

In collaboration with
Duke Kunshan University Global
Health Research Center



NCDs 2030: Accelerating Change through Innovation

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Foreword



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The COVID-19 pandemic has exposed the vulnerabilities of global and national health systems. Already-struggling healthcare systems have shifted their resources to the pandemic response, which has exacerbated the burden on people with non-communicable diseases (NCDs) by delaying and disrupting their diagnosis, treatment and care.

NCDs, also known as chronic diseases – including cardiovascular diseases, cancers, chronic respiratory diseases and diabetes – remain the number one killer globally, causing nearly three-quarters of deaths worldwide. Every year, 17 million people under the age of 70 die from NCDs, 86% of whom live in low-and middle-income countries.¹

The 2030 Agenda for Sustainable Development recognizes NCDs as a major challenge for sustainable development. As part of the Agenda, global leaders have committed to developing ambitious national responses by 2030 to reduce premature mortality from NCDs by one-third through prevention and treatment (SDG Target 3.4).^{2,3}

At the time of writing, in November 2022, as the pandemic appears to be in transition, it is the optimal moment to reflect on lessons learned. More importantly, it is now time to consider what practices could be adopted from the pandemic response to create more resilient health systems in developing countries in the long term. COVID-19 offers a chance to reset health system priorities, providing a leapfrogging moment for health system transformation through innovation.

As COVID-19 transitions, developing countries will have an opportunity to improve the equity, accessibility, quality, efficiency and resilience of their health systems. Non-communicable diseases present an urgent global health challenge. Governments, private-sector industries and international organizations must work together to strengthen their collaboration, with learning and sharing at the heart of this ethos.

There is no better time for the world to unite and align efforts under these principles.

Executive summary



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For this report, in-depth consultations with policymakers, industry leaders and leading academics from G20 countries were conducted to uncover lessons learned, effective methodologies and innovation strategies – and the results inspire optimism.

Developing countries have reacted rapidly to NCD management challenges by increasing health service provision and strengthening medicine supplies in response to the multifaceted knock-on effects of COVID-19. The paper examines how, with thoughtful planning and careful implementation, some of these rapid responses can, and should, be made permanent to improve the equity, accessibility, quality, efficiency and resilience of health systems.

Examples of replicable responses include the many promising examples of people-centred integrated care models across the disease spectrum; innovative attempts to enable and mobilize community-level primary care for early screening

and diagnosis; and smart integration with digital and technological advancements to increase health access and improve diagnosis and treatment.

There is still room for optimization, but we already see trailblazers identifying cost-effective and globally applicable NCD intervention and treatment pathways from which every country – no matter its income level – can and should benefit.

As the report sets out, to achieve progress and the goal of universal health coverage, we must reflect openly and honestly on the lessons learned so that gaps can be identified and new priorities set. We should move towards a people-centred integrated care model and create an ecosystem where digital and technological advancement can be integrated into each patient's journey and into primary care institutions to improve access and quality of care. Taking an ecosystem approach will require global public and private collaboration. Only by doing so can we save lives, reduce health system burdens and collectively achieve SDG Target 3.4.



1

Introduction

COVID-19's long-term and detrimental impact on NCD management has necessitated active health system reforms in developing countries.



As of 20 September 2022, the global COVID-19 pandemic had resulted in 618,155,539 cases of the disease around the world, leading to 6,533,516 deaths.⁴ Since its emergence, COVID-19 has produced widespread social and economic uncertainty on a global scale. Health systems have been under enormous pressure, notably due to the impact of the virus on people living with non-communicable diseases (PLWNCDs) and

the difficulties it caused for the management of NCDs (cardiovascular diseases, cancers, chronic respiratory diseases and diabetes, as well as mental health disorders). Developing countries, which account for more than 80% of the global disease burden of NCDs,⁵ are exposed to the exacerbated impact of COVID-19 as they often suffer from a lack of health service resources and capacity.⁶

1.1 PLWNCDs are more vulnerable to COVID-19

PLWNCDs are more likely to be infected with COVID-19 compared with healthy people;⁷ in addition, the disease progresses faster, and the long-term health effects are more severe, in these people. Some 60–90% of COVID-19 deaths can be attributed to one or more NCD comorbidities.^{8,9,10}

PLWNCDs are also affected by the pandemic in terms of their mental health, showing a higher probability of concurrent anxiety and depression.¹¹ On top of this, some chronically ill patients voluntarily reject treatment because they fear that going to the hospital will increase the risk of infection.

1.2 Challenges of service provision for NCD management

In addition to the direct impact of COVID-19 on individuals' health, PLWNCDs also face challenges relating to health service accessibility. Many countries and regions have established closed and isolated control measures to prevent susceptible individuals from being exposed to infection and to help stop the spread of COVID-19.

In May 2020, the World Health Organization (WHO) conducted a rapid assessment of service delivery for NCDs during the COVID-19 pandemic. The results showed that, out of 163 countries and

regions surveyed, 122 countries or regions reported chronic health service interruption; cardiovascular emergency services were interrupted in 31% of the countries, cancer treatment services were interrupted in 42% and treatments for hypertension were interrupted in 53%.¹² On top of this, pandemic prevention and control measures have had a knock-on effect on medical resources for NCD management services, leading to insufficient capacity in primary healthcare institutions, and issues with the supply of drugs for NCDs.

1.3 Strengthening health systems with NCD management

As one of the Sustainable Development Goals adopted by all United Nations member states in 2015, SDG 3.4 seeks to reduce premature mortality from NCDs by one-third by 2030 through prevention and treatment and to promote mental health and well-being.¹³ As yet, few countries have succeeded or even come close to reaching this target.¹⁴ It is clear, however, that improving the capacity and efficiency of NCD management and transforming health systems are vital objectives for developing countries, both for their inhabitants' health and for global sustainable development.

Fortunately, the practices involved in improving NCD management capacity also contribute to the strengthening of health systems in general. At the macro level, NCD management requires interdisciplinary collaboration, which provides an anchor point for health systems to implement comprehensive and high-quality development strategies. Specifically, NCD management begins with enhancing community healthcare services; this helps to solidify the “cornerstones” of a health system¹⁵ – healthcare delivery, health information systems and medicine supply security – enabling it to cope with the double threat of communicable and non-communicable diseases¹⁶ and better prepare for a future pandemic.



2 Responding to NCD management challenges during the pandemic

Health systems have adopted flexible response methods to mitigate the impact of the COVID-19 outbreak.



In order to minimize the impact of the pandemic, developing countries and regions have developed rapid response plans to maintain regular in- and

outpatient services, as well as secure drug accessibility for PLWNCDs.

