Are overwhelmed health systems an inevitable consequence of covid-19? Experiences from China, Thailand, and New York State

Drawing on international experiences, **Viroj Tangcharoensathien and colleagues** argue that immediate extensive action to contain local transmission of new infectious diseases protects health systems from being overwhelmed

In January 2021, a year after the covid-19 epidemic began in China, the number of active cases in the US (8.45 million) was placing significant strain on the US health system. This compared with just 443 cases in China and 4847 in Thailand. By 6 January 2021, the US had reported 21.8 million cases of covid-19 and 369 443 deaths, while China had 87 215 cases and 4634 deaths and Thailand 9331 cases and 66 deaths.[1] The cases per million population in the US (65 722), China (61), and Thailand (134), and the death rate per million (1113, 3, and 0.9, respectively) reflect large variations in responses to the epidemic.

Analysis of the responses in these three settings and comparison with the World Health Organization's recommended actions shows their effect on health delivery systems and provides lessons on how to protect health systems from being overwhelmed by covid-19 and future emerging infectious diseases.

China and Thailand locate prime responsibility for outbreak management at central level and have a national homogeneous policy response with implementation through provincial authorities. However, the state federal system in the US has resulted in large variations in covid-19 responses across states. For this reason we have compared the two countries with one US state—New York State, which was the initial epicentre of the US epidemic. By January 2021, New York State with a population of 19.5 million had reported a total of 1 098 725 cases, with 38 879 deaths and 573 358 active cases.

KEY MESSAGES

- Rapid increase in covid-19 cases seriously disrupts health delivery systems, creates stress in the health workforce, limits access to hospital services, and increases mortality
- Country evidence shows that infection of covid-19 can be contained at very early stage of the epidemic through public health measures such as use of face masks and physical distancing
- Cross-sectoral coordinated action and an effective test, trace, quarantine, and treatment system for covid-19 patients are also vital
- Effective governance is needed to ensure citizen adherence to public health measures and social interventions that are key to protect health delivery systems from disruption

WHO recommended action

The value of WHO recommendations on covid-19 responses has been affirmed by countries' implementation experiences.[2 3] The responses can be categorised into three groups:

- Preventing local transmission through social and public health measures—notably use of face masks and physical distancing in public spaces,[4] testing to identify cases, contact tracing, quarantine of affected persons, treatment of severe cases, and preventing hospital acquired covid-19
- Ensuring and mobilising sufficient physical, human, and financial resources to perform public health functions and provide access to clinical services to minimise mortality while maintaining other essential health services
- Governance arrangements, especially whole government orchestrated actions on pandemic management and risk communication with citizens.

WHO recommendations on physical distancing and use of masks are based on systematic review and meta-analysis.[5] Masks are not just for self-protection but also protect others by blocking respiratory droplets from infected asymptomatic people.[6] The high proportion of people with positive results who are asymptomatic—50-75% of those identified through population screening in Italy[7] and 78% in China[8]—supports the use of masks to prevent spread.[9] In a study in 20 614 asymptomatic healthcare workers, use of any mask reduced risk of infection compared with no mask use (odds ratio 0.58, 95% confidence interval 0.50 to 0.66).[10]

Preventing local transmission

At the early stage of the epidemic, the Chinese and Thai governments applied public health measures,[11] notably the use of face masks (table 1).[12] Masks are mandatory in public spaces in China[13] but not Thailand, although its citizens have a high level of awareness and adherence. Physical distancing, hand hygiene, and improved ventilation in living spaces are enforced through a whole society approach with high compliance in China and Thailand; these practices varied across states in the US.

Thai and Chinese governments applied strict measures to test, trace, and quarantine, but practices in New York State were not as rigorous. Active case finding was guided by epidemiological evidence in Thailand and China but varies across states in US. Thailand has been training field epidemiologists since 1980,[14] and had over 1000 surveillance and rapid response teams nationwide, responsible for public health measures. It monitored citizens' preventive behaviour (use of face masks, hand hygiene, physical distancing) through weekly online surveys between April and December 2020 with results reported to the government and general public.

