Asia-Pacific Economic Cooperation

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INCREASING PANDEMIC PREPAREDNESS AND PREVENTION IN THE APEC REGION

A LITERATURE REVIEW OF THE ECONOMIC IMPACTS AND LEVELS OF PREPAREDNESS

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ACRONYMS

ABAC	APEC Business Advisory Council
ADB	Asian Development Bank
AI	Artificial Intelligence
AMR	Antimicrobial resistance
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
CDC	Centers for Disease Control
CEPI	Coalition for Epidemic Preparedness Innovations
CHW	Community health worker
COVID-19	Coronavirus disease 2019
EID	Emerging infectious diseases
EPWG	Emergency Preparedness Working Group
GDP	Gross domestic product
GPMB	Global Preparedness Monitoring Board
H5N1	Highly pathogenic Asian avian influenza A
HIV	Human immunodeficiency virus
HWG	Health Working Group
ICU	Intensive care unit
IHR	International Health Regulations
ILO	International Labor Organization
IMF	International Monetary Fund
JEE	Joint External Evaluation
LSIF	Life Sciences Innovation Forum
MERS	Middle East respiratory syndrome
NHI	National Health Insurance
OECD	Organization for Economic Cooperation and Development
PAHO	Pan American Health Organization
PPE	Personal protective equipment
PSU	Policy Support Unit
R0	Reproduction number
SARS	Severe acute respiratory syndrome
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
SIAPS	Systems for Improved Access to Pharmaceuticals and Services
SME	Small and medium-sized enterprise
TPTWG	Transportation Working Group
UNWTO	World Tourism Organization
USAID	United States Agency for International Development
USSD	Unstructured Supplementary Service Data
WHO	World Health Organization
WTO	World Trade Organization

EXECUTIVE SUMMARY

INTRODUCTION

Emerging infectious diseases (EID) are increasing in frequency and expanding in impact, and this is evidenced by the current COVID-19 (coronavirus disease 2019) global outbreak.[1] The Asia-Pacific region is particularly vulnerable to cross-border disease outbreaks. The region has experienced the impacts of several outbreaks of emerging infectious diseases, including the severe acute respiratory syndrome (SARS) outbreak in 2002–2003 that had significant impacts on several Asia-Pacific Economic Cooperation (APEC) economies, the outbreak of highly pathogenic Asian avian influenza A (H5N1) which followed in 2006, strains of H1N1, as well as the Middle East respiratory syndrome (MERS).

This analysis is timely, as the region focuses on fighting the current COVID-19 pandemic. This report's findings can help strengthen the evidence base to guide policy responses in the region to combat COVID-19 and recover safer for future infectious disease threats. This analysis is closely aligned with the APEC Health Working Group (HWG) Strategic Plan (2016–2020), which emphasizes the importance of managing cross border health threats and disease outbreaks by "enhancing the preparedness and response to public health emergencies and disasters, including prevention and control of emerging and re-emerging infectious diseases."

ESTIMATING THE ECONOMIC IMPACT OF COVID-19

As the COVID-19 pandemic is still evolving globally, its full economic impacts are not yet fully appreciated. However, the extent of the dramatic supply and demand shocks, and the major disruptions to trade, have and will cause severe economic damage. Some experts have suggested that the impacts could surpass those of the 2008 Global Financial Crisis and even the Great Depression.

In terms of impacts to the APEC region, a study undertaken by the APEC Policy Support Unit (PSU) in April 2020 indicates that real gross domestic product (GDP) in the region is expected to contract by 2.7 percent in 2020, compared to 3.6 percent growth in 2019, making this the most significant drop since the near-zero growth rate recorded in 2009 as a result of the global financial crisis.[2] This growth reduction translates to an estimated output loss of US$2.1 trillion due to the economic fallout from the pandemic. This is compounded by an additional 23 million people becoming unemployed in 2020. In July 2020, the PSU revised its estimates to predict a bleaker scenario. Based on the PSU analysis, the APEC region is projected to contract by 3.7 percent in 2020, which translates to an output loss of around US$2.9 trillion. The PSU projections suggest growth in 2021 will rebound to 5.7 percent, subject to the successful containment of the pandemic in the second half of 2020, the continuation of fiscal and monetary support measures, and the development of effective vaccines and treatment.[3]

While the economic losses are staggering, the human toll is devastating, and as of August 2020 there were nearly 19 million cases and 70,000 deaths. The morbidity and mortality from the COVID-19 pandemic will have impacts on economies for the foreseeable future.

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[1] Throughout the report, the disease will be termed "COVID-19" and the virus will be referred to as "SARS-CoV-2" as per World Health Organization, "Naming the Coronavirus Disease (COVID-19) and the Virus that Causes It," https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it.

[2] APEC Policy Support Unit, "APEC in the Epicenter of COVID-19," (policy brief #31, April 2020).

[3] APEC Policy Support Unit, "Deeper Contraction Calls for Decisive Action," APEC Regional Trends Analysis (July 2020).

GAPS IN PREPAREDNESS RESPONSE

Despite improvements in surveillance and preparedness since the severe acute respiratory syndrome (SARS) associated coronavirus or SARS-CoV, the world was woefully ill-prepared for the fast-moving virulent COVID-19 pandemic. The outbreak exposed gaps and limitations in economy-level, regional, and global capacities, to governments' ability to prevent, detect, prepare, report, and respond adequately, which has caused significant human loss, suffering and economic cost, globally. But these gaps were apparent even before COVID-19. For example, the 2019 *A World at Risk* report found that the failure to effectively implement the recommendations following the H1N1 (2009) influenza pandemic and the Ebola outbreak (2014–2016) has left serious gaps in preparedness.[4] This is termed by experts as the "neglected dimensions of global security" where renewed calls for improving preparedness efforts both globally and locally, went unheeded.[5]

Data collected through existing evaluation tools reveal that preparedness levels across economies and regions vary considerably.[6] While most economies have pandemic preparedness plans, most are never exercised to gauge the efficacy of these plans to respond to health emergencies. Furthermore, despite high-level commitments made by regional and multilateral organizations to support preparedness efforts, follow-through is often lacking. In most cases, preparedness efforts are hampered by the lack of funding and effective leadership, stewardship, and poor governance. In addition, good global health security risk management incorporates effective "whole of government" and "whole of society" approaches.[7] But in many contexts, preparedness planning efforts often lack effective multi-stakeholder approaches which should involve engaging local governments and nongovernmental actors such as the private sector and civil society. In addition, resource constraints also influence levels of preparedness.

CONCLUSIONS AND RECOMMENDATIONS

The COVID-19 pandemic has highlighted long-standing weaknesses in health systems and vulnerabilities in global health response capabilities, as the world struggles to reduce the human and economic toll of this pandemic. It is apparent that urgent support, actions, and effective communication are required to increase transparency; accelerate medical countermeasures research, development, manufacturing, and deployment; enhance supply chain scalability and resilience; spur innovation; and strengthen efforts to mitigate direct effects of COVID-19 and the secondary and tertiary health impacts of the pandemic, as existing strategies are having limited success in surging to meet current healthcare needs.

Defining appropriate policy options for APEC aimed at strengthening pandemic preparedness, needs to be viewed in terms of building the resilience of health systems, using as a basis the elements of existing frameworks and approaches developed following previous pandemics and epidemics.[8,9] The findings of this literature review and gap analysis include significant amounts of information on critical gaps in

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[4] Global Preparedness Monitoring Board (GPMB), *A World At Risk: Annual Report on the Global Preparedness for Health Emergencies,* WHO (2019).
[5] P. Sands, C. Mundaca-Shah, and V. Dzau, "The Neglected Dimension of Global Security – A Framework for Countering Infectious Disease Crises," *New England Journal of Medicine*, vol. 374: 1281–87 (2016).
[6] States parties self-assessment annual reporting (SPAR), After Action Reviews (AAR), simulation exercises (SimEx), and voluntary external evaluations including Joint External Evaluations (JEE). For more information, see Annex A.
[7] GPMB, *A World at Risk* (2019).
[8] M. E. Kruk, M. Myers, S. Tornorlah Varpilah, et al., "What is a Resilient Health System? Lessons from Ebola," *The Lancet* 385 (May 2015): 1910–12, https://doi.org/10.1016/S0140-6736(15)60755-3.
[9] J. Hanefeld, S. Mayhew, H. Legido-Quigley, et al., "Towards an Understanding of Resilience: Responding to Health Systems Shocks," *Health Policy and Planning* 33 (2018), 355–367, https://doi.org/10.1093/heapol/czx183.

preparedness capacities as well as key early lessons from the current COVID-19 crisis that can also help inform policy directions to promote health system resilience in the APEC region.

Preparing options to support policy directions will require leveraging work that has been undertaken to date by APEC under HWG and the Life Sciences Innovation Forum (LSIF), as well as other APEC fora such as the Emergency Preparedness Working Group (EPWG), Economic Committee, and the Transportation Working Group (TPTWG). The HWG has undertaken policy initiatives focusing on improving cross-border efforts for communicable disease prevention, following the SARS outbreak. APEC, through LSIF and other fora, has implemented activities focusing on improving regulatory capacity, promoting good regulatory practices, improving standards and harmonization of processes to facilitate trade, as well as emergency preparedness and supply chain resilience. APEC can also draw on work undertaken by other regional organizations such as the Association of Southeast Asian Nations (ASEAN) in developing COVID-19 response and recovery plans.

Based on the above, the following recommendations are proposed to provide a comprehensive approach to address the threat of pandemic disease outbreaks in the Asia-Pacific context.

1. **Recover safer from future infectious disease threats by addressing gaps in pandemic and epidemic preparedness and response capabilities in APEC economies.**

   Improving cooperation and coordination efforts between APEC economies is critical for responding to, and mitigating cross-border transmission of emerging infectious diseases like COVID-19. This requires a sound understanding of the levels of preparedness and health system resilience across APEC economies at local as well as regional levels. This also requires a good appreciation of the secondary health impacts caused by the lack of core health services available during health emergencies.

   As a first step, **after-action reviews**, involving robust assessments of human and economic tolls, experiences at the economy and regional levels, and critical capacity gaps and challenges faced in responding to COVID-19, could be undertaken. This could also involve an assessment of the secondary health impacts caused by gaps in core health services during the COVID-19 crisis.

   Collating and analyzing this information would enable policy makers to make informed decisions about allocating sufficient resources and directing policy efforts to strengthen economy-level public health and health security capacities in areas such as disease surveillance systems and diagnostic capacities; laboratory networks and clinical capabilities; pandemic risk inventories; hazards, and threats; resourcing requirements; strengthening supply chain resilience; enhancing distributed manufacturing; and stakeholder engagement strategies. This approach can create an effective platform within APEC where economies can share information on gaps, best practices, and the results of domestic stocktaking, based on their unique COVID-19 experiences. This platform could also be used to inform well designed, targeted, capacity building programs for APEC economies to strengthen their systems for future health security threats.

2. **Prioritize efforts for sustainable health security financing in the APEC region through targeted analysis.**

   Having sufficient funding to build and sustain strong, scalable, and resilient public health systems that can address diagnostic, testing, and patient care needs during health emergencies is critical. However, mobilizing resources is difficult due to a range of reasons. Therefore, undertaking analysis to develop investment cases and on financing challenges in the APEC region would be useful to guide much-needed policy responses in APEC economies. This analysis could be part of broader efforts to improve health systems strengthening efforts supported by HWG and cover issues such as assessing ways of directing external financing sources to support increased pandemic preparedness efforts and delivering on commitments made under the 2005 International Health Regulations (IHR) in a post COVID-19 context, including through the National Action Plans for Health Security.[10] This could also cover issues such as creating fiscal space in domestic budgets through better public financial management.

3. **Improve multi-stakeholder engagement in enhancing preparedness and response capabilities with a focus on improving resiliency.**

   Lessons learned from previous outbreaks such as the Ebola virus disease outbreak as well as the current COVID-19 pandemic underscore the critical importance of effective, multi-stakeholder engagement. This includes the engagement of the private sector, academia, faith-based organizations, and communities in pandemic preparedness and response efforts. Within APEC, increasing the engagement by the APEC Business Advisory Council (ABAC) in coordinating regional and economy-level efforts to promote health system resilience to respond to future pandemics, is important. The engagement with ABAC provides opportunities for leveraging technical capabilities and resources.

4. **Improve coordination and strengthen cross-fora collaboration within APEC.**

   Further, strengthening cross-fora collaboration within APEC around issues of pandemic preparedness and global health security in order to develop a coherent and coordinated strategy across different sectors, while leveraging work undertaken in the past (SARS/avian influenza), will be useful in a post-COVID-19 environment. This could include collaborative approaches with other APEC fora including LSIF, EPWG, the Sub-Committee on Standards and Conformance and the TPTWG where synergies exist to facilitate the development of appropriate standards or regulations involving medical supplies, vaccines, infrastructure resiliency, and the reliability of supply chains in emergencies. Of note is the work undertaken by the TPTWG to improve supply chain resilience in line with a set of APEC principles agreed to by members. In addition, and where possible, members could explore opportunities to situate pandemic preparedness plans within existing disaster risk management frameworks in the region (such as the APEC Disaster Risk Reduction Framework) or

[10] The term National Action Plan for Health Security" (NAPHS) is a technical term that relates to the implementation of the International Health Regulations (IHR). This refers to a standard term used to describe an "economy owned, multi-year, planning process that can accelerate the implementation of IHR core capacities, and is based on a One Health for all-hazards, whole-of-government approach. It captures national priorities for health security, brings sectors together, identifies partners and allocates resources for health security capacity development." (https://www.who.int/ihr/publications/country_implementation_guide_for_naphs/en/).

within the context of broader frameworks such as the Sendai Framework for Disaster Risk Reduction 2015–2030 or the IHR Monitoring and Evaluation Framework.

5. Strengthening health system supply chains and delivery system scalability and resilience in the APEC region to support pandemic preparedness, response, and recovery efforts.

Ensuring the sustained availability of sufficient diagnostic tests, emergency medical supplies including personal protective equipment (PPE) as well as therapeutics is an essential element of well-functioning health systems. Inadequate investments, stockpiling, distributed manufacturing capacity, particularly when combined with quarantines, lockdowns, travel restrictions, and unwarranted export bans put a significant strain on essential medical products and countermeasures needed in healthcare settings to respond rapidly to COVID-19. Unexpected surges in demand due to panic buying also significantly impacted stock levels of PPE and other medical equipment, and there is no agreed upon allocation method for scarce supplies.

Supply chains need to be capable of a rapid ramp-up in manufacturing and distribution to effectively reach patients during a health crisis. However, as witnessed during COVID-19, this remains an enormous challenge due to the lack of capacity, planning, regulatory discordance, logistics capabilities, and clarity in governance arrangements of emergency supply chains; current supply chain design, approaches and procurement efforts; limitations in leadership and financing efforts; as well as export and trade restrictions imposed during health emergencies that impact stock availability.

Studies undertaken by the Organization for Economic Cooperation and Development (OECD),[11] the Asian Development Bank (ADB),[12] and the United States Agency for International Development (USAID)[13] provide useful insights into ways of improving the resilience of supply chains and maintaining adequate surge capacity to be able to ramp up production to reduce shortages. Some of the key elements of improving the resilience of supply chains involve the following:

- Evaluating and identifying current risks, prioritizing by probability and impact;
- Ensuring supplier quality and conducting procurement due diligence;
- Diversifying suppliers to minimize risk and increase options;
- Including partners in risk planning; and
- Purchasing insurance and reviewing risks periodically.

Furthermore, analyzing the experiences of economies in the region in accessing essential equipment and supplies would supplement the information above.

The work undertaken by LSIF/HWG to improve supply chains for medical products (via the APEC Roadmap to Promote Global Medical Product Quality and Supply Chain Security) could be leveraged as part of APEC's efforts of increasing the scalability and resiliency of health systems to cope with and respond to disease outbreaks. Work on increasing vaccine manufacturing capacity and improving supply chain resilience in the region is already underway via the Vaccine Program of

[11] M. Christopher, "The Mitigation of Risk in Resilient Supply Chains," (roundtable discussion on balancing efficiency and resilience in management of multi-modal supply chains, OECD International Transport Forum, April 12–13, 2018).
[12] C. Y. Park, K. Kim, S. Roth, et al., "Global Shortage of Personal Protective Equipment Amid COVID-19: Supply Chains, Bottlenecks and Policy Implications," (ADB Policy Brief, April 2020).
[13] Chemonics International, Inc. and McKinsey & Company, *Best Practices in Supply Chain Preparedness for Public Health Emergencies* (technical report, USAID, 2019).

Work, a collaborative effort between Canada and the United States which was endorsed by APEC members in February 2020 to maximize the impact of HWG initiatives on improving health security and immunization rates in the APEC region, and to build on the current global momentum to combat COVID-19 and influenza, as well as to address barriers to immunization and harmonize efforts in the APEC region.

In addition, strengthening and harmonizing APEC economies' regulatory capacity, including through improved governance mechanisms that protect patients from substandard and falsified products, is a critical part of these efforts. It is estimated that half of medicines prescribed, dispensed, and sold worldwide are administered or consumed inappropriately; and many of the medicines are of a relatively poor quality or counterfeit. These types of regulatory challenges are anticipated to also affect COVID-19 response, for medical products like PPE, and once safe and effective COVID-19 vaccines become available. Addressing this in terms of facilitating timely global access to safe, reliable and efficacious COVID-19 vaccines and therapeutics is important in the current context. Developing combined approaches to combating respiratory illnesses with pandemic potential, including COVID-19 and influenza, may be an effective way to sustainably enhance preparedness and surveillance, and annual immunization campaigns against these threats may be an effective way to exercise capacities needed to prepare for future pandemic threats. The work undertaken by the APEC Regulatory Harmonization Steering Committee to promote a strategic approach to regulatory harmonization and improve regulatory frameworks across the APEC region can inform broader efforts at improving the resilience of supply chains.