2.1 Increasing temporary facilities to mitigate the impact on hospitalized NCD patients

Certain countries or regions have adopted a system whereby some hospitals have become designated centres for treating COVID-19 while others maintain normal operations as much as possible, treating patients with NCDs who are not infected with COVID-19. Such a two-pronged

response method helps ensure the continued supply of medical services when infection cases are scattered. However, when there is a large-scale outbreak of infections, a serious shortage of hospital beds will ensue.

In 2020, China took the lead by building a new “mobile cabin hospital” in Wuhan. The pressure on normal medical resources was reduced by increasing the medical resources used to treat patients with COVID-19 on a large scale in a short period of time. Serbia, India, Indonesia

and others^{17,18,19,20} have also adopted similar approaches, building new facilities for the isolation and treatment of patients with COVID-19 to ensure that the medical needs of patients with NCDs can also be met.²¹

2.2 Improving efficiency to meet PLWNCD outpatient needs

Faced with a shortage of medical resources, health systems in some developing countries and regions have placed more emphasis on improving service efficiency. During the pandemic, medical institutions in these areas paid more attention to the role of pre-examination and triage, optimized the process of diagnosis and treatment service provision for PLWNCDs. Some countries have formulated guidelines or expert consensus on the diagnosis and treatment of various NCDs during the pandemic to improve the standardization of services.^{22,23,24,25} Patients are encouraged to obtain appropriate services through primary healthcare

institutions, while community health service centres and family doctors interact with patients or their families and provide follow-up services through social media tools.

During the pandemic, especially the period of high incidence of infection cases, the internet became an important asset in relieving the pressure on physical hospitals. “Contactless” healthcare services provided by internet healthcare sites reduced the risk of infection for patients who usually visited physical hospitals, as well as meeting PLWNCDs’ home treatment and medication needs.

2.3 Adopting flexible measures to ensure the accessibility of NCD medications

PLWNCDs generally require long-term medication. Some measures to guarantee the supply of medication of PLWNCDs include:

- **Using designated pharmacies as the main channel for medication supplies to PLWNCDs:** Taking China as an example, Wuhan identified 50 designated retail pharmacies across the city after the outbreak of COVID-19 to serve PLWNCDs.²⁶ Cities such as Shanghai, Beijing and Jilin also relieved medicine supply issues through the use of designated pharmacies for NCD treatments.^{27,28}
- **Extending the time limits for prescriptions for PLWNCDs and implementing a “long prescription” policy:** In 2020, China’s National Medical Security Administration extended the prescription dosage for hypertension and diabetes from two months to three months to ensure the long-term medication needs of PLWNCDs were met.²⁹ Some regions also encouraged physicians in primary healthcare institutions or contracted family doctors to issue prescriptions, which normally come from overloaded hospitals. Local health commissions

are responsible for developing the list of medicines suitable for “long prescriptions” and the relevant policies,³⁰ while pharmaceutical companies have also launched large-package versions of NCD medications, for “long prescriptions”.³¹

- **Providing door-to-door medicine delivery services to reduce social contact:** Door-to-door medicine delivery services for eligible elderly PLWNCDs through community health service staff, community volunteers or drug delivery companies have been encouraged. A number of internet technology companies have collaborated with pharmacy chains to launch online pharmacies, which allow patients to arrange to have medicines delivered to their homes in 30 minutes using a smartphone app.

As tools to deal with the impact of the pandemic in the short term, these measures can reduce the pressure on NCD management to a certain extent. However, as things normalize, health systems in developing countries and regions need more proactive innovation and systematic transformation, if only to better prepare for a future pandemic.

3

The transformation to integrated health systems

Transforming health systems requires a three-pronged approach focusing on people, technology and prevention.



Universal health coverage (UHC) is a priority for the development of global health governance and national health systems, and is key to achieving the health-related SDGs. The WHO proposed a working definition of “integrated people-centred health services” (IPCHS) in 2016 and called on member states to provide health services in a more

integrated and people-centred manner,³² which it sees as critical to achieving the goals of UHC. Due to the scarcity of high-quality medical resources and the greater social and economic pressures caused by NCDs in developing countries, there is an urgent need to establish high-quality, efficient health systems within them.

3.1 Reshaping the diagnosis and treatment process in a people-centred way

CPCs: reducing the onset-to-treatment time and improving acute chest pain patient treatment efficiency

China started building chest pain centres (CPCs) in 2011 and in 2013 established a CPC certification system, with the goal of establishing a mechanism for “sending patients with acute chest pain to a hospital with the ability to receive the best treatment in the shortest possible time”. To achieve this goal, a series of measures in China’s CPC model facilitate the seamless integration of acute chest pain treatment systems in the pre-hospital, in-hospital and post-hospital phases to reduce the emergency response time, which may provide a useful reference for developing countries.

The CPC emergency map mini-app on WeChat enables users who experience sudden chest pain to quickly locate the nearby chest pain centre and call the 120 emergency service with one click. An ambulance, with the support of an intelligent transport system combined with information on hospital percutaneous coronary intervention (PCI) admission capacity, will then take the patient to the nearest hospital with treatment capacity as quickly as possible. On the way to the hospital, emergency personnel can use the electrocardiogram (ECG) machine, multi-function monitor and other equipment located in the ambulance to conduct real-time detection of the patient’s vital signs and transmit the information to the hospital. On receiving the patient’s report, the doctor on duty will conduct a remote initial diagnosis as soon as possible. If the patient is diagnosed with acute myocardial infarction, the on-board emergency personnel will immediately provide the patient with preoperative drugs for PCI and begin preparations for the person to be operated on after admission. On arrival at the hospital, the patient will be sent directly to the catheterization room through a prioritized access system for treatment.

For patients who come to PCI-non-capable hospitals, the CPC emergency command centre will transfer the patient to a PCI-capable hospital as soon as possible; in PCI-capable hospitals, an emergency nurse will evaluate the patient’s vital signs within five minutes, with the first ECG being completed within 10 minutes. This will then be assessed by a professional physician. Patients diagnosed with acute myocardial infarction will also be assigned to PCI as soon as possible.

Cardiovascular diseases cause the largest number of deaths in the world. There are about 330 million patients in China, with three out of every 1,000 people dying of cardiovascular disease every year. Among them, acute myocardial infarction (AMI), the main clinical manifestation of acute chest pain, is an important cause of death from cardiovascular disease.³³ It is crucial for patients with AMI to receive standardized treatment as soon as possible after the onset of symptoms. Minimizing the time for early treatment is the most effective way to save lives. For this purpose, developed countries such as the United States, the United Kingdom, Germany and Australia have established CPCs, and large number of studies have shown that CPC certification is associated with slower disease progression and better patient outcomes for those with AMI.^{34,35,36}

The CPC model in developed countries is based on a relatively robust emergency system, as well as community and on-site rescue capabilities.³⁷ In comparison, the pre-hospital emergency system in developing countries is generally less established, the service capacity of primary medical institutions is insufficient, and the ability to diagnose and treat varies greatly. The developed countries model is not fully applicable to developing countries. China’s CPC model might be a solution as it is based on the regional treatment network and focuses on the goal of reducing the total ischemic time (TIT – the time from the onset of chest pain to the first balloon inflation during primary PCI) of patients. It realizes the full potential of medical institutions on different levels, establishes a cooperative relationship with the emergency medical service (EMS) system and the transport department, and standardizes the patient’s treatment process.

