 2018.2 In parallel, there has been a growth in academic research on the health aspects of migration. Despite this increase in focus at international level, the capacity and opportunities to drive evidence-informed national policy and action on migration and health remain limited in many low- and middle-income countries.3 Clearly, migrant health will need to be more firmly embedded in national agendas if the overarching aims of global initiatives are to be realized, not least the call of the 2030 Agenda for Sustainable Development to “leave no one behind”.4,5

The need to bring together the migration and health research and policy communities was the catalyst for the establishment of the Migration Health South Asia (MiHSA) network in 2019.6 MiHSA evolved during a series of consultations, seminars and policy dialogues held during 2018–2019 in Bangladesh, India, Malaysia and Nepal. These consultations brought together local, regional and international institutions to reflect on the current gaps in knowledge on migration and health in south and south-east Asia and to explore pathways for building communities of knowledge and practice. The objectives were twofold: first, to engage academic scholars, nongovernmental
organizations and advocacy groups to collectively assess the evidence base and identify the main gaps in knowledge; second, to engage key policy stakeholders to assess the utility of current research outputs and identify their key evidence requirements for improved policy-making.

In this paper, we synthesize key lessons learnt to date and identify core values and priorities to advance a collaborative agenda that can shape future research and practice to improve migration, health and rights in south and south-east Asia.

What do we know – and what are the gaps?

Quantifying the bias in what is researched, and by whom

The production and use of knowledge or evidence on migration is entrenched in gross global inequities. Research funding, agenda-setting and practice disproportionately favour institutions in high-income countries. A bibliometric analysis of global migration health research papers published during 2000–2016 in the peer-reviewed literature revealed that the vast majority of articles on migration were authored by research institutions in high-income migrant destination countries. This analysis by Sweileh et al. also showed that the research output on migrant health from Asia was relatively low, despite the region having “the most dense international migration corridors and the largest numbers of international migrants whose country of origin is in Asia”. In addition, analyses limited to the formal research literature largely fail to capture the insights of the civil society organizations that work closely with migrants and displaced populations. These groups have limited access to funding and tend to publish their findings in less formal outlets, such as reports and briefs, that may not be captured by systematic reviews and bibliometric analysis.

As noted in the International Organization for Migration’s 2020 annual report, more sustained effort is needed to support research institutions and researchers in low- and middle-income settings, including by confronting some structural impediments to gaining funding and building capacity. Part of MiHSA’s role will be to examine the power inequalities in international knowledge networks and aim to rebalance them by creating and sharing new opportunities through collaborative research, writing and joint webinars for more knowledge generation and leadership situated in south and south-east Asia.

Addressing the lack of prioritization in the region

Migration health continues to be a relatively underexplored topic within south and south-east Asia, with limited attention given to the health and social care needs of migrants, who are a highly transient, diverse and heterogeneous population group, or to the peculiarities of the geopolitical context of the region. For example, the health of internal migrants in the region is poorly understood, despite their high numbers. The Global report on internal displacement 2020 estimated that south Asia experienced 30% of the world’s internal displacement in 2019, mostly triggered by population exposure to disasters including floods and droughts, as well as to unresolved conflicts and violence. There were 5 million new disaster displacements in India alone in 2019, the highest number in any country in the world, resulting from factors such as increasing hazard intensity, high population exposure to floods, cyclones and violence, and high levels of social and economic vulnerability.

An unpublished subset analysis of the global dataset produced by Sweileh et al. by one of the authors (KW) found that migration health research for south and south-east Asia was disproportionately focused on infectious diseases and mental health (by health theme) and on undocumented migrants and refugees (by migrant category). MiHSA is supporting researchers in the region to build on this work using robust bibliometric analysis to more fully understand the gaps in published and unpublished research. In addition, the broader context of migration and the conditions in which migrants work and live shape their health and well-being. Yet insufficient attention has been given to studying the role of structural inequalities in determining low-income migrants’ poor access to health care and vulnerability to ill health.

Analysis of vulnerability and agency across different stages of people’s mobility and settlement is critical to inform inclusive and effective policies and institutional responses. Research in south and south-east Asia therefore needs to capture not only the factors that place migrants at risk but also those that facilitate thriving and resilience. Such a focus is core to MiHSA’s capacity-building workshops in the region, which provide early-career scholars with the necessary conceptual and methodological skills and insights to undertake research in this field, and which emphasize the intersections of gender and other social inequalities in such research.

Unlocking the capacity to identify feasible, impactful research

Migration health research globally is characterized by glaring methodological and data gaps, and thus this is also the case for south and south-east Asia. There continues to be a lack of disaggregated baseline information on migrants based on factors such as their gender, livelihood, religion and ethnicity. The omission is particularly striking for internal migrants, as these factors determine different needs of different migrant populations across socioeconomic contexts. This dearth of information hampers effective policy development and may even undermine the impact of any actions taken. With respect to design, research in this area is dominated by cross-sectional studies, which cannot take account of the temporal and spatial dimensions of mobility and the circularity of migration that is characteristic of the south and south-east Asian context. With respect to focus, there is a need for more operational research on neglected topics including remittances and their utilization for nutrition and food security, and portability of social protection, health and welfare schemes.

MiHSA recognizes the need for (i) country-level mapping of existing sources of data such as the national Demographic and Health Surveys and sources compiled by non-government initiatives, (ii) identifying gaps in evidence and (iii) more targeted commissioning of research in key priority areas. In parallel, building the capacities of local research institutions to advance more in-depth research on experiences and outcomes is essential. This exercise is currently under way, and involves identifying and defining research priorities using the Child Health and Nutrition Research Initiative approach to research priority setting. This brings together funders, researchers and policy-makers in deciding the most pressing yet feasible research questions that could help strengthen...
migrant and refugee health in national contexts in south and south-east Asia.

Engaging in researcher–policy-maker collaboration from the outset

A stark disconnect exists between the production of knowledge by researchers and its use by policy-makers. On the one hand, the rich information and analysis produced by researchers may not be synthesized in a way that is accessible to policy-makers. Researchers often tend to see policy-makers as a community to engage with after findings are generated and published, rather than as potential collaborators. On the other hand, meaningful engagement and consultation with migration scholars, advocates and practitioners, as well as migrants themselves, is often lacking in the development and implementation of national and subnational policies. Whatever the reasons, the lack of perspective on migrant health in national task forces and policy work results in important omissions. For example, a review of the pandemic influenza preparedness plans in place in 21 countries of the Asia Pacific region in 2016 found that only three countries – Maldives, Papua New Guinea and Thailand – identified at least one migrant group in their national plan.14

Tackling the knowledge–policy gap prompted intersectoral working being adopted as a core principle in the work and mandate of the MiHSA network, with an emphasis on prioritizing engaging with policy actors at every stage. Rather than taking an instrumental role in linking research and policy, MiHSA seeks to enable researchers, policy-makers and other stakeholders to collaborate on defining the analyses needed to design effective responses. This approach requires researchers to be alert to political and policy opportunities that might arise and to respond with evidence on critical issues. To address health issues and determinants stemming from various migration flows, a whole-of-government approach was adopted by Sri Lanka to advance the National Migration Health Policy and an interministerial action plan.15 This was guided in large part by the evidence generated through a national research agenda commissioned by the Ministry of Health with technical cooperation from the International Organization for Migration. Health risks and their consequences were identified through rigorous research, and policy was then developed based on the evidence generated. The collaborative approach used by Sri Lanka offers important insights into how health policy-makers, local researchers and civil society can meaningfully work together in driving a research agenda that leads to national policy-making and priority-setting on migration and health.16

Addressing the broader structural impediments to progress

Despite migration being a major issue for many south and south-east Asian countries, migrants are not prioritized in policies and resource allocation. Benefits could accrue from greater cooperation among countries, and states within countries, from improvements in bilateral relations on mobility and from political commitment to universalize health and social care and allow its portability. At global level, the two disciplines of health governance and migration are beginning to converge. However, at national level, policies continue to be developed in silos such as immigration, humanitarian aid, security, labour and public health, which can have distinct and often conflicting goals.16 A central challenge in developing an integrated agenda for migration and health is that the driver for examining this interface is not migrants’ health needs; rather, it is preservation of population health by containing disease outbreaks that are often associated with migrant populations. Such a focus counters any attempts to redress violations in relation to the health and well-being of migrants that are evident in current health policy initiatives.

Despite these challenges, there are certain enablers and emerging local initiatives that could inform integrated national- and regional-level action, such as initiatives to support tribal migrants in certain states in India17 and, more recently, targeting of social protection measures at migrants in the wake of coronavirus disease 2019.

An important planned initiative is for MiHSA to map policies and provisions for different migrant populations in south and south-east Asia and to review them from health and rights perspectives. This analysis should help to identify opportunities to strategically align research agendas with the questions being asked by policy-makers, as well as the intersections at which action to advance an integrated agenda can take place.

Conclusion

The convergence of migration policy with other areas such as health and labour at global level has created a growing imperative for policy-makers in south and south-east Asia to engage in cross-sector dialogue to align priorities and coordinate responses to migration. Such responses must go beyond narrow public health interventions and embrace rights-based approaches to address the complexities of circular migration in the region, as well as migrants’ precariousness, vulnerabilities and agency. At the heart of this ambitious agenda must lie a vibrant research community of scholars and practitioners who are equipped with appropriate skills and opportunities to engage with diverse communities and voices. Just as policy-makers need to work across sectors, researchers need to bridge the gulf between the two ecosystems of migration research and health policy and systems research.17 Through developing and supporting these synergies, MiHSA aims to support a transformative agenda for improving migrants’ health and lives.

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**References**

Evaluation of the Indonesian Early Warning Alert and Response System (EWARS) in West Papua, Indonesia

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Abstract

Background The Early Warning and Response System (EWARS) is Indonesia’s national syndromic and early warning surveillance system for the rapid detection of infectious diseases and outbreaks. We evaluated EWARS in the remote West Papua province of Indonesia.

Methods Structured telephone interviews were conducted with 11 key informants from West Papuan health services. EWARS data were analysed for usefulness of reporting.

Results Most respondents reported that EWARS is important and useful in improving early detection of outbreaks. The system has led to increased disease control coordination among health jurisdictional levels in the province. However, respondents noted that the limited number of districts involved in the system affected representativeness, and some stated that only about 30–35% of districts in each regency were involved and trained in EWARS reporting, partly owing to lack of a mobile telephone network. Barriers to complete reporting and response to alerts included limited human and funding resources for surveillance, lack of epidemiological training, and technical limitations imposed by limited internet and mobile communication infrastructure in this remote region.

Conclusion Great progress has been made in integrating West Papua into a nationally consistent disease and outbreak detection system. Strategies for addressing barriers resulting from remoteness, constrained human, funding and laboratory resources, lack of training, and limited internet and communications infrastructure are needed if EWARS in West Papua is to advance.

Keywords: emerging diseases, Indonesia, outbreaks, remote settings, surveillance, West Papua

Background

Disease surveillance is a core capacity under the International Health Regulations, 2005 (IHR), and for strategies to improve early detection of outbreaks that have been developed in various countries.¹ Increasing automation of disease reports in low-resource settings can reduce the workload of health workers and increase surveillance sensitivity.²,³ However, implementation of automated surveillance must be accompanied by an evaluation to assess whether or not the system achieves its objectives.⁴

In 2009, to improve infectious disease control and to comply with the IHR, Indonesia developed a national Early Warning Alert and Response System (EWARS).⁵ In 2015, the EWARS website, an automated data capture system, was developed in the capital, Jakarta, to provide the infrastructure for more rapid detection of outbreaks.⁶ The system uses short messaging service (SMS) text messaging for source data transmission by surveillance officers in district public health centres (puskesmas, short for Pusat Kesehatan Masyarakat in Indonesian). An internet-based wide area network is used to distribute the processed surveillance statistics and resulting reports to regional health jurisdictions for review and possible action. The aim is to detect cases of certain serious infectious diseases or unusual disease patterns signalling possible outbreaks of common or rare infectious diseases.⁷,⁸

West Papua (Papua Barat in Indonesian) is one of the least developed provinces of Indonesia. It includes 13 administrative subregions (12 regencies and one city). The total area of West Papua is approximately 100,000 km², and in 2017 it had a total population of 915,361; its Human Development Index score is the second lowest among those of the 34 Indonesian provinces.⁹ With regard to health, the number of infectious diseases, such as malaria and diarrhoeal diseases, has decreased over time but is still higher than those of other provinces. For instance, in 2015 West Papua’s number of positive malaria cases per 1000 population was 31.3, the second highest rate in Indonesia after that of Papua province.¹⁰
It is essential to evaluate the implementation of EWARS in low-resource settings with high rates of infectious diseases. This study used well-established guidelines to evaluate the operation of EWARS in Indonesia’s West Papua province.

Methods

Study design
The Updated guidelines for evaluating public health surveillance systems published by the Centers for Disease Control and Prevention (CDC) were applied. Qualitative data on the operation of the system were collected during September 2018 using semi-structured interviews with key informants involved in the operation of EWARS at various levels of the provincial health governance structure. The questionnaire, developed using the CDC guidelines in English and Bahasa Indonesia, is available from the corresponding author. The questionnaire was piloted in another province and revised as a result.

Count data relating to the diseases and syndromes monitored by EWARS from week 42 (week commencing 12 October) 2015 to week 52 of 2017 were extracted from the EWARS database. The EWARS database includes only aggregated weekly counts of diseases reported by health centres, which can be retrieved using the EWARS website provided by the Indonesian Ministry of Health.

In 2018, there were 159 puskesmas in West Papua province, and most were registered in EWARS. Participants were identified based on the human resource database for EWARS. There are no guidelines on the number of surveillance officers per puskesmas. Since infectious disease surveillance is a health programme operating through puskesmas and the District Health Office, there should be at least one person dedicated to running the programme at each site.

Purposive sampling was used to select participants in the interview. We chose sites to give a selection of urban, rural and remote settings. Prior to the interview, the respondents were asked how long they had been working as a person with EWARS responsibility. If the duration was more than 1 year, they were included in the study. Fourteen key informants and stakeholders responsible for the EWARS programme in West Papua were selected for interview, consisting of eight managers and EWARS officers in health departments at provincial and regency government levels and six EWARS data providers in puskesmas at local government level.

Interviews lasted between 30 and 60 minutes and were carried out in Bahasa Indonesia by telephone from Sydney, Australia. Verbal consent for participation and audio recording was obtained from each informant before the interview.

Following the CDC guidelines, interview recordings and written notes were thematically analysed and the themes were reviewed by the research team. Aggregate surveillance count data from EWARS for West Papua from 2015 to 2017 were used to assess the usefulness of reporting.

Ethics
The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 2000. The study was approved by the University of New South Wales Human Research Ethics Committee (HC180628). Permission to conduct the research was obtained from the Health Department of West Papua Province, and Indonesian ethical exemption was granted by the Indonesian Ministry of Health (LB.02.01/2/KE.297/2018).

Results

System objective and description
The aims and operation of EWARS in West Papua are the same as in all the Indonesian provinces; the objective is to reduce the size and impact of outbreaks through earlier detection.