INTRODUCTION

In December 2019, the novel coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was reported in Wuhan, China and was the latest infectious disease to be declared a Public Health Emergency of International Concern by the World Health Organization (WHO) in January 2020. Subsequently, it was categorized as a pandemic by the WHO in March 2020. Because of its high transmissibility, the virus spread rapidly, and in most contexts, public health systems were unable to control the spread and became burdened by the increasing demand for health services.

The past decade has seen an increase in new pandemics and epidemics which has caused widespread mortality and morbidity. Between 1980 and 2013 it is estimated that there were 12,012 recorded emerging infectious disease outbreaks, including 44 million individual cases and affecting every economy in the world.[14] The WHO states that 7,000 new early warning signals of potential outbreaks occur each month, generating 300 follow ups, 30 investigations, and 10 risk assessments.[15]

While advances in scientific research, better hygiene practices, improved diagnostics, drugs, vaccines, and effective medical equipment have increased defenses against the threat of pandemics, the risks of contagion are significant, as the world connected as a result of globalization and international and domestic mobility. The world is currently witnessing the widespread public health and economic impacts that a quickly-spreading pathogen like a novel coronavirus cause. The COVID-19 pandemic has already impacted nearly 19 million people, caused 700,000 deaths, and caused significant disruptions to economic activities including global trade.

The Asia-Pacific region may be particularly vulnerable to cross border pandemic outbreaks due to the interconnectedness of the region; between economies, and between and species, which may increase the risk posed by pandemic, emerging, and reemerging zoonotic disease threats. The region has experienced the impacts of several previous epidemics and pandemics including the SARS outbreak in 2002–2003 that had significant impacts on several APEC economies, the H5N1 outbreak which followed in 2006, as well as strains of H1N1. The APEC region saw more limited but still significant impacts from other global pandemics such as MERS and the Ebola virus. The severe economic and health impacts from the current COVID-19 pandemic are felt across the APEC region.

Aside from the massive human toll caused by disease outbreaks, the economic impacts of pandemics and epidemics are also not trivial, as demonstrated in the analysis detailed in this report. Yet arguments for increasing epidemic preparedness and addressing health security gaps in domestic capacities made after the SARS and the more recent West African Ebola disease outbreak went unheeded. The COVID-19 crisis has clearly demonstrated that the world is unprepared to handle pandemics of this magnitude, and revealed critical vulnerabilities in pandemic preparedness and response capabilities. The current COVID-19 crisis and its impacts will hopefully lead to a renewed call for action to enhance commitments made

[14] K. F. Smith, M. Goldberg, S. Rosenthal, L. Carlson, J. Chen, C. Chen, and S. Ramachandran, "Global Rise in Human Infectious Disease Outbreaks," *Journal of the Royal Society Interface* 11(101): 20140950 (December 6, 2014).
[15] World Economic Forum, "Outbreak Readiness and Business Impact: Protecting Lives and Livelihoods across the Global Economy" (white paper, January 2019,) http://www3.weforum.org/docs/WEF%20HGHI_Outbreak_Readiness_Business_Impact.pdf.

under the IHR to prevent, detect, report, and respond to future global health security threats, including pandemics.

Regional organizations like APEC have an important role to play in encouraging coherent responses to cross border public-health threats, and the report's findings are expected to strengthen the evidence base further, to direct and guide appropriate policy responses to combat COVID-19, and recover safer from future global health security threats in a post COVID-19 world.

Objective of the Study

Aligned with HWG members' commitment to "enhancing the preparedness and response to public health emergencies and disasters, including prevention and control of emerging and re-emerging infectious diseases," this study seeks to improve APEC members' knowledge of the key economic impacts of emerging infectious disease threats in the region and preparedness gaps with the goal of increasing the evidence base to support the efficacy of policy responses in the Asia-Pacific region.

The origins of this study predate the extraordinary emergence of the COVID-19 pandemic. Though the original scope of work did not account for COVID-19, the report has been adapted to reflect the overall COVID-19 disease burden and the preliminary economic impacts of the pandemic, using widely available secondary sources. However, as the pandemic is still accelerating, a comprehensive assessment of the long- term economic impacts of the COVID-19 pandemic cannot be fully undertaken at this juncture.

This study reflects the strategic directions of the APEC HWG Strategic Plan (2016–2020)[16]. The plan emphasizes the importance of a coordinated approach to manage cross-border health threats and disease outbreaks by "enhancing the preparedness and response to public health emergencies and disasters, including prevention and control of emerging and re-emerging infectious diseases." A similar approach is proposed under the Healthy Asia Pacific 2020 Roadmap which seeks to strengthen "health systems to support Universal Health Coverage providing the whole population with access to safe, effective, quality and affordable and sustainable primary health care" and improve "health emergency preparedness, surveillance, response and recovering systems for public health emergencies including pandemic events and natural disasters." This study also reflects the APEC work on multi-sectoral action on microbial resistance and efforts to promote robust medical product supply chains via the APEC Roadmap to Promote Global Medical Product Quality and Supply Chain Security.[17]

Structure of the Report and Research Methodology

This report is organized into two parts. Part 1 focuses on the disease burden of key pandemics including COVID-19 that have affected the APEC region. This is followed by assessments of emerging infectious diseases and pandemics. The direct and indirect economic costs of pandemics and epidemics are examined, along with specific examples from previous disease outbreaks and a brief summary of the preliminary economic impacts of COVID-19. The information concerning COVID-19 draws from data and sources available as of late June 2020, although the situation is in flux. As the pandemic has yet to reach its peak globally, the assessment of longer-term economic impacts of COVID-19 is limited.

[16] APEC Health Working Group Strategic Plan 2016-2020. 2016/SOM3/HWG/005. Endorsed in Lima, Peru in 2016.
[17] APEC, Roadmap to Promote Global Medical Product Quality and Supply Chain Security (supply chain security toolkit, February, 2017), http://www.nifds.go.kr/apec/SupplyChain/APEC_SupplyChainToolkit_170317.pdf.

Part II highlights the importance of pandemic preparedness and increasing health system resilience as a way of minimizing the risks of disease outbreaks. In doing so, a brief assessment of the regional level of pandemic preparedness is undertaken and elements of resilience are explored. The third and final part of the report offers recommendations that build on lessons learned from previous disease outbreaks in the region and also leverage work already undertaken by APEC to respond to COVID-19.

The study's methodology included a desk review of documents and a stakeholder consultation process. A review of APEC policies and publications was conducted. Numerous studies undertaken by the WHO, the OECD, the ADB, the Asian Development Bank Institute, John Hopkins University, and by other regional institutions as well as academic journals and online resources were also reviewed. Information was also gathered through consultations with experts in the field and discussions with APEC members and private sector stakeholders who attended HWG and LSIF meetings in Chile in 2019.

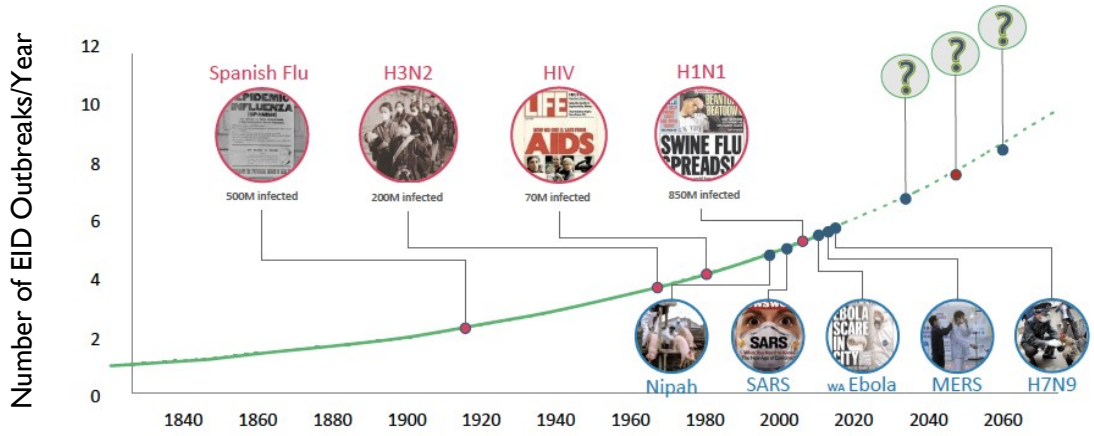
THE THREAT OF PANDEMICS

RECENT HISTORY OF EMERGING INFECTIOUS DISEASE OUTBREAKS

Just 100 years ago, the Spanish Influenza pandemic of 1918–1919 is estimated to have killed between 50 and 100 million people globally, primarily afflicting otherwise healthy people. Since then, the world has witnessed several outbreaks of pandemics and epidemics.[18] These include SARS in 2002–2003, which had significant impacts on several APEC economies; followed by avian influenza H5N1 in 2006, which impacted the Asian continent and Middle East; the Ebola virus disease which was initially discovered in 1976 when two outbreaks of fatal hemorrhagic fever occurred in different parts of Central Africa followed by the 2014–2016 Ebola outbreak in West Africa; zika; Middle East respiratory syndrome (MERS); and strains of H1N1.[19]

Figure 1 demonstrates the rising threat of emerging infectious diseases.[20]

Figure 1 Rising Threat of Emerging Infectious Diseases



[18] N. P. Johnson and J. Mueller, "Updating the Accounts: Global Mortality of the 1918-1920 'Spanish' Influenza Pandemic," *Bulletin of the History of Medicine* 76(1): 105–15 (2002).
[19] The CDC differentiates between seasonal and pandemic flu. An influenza pandemic occurs when a new flu virus emerges that can infect people and spread globally. CDC, "Pandemic Influenza" (webpage), https://www.cdc.gov/flu/pandemic-resources/index.htm.
[20] This does not contain information on COVID-19.

Source: Global Trends in Emerging Infectious Diseases". Jones et al. (2008) *Nature vol 451*.

Pandemics and epidemics cause widespread mortality, morbidity, and economic damage. Novel strains of influenza viruses are generally agreed to pose some of the highest pandemic risks and have caused four pandemics in the last century. For example, the novel influenza A (H1N1) virus first emerged in 2009 in the Americas and spread quickly across the globe. The virus was highly transmissible, but it turned out to not be as severe as anticipated in terms of morbidity or mortality. It is estimated that the pandemic caused 18,500 (laboratory-confirmed) deaths between 2009 and 2010, but that likely represented just a fraction of the total mortality, which was estimated to be fifteen-fold higher globally.[21] The 2009 H1N1 virus continues to circulate seasonally, according to the United States Centers for Disease Control (CDC). The WHO estimates that annual seasonal influenza epidemics may result in 290,000–650,000 deaths each year. Conversely, the SARS outbreak was more severe in terms of morbidity and mortality but it did not transmit easily between people, which made it easier to contain. The 2014–2016 Ebola crisis resulted in 28,652 cases across 10 economies and 11,325 deaths; the estimated mortality rate was 50 percent.[22]

While this review does not specifically cover antimicrobial resistance (AMR), it is important to briefly acknowledge the threat it poses to global health security. Several studies have highlighted how a failure to contain AMR will result in significant macroeconomic impacts.[23] According to the World Bank, the annual healthcare cost in the United States associated with the treatment of antimicrobial resistant infections alone was approximately US$20 billion,[24] and the estimated annual societal cost was US$35 billion.[25] Investing in strengthening health systems and preparedness to manage the risks of infectious disease outbreaks is the best approach to contain AMR since infections from microbial-resistant bacteria remain a serious problem in healthcare settings.

COVID-19 DISEASE BURDEN AND IMPACTS

In December 2019, a novel coronavirus now referred to as SARS-CoV-2 was reported. The WHO declared a Public Health Emergency of International Concern in January 2020 and SARS-CoV-2 as a global pandemic in March 2020. By April 2020, the disease had spread to most parts of the world.

Evidence suggests that COVID-19 is more transmissible than other coronavirus diseases like MERS and SARS and can be spread by asymptomatic or pre-symptomatic carriers, which complicates efforts to contain its spread. The level of transmissibility of an infectious disease is represented by the Basic reproduction number (or R0), which is the average number of people that each infected person can potentially infect. Early studies of the COVID-19 pandemic (as illustrated in a World Bank study) show

[21] F. S. Dawood et al., "Estimated Global Mortality Associated with the First 12 months of 2009 Pandemic Influenza," *The Lancet Infectious Diseases* 12(9) (June 2012).
[22] Centers for Disease Control, "2014–2016 Ebola Outbreak in West Africa" (webpage), https://www.cdc.gov/vhf/ebola/history/2014-2016-outbreak/index.html.
[23] O. B. Jonas, Funding for One Health Capacities in Low- and Middle-Income Countries, (January 15, 2019).
[24] World Bank. "Pandemic Preparedness and Health System Strengthening," (webpage), https://www.worldbank.org/en/topic/pandemics.
[25] E. Leung et al., "The WHO Policy Package to Combat Antimicrobial Resistance," *Bulletin of the World Health Organization,* vol. 89(5): 390–2 (May 1, 2011).

that R0 of SARS-CoV-2 is about 4.5. For comparison, the R0 for a typical seasonal flu is 1.28, 1.5 for the 2014 Ebola outbreak in Guinea, and 1.8 for the 1918–20 Spanish Flu pandemic.[26]

All APEC economies instituted response and containment measures. Some have been more stringent than others, but all have involved control measures such as active surveillance, testing, contact tracing, lockdown measures, social distancing efforts, travel bans and quarantines, to slow down the transmission of the disease. Building on lessons learned from the SARS outbreak, several APEC economies such as China; Chinese Taipei; Hong Kong, China; Korea; and Singapore applied a similar approach to extensive testing and contact tracing using innovative technologies, with broadly successful results.

Despite a range of economies adopting containment measures, the virus has spread worldwide and continues to impact populations in both developed and developing economies alike. As of August 2020, there were nearly 19 million cases and 70,000 deaths worldwide.

The current numbers of infections in the Asia-Pacific region remain relatively stable or increasing in most economies following the relaxation after June of lockdown measures imposed earlier. Some economies such as New Zealand and Viet Nam which went into full lockdown very early, have relatively lower case-loads and fewer deaths, with others like Chinese Taipei and Thailand also reporting relatively low infections overall. Most economies have ramped up testing and contact tracing efforts using new digital technologies and contact tracing apps.

The primary focus that globally remains is containing the disease where it is still spreading and treating those that are ill. Significant efforts have been made to accelerate the research, development, manufacturing, clinical trials, regulatory approvals, and timely and global deployment of safe and efficacious vaccines and therapeutics, to help communities cope with the pandemic.

RISK FACTORS AND THE TRANSMISSION OF DISEASES

The frequency of zoonotic outbreaks is on the rise. Pandemics and epidemics such as SARS, human immunodeficiency virus (HIV), MERS, avian influenza, the Ebola outbreak, and now COVID-19 are zoonotic, meaning that these types of novel human pathogens are thought to have been circulating in animal reservoirs.[27] The CDC estimates that more than six out of every ten known infectious diseases are caused by animals and three out of four new or emerging infectious diseases in people come from animals (both domesticated and farm animals).[28] Analyses of global trends in emerging infectious diseases (EID) indicate that EID events are dominated by zoonoses (60.3 percent of EIDs) with the majority of these (71.8 percent) originating in wildlife and are increasing significantly over time.[29] WHO analysis indicates that the 2002–2003 SARS outbreak was from an (as yet uncertain) animal reservoir, possibly bats, that spread to other animals (civet cats). Dromedary camels were considered as a major reservoir

[26] T. Liu, et al., "Time-varying Transmission Dynamics of Novel Coronavirus Pneumonia in China," (BioRxiv preprint service, Cold Spring Harbor Laboratory), https://www.biorxiv.org/content/10.1101/2020.01.25.919787v2, (cited in World Bank, "East Asia and the Pacific in the Time of COVID-19" (East Asia and Pacific Economic Update, April 2020).
[27] M. E. Woolhouse and S. Gowtage-Sequeria, "Host Range and Emerging and Reemerging Pathogens," *Emerging Infectious Diseases* vol. 11(12): 1842–7 (2005).
[28] CDC, "Zoonotic Diseases" (webpage), https://www.cdc.gov/onehealth/basics/zoonotic-diseases.html.
[29] K. E. Jones, N. G. Patel, M. A. Levy, A. Storeygard, D. Balk, J. L. Gittleman, and P. Daszak, "Global Trends in Emerging Infectious Diseases," *Nature* vol. 451(February 2008): 990–993.

host for MERS-CoV and an animal source of MERS infection in humans although the exact role of dromedaries in transmission of the virus is unknown. More information is still needed to fully understand the origins and early epidemiological information related to the COVID-19 pandemic, including the species and exact source of the animal reservoir for SARS-CoV-2.

Several studies have explored the connection between EID outbreaks and various risk factors that include but are not limited to, changes in land use, greater exploitation of the natural environment, deforestation, increasing population density and displacement, increased urbanization, expanded livestock production, and the growing illicit sale of wildlife.[30] All of these increase the risk of exposure of humans to novel or reemerging pathogens.

Characteristics of a pathogen combined with human actions determine whether an outbreak can become a pandemic.[31] Increased population growth, internal migration, urbanization and deforestation, growing international movement of people, and globalization significantly increase the risks posed by emerging infectious diseases. Characteristics of a pathogen that can contribute to its pandemic risk include being a novel or reemerging pathogen that can transmit before symptoms are present; high transmissibility; high morbidity or mortality; and a lack of sufficient quantities of effective diagnostics or medical countermeasures.