The key elements of China’s successful CPC system that are applicable to developing countries include:

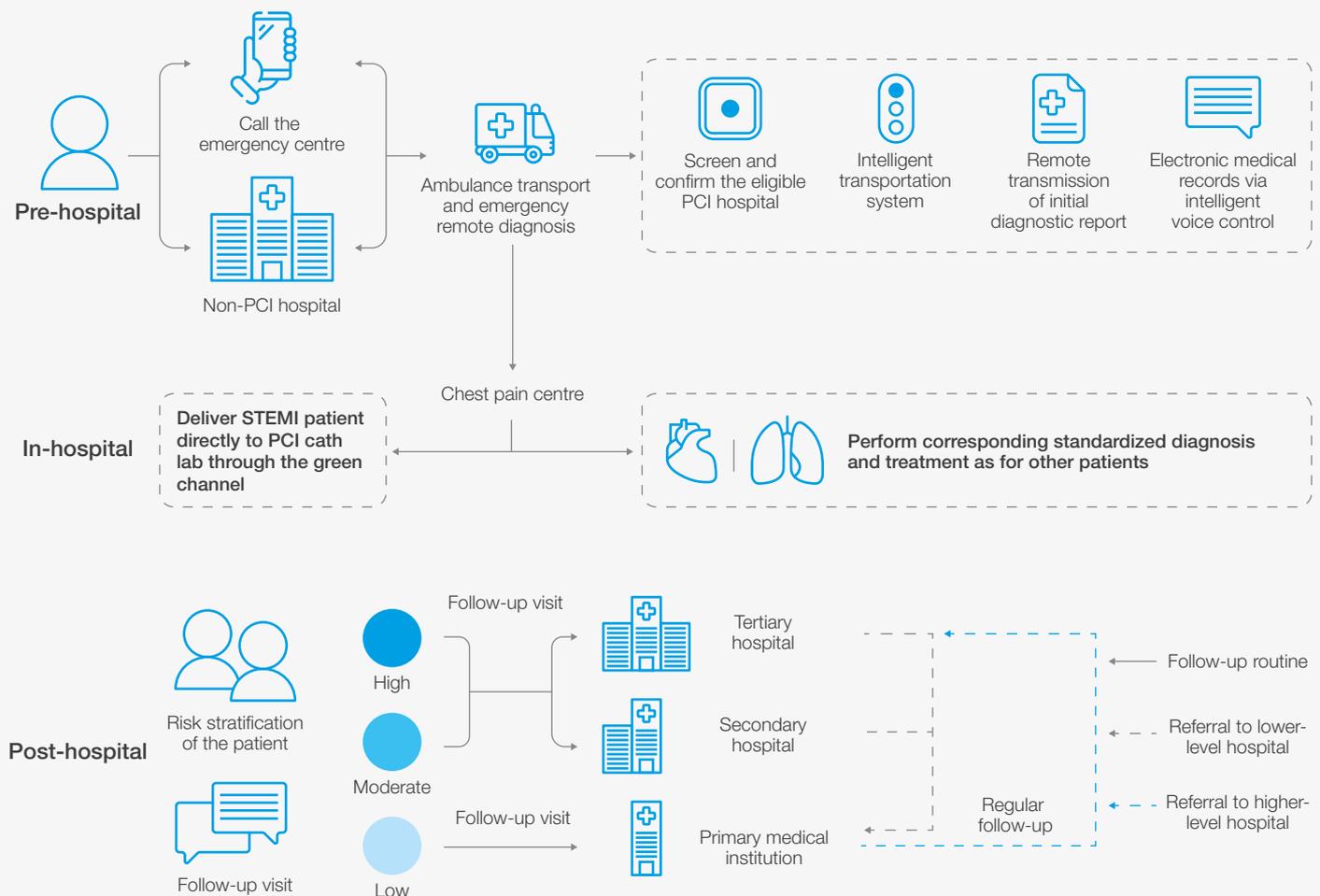
- **Establishing an effective regional treatment network:** The density of CPCs has been increased and a CPC treatment network with a certain scale has been established in China. Additionally, the country’s CPCs use information technology to ensure data sharing between medical institutions at all levels and the emergency call system, and to connect the pre-hospital emergency system with in-hospital prioritized access.

- **Developing a classified certification system:** Different from the accreditation standards of the United States and Germany, China's CPCs have two separate versions of accreditation standards: the standard version is suitable for medical institutions with primary percutaneous coronary intervention (PPCI), which is the most effective treatment for acute ST-segment elevation myocardial infarction (STEMI). The grassroots version is suitable for primary hospitals without PPCI capability for the time being. At the same time, establishing standardized chest pain treatment units in primary medical institutions (town health centres, community hospitals, etc.) is advised.
- **Continuously improving key indexes:** The evaluation and treatment of patients with acute chest pain must conform with treatment pathways recommended by clinical diagnosis and treatment guidelines. On this basis, through cooperation with provincial and municipal

health administrative departments, a national-provincial-municipal three-level quality control system is established, and key monitoring indicators are determined for medical institutions at each level to ensure continuous improvement of medical quality. Apart from facilitating timely treatment, the regional treatment network model also contributes to better long-term patient management. After discharge, patients will be re-examined and followed up according to post-hospital risk stratification assessments. High-risk patients will be scheduled for re-examination and follow-ups at secondary and tertiary hospitals, while medium- and low-risk patients will be diverted to primary medical institutions.