The reporting structure is outlined in Fig. 1. Surveillance data collection begins in subdistrict health centres (pustu). Aggregate counts of diseases and disease syndromes are collected by health workers (nurses, midwives, etc.) and forwarded to the surveillance officer at the puskesmas by SMS, phone or hand delivery. These data from the pustu are then aggregated by the puskesmas surveillance officer with data from the district puskesmas and sent as one SMS to the national Ministry of Health’s application programming interface (API) in the central EWARS computer system. The API transfers the data to the central EWARS database, where they are automatically aggregated, analysed and reported on the central EWARS website.

The SMS message constructed by the surveillance officer is assembled as follows: epidemiological week, disease code 1 and number of cases, disease code 2 and number of cases, and so on, plus the total number of patients visiting the site in 1 week along with the code for the site. The disease codes are single alphabetical characters unique to the system.

Each week, surveillance officers at the regency/city and provincial levels review the data reported on the national EWARS website for their jurisdiction. They verify alerts and coordinate with surveillance officers at the puskesmas level. If necessary, they initiate a response, including outbreak investigation and control measures. This may include collecting specimens from cases. The specimens are sent to the national diagnostic laboratory. Based on the results, regency/city and provincial officials determine whether or not an outbreak or other response is required. Laboratory confirmation for some diseases, such as malaria, can be carried out by a local laboratory at the puskesmas level.

Each disease under surveillance has an alert threshold, with criteria varying by disease or syndrome category. The threshold values consist of criteria such as “increase in cases” (meaning the number of cases has doubled or more than doubled compared with the previous period); that particular criterion is used for categories including diarrhea, malaria, suspected cases of dengue fever, bloody diarrhea, influenza-like illness and pneumonia. For categories with very low probability per unit of time, such as suspected typhoid or chikungunya, a Poisson distribution-based threshold is applied. The category “cluster of unknown disease” uses a “three cases” threshold criterion. Suspected cases of measles, diphtheria or pertussis have a “one case” criterion for reaching the alert threshold.

Interview results
Six of the eight selected provincial and regency key informants and five of the six in puskesmas were interviewed; there were 11 respondents in total from the 14 invited to participate. The
remaining selected informants were unable to be contacted for interview. City-level informants could not be contacted. Five respondents had a bachelor’s degree in health and six had health diploma qualifications. Respondents included managers of the surveillance programmes and EWARS officers at provincial and regency health offices, and designated EWARS surveillance officers in puskesmas.

**Personnel and infrastructure to operate EWARS**

At the puskesmas level, two of five respondents reported that there were two surveillance officers in their workplace, while the rest reported one surveillance officer. Four had attended EWARS training. At the regency and provincial levels, all respondents reported being the only surveillance officer in their workplace and all had attended EWARS training. All respondents had multiple work roles, including their EWARS responsibilities, and four of 11 noted difficulties in managing competing priorities.

Nine of 11 respondents were aware of, and had a copy of, the EWARS guidebook. Seven had access to the forms needed to conduct an outbreak investigation. At the regency and provincial levels, two of six stated that they did not have access to Wi-Fi or internet services, while the remaining four reported that, although they did have Wi-Fi in their workplace, it was not always reliable. They considered this and limited mobile network connectivity to be the biggest challenges they faced. Two respondents mentioned having a workplace computer for EWARS, while the remaining four used their own private laptop computers.

**Funding resources**

At the puskesmas level, the majority of respondents reported that, apart from their salary, funding for EWARS operations was limited. One respondent mentioned having funds for increasing community knowledge about diseases such as diarrhoea and one reported having a budget for outbreak investigations, while the rest of the participants mentioned not having funds to support the EWARS programme. In the cases of puskesmas officers who had access to EWARS funds, those funds were provided by a national government funding programme. At the
regency and provincial levels, only two respondents reported the availability of funding for EWARS and surveillance activities, and they stated that those funds were insufficient for capacity-building and outbreak investigations. At the regency level, the source of funds is the regional government funding programme, and at the provincial level funding comes from both national and regional programmes.

Most respondents at all levels reported that funding was essential for implementing the system. Limited funds for investigating outbreaks, examining specimens and travelling to remote areas cause difficulties in verifying all alerts produced by the system.

**System attributes**

**Simplicity**

All puskesmas respondents considered the system easy to use because reports were sent using SMS. They also thought that the EWARS SMS reporting format was easy to understand, especially after attending EWARS training. Automatic feedback from the central server when the data report was successfully sent was an advantage of the system. All regency and provincial respondents reported that the system was simple to implement. They considered it an advantage that analysis and monitoring of EWARS reports could be done through the EWARS website.

**Acceptability**

All respondents considered that the system was important for early detection of infectious disease outbreaks. One puskesmas officer stated, “I think this system is important and very good because if there is a dangerous disease in the village, by sending an SMS, the government will immediately know [translated from Indonesian].” The respondents believed that the system was suitable for areas with a functioning mobile telephone network, because of its ease of use and simplicity.

**Stability**

The majority of respondents reported never having experienced an EWARS outage lasting more than 1 day or 1 week. Some puskesmas respondents had experienced limited availability of mobile telephone networks for sending SMS messages, especially in rural areas. There were delays in weekly reporting from some pustu to puskesmas. EWARS officers who change their cell phone number must re-register it in EWARS and this does not always occur, leading to delays in SMS data reports. Regency and provincial respondents reported that the central EWARS system was quite stable in providing surveillance information. However, unstable internet and Wi-Fi services affected their ability to review surveillance information.

**Representativeness**

Regency and provincial respondents reported that the limited number of puskesmas involved in the system affected representativeness, and some stated that only about 30–35% of puskesmas in each regency were involved and trained in EWARS reporting, partly owing to lack of a mobile telephone network. At the puskesmas level, the proportion of participating pustu varied. Some reported that it was difficult to obtain data from pustu in remote villages. The solution adopted by puskesmas officers was to empower community members informally trained by health workers (kader) to support community health programmes in distant villages to send surveillance reports or text messages to the puskesmas. Alternatively, puskesmas officers collect data directly during field visits, when operating mobile health centres (pusling) and when implementing other programme activities such as malaria control programmes and immunization programmes.

**Timeliness**

All puskesmas respondents noted that the delivery of each report usually occurs every Monday or Tuesday for the previous week’s reporting period but that some delays occur owing to competing work priorities, mobile network instability and changes to EWARS officers’ mobile phone numbers. Around half of all respondents reported that EWARS, and not rumour, often provided the first indication of an outbreak. Outbreaks not detected by EWARS occurred in areas not participating in EWARS or were reported by hospitals or private doctors.

**Data quality**

All puskesmas respondents reported that they understood the EWARS case definitions and all were able to give correct examples of cases meeting the definitions. Some case definitions caused confusion, such as influenza-like illness, suspected human avian influenza, cluster of unknown disease and suspected chikungunya. This was partly as a result of limited knowledge of these diseases and situations. Moreover, not all diagnoses are made by doctors at the puskesmas. In at least one puskesmas, diagnoses are made by nurses, and there are concerns about accuracy. Errors in SMS reports can cause false alerts. A solution implemented by puskesmas officers was, during field visits, to promote to pustu officers the importance of sending accurate data and reports.

At the regency level, efforts to improve data quality included providing regular feedback to puskesmas and providing monthly reports back to puskesmas and pustu. Provincial officers provide capacity-building training to district officials and technical guidance to puskesmas officers, if funds for these activities are available from annual national or regional programmes. In addition, reviews of and feedback on the quality of EWARS data are also carried out regularly.

**Usefulness**

Based on aggregate data obtained from the EWARS website, there was an increase in alert responses during 2015–2017 (see Fig. 2). Respondents perceived that the system’s usefulness reflected the EWARS objectives, namely early detection of outbreaks of infectious diseases, minimizing mortality and health risks due to outbreaks, monitoring infectious disease trends and assessing the impact of disease control programmes. One puskesmas official stated, “With the reporting of this system, we can know the increasing or decreasing trend of certain diseases in our region so that we can detect outbreaks quickly [translated from Indonesian].” Some puskesmas officers reported that not all objectives were being met.

Most regency and provincial officers stated that EWARS was very useful because of its ability to produce alerts and stimulate prevention and control measures. Some respondents at all levels reported that usefulness was hampered by operational difficulties such as poor mobile networks and inability to include all pustu because of remoteness.
Respondents thought usefulness could be enhanced through advocacy for improving mobile network infrastructure in remote areas, increased stewardship from all administrative levels, and increased funding support for capacity-building, laboratory diagnostics and outbreak investigations. They also suggested that there was a need for improved integration with other surveillance and disease control programmes. Single-sideband modulation radio for data communication from remote pustu was also proposed. Two regencies had established a rapid response team (Tim Gerak Cepat in Indonesian) for early response to outbreaks.

Respondents reported difficulty in confirming infections or outbreaks because local laboratories are only able to carry out limited diagnostics. While there is an absolute threshold (“one case”) set for conditions such as measles, diphtheria and acute flaccid paralysis (for poliomyelitis), an inability to diagnose these conditions locally prevents confirmation of infections or outbreaks. Confirmatory diagnostics for many conditions can be provided only by the national reference laboratory.

Sensitivity
Sensitivity was hampered by incomplete population coverage because of a lack of mobile network infrastructure in some areas. For example, regency and provincial officers found two outbreaks of dengue fever during 2017–2018 not detected by EWARS. These were detected in puskesmas with mobile network difficulties and from hospital reports. Sensitivity is also influenced by the threshold level used nationally for some diseases, which may not be appropriate in some locations. For instance, as malaria is a frequently reported endemic disease, EWARS officers reported difficulty in determining the number of malaria cases that would indicate an outbreak. As a result, the proportion of malaria alerts that indicate actual outbreaks is difficult to determine.

Positive predictive value
Although we do not have data regarding this attribute, respondents estimated that less than 50–70% of alerts signalled actual outbreaks. Regency and provincial respondents stated that there was difficulty in determining positive predictive value because some disease cases or outbreaks are not confirmed or laboratory diagnostic results are sometimes delayed.

Discussion
The results of this evaluation indicate that, compared with previous paper-based approaches used in West Papua, EWARS is simple to implement and operate at the provincial level. The method for weekly reporting of disease data via SMS by health workers at puskesmas is a practical and rapid means of reporting diseases based on EWARS case definitions. The majority of respondents reported that this system was important and useful in improving early detection of outbreaks. The system has led to increased disease control coordination among health jurisdictional levels in the province.

Factors such as limited human and funding resources for surveillance, lack of epidemiological training, and technical limitations imposed by limited internet and mobile communication infrastructure in this remote region present barriers to complete reporting and responding to alerts. These obstacles illustrate the difficulty of detecting outbreaks in areas with the greatest need for syndromic surveillance. A possible solution is very low-frequency radio or single-sideband modulation radio.
Integration of reporting into active hospital surveillance and the development of hospital-based EWARS data will be crucial to increasing the usefulness of EWARS. EWARS could be supplemented with systematic event-based surveillance and community-based surveillance to improve its usefulness.18,17

We identified the need, as in other settings,18,19 for laboratory capacity-strengthening to support confirmation of infectious disease outbreaks. Epidemiological training of surveillance officers is also needed. A provincial laboratory supported by trained laboratory personnel, with adequate facilities, tools and materials, could improve the overall performance and the speed of diagnosis.20

A limitation of this study was that respondents from the only city jurisdiction in West Papua were unable to be contacted for interview, thus limiting our findings to the more rural settings in the province. In addition, given the restrictions of limited numbers of key informants and interviews done by telephone from Australia, other aspects of EWARS – such as policy and governance matters, infrastructural issues, the roles and responsibilities of each administrative level of the surveillance system, and monitoring and supervisory functions of EWARS – could not be systematically assessed by this study.

Conclusion
Great progress has been made in integrating West Papua into a nationally consistent disease and outbreak detection system. Strategies for addressing barriers of remoteness, constrained human, funding and laboratory resources, lack of training, and limited internet and communications infrastructure are needed to further strengthen West Papua’s capacity to rapidly respond to and control infectious disease outbreaks as part of Indonesia’s IHR commitments.

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Knowledge, attitudes and preparedness to respond to COVID-19 among the border population of northern Thailand in the early period of the pandemic: a cross-sectional study

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Abstract

Background Chiang Rai province in northern Thailand is a site of many people travelling among nearby countries and areas, including Yunnan province, China. In February 2020, there was concern about the population’s vulnerability to coronavirus disease 2019 (COVID-19).

Methods A cross-sectional study was conducted in 15 villages less than 10 km from a border. A questionnaire was developed and tested for reliability and validity; 48 questions covered participant characteristics, plus knowledge about, attitudes to and preparedness for COVID-19. Chi-squared tests were used to detect any significant association between variables. Unadjusted and adjusted odds ratios with 95% confidence intervals (CIs) were calculated to assess the possible association of various factors with participants’ level of reported knowledge, attitudes and preparedness.

Results A total of 520 participants were recruited of whom 320 (61.5%) were women. The age range was 18–90 years; the average age was 45.2 years. Variables with an association with good to moderate preparedness for COVID-19 prevention and control that remained after adjustment were: women were better prepared than men (adjusted odds ratio (ORadj) = 2.52; 95% CI = 1.36–4.68); those aged 18–30 years (ORadj = 4.26; 95% CI = 1.18–15.30), 31–45 years (ORadj = 4.60; 95% CI = 1.59–13.32) or 46–60 years (ORadj = 2.69; 95% CI = 1.16–6.26) were better prepared than those aged 60–90 years; and, compared with those with no formal education, those educated to primary school level (ORadj = 2.43; 95% CI = 1.09–5.43) or to university level (ORadj = 3.18; 95% CI = 1.06–9.51) were better prepared.

Conclusion Effective communication of essential, accurate and up-to-date information regarding COVID-19 prevention and control is essential in this population – especially for men, older age groups and those lacking formal education.

Keywords: COVID-19, emergency response, South-East Asia, Thailand

Background

On 31 December 2019, the World Health Organization (WHO) Country Office for China picked up a media statement by the Wuhan Municipal Health Commission from its website on cases of "viral pneumonia” in Wuhan, China.1 On 11 February, WHO announced that the disease, caused by a novel coronavirus, would be named coronavirus disease 2019 (COVID-19). On 13 January, the first recorded laboratory-confirmed case outside China was confirmed in Thailand. By 20 January, there were 7818 confirmed cases of COVID-19, the majority of which were in China. On 14 February, the WHO Country Office for Thailand reported that there were 34 confirmed cases of COVID-19 in Thailand.2 A global pandemic was declared on 11 March.1

Chiang Rai province is located in northernmost Thailand and has land borders with the Lao People’s Democratic Republic and Myanmar; there is also a sea route from China’s Yunnan province to Chiang Saen port. Many people move across the borders among these countries every day, using both temporary
and permanent border crossings and six temporary ones between Thailand and the Lao People’s Democratic Republic, and more than 1 million people cross the border each year. There are four permanent crossings and five temporary ones on the long border (2400 km) between Thailand and Myanmar, with more than 2 million people per year crossing the border. By late January, all people crossing all permanent border crossings were being screened for COVID-19 by trained public health officers using body temperature monitoring; however, no screening was being done at temporary border crossings. The one official sea route between Thailand and China at Chiang Saen port is used for trade and for tourism along the Mae Khong River from China to Thailand, screening by public health officers was being done at the port. There are also a number of unofficial border crossings, which were not being monitored.