The increased transmission of emerging infectious diseases can also be fueled by socio-economic conditions including poverty, a lack of resources, weak health systems (including the lack of proper facilities for surveillance, testing, and diagnostic measures) and veterinary services, and a lack of portable water and sanitation. Several studies highlight the correlation between poverty and inequality and the increased susceptibility of certain segments of the population to infections.[32] High levels of out-of- pocket payments may also deter people from seeking early diagnosis and treatment which could lead to acceleration in the transmission rate. Other analyses focus on how the world's ability to effectively protect against and prepare for pandemics and epidemics diminishes in conflict-affected settings and other unstable situations. For example, the 2014–2016 West African Ebola outbreak and the 2018–2020 Ebola outbreaks demonstrated how challenging and costly responding to epidemic and pandemic threats can be, particularly if there are security concerns or if the health security response is occurring in the midst of a complex humanitarian crisis.[33]

ECONOMIC IMPACTS OF PANDEMICS

CHALLENGES OF ESTIMATING ECONOMIC IMPACTS

When the next pandemic will occur and which pathogen will cause it is generally difficult to predict because pandemics are rare events. Furthermore, no model can estimate with precision the likely economic losses arising from future pandemics, as macroeconomic predictive models have their limitations. These involve challenges with limited data points to inform predictive models, issues

[30] O. B. Jonas, Pandemic Risk, Washington, DC: World Bank (2013), (background paper for World Bank, *World Development Report 2014: Risk and Opportunity: Managing Risks for Development*).
[31] Jonas, Pandemic Risk (2013).
[32] P. Farmer, "Social Inequalities and Emerging Infectious Diseases," *Emerging Infectious Diseases* 2(4):259–69 (Oct. 1996).
[33] Sands, P., C. Mundaca-Shah, and V. Dzau. 2019. "The Neglected Dimension of Global Security — A Framework for Countering Infectious-Disease Crises." *New England Journal of Medicine* 374(13): 1281–87. https://www.nejm.org/doi/full/10.1056/NEJMsr1600236.

concerning data variations and the validity of the data, the number of assumptions, and uncertainties that influence predictions.[34]

Quantifying the short-to medium-term economic impacts is easier than assessing the precise, longer-term impacts of disease outbreaks, as the length of the outbreak, the spread of a disease, and whether future outbreaks are manageable are all elements that need to be considered when assessing long-term impacts. This can lead to an underestimation of infectious disease risk and shortfalls in preparedness and responses to infectious disease crises.[35] However, even less severe pandemics can cause significant loss of life, negative health impacts, and economic disruption. Therefore, quantifying the impact, whatever modelling method is used, can equip policymakers with information to build a sound investment case to increase sustainable funding for strengthening health systems resilience and pandemic preparedness.

ECONOMIC IMPACTS OF SPECIFIC PANDEMICS AND EPIDEMICS

Pandemics and epidemics can cause short- and long-term impacts, as well as direct and indirect economic impacts. When pandemics and epidemics occur, both supply and demand side impacts are felt, and sometimes the multiplier effects can be wide-ranging. The examples highlighted below demonstrate how some disease outbreaks have resulted in minimal demand shocks relative to others, and even where there were impacts, these did not translate into significant macroeconomic downturns. The pre-COVID-19 results indicate that developing economies are impacted the most by pandemics and epidemics because higher population densities and poverty accentuate the economic impacts in some economies.

Current World Bank projections suggest that the COVID-19 global recession will be the deepest since the end of World War II (global contraction of 5.2 percent of GDP), with the largest fraction of economies experiencing declines in per capita output since 1870.[36] The World Bank estimated that growth in the Asia-Pacific region is projected to fall to 0.5 percent in 2020, the lowest rate since 1967, reflecting disruptions caused by the pandemic. Economic activity in the rest of East Asia and Pacific is forecast to contract by 1.2 percent in 2020 before rebounding to 5.4 percent in 2021. Among major economies in the region, Malaysia (-3.1 percent), the Philippines (-1.9 percent), and Thailand (-5 percent) are forecast to experience the biggest contractions this year.[37]

Most pre-COVID-19 work underestimated the economic impacts of pandemics. A study conducted by the Commission on Global Health Risk Framework for the Future estimates that pandemics cost approximately US$60 billion per year or more than US$6 trillion per century. The economic loss from each of the 20th-century pandemics is estimated as 0.7–4.8 percent of GDP.[38] Other studies, using the 1918 pandemic outbreak as a basis, estimate economic losses at around 4.8 percent of global GDP, or more than US$3 trillion.[39] Some studies have compared pandemic risks to risks posed by climate change (estimated at around 0.2–2.0 percent of global GDP by the Intergovernmental Panel on Climate Change

[34] A. El Turabi and P. Saynisch. "Modelling the Economic Threat of Pandemics," (available online as Appendix C to GHC Commission, 2016).
[35] P. Sands, A. El Turabi, Saynisch, and V. Dzau, "Assessment of Economic Vulnerability to Infectious Disease Crises," *The Lancet*, vol. 388(10058): 2443–48 (2016).
[36] World Bank. "Global Economic Prospects". June 2020.
[37] World Bank. "Global Economic Prospects". June 2020.
[38] W. J. McKibben and A. A. Sidorenko, "Global Macroeconomic Consequences of Pandemic Influenza" (Lowy Institute for International Policy, 2006).
[39] O. B. Jonas, Pandemic Risk (2013).

2014) and natural disasters.[40] June 2020 World Bank estimates suggest that more than US$4.5 trillion will be lost in 2020 alone and that this generation of students will experience a loss of US$10 trillion in earnings over time.

PRELIMINARY ECONOMIC IMPACTS OF COVID-19

As the COVID-19 pandemic continues to evolve globally, the full economic impacts are not yet clear. There is still uncertainty about the eventual duration and possible intensity of the shock. In order to assess the impacts, experts have compared the crisis with previous economic shocks such as the Great Depression or the Global Financial Crisis. However, the World Bank asserts the COVID-19 crisis differs in that the disease outbreak is impacting all economies across the world almost simultaneously with demand and supply shocks felt everywhere.[41]

Impacts on Supply Chains and Trade

The initial assessments on economic impacts of COVID-19 focused mainly on supply chains given that the world is much more integrated today than it was before through the globalized production and consumption networks. The disruptions to supply chains were exacerbated by the limited use of inventories supported by lean and "just-in-time manufacturing processes" which impacted businesses' production capabilities and overall exports.[42]

The World Trade Organization (WTO) estimates that world merchandise trade is expected to fall by between 13 percent and 32 percent in 2020 as a direct result of the economic and social disruptions caused by the COVID-19 pandemic, and this decline is expected to exceed the trade slump brought on by the global financial crisis in 2008–2009.[43] In addition, the WTO predicts that all regions will experience double digit declines in trade volumes in 2020, with exports from North America and Asia hit hardest. It is expected that trade impacts will be felt more in sectors with more complex value chains, particularly electronics and automotive products. Services trade could be directly affected by COVID-19, through transport and travel restrictions.

Demand Shocks

According to the World Bank, the immediate economic costs of COVID-19 are due to the preventive behavior of individuals caused by fear and the transmission control policies of governments which are impacting a range of service sectors.[44] Travel restrictions and the cancellation of flights and business and leisure travel spread to many economies in the region including Australia, Japan, Singapore, and the Republic of Korea.[45]

The COVID-19 pandemic has brought international travel close to a standstill due to travel bans, social distancing measures, and quarantines with unprecedented effects. The Asia-Pacific region is predicted to be the most affected region, with a decline in international tourist arrivals ranging from 9 to 12 percent.[46] Initial OECD estimates indicate that the pandemic will cause more disruption in its member

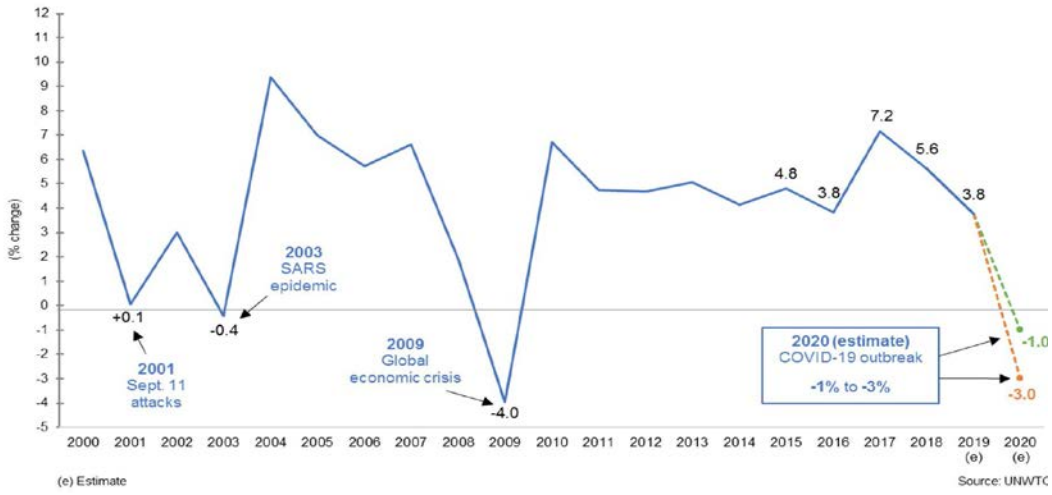
[40] United Nations Office for Disaster Risk Reduction (UNDRR).
[41] World Bank, "East Asia and Pacific in the Time of COVID-19" (World Bank East Asia and Pacific Economic Update, April 2020).
[42] OECD, "Coronavirus: The World Economy at Risk" (OECD Interim Economic Assessment, March 2, 2020).
[43] World Trade Organization, "Trade Statistics and Outlook" (press release, April 2020).
[44] World Bank, "East Asia and Pacific in the Time of COVID-19" (April 2020).
[45] OECD, "Coronavirus: The World Economy at Risk," OECD Interim Economic Assessment, March 2, 2020.
[46] World Tourism Organization (UNWTO), "COVID-19: Putting People First," webpage updated April 1, 2020.

economies since tourism accounts directly for 41 to 44 percent of GDP in the OECD economies and almost 7 percent of employment.[47] The World Travel and Tourism Council in collaboration with Oxford Economics, conducted a scenario analysis to examine the impacts from COVID-19 on the global Travel and Tourism sector. The analysis examined three scenarios - upside, baseline and downside; to assess the level of uncertainty in the tourism outlook. The global upside, best case scenario (which involves current restrictions easing from June for domestic and short-haul/regional travel, and from August for intercontinental travel) indicates approximately US$2.68 billion loss in Travel & Tourism GDP which represents a 30 percent reduction in jobs and GDP, compared with 2019. A more realistic global baseline scenario predicts a US$3.43 billion loss in Travel and Tourism GDP which represents a 37 percent reduction in jobs compared with 2019, and a 39 percent reduction in GDP.[48]

The World Economic Forum estimated that global travel would decline at least 25 percent in 2020 and cause a drop of almost 50 million jobs in the tourism sector due to COVID-19, with 30 million of those lost jobs in Asia, around 7 million in Europe, and 5 million in the Americas and the rest of the world.[49]

Figure 2 shows the revised 2020 tourist arrival forecast by the World Tourism Organization (UNWTO) and Table 1 details the losses by market, in the airline industry.

Figure 2 Revised 2020 Forecast - International Tourist Arrivals (world, % change)



Source: World Tourism Organization (UNWTO), "Impact Assessment of the COVID-19 Outbreak on International Tourism," updated March 5, 2020.

[47] OECD, Coronavirus: The World Economy at Risk," OECD Interim Economic Assessment, March 2, 2020.
[48] World Travel and Tourism Council. "Travel and Tourism Recovery Scenarios 2020 and Economic Impact from COVID-19". Research Note. June 2020.
[49] World Economic Forum, "This is How Coronavirus Could Affect the Travel and Tourism Industry," online article published in collaboration with Reuters, March 17, 2020.

Table 1 Economic Losses in Airline Industry (by market)

ECONOMIC LOSSES OF AIRLINE INDUSTRY BY MARKET		
MARKET	IMPACT ON PASSENGER NUMBERS	IMPACT ON PASSENGER REVENUES
Australia, People's Republic of China, Japan, Malaysia, Singapore, Korea, Thailand, Viet Nam	-23%	-$49.7 billion
Rest of Asia-Pacific	-9%	-$7.6 billion
Austria, France, Italy, Germany, Netherlands, Norway, Spain, Switzerland, Sweden, the United Kingdom	-24%	-$37.3 billion
Rest of Europe	-9%	-$6.6 billion
Bahrain, Iraq, Iran, Kuwait, Lebanon, the United Arab Emirates	-23%	-$4.9 billion
Rest of the Middle East	-9%	-$2.3 billion
Canada and the United States	-10%	-$21.1 billion

Source: International Air Transport Association (IATA), "IATA Updates COVID-19 Financial Impacts - Relief Measures Needed," press release, March 5, 2020.

Macroeconomic Impacts

In May 2020, the International Monetary Fund (IMF) estimated that as a result of the pandemic, the global economy is projected to contract sharply by 3 percent in 2020, much worse than during the 2008–09 Global Financial Crisis.[50] The study estimated that in a scenario which assumes that the pandemic is fully contained by the second half of 2020 and that economies are able to transit out of existing measures that limit disease transmission, the global economy will grow by a projected 5.8 percent in 2021, with a return to normal economic activity supported by appropriate policy measures.

The IMF estimates provided in May 2020 are presented with a number of caveats that demonstrate that there is considerable uncertainty surrounding a range of issues. The economic impacts and projections of global growth depend on several issues that are still hard to predict at this stage. These include the duration and specific epidemiological impacts of the pandemic in various contexts, the efficacy of containment efforts, the extent of supply disruptions, the economic fallout as a result of the tightening in global financial market conditions, changes in spending patterns, continued behavioral changes that impact demand, consumer confidence and consumption, and volatile commodity prices. If the containment measures last longer and emerging and developing economies are even more severely hit, it is expected that the impacts will be greater. More recent projections from the IMF state that global growth is projected at -4.9 percent in 2020, which is 1.9 percentage points below the previous forecast. The analysis confirms that the pandemic has had a more negative impact on activity in the first half of

[50] International Monetary Fund, "The Great Lockdown". (April 2020).

2020 than previously anticipated, and recovery is projected to be more gradual than previously anticipated. In 2021, global growth is projected at 5.4 percent.[51]

The uncertainty in forecasting economic impacts of COVID-19 is also reflected in a recent analysis undertaken by the ADB.[52] The ADB's original projections of the potential economic impact of the COVID-19 pandemic released in early March 2020 estimated a global impact ranging from US$77 billion to US$347 billion (0.1 percent to 0.4 percent of global GDP). The updated estimates indicate a higher impact on GDP figures which, using the Global Trade Analysis Project model, estimate the global economic impact of COVID-19 could reach US$5.8 trillion (6.4 percent of global GDP) under a 3-month containment scenario and US$8.8 trillion (9.7 percent of global GDP) under a 6-month containment scenario.

Another World Bank study conducted in April 2020 simulates the potential impacts of COVID-19 on GDP and trade, building on previous studies that have been used to assess the impacts of earlier pandemics.[53] The study focuses on four elements: the underutilization of labor and capital; an increase in international trade costs; a drop in travel services; and a reduction in demand for activities that require proximity between people. It uses two scenarios to map potential impacts: a global pandemic and an amplified global pandemic. Under the first scenario, the study assumes that economies will bear one-half of the impact of the shock experienced by China. In the latter scenario, the shock is expected to be more uniform across the board. The study demonstrates that under a global pandemic scenario, global GDP will decrease by 2 percent below the baseline, which translates to around 2.5 percent in developing economies and 1.8 percent in developed economies. The declines are expected to be almost twice the amount in an amplified pandemic scenario where containment may take longer. Like the analyses mentioned above, the World Bank study also asserts that it is still too early to make an assessment of the possible impact of the pandemic based on full statistical evidence as there are so many unknowns about the duration and spread of the pandemic and how long it will take economies to return to normal. The study also calls for a coordinated international response to the crisis which covers not only the health sector but also trade, finance, and macroeconomic policies.

Because the development of a vaccine is ongoing and the knowledge of the new virus limited, economic predictions continue to be uncertain. Using similar assumptions, a study conducted by the APEC Policy Support Unit (PSU) in April 2020 indicated that in the APEC region, real GDP was expected to contract by 2.7 percent in 2020, compared to 3.6 percent growth in 2019.[54] This reduction in growth translated to an estimated output loss of US$2.1 trillion due to the economic fallout from the pandemic. In July 2020, the PSU revised its estimates to predict a bleaker scenario. Based on the updated PSU analysis, the GDP of the APEC region is projected to contract by 3.7 percent in 2020, which translates to an output loss of around US$2.9 trillion. The PSU projections suggest growth in 2021 will rebound to 5.7 percent, subject to the successful containment of the pandemic in the second half of 2020, continuation of fiscal and monetary support measures. and the development of effective vaccines and treatments.[55]

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[51] International Monetary Fund, *A Crisis Like No Other: An Uncertain Recovery* (World Economic Outlook Update, June 2020).
[52] Asian Development Bank, "An Updated Assessment of the Economic Impact of COVID-19" (May 2020).
[53] World Bank, "The Potential Impact of COVID-19 on GDP and Trade: A Preliminary Assessment," (working paper, April 2020).
[54] APEC Policy Support Unit, "APEC in the Epicenter of COVID-19" (April 2020).
[55] APEC Policy Support Unit, "Deeper Contraction Calls for Decisive Action" (July 2020).