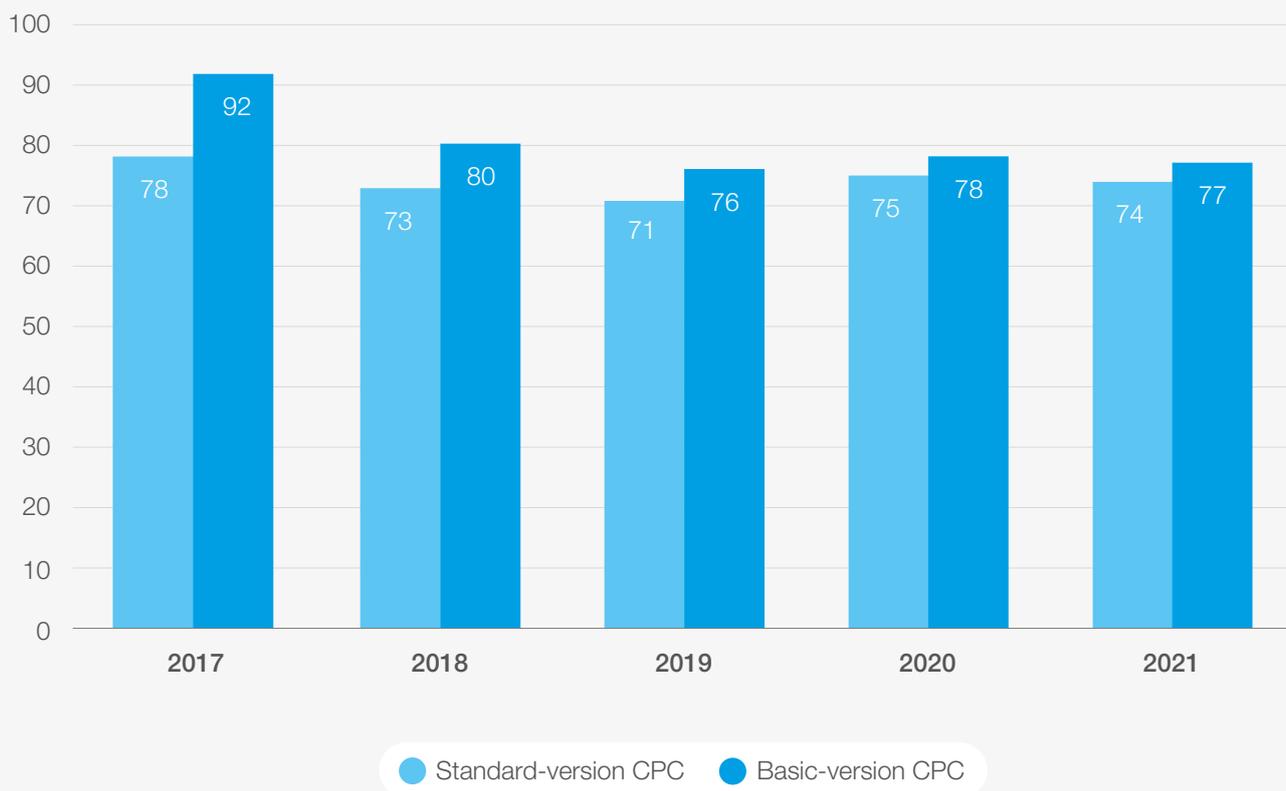
As of the end of 2021, a total of 5,151 medical institutions across China have started building CPCs, of which 2,096 hospitals have passed accreditation (1,047 standard CPCs and 1,049 primary CPCs), covering all provinces and 96% of counties.

FIGURE 1 Service flow of chest pain centres in China



Source: China Healthcare IoT Innovation Center

FIGURE 2 | Door-to-wire (D2W) time for STEMI patients undergoing direct PCI (minutes)



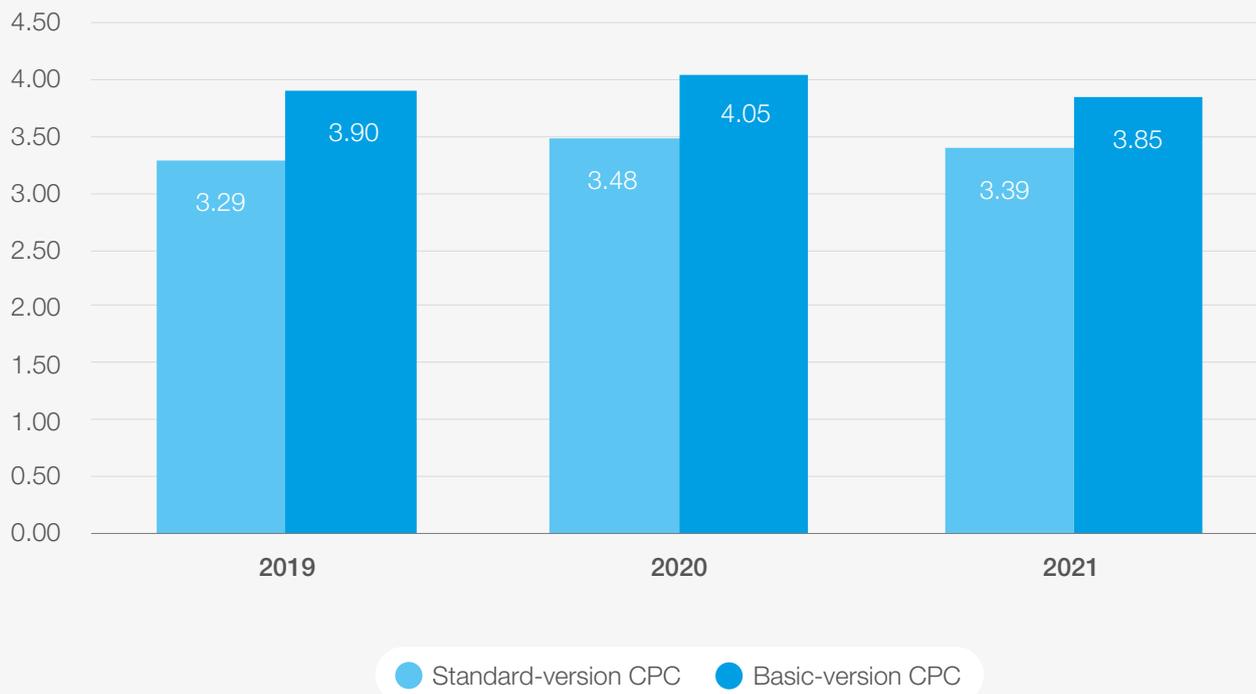
Source: China Chest Pain Center Quality Control Report (2021)



Since the establishment of CPCs, the average door-to-wire (D2W) time for STEMI patients undergoing PPCI has continued to decline from 115 minutes in 2012 to 74 minutes in 2021 (77 minutes for the primary CPC). In 2020 and 2021, due to the impact of COVID-19, CPCs in China still maintained the

same level of treatment capacity as in 2019,^{38,39} even under strict pandemic control measures. The highest in-hospital mortality rate of STEMI patients was 4.7%, which is significantly lower than the STEMI mortality rate during the pandemic in other countries.^{40,41,42}

FIGURE 3 | In-hospital mortality of STEMI patients (%)



Source: China Chest Pain Center Quality Control Report (2021)

MMCs: improving follow-ups and management of diabetes patients through one-stop services

According to 2021 statistics from the International Diabetes Federation (IDF), 537 million adults worldwide suffer from diabetes, 81% of whom are patients in low- and middle-income developing countries. There are 141 million diabetic patients in China,⁴³ meaning that 1 in 10 people in China suffer from diabetes. Once diagnosed, the patient requires frequent hospital visits to avoid further health complications, with multiple hospital departments usually being involved in a single visit. In addition, lifestyle (diet, exercise and medication usage) monitoring is as critical as the hospital visits.