With the outbreak of COVID-19, many people living in this area were in a state of panic. Moreover, most people living in the area have low socioeconomic status and have a low level of education. Some are from minority groups that have migrated from China to Thailand over centuries, such as the hill tribe people, who account for 30% of the population of Chiang Rai province. Therefore, in February 2020, there was an urgent need to examine their understanding of this new disease. This cross-sectional study was undertaken to gain a better understanding of the knowledge, attitudes and preparedness to respond of this population in relation to the outbreak of COVID-19, in order to support policy development and public health implementation.

Methods

A cross-sectional study was performed to collect information from participants living in the border areas in Chiang Rai province, northern Thailand, specifically on the borders of Thailand, Myanmar and the Lao People’s Democratic Republic, close to southern China. Those who were not willing to participate in the study or could not provide the answers to the questionnaire were excluded.

We calculated the sample size required to estimate prevalence with a specified level of confidence and precision. The outcomes sought were estimates of the levels of knowledge, attitudes and preparedness to respond to COVID-19. The prevalence of knowledge, attitudes and preparedness of the population for COVID-19 patients was estimated as 0.91% from a previous study in a Chinese population. We aimed for a precision of 2.5% in the prevalence estimate (i.e. a 95% confidence interval (CI)) for an infinite sample, resulting in a sample size of 503. The sample size was calculated using the formula \( N = \frac{Z^2 \cdot P \cdot (1 - P)}{e^2} \), where \( Z \) = value from standard normal distribution corresponding to desired confidence level \( (Z = 1.96 for 95\% CI) \), \( P \) = expected true proportion, and \( e \) = desired precision (half desired CI width).

A questionnaire was developed and tested for reliability and validity. The item–objective congruence (IOC) technique was used to evaluate validity. The IOC index ranges from −1 to 1, i.e. congruent (+1), questionable (0) and incongruent (−1). Three external experts in the field (one epidemiologist, one medical doctor and one public health practitioner) scored and commented on each item. Items with an average score from the committee of less than 0.5 were excluded from the questionnaire, while items with an average score of between 0.51 and 0.7 were revised according to the comments and included in the questionnaire. Items with scores greater than 0.7 were included in the questionnaire without revisions. The questionnaire was also piloted with 15 participants who had similar characteristics to the study participants in Mae Fah Laung District, Chiang Rai province, on 1 and 2 February 2020. This step was used to determine the feasibility of using the questionnaire for the study and to decide on the order of the questions.

The questionnaire in its final form consisted of five parts and 48 questions and is available from the corresponding author. Part 1 was made up of eight questions used to collect data on the general characteristics of participants, including sex, age, religion and marital status. Part 2 comprised 10 questions that were used to collect information on medical history and exposure to influenza (e.g. history of influenza diagnoses, history of family members being diagnosed with influenza).

The 10 questions in Part 3 examined knowledge about COVID-19, covering statements such as “COVID-19 is a close-contact communicable disease”. For this part, each participant was scored 0 for an incorrect answer and 1 for a correct answer. Those who received scores of 0–5 were classified as having poor knowledge, those with scores of 6–8 were classified as having moderate knowledge and those with scores of 9–10 were classified as having good knowledge.

Part 4 consisted of 10 questions regarding attitudes related to COVID-19 prevention, asking participants to respond to statements such as “Staying at home is a good way to prevent and control COVID-19”. Each question was rated on a 5-point scale reflecting attitudes ranging from “totally agree” to “totally disagree”. Responses to positive-attitude questions were scored on a scale ranging from 5 for “totally agree” to 0 for “totally disagree”. Responses to negative-attitude questions were scored on a scale ranging from 0 for “totally agree” to 5 for “totally disagree”. There were five negative-attitude questions and five positive-attitude questions, resulting in a maximum score of 50. People who scored less than 26 were classified as having a poor attitude to COVID-19 prevention, those who scored 26–40 were classified as having a moderate attitude and those who scored 41–50 were classified as having a good attitude.

The 10 questions in Part 5 assessed behaviours related to preparedness to respond to the occurrence of COVID-19 in the area, such as hand washing, mask use and avoiding crowded areas. Three response options were provided for each item: “always”, “sometimes” and “never” (resulting in a maximum score of 30). A score of less than 16 indicated a poor level of preparedness to respond to an outbreak of COVID-19, a score of 16–24 indicated a moderate level of preparedness and a score of 25–30 indicated a good level of preparedness.

Three villages were randomly selected from five districts: Chiang Saen, Wiang Ken, Chiang Khong, Mae Sai and Wiang Pa Pao. These five districts are located at the border of Thailand and the Lao People’s Democratic Republic and at the border of Thailand and Myanmar. All the selected villages are less than 10 km from a border. Moreover, they are close to, although not directly bordering, Yunnan province in southern China, which is a common place of transit for people moving among countries.
Access to the villages was granted by district officers. After that, village leaders were contacted and agreed to provide villagers with all the essential information and explain the significance of the study. People aged 18 years or older living in the selected villages were invited to participate in the study. Data were collected between 3 and 10 February 2020, by trained researchers. All participants were asked to respond to the questionnaire verbally, giving their answers to a researcher. For those who could not read Thai, the researcher read the questionnaire to them so that they could provide their answers. The questionnaire required 20 minutes for participants to complete.

Data analysis
Data from the questionnaires were coded and entered into an Excel spreadsheet to check for errors before they were transferred into SPSS (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp) for analysis. Data explorations were performed by running frequency checks and descriptive statistics. A chi-squared test and Fisher’s exact test (when the total per cell was less than 5) were used where appropriate to assess associations between any two independent parameters. Associations between participant characteristics and each of the defined outcomes of knowledge, attitudes and preparedness were evaluated using univariable and multivariable logistic regression. The statistical significance level was set at 5% (P value < 0.05).

Ethics approval and consent to participants
All study materials, including research protocols, were approved by the Chiang Rai Public Health Provincial Ethical Committee (No. CRPPHO 12-2563). All participants gave their informed consent before their data were collected.

Results
A total of 520 participants were recruited to the study and all completed the questionnaire; 320 (61.5%) were female and almost all were Buddhist (468, 90.0%). The age range was 18–90 years; the average age was 45.2 years (standard deviation = 16.5 years). The majority were married (379, 72.9%), were of Thai nationality (460, 88.5%), had completed primary school or high school (316, 60.8%) and had an annual family income of less than 50 000 baht (256, 49.2%). Among the participants, 193 (37.1%) had a chronic disease. Only nine people (1.7%) had received the influenza vaccine in 2017–2018; however, 186 people (35.8%) had been immunized in 2019. A few people had been diagnosed with influenza by a medical doctor in 2017–2018 (1.7%) or 2019 (1.9%). Only three people (0.6%) had been to Wuhan, China, and 69 (13.3%) had been in close contact with people who had been to Wuhan in late 2019 or early 2020 (see Table 1).

Regarding participants’ perception of the danger posed by COVID-19, the majority (351, 67.5%) considered it dangerous to seriously dangerous, while 140 people (26.9%) reported that they did not consider it dangerous. A total of 293 people (56.3%) reported feeling very worried to most worried about the situation, and 507 (97.5%) perceived that there was a moderate to high risk of contracting COVID-19. Half of the participants (245, 47.3%) agreed that it was a treatable disease, and 310 people (59.6%) perceived those who had travelled to China and those who had close contact with people who had been in Wuhan, China, as being highly vulnerable to COVID-19. Of the participants, 162 (31.2%) believed that a vaccine was available for COVID-19, and 295 people (56.7%) did not know the major signs of the infection. The majority (297, 57.1%) received information on COVID-19 primarily from television, and 404 people (77.7%) reported that the information they received was not sufficient for making decisions. A total of 144 people (27.7%) reported that they never wore a mask, and 285 people (54.8%) did not always use soap while washing their hands (see Table 1).

In the assessments of independent parameters, several variables were statistically significantly associated with knowledge, attitudes and preparedness (data not shown). Six variables were significantly associated with knowledge: marital status; education; occupation; annual income; close contact with people who had been in Wuhan, China, between November 2019 and January 2020; and main channel for receiving COVID-19 information.

Nine variables were significantly associated with attitudes: age; marital status; education; occupation; annual income; having a chronic disease; having a family member who had been diagnosed with influenza in 2019; close contact with people who had been in Wuhan, China, between November 2019 and January 2020; and main channel for receiving information on COVID-19.

Eight variables were significantly associated with preparedness: sex; age; education; occupation; annual income; having a family member who had been diagnosed with influenza in 2019; close contact with people who had been in Wuhan, China, between November 2019 and January 2020; and main channel for receiving COVID-19 information.

Results from logistic regression are shown in Tables 2–4. For these analyses, we combined the good and moderate groups. This was because (i) we assumed that even a moderate level of knowledge, a moderately good attitude and a moderate degree of preparedness might have an impact on COVID-19 prevention and control, and (ii) since this research was done early in the pandemic we assumed that few participants would receive a high score for any of the parameters. The results indicated that the variables with an association with good to moderate preparedness for COVID-19 prevention and control that remained after adjustment for other variables were as follows: women were better prepared than men (adjusted odds ratio (ORadj) = 2.52; 95% CI = 1.36–4.68); those aged 18–30 years (ORadj = 4.26; 95% CI = 1.18–15.30), 31–45 years (ORadj = 4.60; 95% CI = 1.59–13.32) or 46–60 years (ORadj = 2.69; 95% CI = 1.16–6.26) were better prepared than those aged 60–90 years; and, compared with those with no formal education, those educated to primary school level (ORadj = 2.43; 95% CI = 1.09–5.43) or to university level (ORadj = 3.18; 95% CI = 1.06–9.51) were better prepared (see Table 2). Analyses of factors associated with good to moderate knowledge and good to moderately good attitude are shown in Tables 3 and 4.
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>200 (38.5)</td>
</tr>
<tr>
<td>Female</td>
<td>320 (61.5)</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
</tr>
<tr>
<td>18–30</td>
<td>130 (25.0)</td>
</tr>
<tr>
<td>31–45</td>
<td>140 (26.9)</td>
</tr>
<tr>
<td>46–60</td>
<td>148 (28.5)</td>
</tr>
<tr>
<td>61–90</td>
<td>102 (19.6)</td>
</tr>
<tr>
<td>Religion</td>
<td></td>
</tr>
<tr>
<td>Buddhist</td>
<td>468 (90.0)</td>
</tr>
<tr>
<td>Christian</td>
<td>27 (5.2)</td>
</tr>
<tr>
<td>Other</td>
<td>25 (4.8)</td>
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<tr>
<td>Marital status</td>
<td></td>
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<tr>
<td>Single</td>
<td>128 (24.6)</td>
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<tr>
<td>Married</td>
<td>379 (72.9)</td>
</tr>
<tr>
<td>Ever married</td>
<td>13 (2.5)</td>
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<tr>
<td>Nationality</td>
<td></td>
</tr>
<tr>
<td>Thai</td>
<td>460 (88.5)</td>
</tr>
<tr>
<td>Burmese</td>
<td>11 (2.1)</td>
</tr>
<tr>
<td>Laos</td>
<td>48 (9.2)</td>
</tr>
<tr>
<td>Chinese</td>
<td>1 (0.2)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>66 (12.7)</td>
</tr>
<tr>
<td>Primary school</td>
<td>167 (32.1)</td>
</tr>
<tr>
<td>High school</td>
<td>149 (28.7)</td>
</tr>
<tr>
<td>University</td>
<td>138 (26.5)</td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>36 (6.9)</td>
</tr>
<tr>
<td>Agricultural worker</td>
<td>116 (22.3)</td>
</tr>
<tr>
<td>Trader</td>
<td>128 (24.6)</td>
</tr>
<tr>
<td>Government officer</td>
<td>37 (7.1)</td>
</tr>
<tr>
<td>Other</td>
<td>203 (39.0)</td>
</tr>
<tr>
<td>Annual income (baht)</td>
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<tr>
<td>No income</td>
<td>64 (12.3)</td>
</tr>
<tr>
<td>&lt;30 000</td>
<td>130 (25.0)</td>
</tr>
<tr>
<td>30 001–50 000</td>
<td>62 (11.9)</td>
</tr>
<tr>
<td>50 001–100 000</td>
<td>127 (24.4)</td>
</tr>
<tr>
<td>≥100 001</td>
<td>137 (26.3)</td>
</tr>
<tr>
<td>Number of family members</td>
<td></td>
</tr>
<tr>
<td>1–3</td>
<td>192 (36.9)</td>
</tr>
<tr>
<td>4–6</td>
<td>293 (56.3)</td>
</tr>
<tr>
<td>≥7</td>
<td>35 (6.7)</td>
</tr>
<tr>
<td>Living with a chronic disease</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>193 (37.1)</td>
</tr>
<tr>
<td>No</td>
<td>327 (62.9)</td>
</tr>
<tr>
<td>Diagnosed with influenza in 2017–2018</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>9 (1.7)</td>
</tr>
<tr>
<td>No</td>
<td>511 (98.3)</td>
</tr>
</tbody>
</table>