In New York State, the first covid-19 case was reported on 29 February 2020 and

Table 1 | Summary of policy responses to covid-19 and their effect in China, Thailand, and New York State

	China	Thailand	New York State
Use of face masks and physical distancing	Mandatory in public areas with high adherence	Voluntary and high adherence	Partial implementation with large variations across states
Restriction of domestic travel and social gatherings	No state of emergency introduced, but high compliance with stay at home policy	State of emergency declared; high level of compliance with stay at home	Belated state of emergency introduced two weeks after the first cases, resulting in large surge of cases
Restriction of inbound international arrivals	Mandatory test and state quarantine for all travellers	Mandatory state quarantine for all arrivals	US introduced international travel restriction
Test, trace, quarantine	Rigorous implementation and mandatory quarantine of positive cases	Scaled up laboratory capacity, strong capacity on surveillance and rapid responses, and mandatory quarantine	Initial limitation in laboratory capacity, contact tracing not rigorously implemented, self quarantine at home may not prevent spreading
Availability of PPE	Self reliance through local production	Initial shortage but rectified by scaling up local production	Critical shortage, reliance on suppliers from other countries
Treatment and access to care	Access is facilitated by universal health coverage, plus additional budget allocation; no supply side constraints when cases are brought under control	Universal coverage grants full access, plus additional budget allocation, treatment is free for all Thais and non-Thais	Federal government pays doctors and hospitals for the uninsured at Medicare rates but balance billing not allowed; long queues and limited access
Mobilising surge capacity and critical resources	Central government provides substantial resources to support Wuhan responses	Cases are few and within resource capacity of each province	Inadequate federal government support to state's mitigation efforts
Governance and public communication	Effective whole government approach; daily update and high trust in the population	Whole government responses led by prime minister, effective daily communication builds trust and gains citizen adherence to measures	Conflicting announcements between governor and mayor; generally inconsistent, insufficient, and confused public messaging in US
Effect on transmission	Local transmission contained to less than two digits by March 2020; volume of covid-19 patients did not overwhelm the health system	Local transmission contained to two digits by May 2020; case load did not disrupt health system	Daily cases contained to less than 1000 by June 2020, but the large number of patients disrupts health systems

the first death on 11 March.[15] The state's response was limited by its laboratory testing capacity and the initial guidance to focus testing on people with a history of exposure, as recommended by the Centers for Disease Control and Prevention (CDC). Information from its surveillance of emergency department visits showed influenza-like illnesses were on the rise, raising the spectre of community spread.[16]

New York State implemented the usual public health measures. A communications campaign emphasised hand washing and social distancing, which the city mayor modelled in his conduct of business. Public messages urged people to stay home if symptomatic (eg, fever and cough) and to seek testing if ill. A contact tracing system was implemented[17] with considerable support offered to people recommended to self-quarantine, though adherence is not known. New York's responses in term of contact tracing and quarantine were not as systematic and rigorous as in Thailand and China, as shown by the rapid spread of infection.

Population use of face masks was 95% in Thailand[18] and China.[19] Despite the US surgeon general and CDC advice that everyone should wear a mask, it was up to state and local governments to issue mandates, and not all did so. By July 2020, 72% of US states had mandated the use of masks in public places,[20] but on average, only 59% of US citizens reported always wearing a mask when leaving home, with large geographical variation reflecting differences in disease risk and politics.[21]

On 13 March, with 95 confirmed covid-19 cases but far more suspected,[22] the New York mayor announced a state of emergency, limiting gatherings and urging work from home where possible. It was two full weeks after the first confirmed case before public health authorities acted to limit population movement by closing restaurants, bars, and schools. They also further limited public gatherings, effectively beginning an economic shutdown. The Thai government declared a state of emergency nationwide on 25 March, eight weeks after the first confirmed local transmission, which triggered prompt interventions such as a stay at home policy, physical distancing, scaled-up local private sector production of face masks and other protective equipment (PPE), closure of all public venues, and a curfew between 2200 and 0400 to prevent all social gatherings. Though China did not declare a state of emergency, the government encouraged a stay at home policy, discouraged mass gatherings, cancelled or postponed large public events, and closed schools, universities, government offices, libraries, museums, and factories.[23]