China's National Metabolic Disease Management Centers (MMCs) provide a streamlined solution:

- MMCs provide a "one-stop" service to patients, offering hospital registration, risk assessment, complication screening, diagnosis and treatment, prescription and health education all in one place, among other options. The centres contain "all-in-one machines", which integrate various examinations, enabling screening for all major conditions in about 30 minutes. This removes the need to make multiple, unnecessary trips to different departments, as

in traditional diagnosis and treatment scenarios. The patient receives an exclusive ID and their own electronic medical record on their first visit to an MMC, and all examination, diagnosis and treatment information in the hospital is stored in a centralized big data cloud platform. Daily health data (blood sugar, blood pressure, exercise, diet, etc.) recorded by Bluetooth-enabled devices can be integrated with hospital tests via the patient's ID. Patients can then view this information through smartphone apps, while doctors and nurses can access it through workstations, medical-end applications and other tools. In this way, it becomes possible to conduct timely intervention and precise adjustments to patients' diagnosis and treatment plans. With these tools, anytime-anywhere digital follow-up becomes a reality.

- MMCs across the country collectively form a four-level prevention and control network, including a national general centre and many regional, county and community centres.⁴⁴ The general MMC is responsible for the development of standards and procedures as well as oversight of medical quality; the regional

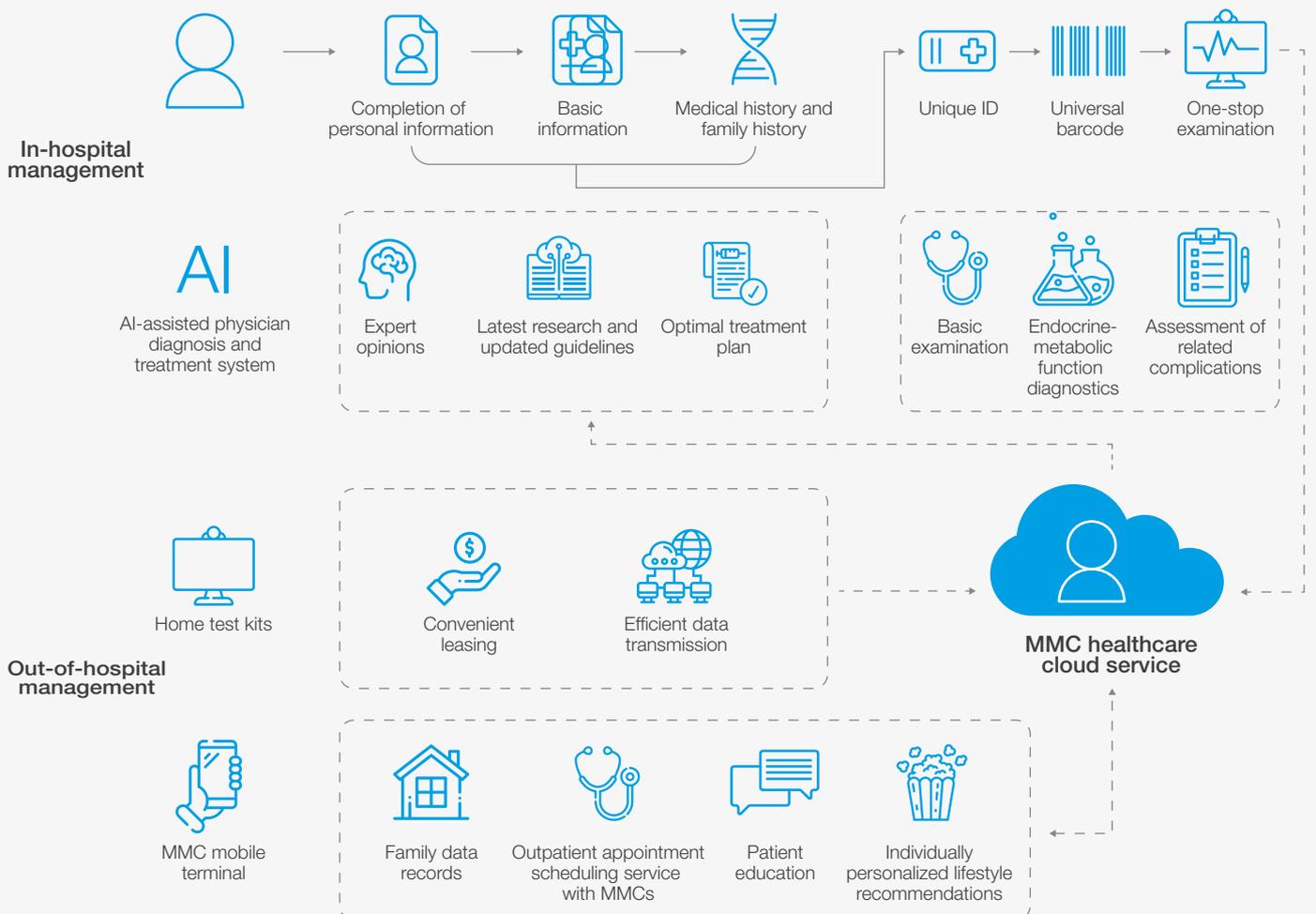
MMCs are located within municipal hospitals and undertake the diagnosis and treatment of complex complications and acute and severe diseases; the county MMCs are located within county hospitals and conduct the diagnosis and treatment of mild to moderate complications; the community MMCs are responsible for the screening and management of high-risk groups. This four-level prevention and control network is conducive to leveraging the capabilities of different medical institutions in disease diagnosis, treatment and patient management.

- In order to achieve better continuous management of diabetic patients, MMCs have also developed the “1 + X” model, in which a regional MMC or county MMC and three or more community MMCs establish a standard process of two-way referral; through telemedicine and staff training, the community MMCs are guided to provide efficient follow-up visits and disease management.

In the early days of MMCs, only 21% of MMC diabetes patients’ HbA1c (a measure of blood glucose) reached the standard level recommended by clinical guidelines. Currently, among the 1.5 million people in the MMC system, the compliance rate reaches 50%. The compliance rate for hypertension, hyperglycaemia and hyperlipidaemia has also increased from less than 10% to the current 17.9%.

During the pandemic, MMCs continued to provide essential services by conducting online follow-up visits. Taking Shanghai as an example, in April 2022, 69 medical institutions with MMCs completed follow-up visits for 40,000 people within 10 days, and delivered critical medicines to hundreds of patients.