More recent analysis undertaken by the OECD indicates economic activity has collapsed in OECD economies by as much as 20–30 percent, and many emerging-market economies and developing economies, particularly commodity producers, are experiencing considerable difficulties due to the dual health and economic crisis.[56] The analysis focuses on two scenarios: one in which a second wave of infections, with renewed lock-downs, hits before the end of 2020, and one in which a second wave is avoided.

Impacts on Commodities

It is important to highlight that the COVID-19 pandemic is impacting both the demand and supply of commodities directly affected through lockdowns and disruptions to supply chains. The World Bank Commodity Market Outlook (April 2020) reports that the impact of COVID-19 on commodity markets has been more extensive than most previous crises and may lead to long-term shifts in global commodity demand and supply.[57] For example, mitigation measures have significantly reduced transport, causing an unprecedented decline in demand for oil. In addition, weaker economic growth is expected to reduce overall commodity demand. Crude oil prices are expected to average US$35 per barrel (bbl) this year and US$42/bbl in 2021, which reflects a significant downturn. The price of oil has been in free fall since January 2020 and reached a historic low in April 2020. The initial drop was related to the outbreak and expectations of falling demand for commodities.

Impacts on Employment and Household Incomes

Preliminary analysis conducted by the International Labor Organization (ILO) in March 2020 indicate that sustaining business operations in the current context, will be particularly difficult for small and medium-sized enterprises (SMEs).[58] Many workers are unable to get to workplaces, which leads to reduced incomes, particularly for informal and casually employed workers. Consumers in many economies are also hesitant or, in some cases, unable to purchase goods and services except for essential food items. Given the current environment of uncertainty and fear, enterprises are likely to delay investments, purchases of goods, and the hiring of workers. The ILO analysis specifies three main areas of impact: the quantity of jobs (both unemployment and underemployment); the quality of work (e.g., wages and access to social protection); and effects on specific groups of people who are more vulnerable to adverse labor market outcomes.[59] Cost-reduction measures being undertaken include employee layoffs, reduced hours, and limited services, and these measures are likely to have downstream effects, like filing for bankruptcy or completely reshaping how companies do business. The level of impacts expected depend on the duration of the pandemic and whether it forces economies into recessions.[60]

A study on the impacts of COVID-19 on vulnerable populations including migrant workers indicates that global remittances are expected to decline sharply by almost 20 percent in 2020 due to the economic crisis induced by the COVID-19 pandemic and shutdown.[61] This is a direct result of the decline in wages

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[56] OECD, *OECD Economic Outlook* (vol. 2020(1), preliminary version, no. 107), https://doi.org/10.1787/0d1d1e2e-en.
[57] World Bank, *Commodity Markets Outlook* (April. 2020), https://openknowledge.worldbank.org/bitstream/handle/10986/33624/CMO-April-2020.pdf.
[58] International Labor Organization. "COVID-19 and the World of Work: Impacts and Policy Responses." (*ILO Monitor*, first edition, March 2020), https://www.ilo.org/global/about-the-ilo/WCMS_738753/lang--en/index.htm.
[59] International Labor Organization, "COVID-19 and the World of Work" (March 2020).
[60] M. Craven, M. Mysore, S. Singhal, and M. Wilson, "COVID-19: Implications for Business" (McKinsey & Company executive briefing, August 2020), https://www.mckinsey.com/business-functions/risk/our-insights/covid-19-implications-for-business.
[61] D. K. Ratha et al., *COVID-19 Crisis Through a Migration Lens* (Migration and Development Brief no. 32., World Bank, 2020), http://documents.worldbank.org/curated/en/989721587512418006/COVID-19-Crisis-Through-a-Migration-Lens.

and employment of migrant workers who are vulnerable as a result of the loss in employment and wages during the economic crisis in host economies. Remittances to low- and middle-income economies are expected to decrease by 19.7 percent to US$445 billion, representing a significant impact on many vulnerable households.

The section below highlights the impacts of the H1N1 influenza pandemic, SARS, Ebola, and MERS in an effort to compare the COVID-19 impacts with those from previous pandemics.

SEASONAL INFLUENZA PANDEMIC AND H1N1 IMPACTS

Influenza poses a seasonal epidemic threat which is estimated to result in approximately 1 billion cases globally each year, leading to more than 5 million hospitalizations and as many as 650,000 deaths. A study examining the economic impacts of a flu pandemic using macroeconomic simulations estimates that a mild pandemic would reduce global output by less than 1 percent of GDP, a moderate outbreak by more than 2 percent, and a severe pandemic by almost 5 percent, constituting a major global recession.[62] These impacts cost billions of dollars in healthcare costs and lost productivity. A recent report by the U.S. government's Council of Economic Advisers found that in a pandemic year, depending on the virulence of the virus, the economic damage could range from US$413 billion to US$3.79 trillion.[63] The findings of a 2005 U.S. Congressional Budget Office assessment of the macroeconomic effects of a pandemic flu (revised in 2006) indicate that a severe pandemic would result in about a 4.25 percent reduction in U.S. GDP compared to GDP in the absence of a pandemic, while a mild pandemic would result in a 1 percent reduction.[64] The H1N1 pandemic was considered a "weak" pandemic and World Bank modelling estimates indicate that the 2009 H1N1 influenza pandemic may have had economic impacts of less than 0.5 percent of global GDP.[65]

THE SARS OUTBREAK

There are limited robust estimates of the global costs of the SARS pandemic, and available estimates fail to provide a full picture of the total impact. The estimates focus mainly on effects of individual economies such as China; Hong Kong, China; and Chinese Taipei, and focus mostly on assessing the damages by SARS in affected industries, such as tourism and the retail service sector.[66, 67]

The main impact of SARS was on the demand side, as consumption and the demand for services contracted.[68] These economic impacts were significant although short-lived and related to shocks caused by measures taken by governments to curb the transmission of the disease. Most were

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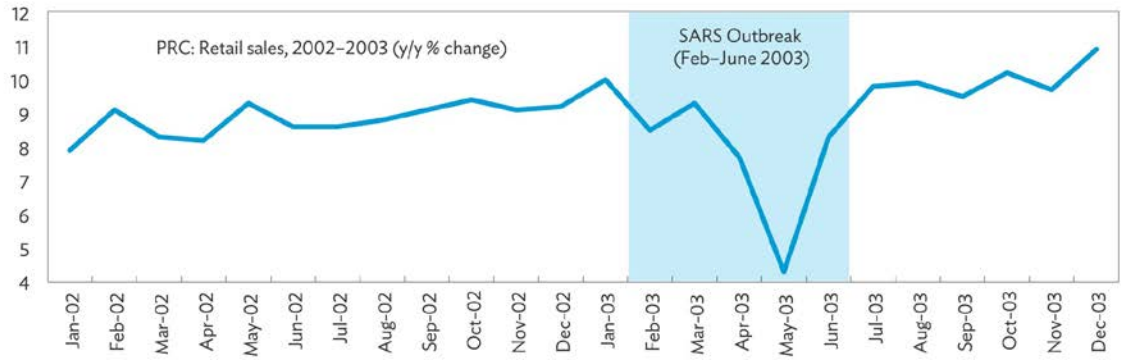
[62] A. Burns, D. Van de Mensbrugghe, and H. Timmer, "Evaluating the Economic Consequences of Avian Influenza," (as updated in 2008), see https://www.researchgate.net/publication/237345628.
[63] Council of Economic Advisers, *Mitigating the Impact of Pandemic Influenza through Vaccine Innovation* (2019), https://www.whitehouse.gov/wp-content/uploads/2019/09/Mitigating-the-Impact-of-Pandemic-Influenza-through-Vaccine-Innovation.pdf.
[64] H. Rubin, "Future Global Shocks," International Futures Program Project on Future Global Shocks, OECD (2011), https://www.oecd.org/fr/gouvernance/risques/Pandemics.pdf.
[65] Jonas, Pandemic Risk (2013).
[66] A. Siu and R. Wong, "Ravaged by SARS: The Case of Hong Kong SARS" (paper presented at Asian Economic Panel, Keio University, Tokyo, May 2003).
[67] H. Wen, "China in the Eye of the Storm" (paper presented at Asian Economic Panel; Keio University, Tokyo, May 2003).
[68] E. Fan, "SARS: Economic Impact and Implications" (ERD Policy Brief no. 15, Economics and Research Department, Asian Development Bank, 2003).

associated with reductions in foreign and domestic tourism, as well as reductions in services sectors such as retail stores, hotels, restaurants, and transportation.[69]

The significant economic impacts from SARS occurred mostly in the following four APEC economies: China; Hong Kong, China; Chinese Taipei; and Singapore. Following the 2003 SARS outbreak, APEC members undertook a qualitative study to collate information on the potential impact of SARS on the 21 economies.[70] The study, conducted by the APEC Economic Committee, demonstrated that while impacts on specific sectors would be serious, it would be seen as a "temporary shock to economic growth." The findings indicate that the impacts were more serious in some sectors than others, particularly the travel sector. The analysis demonstrated that SARS also reduced consumer confidence, which is reflected through a reduced demand for services relating to air travel, tourism, and retail, and also in the fact that that industrial output and export performance experienced limited impact. Given the timing, it was difficult to forecast the full economic impact of SARS on the APEC region. The report incorporates economy-level analysis including measures implemented to mitigate the health and economic effects of SARS.

Figure 3 shows the impact of SARS in terms of retail sales and personal consumption expenditures.

Figure 3 Impact of SARS on Retail Sales, Personal Consumption Expenditures



SARS = Severe Acute Respiratory Syndrome.

Source: A. Abiad, A, M. Arao, S. Dagli, et al., "The Economic Impact of the COVID-19 Outbreak on Developing Asia," ADB Briefs no. 128, March 6, 2020.

Table 2 compares economic impacts of the SARS outbreak in a number of APEC economies. The economic impact is tabulated in terms of the loss of GDP, economic growth, exports and trade and tourism, food and travel. The study found that the largest economic impact of SARS was related to overall impacts and investment in the tourism, dining, and hospitality sectors. It also demonstrated that economic impacts ranged from very high (Hong Kong, China; China) to minor (Singapore and Canada).

[69] M. Brahambhatt and A. Dutta, "On SARS type Economic Effects During Infectious Disease Outbreaks" (Policy Research Working Paper #4466, World Bank, 2008).
[70] Asia Pacific Economic Cooperation, "Economic Impacts of SARS in the APEC Region" (APEC Economic Committee, Special Senior Officials Meeting on SARS, Bangkok Thailand, June 2003).

Table 2 Summary of Main SARS Impacts

			billion)	
China	←	↓3% in Q2	↓7.12 (FDI) but 0 (Exports)	↓5 (International) 3.5 (Domestic)
H'Kong China	↓3.7	↓4.75% in Q2	↓23.1 (Outward FDI)	↓0.86 (Tourism) 0.2 (Hotels) 0.26 (Restaurants)
Canada	↓3.2–6.4	↓1% for 2003	↓5.2 (Investment Outflow)	↓0.03 (Tourism) 6.25% (Airline) 4.33 (Accommodation and food)
Singapore	↓4.9	↓1% for 2003	←	↓0.2 (Hotels) 17.4% (Airline)
Malaysia	←	←	←	↓1.7
Vietnam	←	←	←	↓0.14 (Hotels and restaurants)
Thailand	←	?	←	←33.5 (Tourism)
United States	←	←	←	←
Chinese Taipei	←	←	←	←
Australia	←	←	↓10.1% (2001–2002 decline also)	↓0.119 (Accommodation and food)
Germany	←	←	←	←
Japan	←	?	↓0 Exports but 3.5 (FDI out) and 2.9 (FDI in) but 2001–2002 decline also	←
Mongolia	?	?	←	←
Philippines	←	?	↓1.2 or 3%	←
France	←	?	←Losses in Q1–3 = Iraq war?	←
Sweden	↓Notable loss, probably not SARS	?	?	←

KEY: ↓ = SARS related loss, ← = no evidence of a loss, ? = missing data.

Source: H. Rubin "Future Global Shocks: Pandemics," OECD International Futures Program (2011), (figure developed by Keogh-Brown and Smith (2008)), https://www.oecd.org/gov/risk/46889985.pdf.

A study in 2008 undertook a retrospective analysis of the macroeconomic impact of the SARS outbreak.[71] Accessing a range of statistics available after 2003, it provided a more accurate estimate of the actual macroeconomic impacts of SARS. Early estimates and models prepared at the time of the outbreak predicted impacts would be much greater than what eventually transpired due to the levels of panic generated.[72] This study concluded that retrospective analysis holds important lessons for estimating impacts of future outbreaks.

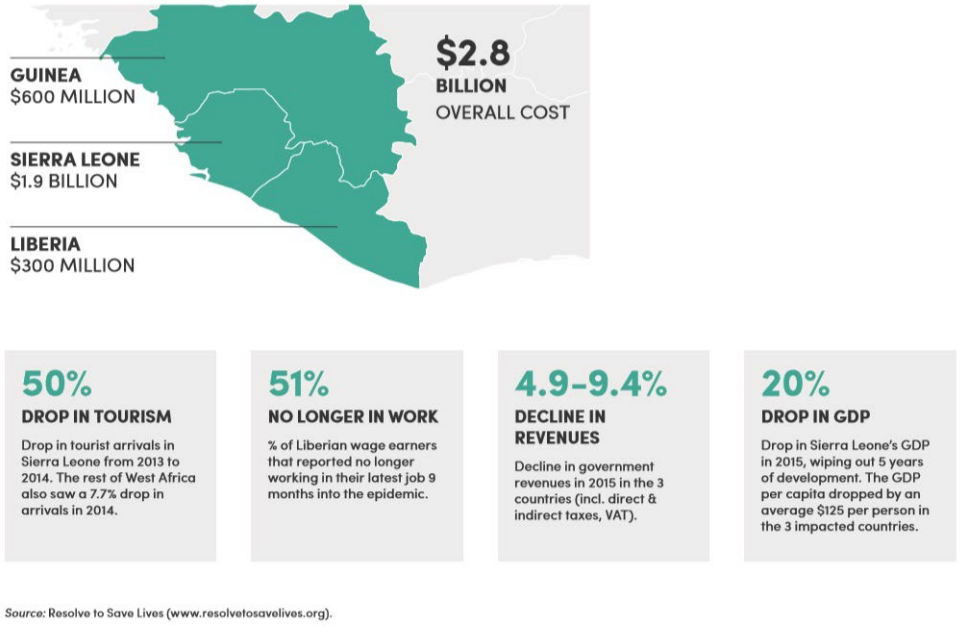
THE EBOLA DISEASE OUTBREAK

The 2014 Ebola outbreak lasted over two-and-a-half years, infecting 28,652 people and causing 11,325 deaths. Studies indicate that the 2014–2015 epidemic exposed how a "perfect storm" of weak health systems, poverty, and political and economic fragility can fuel outbreaks.[73] Approximately 99 percent of the Ebola cases were recorded in three economies: Guinea, Liberia, and Sierra Leone. More recently, the Democratic Republic of the Congo has been grappling with an Ebola epidemic with more than 2,200 lives lost and 3,400 confirmed infections according to a December 2019 WHO report.[74] Figure 4 includes details of a 2016 World Bank impact assessment on the Ebola outbreak which found the three impacted economies (Guinea, Liberia, and Sierra Leone) collectively sustained an estimated loss of US$2.8 billion in GDP (Guinea US$600 million, Liberia US$300 million, and Sierra Leone US$1.9

[71] Keogh-Brown, M. R., and R. D. Smith, "The Economic Impact of SARS: How Does the Reality Match the Predictions?" *Health Policy* 88(1): 110–20 (2008).
[72] Keogh-Brown and Smith, "The Economic Impact of SARS" (2008).
[73] P. Piot, "Ebola's Perfect Storm," *Science* 345(6202): 1221 (2014), https://doi.org/10.1126/science.1260695.
[74] WHO, "Ebola in the Democratic Republic of Congo: Health Emergency Update" (December 26, 2019).

billion).[75] The findings indicate the economic impact outlasted the epidemiological impact due to investment, production, and consumption-related shocks in the region, caused by declines in the world price of iron ore and other commodities, and, in the case of Sierra Leone, corporate governance issues in the mining sector. The spillover effects included high unemployment, lost incomes, lower schooling, and less food consumption, which created substantial challenges in the longer term. The fiscal impact of the pandemic was high, leading to declining revenues, increasing Ebola-related and health expenditures, and exacerbation of fiscal deficits. The deficits in 2015 were estimated at 8.5 percent of GDP in Liberia, 9.4 percent in Guinea, and 4.8 percent in Sierra Leone.

Figure 4 Costs of the 2014–2016 Ebola Epidemic, West Africa (US$)

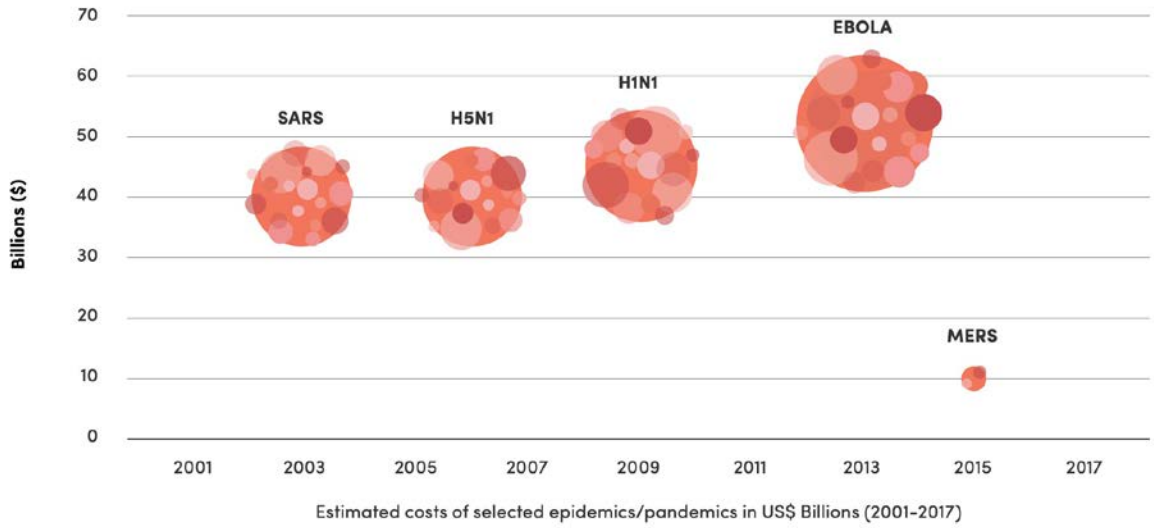


Source: World Bank, "2014–2015 West Africa Ebola Crisis: Impact Update," May 10, 2016.