**Table 1. Characteristics of the 520 participants**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family member diagnosed with influenza in 2017–2018</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>9 (1.7)</td>
</tr>
<tr>
<td>No</td>
<td>511 (98.3)</td>
</tr>
<tr>
<td>Diagnosed with influenza in 2019</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10 (1.9)</td>
</tr>
<tr>
<td>No</td>
<td>510 (98.1)</td>
</tr>
<tr>
<td>Family member diagnosed with influenza in 2019</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>9 (1.7)</td>
</tr>
<tr>
<td>No</td>
<td>511 (98.3)</td>
</tr>
<tr>
<td>Diagnosed with influenza in 2020</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10 (1.9)</td>
</tr>
<tr>
<td>No</td>
<td>510 (98.1)</td>
</tr>
<tr>
<td>Went to Wuhan, China, between November 2019 and January 2020</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>3 (0.6)</td>
</tr>
<tr>
<td>No</td>
<td>476 (91.5)</td>
</tr>
<tr>
<td>Had close contact with people who had been to Wuhan, China, between November 2019 and January 2020</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>69 (13.3)</td>
</tr>
<tr>
<td>No</td>
<td>451 (86.7)</td>
</tr>
<tr>
<td>Immunized with the influenza vaccine in 2017–2018</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>9 (1.7)</td>
</tr>
<tr>
<td>No</td>
<td>511 (98.3)</td>
</tr>
<tr>
<td>Immunized with the influenza vaccine in 2019</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>186 (35.8)</td>
</tr>
<tr>
<td>No</td>
<td>334 (64.2)</td>
</tr>
<tr>
<td>Perception of the danger posed by COVID-19</td>
<td></td>
</tr>
<tr>
<td>Seriously dangerous</td>
<td>57 (11.0)</td>
</tr>
<tr>
<td>Very dangerous</td>
<td>98 (18.8)</td>
</tr>
<tr>
<td>Dangerous</td>
<td>196 (37.7)</td>
</tr>
<tr>
<td>As dangerous as influenza</td>
<td>29 (5.6)</td>
</tr>
<tr>
<td>Not dangerous</td>
<td>140 (26.9)</td>
</tr>
<tr>
<td>Level of worry about COVID-19</td>
<td></td>
</tr>
<tr>
<td>Most worried</td>
<td>246 (47.3)</td>
</tr>
<tr>
<td>Very worried</td>
<td>47 (9.0)</td>
</tr>
<tr>
<td>Worried</td>
<td>214 (41.2)</td>
</tr>
<tr>
<td>As worried as if it were influenza</td>
<td>5 (1.0)</td>
</tr>
<tr>
<td>Not worried</td>
<td>8 (1.5)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perception of level of risk of contracting COVID-19</td>
<td></td>
</tr>
<tr>
<td>Highest risk</td>
<td>246 (47.3)</td>
</tr>
<tr>
<td>High risk</td>
<td>47 (9.0)</td>
</tr>
<tr>
<td>Moderate risk</td>
<td>214 (41.2)</td>
</tr>
<tr>
<td>Risk similar to that of contracting the common cold</td>
<td></td>
</tr>
<tr>
<td>No risk</td>
<td>8 (1.5)</td>
</tr>
<tr>
<td>Thinks COVID-19 is a treatable disease</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>245 (47.3)</td>
</tr>
<tr>
<td>No</td>
<td>47 (9.0)</td>
</tr>
<tr>
<td>Not sure</td>
<td>228 (43.8)</td>
</tr>
<tr>
<td>Perception of the following groups as highly vulnerable to COVID-19</td>
<td></td>
</tr>
<tr>
<td>Those who have travelled to China</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>120 (23.1)</td>
</tr>
<tr>
<td>No</td>
<td>190 (36.5)</td>
</tr>
<tr>
<td>Medical and public health-care workers</td>
<td></td>
</tr>
<tr>
<td>People in general</td>
<td>91 (17.5)</td>
</tr>
<tr>
<td>Don’t know</td>
<td>78 (15.0)</td>
</tr>
<tr>
<td>Believes that a vaccine is available for COVID-19</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>162 (31.2)</td>
</tr>
<tr>
<td>No</td>
<td>107 (20.6)</td>
</tr>
<tr>
<td>Not sure</td>
<td>251 (48.3)</td>
</tr>
<tr>
<td>Knows the major signs and symptoms of COVID-19</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>225 (43.3)</td>
</tr>
<tr>
<td>No</td>
<td>295 (56.7)</td>
</tr>
<tr>
<td>Main channel for receiving COVID-19 information</td>
<td></td>
</tr>
<tr>
<td>Internet</td>
<td>188 (36.2)</td>
</tr>
<tr>
<td>Television</td>
<td>297 (57.1)</td>
</tr>
<tr>
<td>Medical staff</td>
<td>35 (6.7)</td>
</tr>
<tr>
<td>Has received sufficient information on COVID-19 to inform decision-making</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>116 (22.3)</td>
</tr>
<tr>
<td>No</td>
<td>404 (77.7)</td>
</tr>
<tr>
<td>Uses a face mask</td>
<td></td>
</tr>
<tr>
<td>Every day at all times</td>
<td>87 (16.7)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>289 (55.6)</td>
</tr>
<tr>
<td>Never</td>
<td>144 (27.7)</td>
</tr>
<tr>
<td>Uses soap to wash hands</td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>55 (10.6)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>230 (44.2)</td>
</tr>
<tr>
<td>Every time</td>
<td>235 (45.2)</td>
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</table>
Table 2. Univariable and multivariable logistic regression results for factors associated with good to moderate preparedness for COVID-19 prevention and control

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Good to moderate</th>
<th>Poor</th>
<th>Unadjusted analysis</th>
<th>Adjusted analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preparedness n (%)</td>
<td>Poor n (%)</td>
<td>OR 95% CI</td>
<td>P value</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>170 (85.0)</td>
<td>30 (15.0)</td>
<td>1.00 – – –</td>
<td>1.00 – – –</td>
</tr>
<tr>
<td>Female</td>
<td>298 (93.1)</td>
<td>22 (6.9)</td>
<td>2.39 1.33–4.27</td>
<td>0.003*</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–30</td>
<td>121 (93.1)</td>
<td>9 (6.9)</td>
<td>4.13 1.82–9.36</td>
<td>0.001*</td>
</tr>
<tr>
<td>31–45</td>
<td>133 (95.0)</td>
<td>7 (5.0)</td>
<td>5.84 2.40–14.19</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>46–60</td>
<td>136 (91.9)</td>
<td>12 (8.1)</td>
<td>3.48 1.65–7.35</td>
<td>0.001*</td>
</tr>
<tr>
<td>61–90</td>
<td>78 (76.5)</td>
<td>24 (23.5)</td>
<td>1.00 – – –</td>
<td>– –</td>
</tr>
<tr>
<td><strong>Religion</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buddhist</td>
<td>422 (90.2)</td>
<td>46 (9.8)</td>
<td>1.00 – – –</td>
<td>– –</td>
</tr>
<tr>
<td>Christian</td>
<td>23 (85.2)</td>
<td>4 (14.8)</td>
<td>0.62 0.20–1.89</td>
<td>0.407</td>
</tr>
<tr>
<td>Other</td>
<td>23 (92.0)</td>
<td>2 (8.0)</td>
<td>1.25 0.28–5.48</td>
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<tr>
<td><strong>Marital status</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>117 (91.4)</td>
<td>11 (8.6)</td>
<td>1.00 – – –</td>
<td>– –</td>
</tr>
<tr>
<td>Married</td>
<td>351 (89.5)</td>
<td>41 (10.5)</td>
<td>0.80 0.40–1.61</td>
<td>0.542</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>51 (77.3)</td>
<td>15 (22.7)</td>
<td>1.00 – – –</td>
<td>– –</td>
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<tr>
<td>Primary school</td>
<td>150 (89.8)</td>
<td>17 (10.2)</td>
<td>2.59 1.20–5.56</td>
<td>0.014*</td>
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<tr>
<td>High school</td>
<td>136 (91.3)</td>
<td>13 (8.7)</td>
<td>3.07 1.37–6.91</td>
<td>0.006*</td>
</tr>
<tr>
<td>University</td>
<td>131 (94.9)</td>
<td>7 (5.1)</td>
<td>5.50 2.12–14.28</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>34 (94.4)</td>
<td>2 (5.6)</td>
<td>1.00 – – –</td>
<td>– –</td>
</tr>
<tr>
<td>Agricultural worker</td>
<td>106 (91.4)</td>
<td>10 (8.6)</td>
<td>0.62 0.13–2.98</td>
<td>0.55</td>
</tr>
<tr>
<td>Trader</td>
<td>115 (89.8)</td>
<td>13 (10.2)</td>
<td>0.52 0.11–2.42</td>
<td>0.405</td>
</tr>
<tr>
<td>Government officer</td>
<td>36 (97.3)</td>
<td>1 (2.7)</td>
<td>2.11 0.18–24.43</td>
<td>0.548</td>
</tr>
<tr>
<td>Other</td>
<td>177 (87.2)</td>
<td>26 (12.8)</td>
<td>0.40 0.09–1.76</td>
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<td>24 (18.5)</td>
<td>0.54 0.22–1.33</td>
<td>0.183</td>
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<td>176 (91.7)</td>
<td>16 (8.3)</td>
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CI: confidence interval; OR: odds ratio.
*Statistically significant at α = 0.05.

Discussion

People who live in northern Thailand are close to the original source of the COVID-19 outbreak in Wuhan, China. With several border crossings between China, Myanmar, the Lao People’s Democratic Republic and Thailand, these individuals are a population vulnerable to COVID-19, particularly those who have poor knowledge, attitudes and preparedness to engage in COVID-19 prevention and control. This study found that women, younger adults and those with certain levels of education were more likely to have a good level of preparedness for COVID-19 prevention and control. To our knowledge, there are no other similar data on COVID-19 for this population with which our findings could be compared. However, in a study among migrant workers in Chiang Rai, half of participants had poor knowledge of and one third had a negative attitude towards tuberculosis prevention and control measures. In view of the urgency of managing the COVID-19 outbreak, nearly 400 world scientists met at WHO’s Geneva headquarters on 11 and 12 February 2020 to assess the current level of knowledge about the new coronavirus, to agree on critical research questions that needed to be answered.
### Table 3. Univariable and multivariable logistic regression results for factors associated with good to moderate knowledge about COVID-19 prevention and control

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Knowledge</th>
<th>Good to moderate &lt;i&gt;n (%)&lt;/i&gt;</th>
<th>Poor &lt;i&gt;n (%)&lt;/i&gt;</th>
<th>Unadjusted analysis</th>
<th>Adjusted analysis</th>
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<td>OR 95% CI</td>
<td>&lt;i&gt;P value&lt;/i&gt;</td>
<td>OR 95% CI</td>
<td>&lt;i&gt;P value&lt;/i&gt;</td>
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<td><strong>Sex</strong></td>
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</tr>
<tr>
<td>Male</td>
<td>55 (27.5)</td>
<td>145 (72.5)</td>
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<tr>
<td>Female</td>
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<td>237 (74.1)</td>
<td>0.92 0.62–1.37</td>
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<td><strong>Age (years)</strong></td>
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<td>18–30</td>
<td>36 (4.6)</td>
<td>94 (72.3)</td>
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</tr>
<tr>
<td>31–45</td>
<td>44 (31.4)</td>
<td>96 (68.6)</td>
<td>1.19 0.70–2.02</td>
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</tr>
<tr>
<td>46–60</td>
<td>36 (24.3)</td>
<td>112 (75.7)</td>
<td>0.83 0.49–1.43</td>
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<tr>
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<td>22 (21.6)</td>
<td>80 (78.4)</td>
<td>0.71 0.39–1.31</td>
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<td>443 (73.5)</td>
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<td>Christian</td>
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<td>1.41 0.83–2.38</td>
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<td>1.00 – – –</td>
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<td><strong>Education</strong></td>
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<tr>
<td>Illiterate</td>
<td>10 (15.2)</td>
<td>56 (84.8)</td>
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<td>Primary school</td>
<td>38 (22.8)</td>
<td>128 (77.2)</td>
<td>1.65 0.76–3.54</td>
<td>0.199</td>
<td>1.79 0.81–3.97</td>
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<td>High school</td>
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<td>112 (75.2)</td>
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<td>1.67 0.72–3.84</td>
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<td>University</td>
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<td>85 (61.6)</td>
<td>3.49 1.64–7.43</td>
<td>0.001*</td>
<td>2.75 1.15–6.59</td>
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<td>Student</td>
<td>17 (47.2)</td>
<td>19 (52.8)</td>
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<tr>
<td>Agricultural worker</td>
<td>19 (16.4)</td>
<td>97 (83.6)</td>
<td>0.21 0.09–0.49</td>
<td>&lt;0.001*</td>
<td>0.66 0.22–1.95</td>
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<tr>
<td>Trader</td>
<td>38 (23.7)</td>
<td>90 (70.3)</td>
<td>0.47 0.22–1.00</td>
<td>0.052</td>
<td>0.97 0.36–2.64</td>
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<td>Government officer</td>
<td>14 (37.8)</td>
<td>23 (62.2)</td>
<td>0.68 0.26–1.72</td>
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<td>1.06 0.35–3.19</td>
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<td>0.72 0.29–1.79</td>
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<td><strong>Annual income (baht)</strong></td>
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<td>38 (59.4)</td>
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<tr>
<td>&lt;30000</td>
<td>33 (25.4)</td>
<td>97 (74.6)</td>
<td>0.49 0.26–0.93</td>
<td>0.031*</td>
<td>0.59 0.28–1.24</td>
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<tr>
<td>30001–100000</td>
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<td>154 (81.5)</td>
<td>0.33 0.17–0.61</td>
<td>&lt;0.001*</td>
<td>0.38 0.18–0.82</td>
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<td>≥100001</td>
<td>44 (32.1)</td>
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<td>0.69 0.37–1.27</td>
<td>0.239</td>
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<td>233 (71.3)</td>
<td>1.36 0.90–2.06</td>
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CI: confidence interval; OR: odds ratio.

*Statistically significant at <i>α</i> = 0.05.

urgently, particularly with respect to care and diagnosis at the community level, and to optimize the use of protective equipment and other infection prevention and control measures in health-care and community settings. At the end of January 2020, Wu et al. reported that COVID-19 was already a global problem requiring plans and mitigation interventions for quick deployment globally, particularly in neighbouring countries. At the same time, Chen et al. reported that the population most vulnerable to COVID-19 was older men. Since then, the severity of COVID-19 has been widely reported to be influenced by age, sex and underlying comorbidities.

### Conclusion

Given their low economic and educational profiles, and since there are a number of busy border crossings, people living in Chiang Rai province in northern Thailand are vulnerable to COVID-19. Furthermore, knowledge and attitudes toward disease prevention and control are poor. While a few people were adequately prepared to prevent and control the disease, there is still a need for the implementation of public health efforts to improve knowledge of, attitudes to and preparedness for COVID-19 among those living in Chiang Rai province near busy border crossings. Effective, continuous communication
of essential, accurate, up-to-date and sufficient information regarding COVID-19 prevention and control – especially to men, older age groups and those lacking formal education – is a major public health concern and is currently being prioritized by the government.

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Source of support: The study was supported by the Center of Excellence for Hill Tribe Health Research, Mae Fah Luang University. The funder had no role in the design of the study, in the collection, analysis and interpretation of the data, or in writing the manuscript.

Conflict of interest: None declared.

Authorship: PS developed the questionnaire, collected the data, analysed the data, and prepared and approved the final manuscript.

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<th>Characteristics</th>
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<th>Poor (n, %)</th>
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<td>OR 95% CI P value</td>
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<td>149 (74.5)</td>
<td>51 (25.5)</td>
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<tr>
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<td>Education</td>
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<tr>
<td>Illiterate</td>
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<td>20 (30.3)</td>
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<td>1.00 – –</td>
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<td>Student</td>
<td>26 (72.2)</td>
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<td>60 (31.7)</td>
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<td>Number of family members</td>
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<td>1.00 – –</td>
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<td>96 (29.3)</td>
<td>0.89 0.60–1.33 0.594</td>
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<tr>
<td>Having chronic disease</td>
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<td>140 (72.5)</td>
<td>53 (27.5)</td>
<td>1.00 – –</td>
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CI: confidence interval; OR: odds ratio.
*Statistically significant at α = 0.05.
TA designed the study, developed the questionnaire, analysed the data, and prepared and approved the final manuscript. RT, FY, SKh, SKl, PW, AW and PU conducted the pilot survey, collected the data, analysed the data and approved the final manuscript. All authors have read and approved the manuscript.

Availability of data and materials: The raw data are available upon reasonable request from the corresponding author.