To respond to demand spikes for N95 and face masks and given the global shortage, the Thai private sector constructed a new factory in a month and supplied free N95 masks to health facilities. China also scaled up daily production of N95 and non-N95 masks, from 13 000 and 5.86 million, respectively, in February to 5 and 200 million by April. China had 1266 certified PCR laboratories nationwide, while Thailand scaled up from 80 laboratories in April to 244 in September. The US had a critical shortage of face masks, including N95, as the country relied on contractors and suppliers from low and middle income countries.[24]

Although there are no comparable data on population movement, such as mobile device location across the three settings, China and Thailand introduced policies that discouraged domestic travel while practice varied across US states. New York State implemented travel restrictions that required quarantine on arrival to the state from certain jurisdictions. All three countries introduced restrictions on international travel (table 1). By June 2020, the infection had not spread to other provinces in China except for some small outbreaks in Beijing, Liaoning, and Xinjiang. Thailand stopped local transmission by 25 May 2020; subsequent infections have been mainly in international arrivals detected during the 14 day mandatory quarantine, though in December 2020 there was a second surge of local transmissions. New York State brought down the number of cases by the end of May 2020, but there were still around 1000 cases a day between June and September and cases rose again at the

end of the year, from 3000 cases a day in October to 12 000 in December.

Mobilising resources

The Chinese government mobilised 346 medical teams—a total of 42 600 medical staff and 900 public health professionals—to support Wuhan city and Hubei province. Two new hospitals were rapidly constructed to provide an extra 2600 beds while 16 mobile cabin hospitals with 14 000 beds were designated for mandatory quarantine of patients with mild disease.[25]

Thailand's cases were similarly concentrated; the top 10 affected provinces had 87% of total cases, prompting the public health ministry to mobilise surge capacity of intensive care bed and specialists, though they were eventually not fully needed. Pressure on health facilities in Bangkok at the peak of the epidemic triggered the development, in consultation with stakeholders, of a "rationing protocol"[26] which was eventually not applied as demand for critical resources was small.

In New York City, mobilisation efforts were more fragmented. A non-profit organisation set up hospital beds in a convention centre and a medical tent in the city's Central Park. Volunteer health workers came from other jurisdictions. The public and private hospital systems sought to collaborate to rationalise access to critical resources such as intensive care beds and ventilators[27 28] when numbers of covid-19 patients rose exponentially and demand exceeded capacity.[29] Evidence shows lack of federal government support to the New York State's mitigation efforts, in a context of the politicisation of covid-19 responses in the US and conflict between New York Governor Cuomo and President Trump over the gravity of New York's situation.[30]

The Chinese local governments were responsible for financing the mandatory test and quarantine of international travellers. In China, the ministry of finance allocated $23.8bn (£17.5bn; €20bn) by May 2020 to support local government response.[31] Since China has universal health coverage, the two social health insurance schemes paid treatment costs, while other costs were fully subsidised by the government. Similarly, the Thai government earmarked additional funding for free PCR tests for all suspected cases, personal protective equipment for specimen collection, and state quarantine for anyone with a positive result,regardless of citizenship; treatment was fully covered by universal health coverage with no copayments. Though uninsured populations in the US were liable to pay for covid-19 treatment, the federal government paid doctors and hospitals for their care at Medicare reimbursement rates on condition that patients were not billed for the balance.[32] Some insurance companies waived copayment for insured members.[33] The upsurge of demand and supply side constraints in New York State resulted in long queues and probably affected ability to access treatment, unlike in Thailand and China where everyone who needed treatment had access.