FIGURE 4 Service flow of MMCs



Source: China Healthcare IoT Innovation Center

CWMCs: conducting whole-disease-course management to improve the quality of life for patients with respiratory diseases

Coughing and wheezing are common everyday symptoms, affecting 10% of the population.⁴⁵ Many chronic respiratory diseases, including chronic obstructive pulmonary disease, asthma, bronchiectasis, pneumonia and lung cancer, share coughing and wheezing as the main symptoms. In reality, due to inconsistent diagnosis and treatment procedures and a lack of pulmonary function tests, a patient could be misdiagnosed with other respiratory system diseases, which could result in them being referred to the wrong specialist, or simply going undiagnosed. Worse still, as coughing and wheezing are very common symptoms, the patient often ignores them. Even if a patient has been diagnosed with chronic obstructive pulmonary disease (COPD), it is highly possible that the patient will stop taking their medication as soon as the symptoms subside. In some cases, the condition worsens due to a lack of follow-up consultations. Low awareness, low diagnosis rates and low follow-up rates are major barriers to the prevention and control of chronic respiratory diseases.

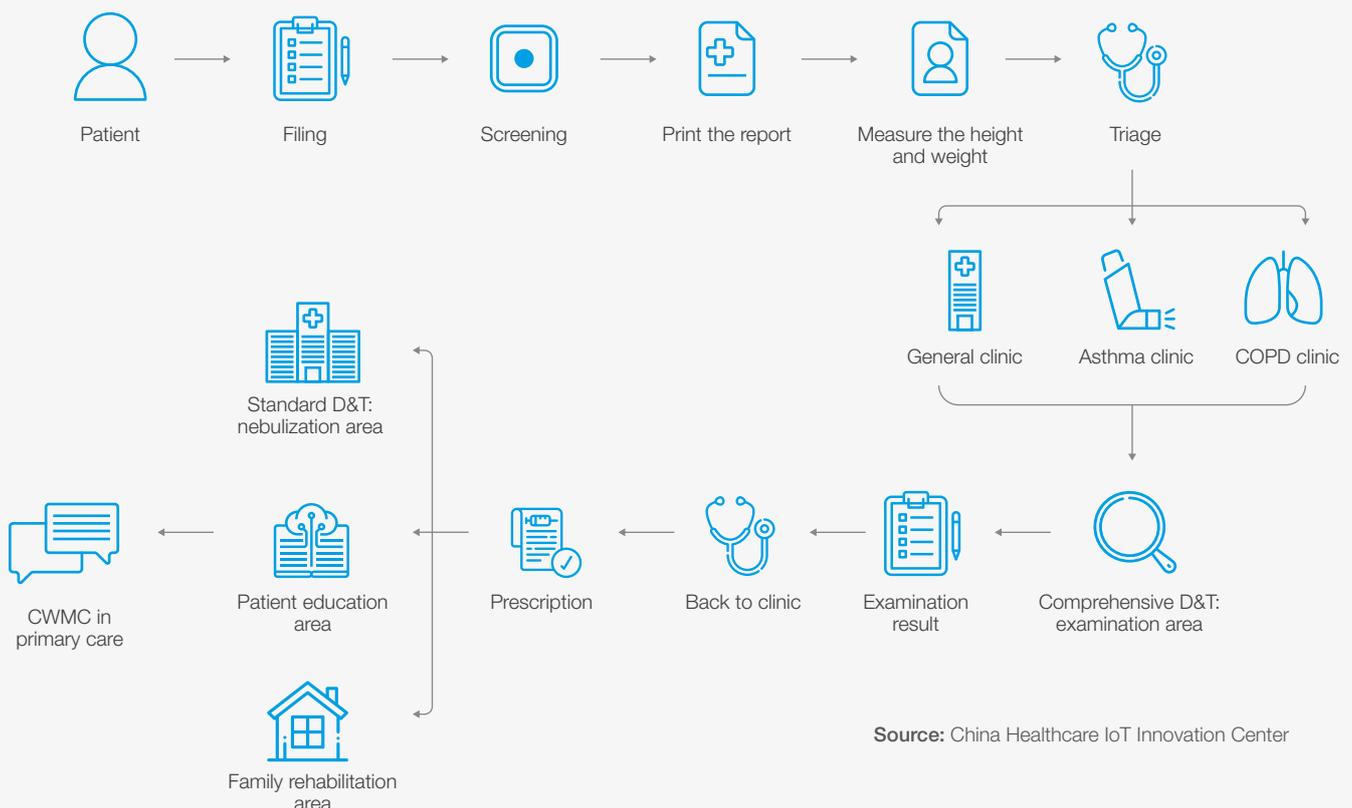
In order to tackle these three barriers, Cough and Wheezing Management Centers (CWMCs) have been pioneered in China, which operate as follows:

- Patients fill in a questionnaire about their symptoms before the first consultation. If appropriate, they will receive an appointment at a CWMC. Nurses will then guide patients

through a pre-diagnosis risk assessment and screening. If the screening results are positive, clinical diagnosis will be conducted according to the corresponding diagnosis and treatment path. Pre-diagnosis risk assessment can help improve patients' awareness of their own symptoms and diseases, and improve follow-up examinations and treatment compliance, as well as the efficiency of doctors' diagnosis.

- Patients diagnosed with COPD, asthma or bronchiectasis will receive long-term management and follow-ups at the CWMC, including therapeutic solutions such as nebulizer therapy, desensitization therapy and/or rehabilitation therapy. Other services such as disease education and drug/device use guidance are provided at the nurses' workstation.
- After patients have received their hospital treatment, dedicated personnel are assigned to manage any post-diagnosis follow-ups using mobile or smart devices. CWMCs aim to achieve closed-loop management of both the hospital and home environment through the use of an intelligent management platform and equipment, with the aim of reducing the frequency of hospital visits and improving patient compliance.

FIGURE 5 Service flow of CWMCs



Source: China Healthcare IoT Innovation Center



3.2 Improving efficiency by developing and applying innovative technology

Even prior to the pandemic, digital health (the application of digital and information technology in the medical field) had been developing for decades. Digital health solutions include mobile health (mHealth), health information technology, wearable devices and telemedicine, as well as artificial intelligence (AI) and surgical robots. The need for telemedicine and computer-assisted decision-

making existed before the pandemic, but the use of such technologies has accelerated since the outbreak. Whether it is supporting doctors' clinical decision-making or helping patients access medical services, the role of digital healthcare is becoming increasingly prominent, and will inevitably play an even greater role in the health systems of the future.

Telemedicine: facilitating efficient connections between doctors and patients

Thanks to the development and popularization of internet technology and internet of things (IoT) technology, telemedicine has become one of the fastest growing sectors in the digital health space. Online consultations, real-time remote monitoring and remote medical guidance are all made possible by mobile devices as well as biosensors based on IoT technology.