References

Policy and practice

Impact of COVID-19 on the global supply chain of antiretroviral drugs: a rapid survey of Indian manufacturers

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Abstract
Most people living with HIV in low- and middle-income countries are treated with generic antiretroviral (ARV) drugs produced by manufacturers in India – the “pharmacy of the developing world”. India’s nationwide lockdown in March 2020 in response to the coronavirus disease 2019 (COVID-19) pandemic therefore prompted concerns about disruption to this essential supply. A preliminary assessment of ARV drug manufacturers in India in March 2020 indicated a range of concerns. This prompted a rapid questionnaire-based survey in May 2020 of eight manufacturers that account for most of India’s ARV drug exports. The greatest challenges reported were in international shipping, including delays, increased lead times and rising costs. Contrary to expectations, lack of access to the active pharmaceutical ingredients (APIs) required for ARV drug manufacture was not a major hindrance, as manufacturers reported that their reliance on China for API supplies had reduced in recent years. However, their reliance on overseas markets for the raw materials required for local API synthesis was a major challenge. The findings from this survey have implications for addressing some of the immediate and medium-term concerns about the production and supply of generic ARV drugs. Long-term orders to support multi-month dispensing and buffer stocks need to be in place, together with computerized inventory management systems with real-time information from the lowest-level dispensation unit. Manufacturers and industry associations should have regular, formal interaction with the key ministries of the Government of India regarding these issues. Measures to improve the resilience of the generic ARV drug supply system are essential to minimize ongoing supply shocks resulting from the COVID-19 pandemic and to prepare for future emergencies.

Keywords: antiretroviral drugs, COVID-19, HIV, India, manufacturers, shortages, supply chain

Background
The beginning of 2020 marked the start of the “Decade of Action” to accelerate efforts towards achieving the 2030 Sustainable Development Goals (SDGs). These include the SDG 3.3 target of ending the AIDS epidemic and other diseases as a public health threat. The successes achieved so far in terms of reducing new HIV infections and AIDS-related mortality are attributable to both preventive measures and a significant scale-up of antiretroviral therapy (ART). By 2019, estimated ART coverage among people living with HIV in the World Health Organization (WHO) South-East Asia Region had reached 60%, although this was still far from the 90–90–90 target by 2020. Therefore, it is important to ensure continued and sustained scale-up of ART. This will help to achieve the target in two ways. First, the direct therapeutic benefit of ART to people who are receiving treatment reduces the number of AIDS-related deaths worldwide. Second, ART has the potential ancillary benefit of reducing new HIV infections, since ART reduces viral load in people receiving it, which significantly reduces the risk of transmission to someone else.

As with other low- and middle-income countries, most ART dispensation in countries of the region occurs through the public sector. Scale-up of ART in many countries has been possible owing to a seamless supply of low-cost and high-quality antiretroviral (ARV) drugs, especially from generic manufacturers based in India. This started as early as 2001, when an Indian generic manufacturer was able to supply a triple combination of ARV drugs for less than US$ 1 per person per day. The trend has continued since then, and India has been referred to as the “pharmacy of the developing world”; the majority of people with HIV in low- and middle-income countries are treated with generic ARV drugs produced by Indian manufacturers.

In response to the coronavirus disease 2019 (COVID-19) pandemic, many countries in the WHO South-East Asia Region began implementing lockdowns and other measures in March 2020. India’s lockdown began at midnight on 24 March 2020, initially for a period of 3 weeks, followed by multiple
extensions. This prompted concerns about the procurement and supply chain management of ARV drugs and the ability of India’s generic ARV drug manufacturers to meet regional and global demand. While the COVID-19 pandemic might be expected to have adverse effects on provision of health care in all settings, its immediate capacity to disrupt services for HIV, tuberculosis and malaria in low- and middle-income countries with high burdens of these diseases was a particular concern. Modelling studies estimate that a 6-month interruption of supply of ARVs across the whole population of people living with HIV on treatment in sub-Saharan Africa would be expected to lead to an approximately twofold increase in HIV-related deaths and a similar increase in mother-to-child transmission over 1 year.10 A separate study estimates that in low- and middle-income settings with a high HIV burden, COVID-19 disruption to services could increase mortality by 10%, largely as a result of interruption of ART.11

This policy and practice paper reports findings arising from the activities of the WHO Regional Office for South-East Asia to minimize disruption in the supply of ARV drugs from Indian manufacturers. A preliminary assessment of ARV drug supply in countries of the region was done in March 2020, the results of which prompted a rapid questionnaire-based survey in May 2020 of the eight manufacturers that account for most of India’s ARV drug exports.

**Approach**

**Preliminary assessment: March 2020**

From the start of the COVID-19 pandemic, the WHO Regional Office for South-East Asia was liaising regularly with the national AIDS programme (NAP) managers of countries of the region, through the WHO country offices. Early support included technical guidance, advisory notes and related communications emphasizing the importance of continuity in ART. At the same time, the regional office actively promoted sharing of experiences and good practices among the countries in areas such as innovative service delivery options including community-led models, as well as early policies and experiences regarding measures such as multi-month dispensing of medicines.

A preliminary assessment of WHO country offices and NAPs to gauge countries’ ARV drug stock levels in March 2020 found that, although there were no acute shortages, there were concerns about the supply of certain medicines in the medium to long term. These concerns in March were set against a background of potential official restrictions on medicines. For example, there were concerns regarding an export policy amendment made in early March by the Government of India restricting export of certain essential drugs,12 although the restrictions imposed through this amendment were lifted in April.13 Similarly, another directive from the Government of India asked manufacturers to maintain adequate stocks of fixed-dose combination lopinavir–ritonavir, since this was one of the formulations being considered for inclusion in clinical trials on COVID-19 management.14

Early efforts to minimize COVID-19-related disruptions for Member States’ health-care systems by the WHO Regional Office for South-East Asia included facilitating shipping arrangements for current ARV drug orders. We informally contacted manufacturers in India during the last week of March 2020 to ascertain their ability to fulfill orders that were already in the pipeline for ARV drugs to countries of the region and whether or not any delays in lead times were anticipated. Most manufacturers indicated that, at that time, they had adequate stock of the active pharmaceutical ingredients (APIs) required for ARV drug manufacture. They did, however, indicate other challenges. These included reduced workforce in plants and for loading trucks; lack of ground transport to reach warehouses and beyond; shortage of packaging materials; and reduced movement of cargo flights.

Suppliers had found no flights or other means to transport these drugs, which were already manufactured and in the warehouses. Because of the lockdown, there were no forwarding agents to get clearances at international borders. It took significant time and interaction at multiple levels in WHO and other agencies to get supplies to countries. In the case of one of the countries sharing a border with India, delivery was rerouted by road through specially arranged goods carriers. For another country, supplies were transported by sea instead of air, to prevent impending stock-out situations. The issue of transport was more of a practical consideration than a policy issue, since the Government of India had by late March issued clarifications allowing transport of medicines, since they were defined as essential goods.15 We therefore shared relevant orders from the government with those manufacturers that had indicated that they were experiencing challenges, to facilitate ground transport; showing central government orders to local transport companies and authorities helped to ease the transport challenges.

From this initial work in March 2020, and in view of the evolving COVID-19 situation in the region, it was clear that evidence to inform longer-term mitigation efforts was needed. We therefore contacted ARV drug manufacturers in India to invite them to take part in a survey in May 2020. The objective was to identify the main challenges and constraints in ARV drug production and supply chain management in order to formulate recommendations and identify solutions.

**Rapid questionnaire-based survey: May 2020**

Eight leading manufacturers of ARV drugs based in India, which account for most ARV drug exports from the country, were invited on 19 May 2020 to respond to a semi-structured open-ended set of questions by email. The eight themes covered by these questions were largely determined by (i) what manufacturers themselves shared in March 2020; (ii) the authors’ initial experiences in March 2020 of facilitating delivery of essential commodities delayed by the COVID-19 situation, and (iii) media reports and research reports that were available on this topic, including the 12 March 2020 assessment by the Global Fund.16,17,18 The questions were intended to be as objective as possible but were also meant to encourage sharing of perspectives, concerns and possible solutions. To facilitate candid responses, we did not include questions on business-sensitive information, such as absolute volumes of production. The questions were as follows:

1. Do you have enough APIs and other active ingredients to manufacture ARV drugs at your usual capacity?
2. Have your supplies of key starting materials and other raw materials [for API synthesis] from China or other countries been impacted?
3. Are you facing shortage of workforce in your manufacturing plants?
4. Are there any issues in moving drugs from the plant to warehouses?
5. What are the challenges in shipping drugs to other countries?
6. Due to the lockdown, what percentage of your orders could not be met on time?
7. How soon do you think you will be able to normalize the supplies?
8. Can you please share your inputs or suggestions to ensure continued access to ARV drugs in the context of the evolving COVID-19 situation?

Considering that the information was required as quickly as possible to help countries to avert stock-out situations, we did not have enough time to undertake a pilot test of the questionnaire. Furthermore, we restricted the survey to manufacturers in India, since they have a predominant role in export of ARV drugs in the region and beyond. We sent the questionnaire to all Indian drug manufacturers known to us from which countries of the region had been procuring ARV drugs and for which contact details were readily available. Individual emails were sent on 19 May 2020 to the eight manufacturers identified, with the eight questions listed above. Three manufacturers responded within 24 hours while four more responded after a reminder, a week later. All eight companies contacted eventually responded, giving a response rate of 100%. They were assured that their responses would be analysed and reported only in aggregate, thereby ensuring confidentiality.

Descriptive responses from the manufacturers to the above questions were tabulated using Microsoft Excel. They were reviewed and coded to identify subthemes emerging from each question. We then summarized the responses to each of the questions. The aggregate relative importance of each of the areas covered in questions 1–7 was assigned a score of 0 to 5, with 0 reflecting the highest vulnerability and 5 reflecting the highest resilience, and plotted in a radar chart. It should be noted that this was not intended to reflect the business models or operational efficiency of the ARV drug manufacturers; it was merely an attempt to provide a graphical representation of the situation, similar to a scorecard. A word cloud depicting the relative frequency of key words that appeared in the responses was also created to help unpack the main themes.

**Key findings**

Fig. 1 shows the vulnerability–resilience scores as a radar chart, indicating that difficulties with international shipping were the challenge most often cited by the ARV drug manufacturers; these difficulties included increased costs in addition to factors causing delays and increasing lead times. The next biggest challenge was access to supplies of the key starting materials (KSMs) and other raw materials that are required for API synthesis. Overreliance of India’s manufacturers on China for APIs has given rise to concerns in the past, but respondents indicated that this had reduced in recent years. The more important consideration now was reliance on China and other overseas markets for supplies of KSMs and other raw materials required for manufacturing APIs. Notably, when the responses from all respondents are visualized in a machine-generated word cloud, “API” appears prominently (Fig. 2). This underscores the need to undertake more nuanced analyses of the determinants of the resilience of India’s ARV drug manufacturers, to mitigate future shocks.

![Radar plot showing the relative magnitude of challenges](image-url)
Both international shipping and access to raw materials require urgent attention from policy-makers. Manufacturers and industry associations should have regular, formal interactions with the key ministries of the Government of India regarding these issues. Regular discussions with all stakeholders could identify ways of ensuring better preparedness to deal with such situations in the future.

The responses to questions 1–8 are summarized below.

1. APIs and other active ingredients required to manufacture ARV drugs at usual capacity

APIs for the production of ARV drugs by Indian manufacturers are mainly sourced from India and China. Two out of the eight manufacturers that responded indicated that they had enough APIs and other ingredients to manufacture ARV drugs at normal capacity. However, one was a recent entrant into the ARV drug segment, and at the time it required APIs only to produce validation batches. Nevertheless, it expressed confidence that an API shortage was not anticipated and that emergency supplies could be started as early as August 2020.

Two other respondents stated that they usually maintained 3–4 months’ stock of APIs. However, because of COVID-19-related interruptions, an acute shortage was expected as early as June 2020, in the absence of specific measures to address the challenges. Such impending shortages were anticipated for only a few ARV products, for which in-house or in-country API production was not happening and the manufacturers were therefore dependent on supplies from other countries such as China. One manufacturer reported that a shortage of APIs and other active ingredients had already impacted its capacity by 20–30% of normal production capacity, while another manufacturer responded that the impact was only marginal. Two other manufacturers had full capacity to produce APIs themselves and hence did not find this aspect challenging. There were also indications that the costs of acquiring APIs were increasing, although these increases were marginal at the time of data collection. Respondents further added that it was hard to predict when API stock levels would return to normal.
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2. KSMs and other raw materials for API synthesis
A significant proportion of KSMs used by Indian pharmaceutical companies are sourced from China, with a much smaller share coming from Indian and European sources. In line with the findings of the preliminary assessment, all eight respondents stated that they faced significant challenges in acquiring the KSMs and other raw materials required for manufacturing ARVs, especially those that they would usually source from China. Two of them reported that they had been affected by this issue “hugely” and “heavily”. A couple of respondents explained that they had reduced their reliance on companies in China, or other foreign countries, for APIs but still depended on foreign sources for KSMs. Therefore, problems faced in obtaining KSMs and other raw materials from abroad had had a significant impact on ARV drug production by manufacturers in India, according to respondents.

Business links for importing such raw materials were being re-established where they had been temporarily disrupted. However, challenges remained with regard to logistics and shipping, with issues such as delayed shipping, vessels being diverted to other ports and delayed customs clearance. With a reduced number of flights, sea routes were being attempted in some cases as an alternative option, but reduced staff at ports posed additional challenges. Moreover, manufacturers were trying to ensure multiple sources for these raw materials, to minimize the impact if one of them faced challenges. Two respondents mentioned an increase in freight costs as a further challenge faced in this regard, with one of them reporting a fourfold increase in logistics costs compared with the pre-COVID-19 period.

These challenges were particularly acute in the first quarter of 2020, and there were indications that supplies of KSMs and other raw materials had improved at the time of the survey in May 2020. Nevertheless, none of the respondents reported a full restoration to normalcy. One of the respondents even stated that it might not get back to normal before the end of the year, indicating a protracted impact.

3. Shortage of workforce in manufacturing plants
The impact on this front was not reported as severe by any of the respondents, with one of the manufacturers reporting no challenges faced at all. A reason cited for the reduced impact on this front was the government’s policy of exempting pharmaceutical manufacturing units from the lockdown. Yet respondents referred to governmental guidance on physical distancing in the workplace and some other challenges unique to local contexts that had prevented them from operating at 100% capacity.

Measures adopted by ARV drug manufacturers included reorganizing work shifts to meet physical distancing requirements; arranging special passes to enable free movement to and from units; facilitating pick-up and drop-off services for employees; and providing temporary accommodation for employees near manufacturing units. Accordingly, they were able to operate with a workforce of 50–80% of normal. Respondents stated that, as in the other domains, the challenges were greater during the first 4 weeks of lockdown in March to April 2020. The difficulties had eased significantly by the time of data collection in May.

4. Transport of drugs to warehouses and beyond
Six out of eight respondents indicated no challenges in transporting goods from manufacturing units to warehouses. In some instances, this was partly because warehouses were not far from manufacturing units. Others ensured that their transport mechanisms used governmental exemptions for pharmaceutical manufacturing as an essential service during the COVID-19 lockdown. Onward transport from warehouses to ports was, however, affected, especially where interstate transport was involved in reaching ports for shipment.

One respondent that indicated that it had experienced early challenges relating to transport of goods to warehouses added that transport by lorry was returning to normal by the first half of May 2020. At the same time, another respondent, which had not faced any challenges so far, was not sure that this would continue. The respondent sounded a note of caution – “however, the situation is ever evolving” – indicating a lingering concern. Nevertheless, this question elicited the fewest indications of concern or challenges from the manufacturers.