Figure 5 summarizes the overall estimated impacts of the disease outbreaks discussed above.

[75] World Bank, "2014–2015 West Africa Ebola Crisis: Impact Update" (May 10, 2016).

Figure 5 Cost of Selected Pandemics (US$ billions)



Source: Global Preparedness Monitoring Board, *A World at Risk: Annual Report on Global Preparedness for Health Emergencies*. World Health Organization (2019).

SECTORAL IMPACTS OF PANDEMICS

The analysis clearly demonstrates that the impacts of outbreaks are not distributed evenly across the various sectors. There are also variations in impacts felt across different economies. Examining the impacts of past outbreaks, the analysis for this report reveals that social isolation and quarantine measures instituted to minimize disease transmission impact the travel and tourism sectors the most. As expected, the number of tourist arrivals plummets during an outbreak, leaving airlines and hotels severely affected. In addition to these two sectors, other impacted services include retail and the restaurant industry, although in some instances there has been evidence of online sales reflecting some increase. In addition, in some instances, the agriculture sector has been impacted due to labor shortages and the lack of agricultural inputs.

Table 3 demonstrates the impact of lockdowns and travel restrictions on travel and tourism across several APEC economies.

Table 3 Impacts on Travel and Tourism, Selected APEC Economies

IMPACT OF TRAVEL AND TOURISM ACROSS SEVERAL APEC ECONOMIES		
ECONOMY	TRAVEL OR TOURISM DATA CITED	IMPACT
Australia	Number of inbound tourists, m/m percentage change	April 8.5% May 0.8%
Canada	Air Canada air travel to Asia y/y percent change	March 18%
Hong Kong; China	Visitor arrivals, y/y percent change	April 65% May 68%
Indonesia	Visitors to Bali, y/y percent change	March 35%
Japan	Overseas travel sales at 13 major travel agencies, y/y percent change	April 47.4% May 59.3% June 59.3%
Malaysia	Tourist arrivals, y/y percent change	April 58.6%

Y/y = year-on-year.

Source: H. Rubin "Future Global Shocks: Pandemics," OECD International Futures Program (2011), figure developed by Keogh-Brown and Smith (2008), https://www.oecd.org/gov/risk/46889985.pdf.

There is evidence that suggests that pandemics cause relatively more economic damage in specific contexts. The World Bank highlights regional differences in impacts caused from pandemics (Table 4).

Table 4 Estimated Regional Vulnerability to Economic Losses from Pandemics

ESTIMATED REGIONAL VULNERABILITY TO ECONOMIC LOSSES FROM PANDEMICS				
REGION (SELECTED REGIONS)	POPULATION (BILLIONS)	2015 GDP (US$ TRILLION)	EXPECTED ANNUAL PANDEMIC LOSS (US$ BILLION)	EXPECTED ANNUAL PANDEMIC LOSS (% GDP)
East Asia and Pacific	2.23	21.2	196.9	0.9
South Asia	1.74	2.7	53.3	0.2
North America	0.36	19.6	86.5	0.4
Latin America and Caribbean	0.63	5.4	59.4	1.1

Source: World Bank, *From Panic and Neglect to Investing in Health Security: Financing Pandemic Preparedness at a National Level*, World Bank (2017).

SECONDARY EFFECTS OF PANDEMICS

The global COVID-19 pandemic has exposed the fragility and the limited resilience of health systems to cope with a health emergency of this magnitude. Evidence clearly suggests the world was ill prepared for the fast-moving virulent SARS-CoV-2 pathogen which exposed fundamental gaps in health systems' capacities and limitations in governments' ability to detect, prepare and respond effectively to the disease outbreak.

Most economies aimed to contain transmission by imposing lockdowns of varying degrees, heightened surveillance, and ramped up testing and tracing capacities to protect their citizens, mitigate the pandemic's effects, and reduce demand of hospital beds and intensive care unit (ICU) services. In most contexts, health systems were overwhelmed by the demand. All of this has had broad ranging, unintended consequences on non-communicable diseases, immunization rates, and maternal and infant care.

Most healthcare facilities postponed routine, non-critical elective, and non-emergency treatments and operations to cope with the surge of COVID-19 patients. For example, oncology services have been negatively impacted by the pandemic, resulting in a decrease of new cancer diagnosis. A report by Lai et al. estimates a fall in admissions for chemotherapy in England and Wales of 45 to 66 percent and in urgent referrals for early cancer diagnosis 70 to 89 percent compared to pre-pandemic levels.[76] Under conservative assumptions whereby only people with newly diagnosed cancer are affected, modellers estimated 6,270 excess deaths in one year in England and 33,890 excess deaths in the United States.

There is also evidence of lower vaccination coverage in most developing economies as a result of the burden on health systems due to COVID-19. For example, a UNICEF (the United Nations Children's Fund) study indicates around 80 million children under the age of one, are at risk of diseases such as diphtheria, measles, and polio due to disruptions in routine vaccination efforts in at least 68 economies.[77]

Several examples highlight how core health service delivery was disrupted as a result of deploying heath workers to care for COVID-19 patients. In addition, health worker attrition has resulted in the lack of adequate primary healthcare support. Social distancing and the fear of contagion also led health workers to deny laboring mothers a companion or to separate newborns from mothers after delivery.[78] Lack of proper information on how the virus is transmitted and fear of physical proximity impact breastfeeding rates and limit or alter care provision. These are symptomatic of broader, systemic issues which include the lack of trained health sector personnel, challenges with procuring PPE and medicine due to limited stockpiles, disruptions in supply chains, and price volatility for essential therapeutics.

Insights into the unintended consequences of pandemics can be drawn from examples from previous pandemics such as the 2014–2015 Ebola virus disease outbreak in Liberia, Guinea, and Sierra Leone. The outbreak overwhelmed health systems and impacted the diagnosis and treatment of major endemic diseases in the region: malaria, HIV/AIDS, and tuberculosis. Parpia et al. estimated a 50 percent reduction in access to healthcare services during the Ebola outbreak which exacerbated malaria, HIV/AIDS and tuberculosis mortality rates by additional death counts of 6,269 in Guinea, 1,535 in

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[76] Lai, AG, et.al. 2020. "Estimating excess mortality in people with cancer and multi-morbidity in the COVId-19 emergency" April 28, 2020. https://www.researchgate.net/publication/340984562_Estimating_excess_mortality_in_people_with_cancer_and_multimorbidity_in_the_COVID-19_emergency

[77] United Nations Children's Fund (UNICEF). https://www.unicef.org/press-releases/least-80-million-children-under-one-risk-diseases-such-diphtheria-measles-and-polio Information Note. May 22, 2020

[78] https://blog.savethechildren.org/2020/05/the-unintended-consequences-of-covid-19-on-mothers-and-newborns.html

Liberia, and 2,819 in Sierra Leone.[79] The indirect impact of mortality rates of other diseases was also substantial.

The interplay between economics and health represents a prominent feature of the current COVID-19 pandemic. Health seeking behaviors have also been eroded due to socio-economic factors. Due to the loss of income, families have been unable to afford transportation to travel to distant health posts or pay out-of-pocket expenses for health costs.

INVESTING IN PREPAREDNESS AND RESILIENCE

The examples included in the sections above highlight that pandemics cause significant direct and indirect economic, social, and health impacts. The economic costs are considered to be on par with other significant economic threats including climate change which is estimated by the Intergovernmental Panel on Climate Change, at approximately 0.2–2.0 percent of global GDP[80]. Yet, limited efforts and resources have been committed to countering the risk of global pandemics.

The 2019 *A World at Risk* report found that the failure to effectively implement the recommendations following the H1N1 (2009) influenza pandemic and the Ebola virus disease outbreak (2014–2016) has left serious gaps in preparedness.[81] While the evidence pointed to the need to increase efforts to prepare for potential future pandemics based on key lessons learned, no action was taken. This has been described as the "neglected dimensions of global security".[82]

As pandemics risks are global in nature, countering the threat of pandemics requires strengthening international coordination, cooperation, and engagement efforts. Global health security is seen as a "global public good" supported by effective collective action,[83] and as such, several multilateral organizations including the World Bank and the United Nations, global organizations (G7, G20, and G77), and mechanisms such as the Global Health Security Agenda aim to increase economy-level capacities and coordination mechanisms for disease detection, prevention, and control. In addition, regional organizations including APEC and ASEAN, philanthropic foundations like the Gates Foundation and Rockefeller Foundation, bilateral donors, and private sector entities across the globe have made formal, high-level commitments to improve preparedness. These commitments have been accompanied by funding pledges to support health systems strengthening and promote universal health coverage. For example, the Rockefeller Foundation has committed US$20 million to create a better tracking and management system for COVID-19 and address the needs of vulnerable communities around the world. The Global Fund has provided funding up to US$1 billion to help recipient economies fight COVID-19

[79] Parpia, AS, Ndeffo-Mbah, ML, Wenzel, N, Galvani, AP. 2016. "Effects of Response to 2014–2015 Ebola Outbreak on Deaths from Malaria, HIV/AIDS and Tuberculosis in West Africa. Emerging Infectious Diseases, 2016 March; 22 (3) 433–441. doi: 10.3201/eid2203.150977
[80] N. Madhav et al. "Disease Control Priorities: Improving Health and Reducing Poverty. 3rd edition.", Chapter 17 Pandemics: Risks, Impacts, and Mitigation. The National Center for Biotechnology Information (2018).
[81] GPMB, "A World At Risk" (2019).
[82] Sands, Mundaca-Shah, and Dzau. "The Neglected Dimension of Global Security" (2016).
[83] Sands, Mundaca-Shah, and Dzau. "The Neglected Dimension of Global Security" (2016).

and prevent fragile health systems from being overwhelmed,[84] and the Asian Development Bank (ADB) provided US$7 billion of assistance.[85]

LEVELS OF PANDEMIC PREPAREDNESS

The International Health Regulations (2005 IHR), were formulated as an overarching legal framework to determine economies' rights and obligations involved in handling public health events and emergencies with the potential to cross borders. The framework is a prerequisite for emergency response, as it aims to build core public health capacities and develop approaches to coordinate effective responses to health emergencies with regional and global partners.

An analysis of preparedness levels across the world indicate that the international community has made some progress in implementing the 2005 IHR. For example, APEC and ASEAN economies have preparedness and response plans that form the basis of immediate and urgent activities to address pandemic threats in line with binding commitments under the IHR. The WHO confirms that 22 out of 27 economies in the Western Pacific region have National Plans for Pandemic Preparedness and 92 percent of economies conduct outpatient surveillance for influenza-like illness.[86] The Pan American Health Organization (PAHO) during its 55th Directing Council resolved to support the development of resilience in member states in their development of multi-sectoral plans and strategies to support health systems resilience and improved health and wellbeing.[87] The PAHO Plan of Action for Disaster Risk Reduction 2016–2021 promotes the inclusion of health sector disaster risk management into domestic policies, plans, and budgets.[88]

Many economies have also signed up for external evaluations of their preparedness and response systems. This demonstrates an openness and willingness to collectively identify problem areas and explore solutions. An assessment of progress undertaken by the Global Preparedness Monitoring Board (GPMB)[89] indicates that economy-level assessments and plans have improved; and as of July 2019, 190 economies globally reported progress on implementing the IHR. As of 2018, 102 economies were reported to have conducted a voluntary Joint External Evaluation (JEE) using the State Party Self-Assessment Annual Reporting tool.[90] In addition, 103 economies were reported to have conducted evaluation exercises. Fifty-one economies had completed After Action reviews, with 59 economies developing National Action Plans for Health Security, 51 of which provide fully costed plans.[91] Refer to **Annex A** for details on JEE and the IHR models for monitoring, evaluation, and learning.

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[84] Global Fund to Fight HIV, Tuberculosis and Malaria, COVID-19 Situation Report (no. 17, June 16, 2020). https://www.theglobalfund.org/media/9789/covid19_2020-06-16-situation_report_en.pdf?u=637279277230000000.
[85] Asian Development Bank, "COVID-19 Policy Database" (online database, accessed June 15, 2020) https://covid19policy.adb.org.
[86] WHO, "Preparing for Pandemics" (WHO Western Pacific webpage), https://www.who.int/westernpacific/activities/preparing-for-pandemics.
[87] Pan American Health Organization. "Resilient Health Systems" (55th Directing Council, 68th Session of the Regional Committee of WHO for the Americas, September 26–30 2016), https://www.paho.org/hq/dmdocuments/2016/CD55-9-e.pdf
[88] Ibid. Section on Plan of Action for Disaster Risk Reduction 2016–2021.
[89] GPMB, *A World at Risk* (2019).
[90] The International Health Regulations (2005) State Party Self-Assessment Annual Reporting Tool helps support economies meeting their commitments under IHR (2005). WHO, State Party Self-assessment Annual Reporting Tool, (2018), https://extranet.who.int/sph/state-party-self-assessment-annual-reporting-tool.
[91] GPMB. *A World at Risk* (2019).

GAPS IN PANDEMIC PREPAREDNESS

The response to the COVID-19 pandemic exposed limitations in healthcare systems' ability to rapidly scale up capacity to respond to the outbreak. This suggests that while there are well-established legal and policy foundations to guide emergency responses and some success with implementing IHR (2005) commitments, there is still a long way to go to achieve the required levels of preparedness to enable economies to respond effectively and efficiently to health emergencies.

The GPMB's data, collected using the IHR Monitoring and Evaluation Framework,[92] reveal variations in overall levels of pandemic preparedness across the world, with some areas such as laboratory systems, surveillance and immunization displaying stronger capacities than others.

The key recommendations of the Commission on a Global Health Risk Framework for the Future initiated in 2015 focused on strengthening public health as the foundation of the health system and the first line of defense against infectious disease outbreaks.[93] While this is acknowledged as critical, many economies failed to build the required health infrastructure capabilities to respond adequately to health crises. According to the Global Health Index, while developed economies reported an average score of 51.9 out of 100 (overall average score being 40.2), the collective level of international preparedness for epidemics and pandemics remains very weak.[94] A COVID-19 readiness self-assessment conducted in February and March 2020 reveals that in the Americas, 18 economies and territories show moderate levels of preparedness in key areas such as laboratory capacity for COVID-19 diagnosis, isolation and case management.[95] Scores were lowest for areas related to the care of patients requiring critical care and the availability of equipment for medical care, including PPE and ventilators.

Fragmentation and inequitable access to health service coverage, gaps in human resources needed for effective service delivery, inequitable access to health technologies, limited capacities for essential public health functions, and underfunded infection prevention and control[96] are symptoms of fundamental structural limitations that persist in several economies. Addressing these shortcomings, which are highlighted below, remains a core part of heath sector strengthening and pandemic preparedness efforts.

Limitations with Financing Pandemic Preparedness

One of the critical constraints impacting health emergency preparedness efforts is the lack of adequate financing. This remains a challenge faced by both developed and developing economies alike. Underinvestment in planning and preparing for emerging infectious disease risks is largely due to the fact that pandemic preparedness is not an "easy sell." It reflects uncertainties concerning the direct rewards to be gained from investments in preparedness, particularly when there are competing priorities in the

[92] GPMB. *A World at Risk* (2019).
[93] Sands, Mundaca-Shah, and Dzau, "The Neglected Dimension of Global Security" (2016).
[94] John Hopkins University. Centre for Health Security. Global Health Security Index. "Building Collective Action and Accountability" (2019)
[95] Pan American Health Organization. "COVID-19 Pandemic in the Region of the Americas". 166th Session of the Executive Committee. June 22–23 2020. https://iris.paho.org/bitstream/handle/10665.2/52345/CE166-5-e-covid-19.pdf?sequence=1&isAllowed=y
[96] Pan American Health Organization. "COVID-19 Pandemic in the Region of the Americas." (166th Session of the Executive Committee, June 22–23 2020), https://iris.paho.org/bitstream/handle/10665.2/52345/CE166-5-e-covid-19.pdf?sequence=1&isAllowed=y.

health sector which can easily demonstrate more immediate and visible results.[97] Furthermore, more priority is assigned to supporting curative care as opposed to investments in strengthening public health capacities.[98] In addition to the issues raised above, the manner in which pandemic risks are perceived and framed makes it difficult to generate much attention to the issue.[99] When pandemic risks are framed as health risks there is a tendency for governments to devote attention to other more pressing and visible health priorities which then take priority over the threat of potential pandemics. Even when the issue is framed as a threat to human life or as a risk to global security more broadly, governments are often unable to justify spending to avoid a potential or low probability crisis.[100] The difficulties in estimating with precision the likely impacts of pandemics, as discussed earlier, also adds to the complication, as there is "high uncertainty of direct reward from investments in preparedness."[101] The requirements for preparedness are also challenging as these require a multi-sectoral, multi-level, whole-of-government coordination efforts in implementation.[102] Improving the speed of vaccine development and vaccine efficacy are important goals to mitigate pandemic risk.[103]

Based on the analyses reviewed for this study, investing in health systems strengthening in accordance with IHR (2005) requirements would achieve a positive return on investment. In addition to considerations of cost effectiveness, investing in pandemic preparedness also contributes to poverty alleviation, especially because infectious diseases tend to affect poor people disproportionately.[104] According to the WHO, the COVID-19 crisis has once again revealed the importance of investing in domestic health systems which comprise the foundations of global health security.[105]

While it would have been useful to undertake a comparative analysis of budgetary allocations for pandemic preparedness and health systems strengthening at a local level in the context of the discussions above, this level of data is not easily accessible. Information does exist about the levels of out-of-pocket expenditures relating to health service delivery in most economies.[106] Studies indicate that Asian economies spend 25 percent of income on health (a higher percentage than the global average), with medicine procurement being the primary driver. However, there is a dearth of publicly available, up-to-date, robust comparable data on how much governments across the region spend on health systems strengthening.