Telemedicine helps to improve the accessibility of medical services for remote and under-resourced

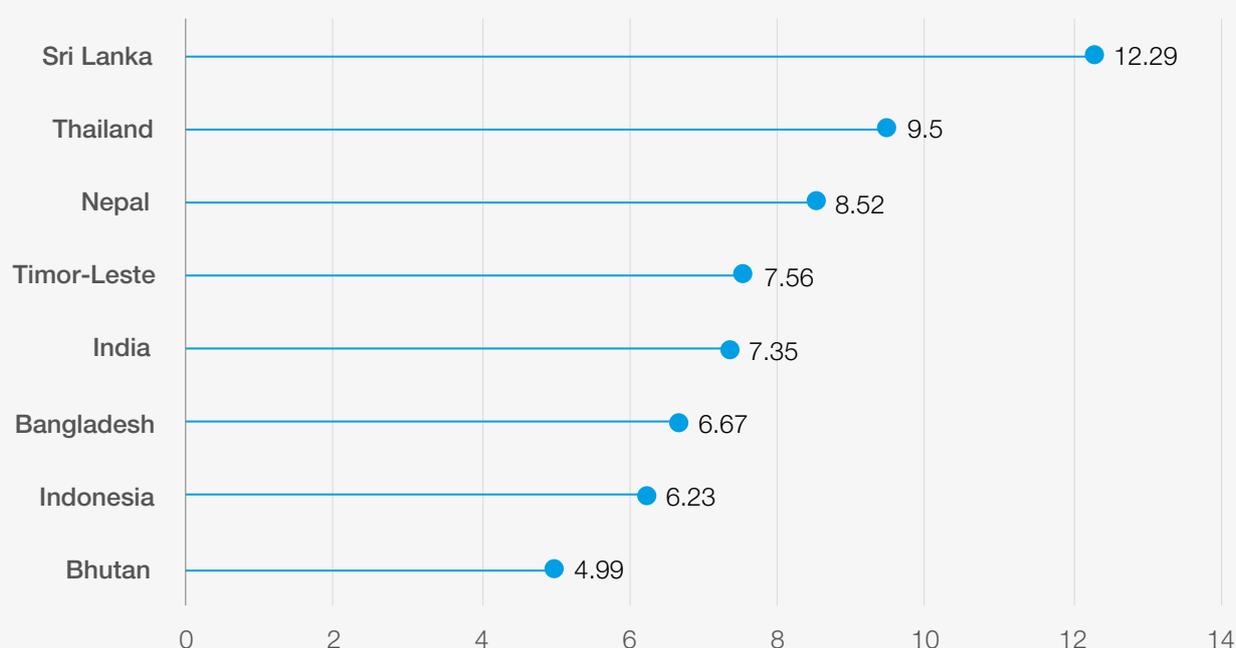
areas. For example, in Indonesia, the most populous country in South-East Asia, the ratio of doctors to the general population is 6.23 to 1,000, which is lower than neighbouring developing countries and significantly lower than that of developed countries (see Figure 6). Issues such as long hospital waiting times and inaccessibility of services fuel the demand for telemedicine. Taking the largest mobile health platform in Indonesia, Halodoc, as an example, users are provided with the following services through the mobile app:

- **Easy access to doctor health consultation services:** Users have access to 24/7 health consultation services through chat, voice or video calls. They can also upload medical reports in order to seek medical advice from qualified physicians, who receive training on how to interact with patients on joining the platform.
- **Convenient drug purchase and delivery:** Patients can have their drugs delivered in 45 minutes thanks to a collaboration between the relevant ride-hailing service company and e-commerce platform.
- **Convenient insurance payment:** Users can use different payment methods, including

government-funded insurance. Halodoc has signed a memorandum of understanding with Indonesia’s healthcare and social security agency (BPJS Kesehatan), which administers the country’s national health insurance (JKN), the world’s most extensive single-payment system. Similar collaborations are also taking place between Halodoc and other commercial insurance companies.

As in Indonesia, where several mobile health service providers offer patients convenient medical services through health apps, it’s common for countries in the South-East Asia/APAC region to have multiple competing digital health platforms.⁴⁶

FIGURE 6 Medical doctors per 10,000 population in South-East Asia (2020)



Source: WHO, “Medical Doctors (Number)”: [https://www.who.int/data/gho/data/indicators/indicator-details/GHO/medical-doctors-\(number\)](https://www.who.int/data/gho/data/indicators/indicator-details/GHO/medical-doctors-(number))

TABLE 1 Key digital health platforms in South-East Asia

Country	Key digital health platforms
Indonesia	Aldokter, Halodoc
Malaysia	DoctorOnCall, Speedoc, Doctor Anywhere
The Philippines	Medgate Philippines, HealthNow, SeeYouDoc
Thailand	Doctor Raksa, Doctor Anywhere
Viet Nam	Viettel, Doctor Anywhere, VieVie Healthcare

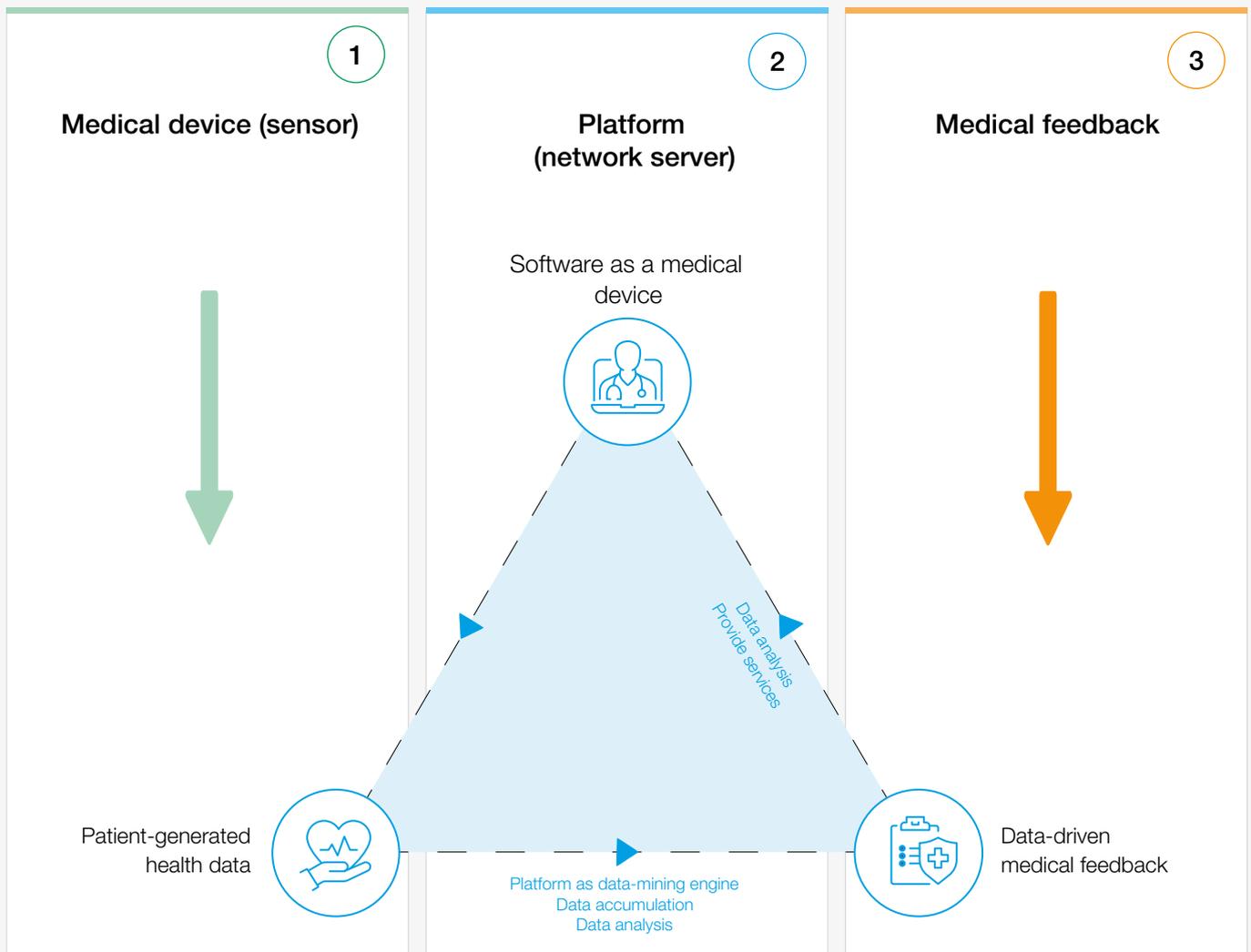
Digital health services are also widely available in China, although digital health service follow-ups are allowed only for common diseases and NCDs. According to data released by the National Health Commission of China, as of June 2021 more than 1,600 internet hospitals were operating in China, while the year before the COVID-19 outbreak, there were only 100 nationwide. In 2020, the number of diagnosis and treatment services delivered through internet hospitals also showed a substantial increase.⁴⁷