5. International shipping disruption
All eight respondents reported disruption in international air traffic as a challenge that had impacted their operations. Sea shipping had been similarly affected, as had local transport by road to ports, and issues had been faced at ports. All this had led to increased lead times for most ARV products. In terms of air freight charges, respondents estimated a fourfold to tenfold increase in certain instances. Sea freight charges were also reported to be higher, to the tune of 1.3 to 1.5 times, than pre-COVID-19. Reduced flights were a challenge noted by all respondents. This was despite the fact that there had been no ban preventing movement of international cargo, and certainly not for essential goods. However, an overall reduction in flights meant less chance of gaining acceptance for a cargo booking request.

In the case of many destination countries to which shipping requires waivers and pre-clearance permissions, there were additional delays. Waivers and clearances were being received late because officials and systems in the destination countries were being directly or indirectly impacted by COVID-19. Additional challenges in this domain were reported in certain special instances. Respondents highlighted that, if the overall volume of a shipment was small, some cargo companies resisted the booking, which could be a major challenge for essential ARV drugs required in certain special cases, including for paediatric patients. Similarly, for destinations requiring multiple connecting flights, respondents indicated difficulties in securing confirmed end-to-end flight schedules. Six of the respondents also noted increased supply chain costs – local freight charges, air and sea fares, and demurrages due to delay – as another major challenge in addition to the overall delays in shipping.

6. Overall supply shock due to COVID-19
Two respondents estimated that 20–30% of their total orders could not be delivered on time because of the COVID-19 pandemic. A third manufacturer, without quantifying the effect in terms of percentage of total orders, shared that the delivery dates of “a few” of its orders had been shifted by 40–50 days. Delays were particularly likely in the case of orders with specific packaging requirements and/or products that were produced not regularly or routinely but on a made-to-order basis. Two of the respondents said that none of their promised delivery dates had been impacted. One of them attributed its
ability to meet delivery deadlines for ARV drugs to central and state governments’ treatment of the pharmaceutical sector as an essential service.

Two other respondents reported overall challenges in this regard but did not assign any quantitative values to either percentage of overall orders affected or average number of days’ delay. One respondent indicated that the situation was fluctuating and dynamic, also mentioning that the rapid mitigation measures that were in place had helped to minimize any supply shock due to COVID-19. Two respondents elaborated on some of the measures that they had adopted in this regard, such as regular interaction with customers in order to prioritize orders; arranging alternative shipping arrangements whereby customers were able to get their orders picked up directly from warehouses; regular and close monitoring of the situation, including inventory management; and full utilization of governmental provisions with regard to the pharmaceutical sector as an essential service.

7. Forecast for a return to normalcy
The earliest forecast for normalcy to be restored was August 2020, as expressed by two respondents. Another respondent referred to its current backlog, quantified as 2 months, which it stated would need to be taken into account in considering when it would be able to restore normalcy. While maintaining an overall positive outlook, most respondents alluded to prolonged uncertainty.

One of the respondents attributed such prolonged uncertainty to the nature of the pandemic itself. The respondent observed that the COVID-19 pandemic could last much longer and did not foresee restoration of full production capacity until at least the end of the year. Nevertheless, most of the respondents were confident based on their experiences so far. They expressed hope that the improvements in the situation on the ground would be further enhanced in the coming weeks and months, including through proactive and innovative measures to overcome the specific challenges they were encountering. However, they indicated that much depended on external factors, hinting at a need for measures at policy level to improve the external operational environment.

8. Recommendations and suggestions from the ARV drug manufacturers
Overall, respondents highlighted that they accorded high priority to supplying ARV drugs. They were resolved to adopt all possible measures to meet their commitments and ensure life-saving treatment for all people living with HIV globally. Their recommendations, listed below, are relevant to both the current COVID-19 pandemic and potential future emergencies. Some suggestions target manufacturers, while others are aimed at customers and policy-makers.

- Immediately increase stock levels of essential medicines in countries where potential disruption is expected. At the same time, discourage unreasonable stockpiling of medicines beyond a few months.
- Ensure longer-term contracts with lead times of more than 12 weeks. Issuance of orders in advance for 6–12 months could provide certainty to manufacturers and encourage them to stock up on the required raw materials and packaging materials.
- In the event of shortages, countries are encouraged to switch to an alternative regimen depending on availability, as recommended by WHO in relation to first-line and second-line ART.
- While multi-month dispensing is generally encouraged, not all countries need to transition to this to the same extent. This must also be tailored to supply constraints associated with large-scale procurement of medicines meant for longer duration dispensation as well as supply chain issues.
- Improve inventory management for KSMs, APIs and finished pharmaceutical products by all manufacturers, so that supplies are not gravely impacted. Manufacturers of finished pharmaceutical products should maintain 2- to 3-month inventories, so that disruptions can be better mitigated.
- Monitor restrictions and relaxations in China and other countries to decide on the way forward for KSM and API supplies. Explore and develop more options outside China for supplies of KSMs and other raw materials. By promoting more indigenous supplies and reducing dependence on outside sources, the resilience of supply chains can be improved.
- Ensure availability of flight carriers for essential medicines such as ARV drugs.
- Provide fast-track clearance for essential medicines at ports.
- Opt for sea shipment instead of air shipment, wherever feasible.
- Set up regional stocking centres in hubs from which medicines can be delivered to nearby countries.
- Promote an accommodative approach on prices because of the cost escalation in freight and other aspects of the manufacture and supply of ARV drugs.
- Adopt flexible approaches opting for carton-less and leafletless packaging.
- Above all, improve procurement planning and promote prioritized and staggered delivery schedules.

Discussion
This analysis of the responses from the Indian ARV drug manufacturers has provided important insights into the challenges they face in ensuring uninterrupted and seamless supply to different countries of the region and beyond. Of the eight questions, five covered direct determinants of production and supply; two sought perception-based estimates of the current shock due to COVID-19 and prospects of re-establishing normalcy; and, finally, one was on manufacturers’ suggestions about how to mitigate current challenges and recommendations to minimize future shocks.

Since the start of the pandemic, the Global Fund has produced a regularly updated assessment of the impact of COVID-19 on health product supply chains. As of the 6 July 2020 update, reduced production of all pharmaceuticals in India was expected to continue throughout the lockdown period. As a result, delays of 1–2 months were expected over the next few months. With respect to freight and logistics, various contingencies have been noted, including rerouting of shipments; changing air freight to ocean freight or changing transit countries to utilize cargo-only aircraft; changing mode of
transport for final delivery; shipping to neighbouring countries; and exploring road transport and air charter options. The Global Fund notes that, in all these cases, cost impacts are highly likely. In May, the assessment concluded that 10% of orders faced delays of more than 30 days, including 19% of orders in transit; in July, these estimated delays had increased to 15% and 24%, respectively.16

The findings from this situation assessment have implications in terms of addressing some of the immediate concerns facing production and supply of ARV drugs in the region and globally. Some of these concerns directly affect supply, such as international shipping disruption, which emerged as a prominent concern among the ARV drug manufacturers. However, measures may also be required in relation to some not-so-direct aspects. For example, the pharmaceutical sector had the privilege of being an essential service during the COVID-19-related lockdown, but, since the packaging material sector did not receive the same treatment, some manufacturers faced issues with timely supply.

The situation assessment described in this paper was undertaken following challenges faced in relation to supplies of life-saving ARV drugs used by NAPs in the region. Therefore, our choice of the respondents invited to participate in this assessment, as well as of the questions and the domains covered by those questions, was determined by immediate practical considerations. Consequently, this assessment has limitations compared with more formal research studies undertaken in this area.

These findings were also shared with the Strategic Information Unit and the AIDS Medicines and Diagnostic Services (AMDS) Unit at WHO headquarters. The AMDS Unit regularly interacts with all manufacturers to assess their capacity in relation to global demand consequent to changes in guidelines on treatment and to notify them of future needs. The findings call for longer-term consideration of the issues raised, particularly since the COVID-19 situation is continuing to evolve in the region. Medium- to long-term measures to build resilience in the procurement and supply chain systems need to be in place.

Conclusion

The COVID-19 pandemic, especially the lockdowns and related developments, have impacted Indian ARV drug manufacturers to a significant extent. Mitigation efforts are continuing, and there was improvement in terms of the challenges faced as between March 2020 and May 2020. However, the situation is dynamic and requires policy-level and operational strategies to be developed for the medium to long term. This is important not only in the context of a potentially protracted COVID-19 episode in the region and globally but also to prevent future shocks.

This paper has set out a broad understanding of the key determinants of continued and seamless supply in the context of COVID-19. Based on inputs from eight leading ARV drug manufacturers in India, the paper summarizes some of the key challenges faced during lockdown in March to May 2020. Further, more in-depth analyses could be considered, leveraging the points made in this paper, some of which are hypothesis-generating ones. By producing this initial exploratory analysis, the authors hope to generate further deliberation and reflection among policy-makers and industry bodies.

Demand-side factors need to be considered too in mitigating the impact of COVID-19-related disruption to AIDS programmes. As soon as movement restrictions are relaxed, catch-up campaigns should be considered to improve coverage of testing, prevention and treatment interventions. Such catch-up campaigns must be informed by facility-level analysis of service coverage, incorporating considerations relating to equity and who may have been affected the most by COVID-19 disruptions. Proactive measures to improve service coverage, such as HIV testing and linking those who are positive to treatment, must be prioritized in the coming months.

Urgent measures need to be adopted to restore ARV drug manufacture and supply to normalcy and full capacity. Long-term orders to manufacturers, to ensure enough stocks for multi-month dispensation and buffer stocks, and computerized inventory management systems with real-time information from the lowest dispensation unit need to be in place. Furthermore, there must be adequate planning and reform measures to improve the resilience of supply chain systems. WHO has recently updated its guidance on maintaining essential HIV services during the COVID-19 pandemic.22 These longer-term measures are essential to minimize supply shocks in the event of disruption induced by a prolonged COVID-19 pandemic or future emergencies.

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Authorship: All authors contributed equally.

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Assessing the COVID-19 diagnostic laboratory capacity in Indonesia in the early phase of the pandemic

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Abstract

The coronavirus disease 2019 (COVID-19) pandemic has put a great burden on countries as a result of the demand for laboratory diagnostic testing for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). This paper reports our experiences in rapidly assessing Indonesia’s COVID-19 laboratory testing capacity in the early phase of the pandemic response. Through a questionnaire-based survey carried out between 23 March and 2 April, we estimated the daily tests that could be done by the 44 facilities, excluding the national referral laboratory, first assigned to be COVID-19 diagnostic laboratories. The capacity constraints were lack of reagents and equipment, and limited human resources; because of these constraints, most of the laboratories were not yet operational. A major hindrance was reliance on imported supplies and the associated procurement time. Expanding real-time polymerase chain reaction testing capacity, through increased numbers of laboratories and optimization of existing facilities, was clearly the main priority. We also assessed the potential yield from using rapid molecular testing machines in the country’s referral hospitals. Even assuming this potential could be tapped, several provinces would still be poorly served by diagnostic services in the event of a surge in cases. Since this rapid assessment, the number of designated COVID-19 laboratories has increased and, by 1 July 2020, was 163. On 29 July 2020, for the first time, the number of specimens examined in a day reached more than 30 000, achieving the WHO testing capacity target of 1 in 1000 inhabitants per week.

Keywords: COVID-19, diagnosis, emergency response, Indonesia, laboratory testing

Background

On 31 December 2019, the World Health Organization (WHO) Country Office for China was informed of cases of pneumonia of unknown aetiology detected in Wuhan, Hubei province. WHO declared a public health emergency of international concern on 31 January 2020, and on 11 March coronavirus disease 2019 (COVID-19) was characterized as a pandemic.¹ The causal agent was named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by the International Committee on Taxonomy of Viruses on 11 February.² Indonesia reported its first two cases of COVID-19 on 2 March 2020, and by 31 March there had been 114 deaths from 1285 cases.³ Presidential Decree No. 11 of 31 March 2020 confirmed COVID-19 as a national public health emergency and announced various public health and social measures to prevent and mitigate the impact of COVID-19. This was prompted by the increasing number of cases and deaths, the spread across the country, and the impact on political, economic, defence and security aspects, as well as on the welfare of the people of Indonesia.⁴ The Indonesian Ministry of Health was instrumental in issuing guidelines on prevention and control of COVID-19, issuing self-isolation protocols and establishing a referral hospital. The Ministry of Health also appointed the National Institute of Health Research and Development (NIHRD) as a diagnostic centre for COVID-19 samples. However, Indonesia is the largest archipelago in the world, with an estimated total of 17 504 islands, and has a population of more than 265 million.⁵ Concerns were therefore raised that having only one COVID-19 diagnostic laboratory for such a large geographical area and population would delay an effective response.⁶ Therefore, the Minister of Health issued three decrees: HK.01.07/Menkes/182/2020 on 16 March; HK.01.07/Menkes/214/2020 on 19 March; and HK.01.07/Menkes/216/2020 on 23 March.⁷ These decrees listed the facilities to be designated COVID-19
diagnostic laboratories by province and elevated the NIHRD laboratory to the status of national reference laboratory for COVID-19.

WHO interim guidance on laboratory testing for COVID-19 on 19 March 2020 was as follows: “Testing on clinical specimens from patients meeting the suspected case definition should be performed in appropriately equipped laboratories by staff trained in the relevant technical and safety procedures. National guidelines on laboratory biosafety should be followed in all circumstances. There is still limited information on the risk posed by COVID-19, but all procedures should be undertaken based on a risk assessment. Specimen handling for molecular testing would require BSL-2 [biosafety level 2] or equivalent facilities. Attempts to culture the virus require BSL-3 facilities at minimum.”

Rapid, accurate diagnosis of COVID-19 is essential for both patient management and contact-tracing purposes. An understanding of a country’s diagnostic laboratory capacity is therefore important to benchmark the ability of facilities to cope with increasing demand, and also to plan for equipment and laboratory requirements. We therefore undertook a rapid assessment of Indonesia’s COVID-19 laboratory testing capacity in the early phase of the pandemic response to identify key areas for strengthening and possible solutions. This assessment included a rapid survey of the laboratories newly designated as COVID-19 facilities.

Approach

This study involved rapid operational research to obtain key information on the current capacities of the 44 facilities that had been assigned by the Minister of Health’s Decree HK.01.07/Menkes/214/2020 to become COVID-19 diagnostic laboratories. Data were collected using a self-administered confidential questionnaire. The questionnaire was filled in by the manager of each laboratory. The completed questionnaire was then signed and approved by the head of the COVID-19 laboratory before being sent back to the researchers.

The main purpose of the survey was to ascertain the maximum capacity of each laboratory under the circumstances pertaining at that time. The questionnaire collected information on testing capacity; respondents were asked for the maximum capacity for specimen examinations in 1 day and the average daily number of specimens examined in the preceding week. They were also asked for the total number of laboratory personnel that were capable of COVID-19 testing and the number who had undergone specialist training. The questionnaire also had questions on the availability of testing equipment and reagents; total laboratory health-care and non-health-care personnel; laboratory apparatus, including if a biosafety cabinet was available; and the availability of personal protective equipment. The questions were developed by a team including a microbiologist and health service management experts, with input from the heads of two COVID-19 diagnostic laboratories.