It is estimated that at the global level, the world spends approximately US$7.5 trillion on health each year, or 10 percent of GDP. While spending has increased, there are significant financing gaps in some resource poor, fragile and conflict affected contexts. Estimates suggest that increasing expenditure on primary healthcare in low and middle-income economies by US$200 billion annually could save 60

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[97] World Bank, *From Panic to Neglect to Investing in Health Security: Financing Pandemic Preparedness at a National Level* (2017), https://documents.worldbank.org/en/publication/documents-reports/documentdetail/979591495652724770/from-panic-and-neglect-to-investing-in-health-security-financing-pandemic-preparedness-at-a-national-level.
[98] World Bank, *From Panic to Neglect to Investing in Health Security* (2017).
[99] World Bank, *From Panic to Neglect to Investing in Health Security* (2017).
[100] World Bank, *From Panic to Neglect to Investing in Health Security* (2017).
[101]World Bank, *From Panic to Neglect to Investing in Health Security* (2017).
[102] World Bank, *From Panic to Neglect to Investing in Health Security* (2017).
[103] Council of Economic Advisers, "Mitigating the Impact of Pandemic Influenza" (2019).
[104] World Bank, Pandemic Emergency Financing Facility Update (May 7, 2019).
[105] World Economic Forum, "COVID-19 Reveals Gaps in Health Systems: WHO Briefing" (April 2020), https://www.weforum.org/agenda/2020/05/covid-19-reveals-gaps-in-public-health-system-who-briefing/.
[106] WHO, *Primary Health Care on the Road to Universal Health Coverage* (2019 Monitoring Report. Conference Edition), https://www.who.int/healthinfo/universal_health_coverage/report/uhc_report_2019.pdf.

million lives[107] and increase life expectancy by 3.7 years by 2030. Data covering 2000–2017 show that, on average, the APEC region's public health expenditures have stayed below 5 percent of GDP for almost two decades while household out-of-pocket health expenditures have doubled. For every 1,000 people in the region, there are only 4.1 hospital beds, 1.9 physicians, and 3.9 nurses and midwives. An additional US$170 billion health expenditure per year is suggested for a more comprehensive health package to address existing gaps. This additional investment represents a 5 percent increase beyond the US$7.5 trillion already spent annually. Investing in broader health systems is estimated to save close to 100 million lives.

In the context of COVID-19, economies in the Asia-Pacific region provided support packages to households and businesses to weather the economic impacts of the pandemic, as detailed in Table 5 below. These packages included support for social protection and social insurance programs; wage subsidies; employment support programs including skills development, tax relief, and tax deferrals; loan moratoriums; and other forms of fiscal stimulus packages and financial assistance programs.108 While some economies had sufficient fiscal space in their budgets to support relief measures, others will bear the longer-term economic impacts for years to come. In several economies, emergency funding was directed at reinforcing existing health service delivery capacity gaps during the pandemic. This included procuring testing kits, ventilators, face masks and other consumables such as personal protective equipment. In some contexts, temporary healthcare facilities were constructed or existing facilities repurposed to house the overflow of COVID-19 infected patients. For example, three new hospitals were built in Wuhan. In Indonesia, the Kemayoram Athletes Village was converted into a new facility to house patients. Isolation facilities were set up by transforming the Singapore Expo Convention and Exhibition center into a community care facility to house mildly infected patients; and four facilities were constructed in downstate New York to accommodate up to 4,000 patients due to the demand on existing healthcare facilities. In other economies, hotels were converted into temporary housing for healthcare professionals and travelers serving quarantine periods.[109]

[107] WHO, *Primary Health Care on the Road to Universal Health Coverage* (2019).
[108] APEC Policy Support Unit, "APEC Regional Trends Analysis: What Goes Around Comes Around" (May 2020), https://www.apec.org/Publications/2020/05/APEC-Regional-Trends-Analysis---What-Goes-Around-Comes-Around.
[109] M. Zulkhibri and J. B. Sinay, "Assessing ASEAN Economic Policy Responses in a Pandemic" (ASEAN Policy Brief. no. 02, May 2020).

Table 5 List of APEC Economies' Financial Support during COVID-19 Response

ECONOMY	FINANCIAL SUPPORT DURING THE PANDEMIC RESPONSE
Indonesia	US$ 5 billion additional budget for healthcare
Singapore	US$10.4 billion for the pandemic response
Japan	US$3 trillion total package by June 2020[111]
The United States	US$6 trillion, the largest amount of support by any economy[112]
Thailand	Health expenditure increased from 11.43 billion baht in December 2019 to 36.67 billion baht in January 2020. February was reduced to 11.16 billion baht, though March and April saw a considerable increase in health expenditure to 26.87 and 42.12 billion baht respectively.[113]

In New Zealand, a combination of mandatory and enforced restrictions which were undertaken with the promise of a short duration, garnered broad public support and high levels of compliance.[114] The NZ$50 billion COVID-19 Response and Recovery Fund - Wellbeing Budget: Rebuilding Together was delivered[115] and a single program of NZ$232.5 million was provided to support post COVID-19 efforts. Significant amounts of this supported wage subsidy extensions, training and apprenticeships and housing programs. Around NZ$3 billion was allocated to stimulate the economy and for infrastructure development, environmental projects, and support for SMEs which provided employment opportunities.

Lack of Leadership, Governance and Challenges with Coordination

In addition to the lack of sufficient financing discussed above, another key constraint is the need for stronger leadership and improved governance at the global and local levels. The World At Risk report indicates that despite high-level commitments made by regional and multilateral organizations to support preparedness efforts, follow-through is lacking, and levels of advocacy for preparedness as well as leadership at the global level need improvements.[116] Without strong leadership and political will, governments are unable to make appropriate decisions about how to respond effectively to crises, as witnessed in several contexts in the COVID-19 crisis.

Good pandemic response efforts also require robust "whole of government" and "whole of society" approaches.[117] However, in many contexts, preparedness planning efforts often lack effective multi-stakeholder approaches. Experience from previous pandemics suggests that pandemic risk management is usually limited to health ministries and health sector related agencies. The GPMB report highlights the importance of coordination mechanisms between veterinary systems and public health systems which need to be coordinated during public health emergencies. However, this remains a challenge in many

[110] This translates to SGD13.8 billion that Singapore spent for pandemic response.
[111] Asian Development Bank, "COVID-19 Policy Database" (accessed June 15, 2020).
[112] Asian Development Bank, "COVID-19 Policy Database" (accessed June 15, 2020).
[113] Bank of Thailand. Government Expenditures. May 2020.
[114] R. W. Parker, "Lessons from New Zealand's COVID-19 Success," *The Regulatory Review* (June 9, 2020), https://www.theregreview.org/2020/06/09/parker-lessons-new-zealand-covid-19-success/.
[115] New Zealand Ministry of Finance, "Budget 2020: Rebuilding Together" (press release, May 14, 2020), https://budget.govt.nz/budget/pdfs/releases/r4-rebuilding-together.pdf.
[116] GPMB, *A World at Risk* (2019).
[117] GPMB, *A World at Risk* (2019).

contexts. Despite an agreement[118] signed by the Food and Agriculture Organization, the World Organization for Animal Health (OIE), and the WHO being in existence since 2018 to strengthen cross-sectoral collaboration to support the implementation of One Health approaches[119] to address the risk of zoonoses, coordination between relevant agencies on the ground continues to remain problematic.

Effective coordination is also important at a regional level to mitigate and manage cross-border transmission of disease outbreaks. For example, ASEAN has been criticized for a relatively slow response to COVID-19, which was attributed to the way its members are grouped under the WHO umbrella[120]. Three ASEAN members are grouped under the WHO's Southeast Asia Regional Office, while the other seven belong to the Western Pacific Regional Office, making it difficult to launch a coordinated and comprehensive regional response during a crisis.

According to analysis undertaken by the World Economic Forum and the Harvard Global Health Institute, managing and mitigating risks through collaborative efforts involving the public and private sector can minimize the damage caused by pandemics.[121] Similarly, a 2019 World Economic Forum white paper discusses the significance of the private sector's engagement in outbreak response and highlights ways of engaging the private sector to support pandemic preparedness and response efforts well before a disaster hits.[122] This may include support for testing preparedness plans using modeling software and other ways of drawing on specialized technical knowledge in areas relevant to mitigating and managing impacts of disease outbreaks.

Health System Capacity and Organizational Challenges

During heath emergencies, health systems run the risk of being overburdened by the surge in demand for diagnostics, critical care treatments, and hospitalizations. Optimizing the capacity of health systems to adapt and respond effectively to the surge in demand for care has been one of the major challenges faced by economies during the COVID-19 crisis. As witnessed in many contexts, there have been significant gaps in the availability of hospital beds, especially acute care beds and space to isolate and treat patients; disease surveillance mechanisms and health information infrastructures; and resources both in terms of staff and supplies. Chronic underinvestment in health systems and the lack of proper planning have left many economies vulnerable to unexpected surges in demand for sufficient diagnostic tests and emergency supplies including PPE. Lack of ICU beds has played an important role in limiting the ability of economies to manage the pandemic satisfactorily.

The significance of robust, integrated health information systems in providing support for disease surveillance, diagnosis, and care cannot be overestimated. Yet, there are gaps in providing timely information and real-time data to support treatment efforts need to be addressed and managed to support effective healthcare delivery during health emergencies. Digital solutions have proven to be appropriate to address systemic challenges, particularly by enabling communication with and between

[118] GPMB, *A World at Risk* (2019).

[119] One Health involves designing and implementing programs, policies, legislation and research in which multiple sectors communicate and work together to achieve better public health outcomes. This approach is relevant in areas such as food security, control of diseases that can be spread between animals and humans and combating AMR. (See, WHO, "One Health" (webpage, Sept. 21, 2017), https://www.who.int/features/qa/one-health/en/.)

[120] S. S. Li-Lian, "ASEAN's COVID-19 Pandemic Response: Practical Next Steps," *ISEAS Yusof Ishak Institute Perspective* (Issue 2020 no. 47, May 18).

[121] World Economic Forum, "Outbreak Readiness and Business Impact" (2019).

[122] World Economic Forum, "Outbreak Readiness and Business Impact" (2019).

various parts of the healthcare value chain. Health systems integration and interoperability are tools for long-term sustainability as digital health is uniquely positioned to strengthen fragile health systems.

SARS-CoV-2 has placed an enormous burden on healthcare workers and healthcare systems across the globe. Doctors, nurses, and other health professionals have been mobilized as first responders. Some economies that spend more on health have relatively high numbers of doctors and nurses compared to economies with lower levels of health sector expenditure in general. The have had to boost their existing workforce capacities by bringing in retired health workers or final year medical students to assist with the increased demand. In addition, in several contexts, healthcare institutions have experienced chronic shortages of healthcare workers as a result of absenteeism due to fatigue or illness, and the reallocation of staff from core functions to deal with the crisis. The crisis has also highlighted the importance of having well-resourced and well-trained staff who are capable of responding effectively and rapidly to provide emergency care to meet the needs of patients. As the COVID-19 crisis has shone a harsh light on overburdened health workers and health systems, it has also highlighted problems associated with recruiting, retaining, and protecting well-trained health workers. A study conducted by the ILO highlights the need for sustainable investments in health systems and in the health workforce.[123]

Supply Chain Issues and Trade Disruptions

Ensuring the sustained availability of sufficient diagnostic tests, emergency medical supplies including PPEs, and essential medicines is a critical element of well-functioning health systems. Lockdowns, travel restrictions, and export bans have put a significant strain on medical supplies needed in healthcare settings to respond rapidly to COVID-19. Unexpected surges in demand due to panic buying, also have significantly impacted stock levels of PPEs and other medical equipment.

Global supply chains have grown in complexity over time. In the past few decades, supply chain management practices have involved strategies that promoted leaner, more efficient production systems that transformed the way goods and services are produced globally. These strategies involved low inventory, just-in-time delivery, single sourcing, centralization, and rationalizing production facilities as strategies for reducing costs, achieving efficiencies, and gaining productivity. Healthcare systems in many economies have encouraged the offshoring of PPE production to low-cost providers. All this contributed to the lack of availability of critical medical equipment and PPE during the crisis.

Health supply systems should be designed to swiftly and reliably source and deliver essential health commodities, including vaccines, medicines, and PPE needed for healthcare workers. It is essential to build resilience in the supply chain which requires system adaptability and transformation. Moreover, it is important that authorities have visibility of their supply chain operations, and are rapidly able to identify gaps and source raw material from alternative locations to avert supply interruptions. Another element is the importance of addressing limitations in governments' abilities to finance, prepare, and plan effectively for possible health emergencies. Advance planning involves storage, transport, and logistics as well as identifying potential disease threats.[124] However, even the best-managed supply chains could still be impacted by events that are impossible to predict.

[123] International Labor Organization (ILO), "COVID-19 and the Health Sector" (ILO Sectoral Brief, April 2020), https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/briefingnote/wcms_741655.pdf.
[124] Chemonics International and McKinsey & Company, *Best Practices In Supply Chain Preparedness for Public Health Emergencies* (2019).

Studies undertaken by the OECD[125] and the ADB[126] provide useful insights into ways of improving the resilience of supply chains and maintaining adequate PPE stocks and enough surge capacity to be able to ramp up domestic production to reduce shortages. Based on these analyses, useful measures to guide risk mitigation of supply chain disruptions in the APEC region include:

- Evaluating and identifying current risks, prioritizing them by probability and impact;
- Ensuring supplier quality and conducting procurement due diligence;
- Diversifying suppliers to minimize risk and increase options;
- Including partners in risk planning; and
- Purchasing insurance and reviewing risks periodically.

Analyzing key lessons learned from the COVID-19 crisis on the specific challenges in accessing essential equipment and supplies would be a key step in developing suitable approaches to strengthen supply chains in the APEC region.

BUILDING RESILIENT HEALTH SYSTEMS: AN APPROACH TO RECOVERING STRONGER

The analysis of critical gaps that impact health service delivery during health emergencies detailed above provide useful insights into areas that need to be improved to ensure economies are well prepared to respond to health emergencies in the future.

There is a large body of research that focuses on the importance of building the resilience of health systems. A review of this literature was undertaken to identify recurring themes and specific capacities needed for health system resiliency to infectious disease outbreaks. Before providing a description of the general attributes of a resilient health system that can respond to health crises, it is important to define what this concept means. In its information note to applicants, the Global Fund to Fight AIDS, Tuberculosis and Malaria (the Global Fund) states that resilient health systems are essential to ending epidemics as they yield broader outcomes, delivering healthcare in a sustainable, equitable, and effective way, accelerating progress toward universal health coverage and helping economies prepare for emerging threats to global health security.[127] The Global Fund expects that resilient health systems are, by definition, also sustainable.

A study undertaken by Kruk et al. defines resilience in terms of adequate planning and preparedness in advance of a potential crisis, and centers the definition around issues involving health actors, institutions, and populations, rather than outcomes and expected impacts.[128] This analysis can be used as an implementation framework to inform policy directions to improve health systems in the APEC region. Essentially, resilient health systems must prepare for and effectively respond to crisis, maintain core functions when a crisis hits, and be informed by lessons learned during the crisis, reorganizing if conditions require it. The key elements of this approach include:

- Being **aware** of strengths and vulnerabilities;
- Having sufficiently **diverse** responses to address a broad range of challenges;

[125] Christopher, "The Mitigation of Risk in Resilient Supply Chains" (2018).
[126] Park et al., "Global Shortage of Personal Protective Equipment Amid COVID-19" (2020).
[127] Global Fund to Fight HIV, Tuberculosis and Malaria (Global Fund), "Resilient and Sustainable Systems for Health Information Note" (August 2019), https://www.theglobalfund.org/media/4759/core_resilientsustainablesystemsforhealth_infonote_en.pdf.
[128] Kruk et al., "What is a Resilient Health System?" (2015).

- Enforcing **self-regulation** to be able to contain and isolate health threats while delivering core health services;
- **Integrating** and sharing information as clear communication and coordination of multiple actors are best achieved through governance and accountability; and
- Being **adaptive** to have sufficient ability to transform in ways that improve functions in the face of highly adverse conditions**.**

The analysis notes that these elements cannot exist in a vacuum as they require a foundation of strong domestic leadership, a committed health workforce, sufficient infrastructure, and global support. Others such as Hanefeld et al. (2018) argue that responding to shocks and adapting is an important aspect of resilience.[129] The analysis focuses on three key health systems functions: health information systems to inform practice; funding/financing mechanisms; and health workforce capacities. The WHO definition involves the ability to anticipate, respond to, cope with, recover from, and adapt, which contributes to sustained improvements in population health.[130] All of these definitions present options that can be explored further to address identified gaps and deficiencies. Given the centrality of supply chains for vaccines and medical supplies in ensuring health systems resiliency, the discussion on resilient health systems will also need to focus on supply chain resilience.