Governance and public communication

The Thai government established a Centre for Covid-19 Situation Administration to coordinate multisectoral actions. This whole government response was led by the prime minister.[34] Similarly, a whole government approach in China involved coordinated action by central and provincial governments.[35] Both countries used epidemic data and trends to inform policy responses; daily confirmed cases and deaths were publicly reported and risks communicated to gain citizens' trust and adherence to policy interventions. An international survey of public perceptions of government responses shows a high Chinese score (80.48 (SD 16.31) out of 100) and a much lower score in the US (50.57 (28.99)), though Thailand was not included.[36]

The US media, particularly print journalism, emerged as the most used source of public health data on covid-19. They reported overwhelmed public hospitals, overflowing morgues, and difficulty obtaining testing.[37] The conflicting announcements between the New York governor and the city mayor reflected a longstanding rivalry that was manifest throughout the initial surge in covid-19 cases.[38] The city faced failure of governance on many fronts: lack of federal government support to expand laboratory capacity and identify community spread, a state authority that seemed to compete with city public health structures, and reluctance of the city's political leadership to take actions that would change daily life, resulting in greatly increased hardship, especially in low income communities. There was inconsistent messaging on wearing masks, incongruent communications on risk of infection, and insufficient communications on the proper use of disinfectant against virus.[39]

By contrast, in both China and Thailand, strong and unified governance structures ensured consistent communications. For example, Thailand has no federal-state relationship and provincial governors were delegated full power for covid-19 management, with the municipality mayor a member of the provincial infectious disease control committee, chaired by the governor.

Effect of covid-19 on health services

In China, between January and June 2020, outpatient visits were 21.6% lower and admissions 16.6% lower than in the same period in 2019.[40] Decline in use of health services was also reported in Wuhan as a result of travel restrictions and longer prescriptions for drugs for non-communicable diseases. Though the number of cases in Thailand was within the capacity of the health delivery system, the coverage of fully immunised children fell slightly, from 83% in the first quarter of 2020 to 79.9% in the second quarter. There was no interruption of lifesaving interventions such as antiretroviral treatment and dialysis, but outpatient visits fell nationally and in Bangkok.

The high case numbers in New York State led to much more severe consequences. Deaths from covid-19 rose to 800 a day, and around 23 000 confirmed and probable deaths were recorded before transmission began to decline. A disproportionate number of deaths occurred in black and Latino populations, who are overrepresented in the lowest socioeconomic groups.[41] From 11 March to 2 May 2020, a total of 32 107 deaths were reported, 24 172 (75%) above the number expected in that period. Of these 24 172 deaths, 57% were in people with laboratory confirmed covid-19, 21% were associated with probable covid-19, and 22% were not directly linked to covid-19 but were probably the result of health system disruption.[22] On 1 July 2020, there were 295 984 active cases in New York, which clearly overwhelmed the health delivery systems and the capacity to maintain other essential health services, though data are unavailable on the consequences. Emergency medical services in New York City faced unprecedented challenges in finding beds for patients and high levels of stress and fatigue.[42] Surge clinics were set up to offload the emergency departments.[43]

What can we learn?

Though the measures taken were similar across settings, large differences in the number of daily cases resulted from differ-

ences in timing of measures, coverage, and citizen adherence as well as in strength and unity of governance and leadership of multisectoral actions.

Effective government action at the early stage of the epidemic in China and Thailand successfully contained cases through synergies between public health and social interventions, and high levels of citizen adherence to personal protection. Evidence from other countries shows that effective and decisive leadership,[44] as well as transparency and accountability of decision makers, contributes to better containment.[45] The politicising of covid-19 and poor coordination between federal and state, and state and city governments impeded responses in the US compared with China and Thailand. Furthermore, universal health coverage in China and Thailand ensured full access to public health interventions and medical treatment.

Population adherence was a critical influence on the epidemic, and population and government attitudes and positions determined adherence. The US has much lower coverage of face masks than Thailand and China. The US libertarian values of emphasising personal liberty and disregarding official advice, and public discourse framing this public health measure as an infringement on personal liberty, meant the decision to wear a mask reflected a political position.

The rapid increase in virus spread and number of active cases significantly strained US healthcare, and US politics, leadership, and tense relations between states and federal government on managing covid-19 infections was reflected in the uncoordinated and ineffective responses in New York State. The experiences of these three settings show that timely and decisive policy decisions, effective and adequately funded public health and social measures, and citizen trust and adherence to these measures are critical elements of effective pandemic control.

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