The questionnaires were sent by email on 23 March and were to be returned by 2 April. Replies were cross-checked with respondents if additional clarification was needed. It was recognized at the outset that not all of the laboratories contacted would be able to answer all of the questions since most were not yet fully operational and the number of cases was still low; therefore, none of the questions was mandatory. The results of the survey were analysed descriptively to determine the capacity of each diagnostic laboratory. The survey was approved by the Health Research Ethics Committee, NIHRD (document number LB.02.01/2/KE.303/2020). We also collected Ministry of Health and National Agency for Disaster Management data on cumulative tests done and cases identified during the period from 2 March to 15 April, to identify changes coinciding with increasing laboratory capacity.

Key findings

Testing in the early phase of the pandemic response

This rapid survey was done at a highly dynamic time. The primary data collection for this study was conducted in 44 COVID-19 diagnostic laboratories. However, during the survey, on 26 March 2020, the government designated a further four laboratories, bringing the total number of COVID-19 diagnostic laboratories to 48. Initially, COVID-19 specimen examination was centralized and conducted only in the Ministry of Health’s NIHRD laboratory. As demand increased, it was impossible to continue with the NIHRD laboratory as the only COVID-19 diagnostic laboratory. Turnaround time for results increased because of the geographical spread of the disease and the increasing numbers of specimens requiring testing. At the same time, demand for faster diagnosis was increasing. In response, on 16 March the government expanded the testing programme by designating 12 new diagnostic laboratories (Fig. 1, point A), followed by more, bringing the total to 44 diagnostic laboratories on 19 March 2020 (Fig. 1, point B). Four more laboratories were designated on 26 March (Fig. 1, point C).

Fig. 1 also shows that, in the initial weeks, there was not a significant increase in the number of specimens examined. Over time, a sharp increase in specimen examination by diagnostic laboratories and test results was seen, in line with the government’s policy of increasing the number of diagnostic laboratories in the network. In addition, there were increasing numbers of cases.

Distribution and capacities of COVID-19 diagnostic laboratories

At the outset of the survey, there were 44 COVID-19 diagnostic laboratories designated by ministerial decree. This meant that, of Indonesia’s 34 provinces, there were 12 without COVID-19 diagnostic laboratory facilities, namely Bengkulu, Lampung, East Nusa Tenggara, Central Kalimantan, East Kalimantan, North Kalimantan, Central Sulawesi, South-East Sulawesi, Gorontalo, West Sulawesi, North Maluku and West Papua. The government had appointed diagnostic laboratories located in other provinces to provide testing services for these provinces.

Of the 44 laboratories contacted, 36 (82%) responded to the survey; 11 were surveillance laboratories and 25 were non-surveillance laboratories. At the time of the survey, only 13 of these laboratories (in addition to the national referral laboratory) had tested specimens for SARS-CoV-2; seven of the 11 surveillance laboratories and six of the 25 non-surveillance laboratories. This finding was unsurprising because surveillance laboratories had been designated as COVID-19 diagnostic laboratories earlier than their non-
surveillance counterparts. Lack of equipment and materials meant that most of the laboratories were not yet operational.

The capacity constraints reported in the survey were lack of reagents and equipment, and limited human resources. A major cause of lack of tools and reagents was procurement time, since all needed to be imported. With respect to equipment, in the 36 COVID-19 diagnostic laboratories, there were 38 real-time polymerase chain reaction (RT-PCR) machines. In addition, there were six conventional PCR machines plus 15 rapid molecular testing (RMT) machines. At the time of the survey, seven laboratories designated as COVID-19 diagnostic laboratories did not have an RT-PCR machine, and four laboratories had only an RMT machine.

A total of 23 laboratories provided estimates of the minimum and maximum capacities of the laboratory, based on the conditions at the time of the survey. As shown in Table 1, between 22 March and 2 April 2020, the daily testing capacity of COVID-19 diagnostic laboratories (excluding the national referral laboratory) ranged from 12 to 200 specimens and the average maximum specimen examination capacity per day was higher for surveillance laboratories than for non-surveillance laboratories.

The capacity of a laboratory is the result of many factors, in particular the availability and adequacy of materials, workforce and equipment, and the speed and purity of RNA extraction. Funding, including overtime payments and other support for diagnostic staff, is also key. With respect to human resources, capacity is a product not only of the number of staff but also of their skills and training. Therefore, the capacities of different laboratories can vary even if they have the same number of staff and use the same RT-PCR equipment.

**Estimate of nationwide capacity**

As shown in Table 2, based on the responses from the 23 laboratories and extrapolating to the rest, we estimated that the testing capacity of the 44 COVID-19 diagnostic laboratories, excluding the national referral laboratory, was 2544 specimens per day. It was clear that there would be challenges not only for the 12 provinces that did not have COVID-19 diagnostic laboratories but also for Jakarta. Although Jakarta had seven COVID-19 diagnostic laboratories, including the national referral laboratory, with the city being at the epicentre of the COVID-19 outbreak, those laboratories would inevitably have a heavy workload. In addition, several diagnostic laboratories in Jakarta not only accommodated Jakarta’s needs but also received specimens from other regions, as well as carrying out surveillance functions. The national referral laboratory was also carrying out various other functions: facilitating, monitoring and quality assurance for other COVID-19 diagnostic laboratories. The same problems were also faced by East Java province, where most of the diagnostic laboratories had to support other provinces.

| Table 1. Estimated daily capacity of COVID-19 diagnostic laboratories, 22 March–2 April 2020 |
|--------------------------------------------|-------|-------|-------|-------|-------|
| **Diagnostic laboratories** | **n** | **Mean** | **Median** | **Minimum** | **Maximum** |
| Surveillance function | 7 | 99 | 96 | 32 | 200 |
| Non-surveillance function | 16 | 60 | 50 | 12 | 180 |
| COVID-19 diagnostic laboratories (total) | 23 | 72 | 50 | 12 | 200 |
Table 2. Estimated daily capacity for testing COVID-19 specimens in each province

<table>
<thead>
<tr>
<th>Province</th>
<th>Diagnostic laboratories assigned by MoH decree</th>
<th>Referral hospitals with RMT machine and BSC</th>
<th>Referral hospitals with RMT machine only</th>
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</thead>
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<tr>
<td></td>
<td>Surveillance (n)</td>
<td>Non-surveillance (n)</td>
<td>Estimated capacity</td>
</tr>
<tr>
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<td>30</td>
</tr>
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<td>North Sumatera</td>
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</tr>
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<td>0</td>
</tr>
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<td>0</td>
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<tr>
<td>Gorontalo</td>
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<td>0</td>
</tr>
<tr>
<td>Total</td>
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<td>28</td>
<td>2544</td>
</tr>
</tbody>
</table>

BSC: biosafety cabinet; MoH: Ministry of Health; RMT: rapid molecular testing.

*Laboratory capacity data missing for at least one COVID-19 diagnostic laboratory in the province.

*Laboratory capacity data missing for at least one COVID-19 diagnostic laboratory in the province without a real-time polymerase chain reaction (RT-PCR) machine.

*Laboratory capacity data missing for at least one COVID-19 diagnostic laboratory in the province.

Note: For surveillance laboratories that did not provide data, it was assumed that the maximum examination capacity was 100 specimens per day; meanwhile, non-surveillance laboratories that did not provide data were assumed to have a maximum capacity of 60 specimens per day. Both assumptions were based on the calculation of the average capacity for each type of laboratory shown in Table 1. For laboratories that did not have an RT-PCR machine, the maximum capacity was assumed to be zero specimens.
Expanding access to RT-PCR testing was the clear main priority, in addition to optimizing the laboratories owned by the NHIRD-Ministry of Health and the existing network of laboratories. Options also included allowing hospitals with biosafety cabinets and RT-PCR machines to carry out their own testing. As described below, we also assessed the potential for use of referral hospitals with RMT equipment.

**Investigation of use of RMT laboratory facilities of referral hospitals**

One of the fastest solutions to the deficit in testing capacity would be to optimize the 166 referral hospitals that had the capacity for RMT and also had a biosafety cabinet (Table 2). Assuming that each RMT machine had four modules (the most common type in Indonesia) and could do nine tests per day, 5976 specimens could be tested daily if all the requirements for COVID-19 examination were fulfilled (Table 2). The main challenges would be obtaining test cartridges for SARS-CoV-2 and the availability of trained personnel.

When we assessed the possibility of utilizing referral hospitals that own RMT machines and biosafety cabinets, it was clear that Bengkulu, Lampung, Central Kalimantan, North Kalimantan, South-East Sulawesi, Gorontalo, West Sulawesi and West Papua provinces would remain in a vulnerable position because of the absence of diagnostic laboratories and no or low availability of RMT plus a biosafety cabinet. We identified 132 referral hospital laboratories that had an RMT machine but did not yet have a biosafety cabinet. To enable these facilities to function as COVID-19 diagnostic laboratories, the government would have to provide biosafety equipment in addition to the cartridges for SARS-CoV-2. Using the same assumptions set out above, these additional facilities would provide an estimated testing capacity of 4752 specimens per day (Table 2). This left North Kalimantan, South-East Sulawesi, Gorontalo, West Sulawesi and West Papua provinces in an insecure position, so further identification of potential facilities was needed for these provinces.

**Lessons learnt and ways forward**

At the time of the assessment and survey discussed in this paper, the experience in China indicated to other countries that it would be essential to rapidly gain an understanding of the disease incidence and prevalence. Researchers used data from several sources to understand why COVID-19 had spread internationally from China at such great speed. They proposed that a reason was the large proportion of cases – estimated at 86% – that were contagious yet had mild, limited or no symptoms before the 23 January 2020 travel restrictions on Wuhan. The WHO–China joint mission on COVID-19 that was completed during 16–24 February 2020 reported that, in the context of meticulous case and contact tracing, between 1% and 5% of close contacts were subsequently laboratory-confirmed cases of COVID-19, depending on location.

In Indonesia, policy-making regarding the designation of diagnostic laboratories was dynamic. The government was aware of the need to be realistic about a possible surge in cases and the importance of speed of diagnosis for the management of patients. It was therefore clear that the 48 diagnostic laboratories and one national reference laboratory for COVID-19 would be insufficient. The Minister of Health therefore issued Circular Letter HK.02.01/Menkes/234/2020 on 7 April 2020, which provided guidelines for non-government laboratories on SARS-CoV-2 testing with RT-PCR equipment. This allowed other laboratories, such as those in universities and private facilities, to become diagnostic laboratories for COVID-19, providing they met the criteria set out in the guidelines. This policy was designed to deal with a challenging situation, and it was clear that a robust recording and reporting system would be needed to integrate data from the expanded and varied sources.

The capacity constraints clearly highlighted by the rapid survey of 44 government laboratories were lack of reagents and equipment, and limited human resources. At the time of the survey, some laboratories had no RT-PCR equipment or were not BSL-2. Some laboratories were obliged to rely on manual extraction processes that require more time to complete a series of examinations, thus limiting the testing frequency per day. Delays between processes were also introduced by the time taken to prepare tools and materials. For these reasons, some laboratories were unable to carry out testing at their maximum capacity. The scarcity of imported supplies, including RNA extraction kits, reagent kits, primers, probes, positive and negative controls, and master mix, was a serious challenge, and developing a strategy for a sustainable supply needs to be seriously considered.

The geography of Indonesia makes any reporting system highly dependent on rapid transport of specimens. Adequacy of tools and materials that support temperature stability during transport is therefore another vital requirement. The sample transport guidance in Indonesia stipulates that the temperature at the time of delivery should be 2–8 °C, to be achieved by placing the specimen in a cool box or using dry ice for the duration of transport for up to 3 days. A retrospective review of the performance of the Victorian Infectious Diseases Reference Laboratory, Australia, during the initial stage of the influenza A/H1N1pdm pandemic noted that transport of specimens had been a challenge. The review also noted that pandemic planning had focused primarily on internal laboratory resources and processes. However, for optimal functioning of the whole testing cycle, the transport of specimens and accompanying data from patient to testing site and the provision of results to the patients’ caregivers also needed to be optimal. In an outbreak situation where there are transport and flight restrictions, the government must facilitate the delivery of specimens, tools and materials so that laboratories can carry out their functions properly.

The increase in COVID-19 cases in Indonesia created a need to enlarge the number of laboratories to leverage capacity for COVID-19 specimen examination. Expanding RT-PCR testing capacity was clearly the main priority, in addition to optimizing laboratories owned by the NHIRD-Ministry of Health and the existing network of laboratories. Options also included allowing hospitals with biosafety cabinets and RT-PCR machines to carry out their own testing.

There was also the option of using SARS-CoV-2-specific kits that have been developed for use with RMT platforms that are currently deployed for tuberculosis diagnosis or HIV viral load testing. This option was supported on 27 April 2020 by the Director General of Prevention and Control of Disease through
Cepheid, Sunnyvale, United States of America), which is an RMT machine that can be operated by laboratory personnel with minimal training. The Food and Drug Administration of the United States of America has granted emergency authorization for the Xpert® Xpress SARS-CoV-2 cartridge; the assay is fully automated and provides results within about 45 minutes. Difficulties encountered relate to the availability of the Xpert® Xpress SARS-CoV-2 cartridges.

At present, there are hundreds of RMT machines spread across all health service facilities in Indonesia. Since 2015, they have been used to diagnose drug-sensitive and drug-resistant tuberculosis. The aim should be to transfer some RMT machines from testing for tuberculosis to testing for COVID-19 without halting or affecting the sustainability of the tuberculosis programme.

The results of the survey show that there are 166 COVID-19 referral hospitals that have both an RMT machine and support facilities. In addition, there are 132 COVID-19 referral hospitals that are equipped with only an RMT machine. However, using these alternatives would still not increase capacity enough, because several provinces would still be in a vulnerable position if case numbers surged. Each of these provinces should be provided with one RT-PCT unit. There are several laboratories that are BSL-3 or BSL-2 and have PCR facilities that are located in non-health institutions, such as faculties of agriculture or veterinary medicine. In addition, laboratories in the Ministry of Agriculture and the Ministry of State-owned Enterprises can also play a role in increasing COVID-19 testing capacity.

WHO has noted that, when testing facilities are limited, available facilities tend to be located in or near a capital city, making timely access to testing difficult for people living in other parts of the country. In these circumstances, mobile laboratories or automatic integrated nucleic acid amplification test systems that can be operated in remote areas and by staff with minimal training can be alternatives. In line with this, mobile BSL-2 laboratories are being developed by the Agency for the Assessment and Application of Technology and the Indonesian Institute of Sciences.

On 1 July 2020, the Minister of Health’s Decree No. HK.01.07/Menkes/405/2020 increased the number of COVID-19 diagnostic laboratories to 163. It also created a mandate for the establishment of further COVID-19 diagnostic laboratories. This extension of the number COVID-19 diagnostic laboratories has increased the coverage of the COVID-19 testing programme. On 29 July 2020, for the first time, the number of specimens examined in a day reached more than 30,000, achieving the WHO testing capacity target of 1 in 1000 inhabitants per week. Further increases in testing capacity for COVID-19 in Indonesia will require developing and establishing a laboratory network system and laboratory referral mechanisms, in addition to increasing the capacity of the laboratory workforce in terms of size and skills.