BEST PRACTICES FROM THE APEC REGION

As noted above, there are best practices and lessons learned from economy-level responses to COVID-19 that can help guide policy responses in APEC. For example, a study that was reviewed, indicates that three APEC economies: Hong Kong, China; Singapore; and Japan were able to respond relatively well to the pandemic.[131] The core levels of resilience in these three economies were analyzed and examples gleaned from their experiences with COVID-19 are as follows[132].

- Surveillance systems were modified to identify potential cases and public health staff identified the contacts of these cases. In addition, laboratory networks developed diagnostic tests once the COVID-19 genetic sequences were published and laboratory testing capacity was increased in all three locations.
- In all three contexts, the economies were able to improve intergovernmental coordination by drawing on previous experiences with SARS, the H5N1 crisis in 1997, and the H1N1 influenza in 2009.
- All three economies adapted financial measures so that direct costs for patient treatment were borne by governments. In Singapore, during the early stages, the cost of hospitalization was covered by the government, irrespective of where the patient came from. In Japan, funding is provided through routine financing and contingency funds. In Hong Kong, China routine financing was used which is already in place for such care.
- The three health systems developed robust plans to sustain routine or core health-care services. However, the integration of services was problematic.

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[129] Hanefeld et al., "Towards an Understanding of Resilience" (2018).
[130] Even in the context of climate resilience, this provides a relevant reference. See, World Health Organization, Operational Framework for Building Climate Resilient Health Systems (2015), https://www.who.int/globalchange/publications/building-climate-resilient-health-systems/en/.
[131] H. Legido-Quigley, N. Asgari, Y. Y. Teo, G. M. Leung, et al., "Are High Performing Health Systems Resilient Against the COVID-19 Epidemic?" *The Lancet* 395(10227): 848–850, https://doi.org/10.1016/S0140-6736(20)30551-1.
[132] Legido-Quigley et al., "Are High Performing Health Systems Resilient Against the COVID-19 Epidemic?" (2020).

- Critical care treatment and medicines were available for COVID-19 patients in all three locations, but supplies of PPE in hospitals and face masks in the community remained a key concern during the early phase in all three locations.
- In all three locations, training and adherence to infection prevention and control measures in hospitals have largely been appropriate.
- Management of information is comprehensive in all three locations. However, there were variations. In Singapore, daily meetings were conducted between regional health system managers, hospital leaders, and Ministry of Health officials. In comparison in Japan, information sharing across prefectures needed improvements. The interoperability of systems between the government health department and public hospitals in Hong Kong, China was not optimal.

In addition, the following examples also demonstrate the significant benefits of responding early and strategically to manage and reduce community transmissions. For example, the government of New Zealand promoted an elimination strategy aimed at completely eradicating COVID-19 within its borders.[133] This involved controlling entry at the border, disease surveillance, social distancing and hygiene measures, testing and tracing all potential cases, isolating cases and their close contacts, and broader public health controls depending on the level of alert. Until an effective vaccine is found and the vaccination program is delivered, these measures will remain in place. Singapore also took an active multi-sectoral approach in communications about the pandemic which involved public education through social media, websites and messaging platforms.

Chinese Taipei's response to COVID-19 and the economy's efforts to act quickly and establish effective testing and contact tracing approaches to contain transmission is another useful example to highlight.[134] Leveraging lessons learned from its 2003 SARS experience, Chinese Taipei responded to COVID-19 by issuing travel alerts and border control measures in a timely manner. The Central Epidemic Command Center (CECC) was activated to provide critical oversight and to guide coordination and communication efforts. Through the National Health Insurance (NHI) card[135], officials were able to identify individuals' travel history. The cross-sectoral coordination efforts between the NHI administration and the immigration agency were effective in identifying and managing risks. Information was disseminated through daily press conferences and the public was kept informed by regular briefings. Measures were taken to support parents with children under 12 years of age due to restrictions imposed on educational activities. Export restrictions were imposed on PPE such as masks to maintain local stock levels.

As part of its comprehensive strategy to boost testing and tracing efforts during the early stages of the COVID-19 crisis, the Republic of Korea developed innovative solutions such as drive-through COVID-19 testing centers together with a network of 96 public and private laboratories where samples were taken while people remained in their cars. More than 50 drive-through centers were established to boost the capacity to quickly identify cases. Around 20,000 tests were conducted every day. The drive-through

[133] New Zealand Ministry of Health, "COVID-19: Elimination Strategy for Aotearoa New Zealand" Ministry (May 8, 2020), https://www.health.govt.nz/system/files/documents/pages/covid-19_elimination_strategy_for_aoteaora_new_zealand_8_may_-_signed.pdf.

[134] V. C. R. Hsieh, "Putting Resiliency of a Health System to the Test: COVID-19 in Taiwan," *Journal of the Formosan Medical Association* 119(4): 884–885 (March 2, 2020), https://reader.elsevier.com/reader/sd/pii/S0929664620300760?token=54E36F5AFA901D76FF037FD2FD6F2E0AD753301381A0FA907DD29204143BE0F8C63059A4E83DA74A0701480E42BB4116.

[135] The terms "national", "nation" used in the text are for purposes of this report and do not imply the "political status" of any APEC member economy.

testing approach was one component of a broader strategy that included infrastructure development for test kit production, distribution, and laboratory analysis, which leveraged lessons learned from previous SARS-CoV-1 and MERS outbreaks.[136]

Approaches used by China have also had success in preventing and controlling the transmission of COVID-19. The approach that was undertaken, according to Chinese Government officials was "based on the premise that policy makers should put people and life first and follow the guidance of science". China's response to the disease outbreak involved a central government-led approach that guided effective coordination efforts at the local government levels. This approach reflected China's "Four Earlys" which (according to China's health ministry) involved early detection, early reporting, early isolation and early treatment. To manage the burden on health systems, several treatment centers were built. This included the Fangcang shelter hospital which was an innovative solution that was able to accommodate all of the patients diagnosed with the disease. China also made use of big data, AI and other innovative technologies in prevention strategies (refer to the table below for further details).

There are also numerous examples of extraordinary measures to ramp up production capacity by reorienting the manufacturers of nonmedical devices for PPE production. For example, during the early stages of the pandemic, New Zealand created a live register for PPE to identify domestic manufacturers that could assist by manufacturing all types of equipment to address the acute shortages.[137] Private sector agencies responded by increasing domestic production, reconfiguring their operations, and working with affiliates in China to source additional purchases of masks, sterilized gowns, hand sanitizer, and face shields. In Canada and the United States, the automotive industry developed options for retooling their factories to produce much-needed medical supplies such as ventilators to support public sector efforts. Private sector companies developed new designs for longer-lasting surgical masks to address critical shortages.[138] The Spanish fashion clothing retailer Zara produced masks and hospital gowns that were needed in healthcare settings. The private sector has also contributed to managing pandemic response efforts by deploying innovative solutions and data science including digital technologies such as global positioning systems (GPS), Artificial Intelligence (AI), [139] and real-time monitoring of mobile phones to ramp up virus testing and contact tracing efforts. For example, private sector companies in the Republic of Korea developed real-time dashboards and mobile apps (e.g., Corona NOW, Corona Map, and Corona 100m) to increase public awareness and to improve planning, coordination and the dissemination of disease information based on data provided by the Ministry of Health and the Korea Centers for Disease Control and Prevention.[140.] In addition, economies including Australia, Canada, China, and the United States have also deployed virtual care or telemedicine for

[136] D. Yoon and T. Martin, "Inside the South Korean Labs Churning Out Coronavirus Tests," *The Wall Street Journal* (March 19, 2020), https://www.wsj.com/articles/inside-the-south-korean-labs-churning-out-coronavirus-tests-11584610667.
[137] New Zealand Manufacturer, "COVID-19: PPE Register Goes Live" (April 24, 2020), https://nzmanufacturer.co.nz/2020/04/covid-19-ppe-register-goes-live/.
[138] T. Goh, "Coronavirus: Local Company Invents New Masks to Tackle Global Shortage," *Straits Times, Singapore* (March 30, 2020), https://www.straitstimes.com/singapore/health/coronavirus-local-company-invents-new-mask-to-tackle-global-shortage-1000-being.
[139] S. Ajadi, "Digital Health: A Health System Strengthening Tool for Developing Countries" (GSMA, 2020), https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/06/Digital-Health-June-2020.pdf.
[140] United Nations Development Program (UNDP) Seoul Center for Knowledge Exchange through SDG Partnerships, *Rapid Innovations in Response to COVID-19: Examples from the Republic of Korea* (UNDP, 2020), https://www.undp.org/content/seoul_policy_center/en/home/library/rapid-innovations-in-response-to-covid-19--examples-from-the-rep.html.

clinical management of COVID-19 patients. Examples from the APEC region and beyond are listed in Table 6.

Table 6 Selected Examples of Technology Solutions to Manage the Impacts of COVID-19[141].

Digital Solution	Description
Health Check[142]	Enables travelers to report symptoms via automated calls with an interactive voice response system. Health agencies can then periodically and automatically monitor the symptoms and well-being of at-risk individuals.
BlueDot Canada[143]	Frontier technologies such as AI have been used to spot infectious disease outbreaks. BlueDot predicted the COVID-19 outbreak at the end of 2019 and issued warnings to clients on December 31, 2019 ahead of the WHO on January 9, 2020.
Jio and the Reliance Foundation India[144]	Based on AI technologies, this tool is used to track and predict how COVID-19 will spread over time. The tool asks users questions about their health and travel history to determine their risk. Based on their answers, the Jio tool uses a set of parameters to tell the user whether they are at low, moderate, or high risk of being infected with COVID-19.
Commcare Dimagi platform[145]	This involves an open source mobile case management platform used by 700,000 frontline health workers in over 60 economies to track clients through a continuum of service delivery, commodity supply chains, and patient messaging. Non-engineers can build and adapt mobile apps for contact tracing, data collection, decision support, client tracking, SMS interaction, and map-based visualizations.
The Corona Virus Risk Scan[146]	This is a self-diagnostic tool to check COVID-19 symptoms on the AitTel Thanks App. The tool is a risk scanner that asks users several questions and guides them through an assessment of their infection risk.
Vodacom South Africa[147]	This is an online platform that includes a self-screening risk assessment tool and virtual healthcare consultations to facilitate testing procedures, referrals, and advice. The service is free and can be accessed on any web interface or mobile phone. Medical consultations can be facilitated through video, audio calls, or text.
Alibaba China[148]	This uses an AI system for diagnosing COVID-19. Alibaba claims its new system can detect coronavirus in computed tomography (CT) scans of patients' chests with 96 percent accuracy against viral pneumonia cases. The system was trained on images and data from 5,000 confirmed coronavirus cases and has already been tested in hospitals in China.
Community Health Tool Kit[149]	This is a global public health good project that includes open-source technologies for community health workers (CHWs) and supervisors, open access resources, and a community of practice to advance universal health coverage. The toolkit can support the COVID-19 response through community and event-based SMS and USSD (Unstructured Supplementary Service Data) check-ins by those in self-quarantine, educational messaging about protective

[141] S. Ajadi, "Digital Health: A Health System Strengthening Tool" (2020).
[142] Health Check, "Track and Check" (webpage), https://healthcheck.instedd.org/.
[143] Blue Dot. "Blue Dot." Website. https://bluedot.global/.
[144] Jio and the Reliance Foundation, "COVID-19 India Tool" (webpage, Jio), https://covid.bhaarat.ai/.
[145] CommCare, "Digital Solutions for COVID-19 Response" (webpage, CommCare), https://www.dimagi.com/covid-19/.
[146] Airtel, "Airtel and Apollo Hospital Group Join Forces to Help India Break the COVID-19 Chain" (press release, April 13, 2020), https://www.airtel.in/press-release/04-2020/airtel-and-apollo-hospital-group-join-forces-to-help-india-break-the-covid-19-chain.
[147] Vodacom, "Vodacom & Discovery Fight COVID-19" (webpage), https://www.vodacom.co.za/vodacom/coronavirus.
[148] Alibaba, "CT Image Analytics for COVID-19" (webpage), https://www.alibabacloud.com/solutions/ct-image-analytics.
[149] Community Health Toolkit, "CHT Resources & Tools for COVID-19 Response" (webpage), https://communityhealthtoolkit.org/covid-19.

Digital Solution	Description
	measures for CHWs and communities, referrals and treatment adherence, and data harmonization with other platforms.
Google's DeepMind[150]	This tool predicted the structure of proteins of the novel coronavirus, which could be useful in developing new drugs although its predictions have not been verified.
Qlue Indonesia[151]	Reports neighborhood conditions to city authorities and businesses including reporting information of confirmed COVID-19 cases which is then populated in an aggregated form to identify virus hot spots. This enables smart lockdowns and contact tracing.
Baidu China[152]	This involves infrared cameras that use computer vision to scan crowds. Reportedly, this can scan 200 people per minute and will recognize those whose body temperature exceeds 37.8 degrees Celsius.
Electronic wrist bands Hong Kong, China[153]	The use of electronic wristbands is being adopted to monitor and enforce quarantine efforts during the coronavirus outbreak. Inbound travelers are required to wear them and use a smartphone app to ensure they remain in their designated dwelling places for a compulsory quarantine period specified by the Government.
Infervision[154]	This AI solution helps frontline healthcare workers detect and monitor COVID-19 efficiently. This solution improves CT diagnosis speed.
Ant Financial[155]	This is a blockchain platform that helps speed up claims processing and reduces the amount of face-to-face interaction between patients and hospital staff.
Terra Drone China[156]	Unmanned aerial vehicles are used to transport medical samples and quarantine material with minimal risk. Drones are used to patrol public spaces, track noncompliance with quarantine mandates, and conduct thermal imaging.
Blue Ocean Robotics[157]	Blue Ocean Robotics robots use ultraviolet light to autonomously kill bacteria and viruses. In China, these have been deployed in more than 40 hospitals. Similarly, in Singapore robots and robotic technologies have been used for heart surgeries. Currently, COVID-19 patients with mild infections that are housed in temporary community centers are provided meals and medication via robots.[158]
Boston Dynamics[159]	Singapore has also been using a robotic dog called "Spot" to enforce social distancing measures in parks and public areas. The robot-dog is made by US-based Boston Dynamics and is fitted

[150] DeepMind, "Computational Predictions of Protein Structures Associated with COVID-19" (webpage), https://deepmind.com/research/open-source/computational-predictions-of-protein-structures-associated-with-COVID-19.
[151] Qlue, "Break COVID-19 Transmission through AI and IoT Technological Solutions," (webpage), https://www.qlue.co.id/covid19/.
[152] Baidu Research, "How Baidu is Harnessing the Power of AI in the Battle Against COVID-19," (web content, Baidu, March 12, 2020), http://research.baidu.com/Blog/index-view?id=133.
[153] A. Lardieri, "Hong Kong; China to Monitor All Arrivals with Electronic Wristband, Mandate Self-Quarantine," *US News and World Report* (March 18, 2020), https://www.usnews.com/news/world-report/articles/2020-03-18/hong-kong-to-monitor-all-arrivals-with-electronic-wristband-mandate-self-quarantine.
[154] Imaging Technology News, "Infervision Launches Solution to Fight Against Coronavirus" (online, March 31,2020), https://www.itnonline.com/content/infervision-launches-solution-fight-against-coronavirus.
[155] Ledger Insights, "UN Lauds Ant Financial's Blockchain, M-Pesa for Combatting COVID-19 Effects on Economy," (online content 2020). https://www.ledgerinsights.com/un-ant-financial-blockchain-covid-19/.
[156] Terra Drone, "Terra Drone Business Partner Antwork Helps Fight Coronavirus in China with Medical Delivery Drones" (online content, 2020), https://www.terra-drone.net/global/2020/02/07/terra-drones-business-partner-antwork-helps-fighting-corona-virus-with-drones/.
[157] Blue Ocean Robotics, "About" (webpage), https://www.blue-ocean-robotics.com/about.
[158] N. Ramanathan, "Battling COVID-19 with Transformational Tech: Singapore Case Study" (Lux Research, May 2020), https://www.luxresearchinc.com/blog/battling-covid-19-with-transformational-tech-singapore-case-study.
[159] Spot. Boston Dynamics. https://www.bostondynamics.com/spot

Digital Solution	Description
	with a camera to monitor areas. It also carries a loudspeaker to broadcast social-distancing messages.
iThermo Singapore[160]	This is a temperature scanner that alerts staff to people with higher temperatures. The system is currently being used in Singapore at the Changi Airport.
Sonovia Israel[161]	This technology involves the development of face masks made from an antipathogen, an antibacterial fabric that relies on metal-oxide nanoparticles.
The Access to COVID-19 Tools (ACT) Accelerator[162]	Founded by the Global Fund, this is a global collaboration of organizations and governments working to accelerate the development, production and equitable access to new COVID-19 technologies.
Geospatial technologies	A range of geospatial technologies is used in the different stages of combating COVID-19. The Health GeoLab Collaborative vision involves facilitating the implementation of the Health Information System (HIS) geo-enabling framework across low and middle-income economies in Asia and the Pacific region to leverage the power of geography and geospatial data and technologies. Through this collaborative model, the health sector not only benefits from a more powerful use of geospatial data and technologies to support geographically based decision making, but also improves data quality across health programs to reach a more systematic approach to solving health problems and therefore reach the health Sustainable Development Goals.[163]

CONCLUSIONS AND RECOMMENDATIONS

The process of defining appropriate policy options for APEC aimed at strengthening pandemic preparedness should be undertaken within the framework of building health system resilience including the elements discussed earlier. The findings of the literature review and gap analysis provide significant information on the economic and health impacts of pandemics, critical gaps in levels of preparedness for health emergencies, options to promote resilient health systems, and lessons learned from COVID-19 that can inform future directions. Key lessons learned from COVID-19 and previous pandemics can be synthesized as follows:

- The importance of coordination at domestic, regional, and international levels to enhance surveillance and communication efforts. As noted earlier, there is limited coordination within economies particularly between the diverse range of health sector agencies and other agencies (e.g., veterinary agencies) and nongovernmental entities that need to be part of a coordinated and holistic effort to respond efficiently to medical emergencies.
- The value of strengthening efforts to train health personnel and increase resources to satisfy requirements for universal health coverage and to achieve the Sustainable Development Goals.
- Ensuring the equitable, reliable, and sustainable access to medicines, medical equipment, and health technologies by improving the overall resilience of supply chains prior to a disaster. Approaches may include identifying domestic manufacturing capabilities and suppliers,

[160] KroniKare, "iThermo," (webpage, 2020), https://kronikare.ai/ithermo/.
[161] Sonovia, "SonoMask by Sonovia," (webpage, 2020), https://sonoviatech.com/.
[162] WHO, Access to COVID-19 Tools (ACT) Accelerator (April 24 2020), https://www.who.int/publications/m/item/access-to-covid-19-tools-(act)-accelerator.
[163] Health GeoLab Collaborative, "Who We Are," (webpage), https://healthgeolab.net/.

undertaking robust risk management efforts, and increasing planning capacities and the visibility of procurement and supply chains to minimize the impacts of disruptions to supply chains.
- Strengthening efforts to develop fully integrated and interoperable health information systems, including the adoption of new technologies and tools to prevent fragmented healthcare delivery.
- Increasing health infrastructure capacities in resource-poor settings for better testing, tracking, and tracing efforts during health emergencies.
- Underfunded health systems are unable to cope with the surge in demand for health services during a pandemic. Efforts could be made to look at funding gaps and resource requirements as well as ways that health systems can adapt to respond to surges in demand for intensive care unit beds, protective equipment, diagnostic health kits, and ventilators.