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References


Monitoring COVID-19 where capacity for testing is limited: use of a three-step analysis based on test positivity ratio

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Abstract
In an effort to monitor coronavirus disease 2019 (COVID-19), many countries have been calculating the ratio of cases confirmed to tests performed (test positivity ratio – TPR). While inferior to sentinel surveillance, TPR has the benefit of being easily calculated using readily available data; however, interpreting TPR and its trends can be complex because both the numerator and the denominator are constantly changing. We describe a three-step process where the ratio of relative increase in cases to relative increase in tests is accounted for in an adjusted TPR. This adjusted value more appropriately reflects the case number and factors out the effect of changes in the number of tests done. Unadjusted and adjusted TPRs are then assessed step-wise with reference to the epidemic curve and the cumulative numbers of cases and tests. Use of this three-step analysis and its potential use in guiding public health interventions are demonstrated for selected countries and subnational areas of the World Health Organization South-East Asia Region, together with the Republic of Korea as a reference. To date, application of the three-step analysis to data from countries of the region has signalled potential inadequacies of testing strategies. Further work is needed on approaches to support countries where testing capacity is likely to remain constrained. One example would be enumeration of the average number of tests needed to detect one COVID-19 case, which could be stratified by factors such as location and population. Such data would allow evidence-informed strategies that best balance the highest detection rate with the prevailing testing capacity.

Keywords: COVID-19, laboratory testing, test positivity ratio

Background
On 11 March 2020, the World Health Organization (WHO) declared coronavirus disease 2019 (COVID-19) a pandemic. By mid-June 2020, while the status of the COVID-19 epidemics in other WHO regions appeared to be post-peak, the numbers of cases were still rising in the Americas, African and South-East Asia regions. Countries of the WHO South-East Asia Region have been actively engaged in increasing capacity for laboratory testing for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), and most have publicly released daily numbers of tests performed. However, there have been vast differences among countries in the reported number of tests done per capita. Reasons include differences in individual countries’ epidemiological situations, infrastructures, resources, supply chains and availability of testing equipment. This deficit in testing capacity in the region, which mirrors the global shortage, is expected to remain a major challenge in the months ahead. This will further hinder countries’ ability to estimate the real incidence of COVID-19, which is indispensable to monitor the effectiveness of public health and social measures and implement changes to these measures with confidence.

Many countries have used laboratory data to calculate a test positivity ratio (TPR) and have used TPR trends to assess and compare their epidemic response performance with countries that are judged to have responded well, such as the Republic of Korea, and with those that are not. However, interpreting TPR and its trends can be complex because both the numerator and the denominator are constantly changing; to date, both the number of positive test results and the number of tests done have been increasing daily. Moreover, both values can be influenced independently by many factors. TPR characteristics depend on whether countries are in community transmission mode or at the beginning or end of an epidemic. In addition, low or high TPRs depend on many factors, such as the scale of transmission in the community, the testing strategy and consistency in its application, and implementation issues. Unless these factors are considered, TPR will not allow correct interpretation of the progression of an outbreak.

This paper describes a three-step analysis of TPR to monitor the progress of an outbreak and the quality of national
response. To demonstrate its utility, we apply this analysis to selected countries and two subnational areas of the WHO South-East Asia Region and, as a reference, to the Republic of Korea. The results should help optimize testing strategy and stimulate further work to improve outbreak response in countries where testing capacity is limited.

Three-step analysis of test positivity ratio

The analysis uses an “observed TPR” and an “adjusted TPR”.

**Observed TPR**
The observed TPR is derived from the daily data reports published on official websites and is calculated by dividing a day’s number of reported cases of COVID-19 by the number of tests for SARS-CoV-2 performed on the same date. This observed TPR differs from the actual TPR in that the denominator is the number of tests done, which will always be more than the number of suspected cases tested because a proportion of cases will be tested more than once. However, since all other factors are relatively constant, the observed TPR serves as a reasonable proxy for the real value.

**Adjusted TPR**
For the adjusted TPR, the daily observed TPR is multiplied by the daily ratio of increase in cases to increase in tests. The adjusted TPR on day t is the observed TPR on day t multiplied by the ratio of relative increase in cases on day t to the relative increase in tests on day t. The adjusted TPR therefore appropriately takes account of the influence of the numerator and factors out the effect of the denominator.

The adjusted TPR for day t is calculated as:

\[
\text{adjusted TPR}_t = \text{observed TPR}_t \times z_t, \quad \text{where} \quad z_t = \frac{r_{\text{case}}}{r_{\text{test}}}
\]

The growth rates of cases and tests on day t, respectively, are calculated as:

\[
r_{\text{case}} = \frac{C_t - C_{t-1}}{C_{t-1}} \quad \text{and} \quad r_{\text{test}} = \frac{T_t - T_{t-1}}{T_{t-1}}
\]

C is the reported number of cases at day t or t − 1; T is the reported number of tests done at day t or t − 1.

**Three-step analysis**
The observed TPR and the adjusted TPR, together with the reported data on cases and tests, are visualized graphically in three separate steps to assess and compare trends.

- **First step, graphs A**: Observed TPR (7-day moving average); tests done (7-day moving average); cases reported (epidemic curve).
- **Second step, graphs B**: Observed TPR (7-day moving average); tests done (cumulative); cases reported (cumulative).
- **Third step, graphs C**: Observed TPR (7-day moving average); adjusted TPR (7-day moving average); cases reported (epidemic curve).

In addition, increases in cases (\(r_{\text{case}}\)) and tests (\(r_{\text{test}}\)) that are exponential are calculated using the LOGEST function in Microsoft Excel.

Examples of use of the three-step analysis

Annex Fig. 1 shows graphs A, B, and C for the following countries/states and time periods: 1. Thailand (13 January–3 June 2020); 2. Republic of Korea (31 December 2019–25 May 2020); 3. India (30 January–3 June 2020); 4. Maharashtra, India (5 April–4 June 2020); 5. Sri Lanka (28 January–3 June 2020); 6. Kerala, India (1 April–3 June 2020).

**First step**: The observed TPR trend (graphs A in Annex Fig. 1) is interpreted with reference to the epidemic curve. Observed TPR trends can be either relatively unchanged (graphs 3A, 4A, 6A) or follow the shape of the epidemic curve (graphs 1A, 2A, 5A). For the latter, the observed TPR trend appears to be a proxy for the trajectory of an epidemic, with lower rates at the beginning and end and higher rates at the peak.

**Second step**: The observed TPR is interpreted against cumulative cases and cumulative tests and the correlation between the two (graphs B in Annex Fig. 1). Correlation between cumulative cases and tests indicates the effect of the denominator, i.e., the increase in the number of cases is a result of increased testing (graphs 3B, 4B). Lack of correlation (i.e., logistic growth for cases versus exponential growth for tests, as seen in graphs 1B and 2B) indicates that the increase in cases is independent of the increase in tests done, provided that the testing strategy has not changed.

**Third step**: Both the observed TPR and the adjusted TPR are interpreted with reference to the epidemic curve. Since the adjusted TPR appropriately takes into account the influence of the numerator and has the effect of increasing or decreasing the observed TPR, an increasing adjusted TPR trend reliably reflects a true increase in cases relative to an increase in tests. Similarly, when the adjusted TPR is decreasing in accordance with the epidemic curve, this is a signal that the number of cases actually is declining. Any discordance between the adjusted TPR and the epidemic curve is then explained by factors such as a change in testing strategy. This is an especially useful indicator for monitoring the progress of an epidemic when the observed TPR is flat.

Illustration of the three-step analysis

The examples shown in Annex Fig. 1 and described below demonstrate the application of the three-step analysis of TPR and its potential use in guiding public health interventions.

Outbreak and post-peak community transmission

(1. Thailand and 2. Republic of Korea)

- **Key trends**: The increase in cases (logistic) was independent of the increase in testing (exponential). The observed TPR trends followed the shape of the epidemic curve (graphs 1A, 2A). This was confirmed (graphs 1C and 2C) by the exaggerated adjusted TPR closely mirroring the epidemic curve. Note that, for Thailand, the number of tests corresponds to the reported number of patients under investigation and not the actual number of tests performed.

- **Interpretation**: This was the expected trend in the adjusted TPR. This indicates that the testing strategy was consistently and effectively applied throughout the epidemic.
Likely community transmission or uncontrolled large and numerous clusters, at least in some subnational areas (3. India)

- **Key trends:** The observed TPR was relatively flat overall or decreasing during 1 April–5 May, while cases were increasing. From 6 May, the observed TPR started to increase steadily (graph 3A). The exponential growths in cumulative tests (10.3%) and cases (8.7%) were similar (graph 3B). After 6 May, TPR trends mirrored the epidemic curve, and the adjusted TPR increased faster than the observed TPR (graph 3C).

- **Interpretation:** The flat observed and adjusted TPRs up to 5 May are explained by the cumulative case trend mirroring that of tests, since the increase in the number of cases was mostly due to an increased number of tests. From 6 May onwards, the increase in the adjusted TPR mirrored the epidemic curve and reflected a significant change in testing strategy, shifting from a low-yield to a higher yield approach. This included, for example, the suspension of testing of asymptomatic cases and resulted in a higher case-detection rate.

Likely community transmission in a subnational area (4. Maharashtra, India)

- **Key trends:** Testing numbers increased and peaked around 29 May (graph 4A). The increase in the observed TPR was relatively uniform apart from a dip during 10–21 May (graph 4A). Cumulative tests and cases grew exponentially, not mirroring each other (different growth rates of 5.9% and 8.4%, respectively, graph 4B). The TPR trends matched the epidemic curve in multiple periods; the adjusted TPR trends significantly exaggerated the observed TPR trends while matching the epidemic curve during these periods (graph 4C).

- **Interpretation:** The testing strategy was responsive. However, variations in the adjusted TPR suggest there were inconsistencies in applying the testing strategy, as the number of cases increased steadily.

Clusters of cases in a country (5. Sri Lanka)

- **Key trends:** There was a steady increase in the number of tests performed (graph 5A). However, observed TPR trends were relatively unchanged (graph 5A). Cumulative tests and cases grew exponentially, but the curves do not match (graph 5B). Observed TPR trends matched the epidemic curve, with amplified adjusted TPR trends during the epidemic peaks (graph 5C).

- **Interpretation:** The testing strategy was consistently applied, with the adjusted TPR reflecting the epidemic curve.

Clusters of cases in a subnational area (6. Kerala, India)

- **Key trends:** TPR was low but mirrored the epidemic curve (graph 6A). Clusters of cases were the transmission pattern until a very large increase in cases at the end of May (graph 6A). Cumulative tests (3.7%) and cases (1.6%) grew exponentially but for limited periods (graph 6B). The observed TPR mostly reflected the epidemic curve; adjusted TPR trends exaggerated the effect of observed TPR trends, but more significantly from mid-May onwards (graph 6C).

- **Interpretation:** The testing strategy was consistently applied but skewed towards lower yield detection rates, indicating a possible need for strategy optimization to improve detection.

**Developing further tools to inform testing strategies in capacity-limited settings**

The WHO Regional Office for South-East Asia has been using TPR and its trends as part of its obligation under the International Health Regulations, 2005, to monitor the epidemic in the region and for risk assessment purposes. WHO has produced guidance on reporting COVID-19 data and has recommended that countries also consider using existing hospital-based severe acute respiratory infection (SARI) and primary care influenza-like illness (ILI) sites, or whichever syndromic respiratory disease systems may already be in place for surveillance. Harnessing these sentinel surveillance data based on random sampling and testing of SARI and ILI cases to monitor the epidemic trajectory would indeed be very helpful. However, most countries in the WHO South-East Asia Region have had limited capacity to share this information with WHO with the timeliness that effective monitoring requires, since they have been overwhelmed with their COVID-19 response activities. Since the three-step analysis described in this paper uses data already available, it could be a useful complement to sentinel surveillance for COVID-19 to monitor the epidemic.

More importantly, the authors have been using TPR and trends to detect and raise questions on potential inconsistencies between data and their interpretation on the response performance. Use of the three-step analysis has allowed the WHO Regional Office for South-East Asia to engage national health authorities. An example was the instance of a consistently low TPR while cases rose in the context of community transmission, as shown in graph 3A. This situation was explained by a low-yield detection strategy combined with under-detection. As testing capacity had been limited, the regional office suggested that the health authorities should review their testing strategy and its implementation to shift from a low-yield to a higher yield strategy.

A major contribution of use of the three-step analysis in the region to date has been to signal potential inadequacies of testing strategies in settings in which testing capacity is limited. We therefore propose a review of testing strategies that allows a basic assessment and comparison of the average number of tests needed to detect one COVID-19 case. The review could assess how this yield effectiveness might be sustained for each country, in the light of projected testing needs and overall testing capacity. For individual countries, testing strategy could be further informed by assessing the yield effectiveness by category. First, especially for large countries, this would be by geographical location (e.g. by subnational level) and by type of transmission dynamics (i.e. no circulation, clusters of cases, community transmission). The estimates would then inform testing strategy in terms of the populations to be prioritized for testing. Second, yield effectiveness could be estimated and compared among population categories, such as asymptomatic cases, contacts, ILI cases, SARI cases, vulnerable populations and health-care workers.
As a caveat, seeking highest yield (i.e. the highest detection rates) could be misleading. For instance, mainly testing patients with SARI as community transmission is evidenced will increase yield, as these patients are more likely to have SARS-CoV-2 infection; however, cases with mild symptoms or that are asymptomatic may not be detected and the disease could consequently spread. A change in testing strategy runs the risk both of increasing and of decreasing case identification.

These data would allow evidence-informed discussion on the approach that best balances the highest detection rate with an acceptable number of tests needed; the approach would be based on feasibility and acceptability and would take into account limited testing capacity. Indeed, obtaining the highest sensitivity of detection would not be within the reach of countries of the region. In the context of this limited testing capacity, the WHO has recommended that testing is prioritized for people who meet the WHO criteria for a suspected COVID-19 case. In addition to increasing yield effectiveness, the priority is to identify and isolate patients with respiratory symptoms, who are more likely to transmit to others.

In conclusion, as testing and isolating many infected cases may not be achievable in capacity-limited settings, interrupting the chain of transmission must rely on substantial organization efforts and dedication to listing, tracing and quarantining all contacts. From the start of the epidemic, the WHO Health Emergencies Programme of the regional office has emphasized improving the quality of contact tracing as its primary objective when supporting Member States.

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**References**

For Thailand, the number of tests corresponds to the reported number of patients under investigation and not the actual number of tests performed.

Exponential growth in tests = 3.7% and in cases = 1.6%.
Annex Fig. 1, continued Three-step test positivity analysis applied to six geographical areas

TPR: test positivity ratio. Both observed and adjusted TPRs plotted as 7-day moving averages.
*For Thailand, the number of tests corresponds to the reported number of patients under investigation and not the actual number of tests performed.

Exponential growth in tests = 10.3% and in cases = 8.7%.
Exponential growth in tests = 5.9% and in cases = 8.4%.
Exponential growth in tests = 3.7% and in cases = 1.6%.
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