It will be important to leverage work that has been undertaken to date under the Health Working Group (HWG) and Life Sciences Innovation Forum (LSIF), as well as fora such as the APEC Emergency Preparedness Working Group (EPWG), Economic Committee, and the Transportation Working Group. APEC economies have undertaken policy initiatives focusing on improving cross-border efforts for communicable disease prevention, following the SARS outbreak under the HWG. LSIF and other fora have implemented activities aimed at improving regulatory capacity; promoting good regulatory practices; improving standards and the harmonization of processes to facilitate trade; and emergency preparedness and supply chain resilience. APEC can also draw on work undertaken by ASEAN in developing COVID-19 recovery plans.

Policy responses to improve pandemic preparedness in APEC will be supported by appropriate public health responses which are guided by scientifically grounded and evidence-based, targeted interventions supported by appropriate social distancing measures, transmission control through the use of personal protective equipment, and testing regimes and surveillance. The following recommendations are proposed to provide a comprehensive approach to address the threat of pandemic disease outbreaks in the Asia-Pacific context.

1. **Recover safer from future infectious disease threats by addressing gaps in pandemic and epidemic preparedness and response capabilities in APEC economies.**

   Improving cooperation and coordination efforts between APEC economies is critical for responding to and mitigating cross-border transmission of emerging infectious diseases like COVID-19. This requires a sound understanding of the levels of preparedness and health system resilience across APEC economies, both at local as well as regional levels. This also requires a good appreciation of the secondary health impacts caused by the lack of core health services available during health emergencies.

   Among the key lessons learned from the samples of economy-level examples examined as part of this study include the importance of undertaking a whole of government, coordinated response to the management of surveillance and treatment efforts, as well as preparedness efforts. Policy makers need to adopt approaches that are underpinned by scientific evidence and that are well targeted and able to adjust to the realities on the ground.

   As a first step, **after-action reviews**, involving robust assessments of human and economic tolls, experiences at the economy and regional levels, and critical capacity gaps and challenges faced in

responding to COVID-19, could be undertaken. This could also involve an assessment of the secondary health impacts caused by gaps in core health services during the COVID-19 crisis.

Collating and analyzing this information would enable policy makers to make informed decisions about allocating sufficient resources and directing policy efforts to strengthen economy-level public health and health security capacities in areas such as disease surveillance systems and diagnostic capacities; laboratory networks and clinical capabilities; pandemic risk inventories; hazards, and threats; resourcing requirements; strengthening supply chain resilience; enhancing distributed manufacturing; and stakeholder engagement strategies. This approach can create an effective platform within APEC where economies can share information on gaps and best practices based on their unique COVID-19 experiences. Once gaps and shortfalls are identified collectively, this platform could also be used to inform well designed, targeted, capacity building programs for APEC economies to strengthen their systems for future health security threats.

2. **Prioritize efforts for sustainable health security financing in the APEC region through targeted analysis.**

Having sufficient funding to build and sustain strong, scalable, and resilient public health systems that can address diagnostic, testing and patient care needs during health emergencies, is critical. However, mobilizing resources is difficult due to a range of reasons. Therefore, undertaking analysis to develop investment cases and on financing challenges in the APEC region would be useful to guide much needed policy responses in APEC economies. This analysis could be part of broader efforts to improve health systems strengthening efforts supported by HWG and cover issues such as assessing ways of directing external financing sources to support increased pandemic preparedness efforts and delivering on commitments made under the 2005 International Health Regulations (IHR) in a post COVID-19 context, including through the "National Action Plans for Health Security". This could also cover issues such as creating fiscal space in domestic budgets through better public financial management.

3. **Improve multi-stakeholder engagement in enhancing preparedness and response capabilities with a focus on improving resiliency.**

Lessons learned from previous outbreaks such as the Ebola virus disease outbreak as well as the current COVID-19 pandemic underscore the critical importance of effective multi-stakeholder engagement. This includes the engagement of the private sector, academia, faith-based organizations, and communities in pandemic preparedness and response efforts. Within APEC, increasing the engagement by the APEC Business Advisory Council (ABAC) in coordinating regional and economy-level efforts to promote health system resilience, is important. The engagement with ABAC provides opportunities for leveraging its technical capabilities and resources.

4. **Improve coordination and strengthen cross-fora collaboration within APEC.**

Strengthening cross-fora collaboration within APEC around issues of pandemic preparedness and global health security to develop a coherent and coordinated strategy across different sectors, while leveraging work undertaken in the past (SARS/avian influenza), will be useful in a post-COVID-19 environment. This could include collaborative approaches with other APEC fora including LSIF,

EPWG, the Sub-Committee on Standards and Conformance, and the Transportation Working Group (TPTWG) where synergies exist to facilitate the development of appropriate standards or regulations involving medical supplies, vaccines, infrastructure resiliency, and the reliability of supply chains in emergencies. Of note is the work undertaken by the TPTWG to improve supply chain resilience in line with a set of APEC principles agreed to by members. In addition, and where possible, members could explore opportunities to situate pandemic preparedness plans within existing disaster risk management frameworks in the region (such as the APEC Disaster Risk Reduction Framework) or within the context of broader frameworks such as the Sendai Framework for Disaster Risk Reduction 2015–2030 or the IHR Monitoring and Evaluation Framework.

5. Strengthening health system supply chains and delivery system scalability and resilience in the APEC region to support pandemic preparedness, response, and recovery efforts.

Ensuring the sustained availability of sufficient diagnostic tests, emergency medical supplies including personal protective equipment (PPE) as well as therapeutics is an essential element of well-functioning health systems. Inadequate investments, stockpiling, distributed manufacturing capacity, particularly when combined with quarantines, lockdowns, travel restrictions, and unwarranted export bans put a significant strain on essential medical products and countermeasures needed in healthcare settings to respond rapidly to COVID-19. Unexpected surges in demand due to panic buying, also significantly impacted stock levels of PPE and other medical equipment, and there is no agreed upon allocation mechanism for scarce supplies.

Supply chains need to be capable of a rapid ramp-up in manufacturing and distribution to effectively reach patients during a health crisis. However, as witnessed during COVID-19, this remains an enormous challenge due to the lack of planning and clarity in governance arrangements of emergency supply chains; current supply chain design, approaches and procurement efforts; limitations in leadership and financing efforts; as well as export and trade restrictions imposed during health emergencies that impact stock availability.

Studies undertaken by the OECD,[164] the ADB,[165] and USAID[166] provide useful insights into ways of improving the resilience of supply chains and maintaining adequate surge capacity to be able to ramp up production and to reduce shortages. Improving the resilience of supply chains involve the following elements:

- Evaluating and identifying current risks, prioritizing by probability and impact;
- Ensuring supplier quality and conducting procurement due diligence;
- Diversifying suppliers to minimize risk and increase options;
- Including partners in risk planning; and
- Purchasing insurance and reviewing risks periodically.

Furthermore, analyzing the experiences of economies in the region in accessing essential equipment and supplies would supplement the information above.

[164] Christopher, "The Mitigation of Risk in Resilient Supply Chains" (2018).
[165] Park et al., "Global Shortage of Personal Protective Equipment Amid COVID-19" (2020).
[166] Chemonics International and McKinsey & Company, *Best Practices in Supply Chain Preparedness for Public Health Emergencies* (2019).

The work undertaken by LSIF/HWG to improve supply chains for medical products (via the APEC Roadmap to Promote Global Medical Product Quality and Supply Chain Security) could be leveraged as part of APEC's efforts of increasing the scalability and resiliency of health systems to cope with and respond to disease outbreaks. Work on increasing vaccine manufacturing capacity and improving supply chain resilience is already underway via the Vaccine Program of Work, a collaborative effort between Canada and the United States, endorsed by members in February 2020 to maximize the impact of HWG initiatives on improving health security and immunization rates in the APEC region, and to build on the current global momentum to combat COVID-19 and influenza, as well as to address barriers to immunization and harmonize efforts in the APEC region.

In addition, strengthening and harmonizing economies' regulatory capacity, including through improved governance mechanisms that protect patients from substandard and falsified products, is a critical part of these efforts. It is estimated that half of medicines prescribed, dispensed, and sold worldwide are administered or consumed inappropriately, and many of the medicines are of a relatively poor quality or counterfeit. These types of regulatory challenges will also likely affect the COVID-19 response involving medical products like PPE and also vaccines and therapeutics, once safe and effective COVID-19 vaccines and therapeutics become available. Developing combined approaches to combating respiratory illnesses with pandemic potential, including COVID-19 and influenza, may be an effective way to sustainably enhance preparedness and surveillance, and annual immunization campaigns against these threats may be an effective way to exercise capacities needed to prepare for future pandemic threats.

The work undertaken by the APEC Regulatory Harmonization Steering Committee to promote a strategic approach to regulatory harmonization and improve regulatory frameworks across the APEC region can inform broader efforts at improving the resilience of supply chains.

ANNEX A – EXAMPLES OF EVALUATION TOOLS

The WHO's Joint External Evaluation (JEE) is a voluntary, collaborative process to assess economy-level capacities under the IHR (2005) to prevent, detect, and rapidly respond to public health threats. Economies use voluntary sets of tools designed to evaluate and address gaps in IHR capacities. These include: the JEE and **after-action reviews** to assist in developing IHR capacities needed to combat health emergencies, including National Action Plans for Health Security and simulation exercises. An economy's capacity to detect and respond to infectious disease events is measured using the JEE. This involves the assessment of economy-level progress in achieving a set of targets set out in Annex 1 of the IHR and contains recommendations for priority actions to be implemented across the 19 technical areas that are evaluated. External evaluations should be regarded as an integral part of a continuous process of strengthening capacities for the implementation of the IHR,[167] following economies' JEES completion of multi-sectoral National Action Plans for Health Security. However, there are limitations with using JEE and SPAR data as these are subjective and can lead to interpretation biases.[168] Table 7 illustrates readiness examples from several APEC economies. While the JEE is a worldwide initiative, at the time this was drafted, Papua New Guinea had no JEE. Figure 6, which follows Table 7, provides an overview of the IHR monitoring and evaluation framework.

Table 7 Pandemic Preparedness Based on Information from WHO JEE Mission Reports

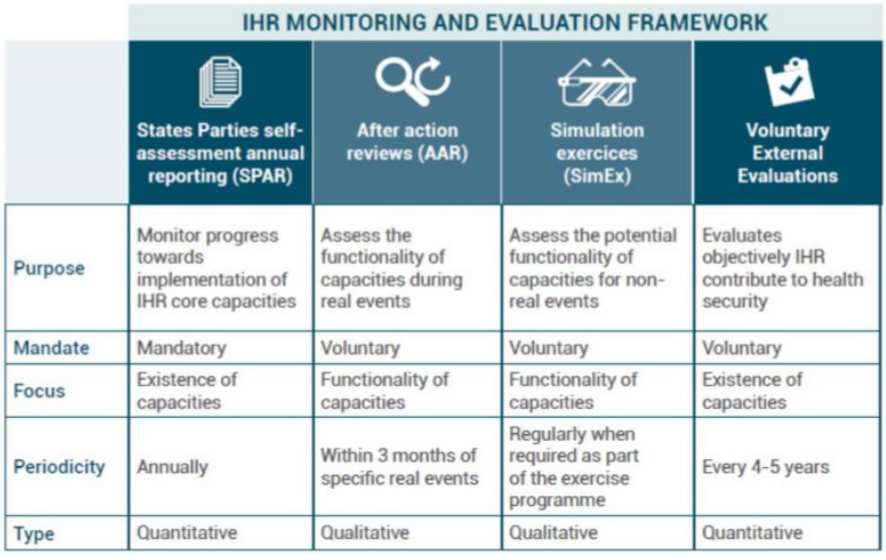
	SINGAPORE	THE USA	THAILAND	INDONESIA	VIET NAM
Find and verify outbreaks					
Laboratory system	✓	✓			
Real-time surveillance	✓	✓	✓		
Reporting	✓	✓			
Workforce development	✓	✓	✓		
Stop outbreaks					
Preparedness	✓	✓			
Emergency response operations	✓	✓			
Linking public health and security authorities	✓	✓	✓	✓	
Medical countermeasures and personnel deployment	✓	✓	✓	✓	
Risk communication	✓	✓	✓		
Prevent outbreaks					
Legislation, policy, and advocacy	✓	✓	✓		

[167] Resolve to Save Lives, "PreventEpidemics.org" (website created by the Resolve to Save Lives initiative of Vital Strategies), Preventepidemics.org.
[168] WHO, "Thematic Paper on the Status of Country Preparedness Capacities," (background report commissioned by the Global Health Preparedness Board (GPMB), WHO, September 2019).

	SINGAPORE	THE USA	THAILAND	INDONESIA	VIET NAM
IHR coordination, communication, and advocacy	✓	✓	✓		✓
Antimicrobial resistance	✓				
Zoonotic disease	✓		✓		
Food safety	✓	✓			
Biosafety and biosecurity	✓	✓	✓		
Immunization	✓	✓	✓	✓	✓
Protect from other threats					
Points of entry	✓	✓		✓	
Chemical emergencies	✓	✓	✓		
Radiation emergencies			✓		
Other		**National Action Plan (Oct. 2018)**	**Develop plan to address critical gaps in epidemic preparedness**	**National Preparedness Plan (June 2018)**	
Date of assessment	**April 2018**		**June 2017**	**Nov. 2017**	**Nov. 2016**
Score	**93**	**87**	**76**	**64**	**57**

Source: WHO, "Joint External Evaluation (JEE) Mission Reports," section of the WHO website, 2005.

Figure 6 The International Health Regulation (2005) Monitoring and Evaluation Framework



Source: WHO, "Thematic Paper on the Status of Country Preparedness Capacities," Global Preparedness Monitoring Board, WHO, 2019,

The APEC Policy Support Unit developed a Pandemic Preparedness Checklist in 2020, which could be used by APEC members should members see the need to develop a specific evaluation tool for the APEC region.[169]

[169] D. Hew. "Preparing for the Next Pandemic" (APEC, April 27,2020), https://www.apec.org/Press/Blogs/2020/0427_COVID.

ANNEX B – BIBLIOGRAPHY

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ANNEX C – GLOSSARY OF KEY TERMS

Epidemic

An epidemic is defined as the occurrence in a community or region of cases of an illness, specific health-related behavior, or other health related events clearly in excess of normal expectancy. The community, region and the period in which the cases occur, are specified. The number of cases varies according to the agent, size and type of population exposed, previous experience or lack of exposure to the disease, and time and place of occurrence.[170]

Endemic Disease

An infectious disease occurs frequently in a specific geographical location. The disease often occurs in cycles.[171]

Health Security

The activities required to minimize the danger and impact of acute public health events that endanger the collective health of populations living across geographical regions and international boundaries.[172]

Outbreak

According to the WHO, a disease outbreak is usually caused by an infection, transmitted through person-to-person contact, animal to person contact or from the environment or other media.[173]

Pandemic

A pandemic is defined as "an epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people."[174] The original definition does not refer to population immunity, virology or disease severity. According to this, pandemics can occur annually in temperate southern and northern hemispheres, as seasonal epidemics cross international boundaries and affect large numbers of people. Seasonal epidemics are not considered pandemics.

Preparedness

The United Nations and the WHO [175] define it in terms of establishing mechanisms that allow domestic authorities, multilateral organizations and relief organizations to be aware of risks and deploy staff and resources quickly once a crisis strikes.

Resilience

Health systems resilience is defined as the capacity of health actors, institutions and populations to prepare for and effectively respond to crisis, maintain core functions and, guided by lessons learned during the crisis, reorganize if conditions require it. Health systems are resilient if they protect human life and produce good health outcomes during a crisis and its aftermath. Resilient health systems can also deliver everyday benefits and positive health outcomes.[176]

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