Remote monitoring using IoT tech and biosensors enables more comprehensive services for patients. Continuous glucose monitoring (CGM) technology monitors the glucose concentration in subcutaneous interstitial fluid through a sensor, providing

continuous, comprehensive and reliable information throughout the day. CGM is typically used by type 1 diabetes (T1D) patients, but in India, due to the large T2 diabetes population base, CGM is also frequently used for management, and has been widely adopted by doctors and patients alike.⁴⁸

An important advantage of the CGM is that blood glucose data obtained from monitoring can be stored on the cloud, enabling healthcare professionals to view blood glucose data in real time. In addition, enabled by algorithms, integrating CGM with insulin pump technology could serve as an “artificial pancreas”, which could prevent potentially life-threatening hypoglycaemic conditions and complications.

FIGURE 7 How continuous glucose monitoring (CGM) works



Source: Lessons from Use of Continuous Glucose Monitoring Systems in Digital Healthcare: <https://pubmed.ncbi.nlm.nih.gov/32981296/>

AI in healthcare: addressing doctor shortages and clinical decision-making

The benefits of AI are clear: 1) AI can be used to improve the accuracy of diagnosis and improve treatment outcomes, especially at primary medical institutions; and 2) AI is operable 24/7.

Many low- and middle-income developing countries are faced with challenges such as insufficient medical resources, shortage of professional doctors, high misdiagnosis rates and low diagnostic efficiency. AI technology, especially imaging technology, has the advantages of improved efficiency, accuracy and reliability. An experienced doctor needs one minute to assess 10 CT scan images. In contrast, AI technology

using image recognition can shorten the time of assessment to a few seconds while improving the accuracy of manual diagnosis by 15–20%.⁴⁹ In addition, AI technology standardizes diagnosis, as discrepancies can be created by human factors such as fatigue or inexperience.

With reference to the content of clinical data collection, the application of AI medical imaging can be divided into categories such as CT images, fundus images, X-ray fluoroscopy, pathological image analysis, ultrasound (US) images, endoscopy images, skin images, electrocardiogram (ECG) images and electroencephalogram (EEG).

FIGURE 8 Applications of AI in diagnostic and therapeutic processes

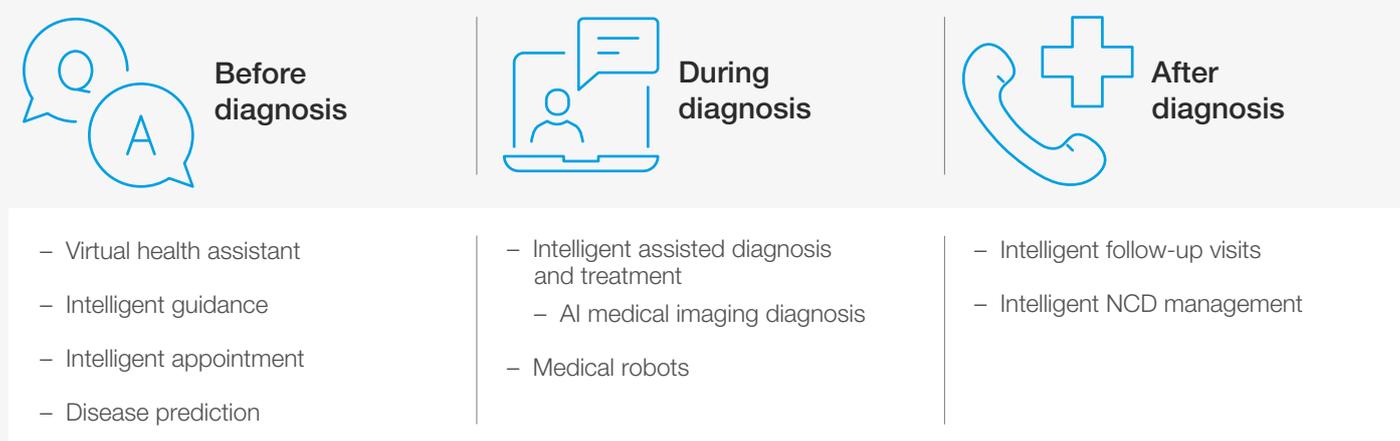


TABLE 2 Disease areas for AI medical imaging applications

Imaging	Disease areas
CT	Lung cancer
Retinal	Diabetic retinopathy, age-related macular degeneration
X-ray	Fracture screening and bone age prediction
Pathological image analysis	Cervical cancer, breast cancer, gastric cancer, prostate cancer
Ultrasound	Breast cancer, thyroid cancer, liver cysts
Endoscope	Gastric cancer, colorectal cancer, oesophageal cancer
ECG	Arrhythmia, ventricular atrial hypertrophy, myocardial ischaemia, myocardial injury, myocardial infarction

AI can be integrated into almost all aspects of a health service system. In addition to improving the efficiency and accuracy of diagnosis, it can also be used before and after diagnosis. Therefore, the application of AI algorithms can accurately match doctors to patients to optimize resources, and formulate personalized follow-ups. For example,

in MMCs, three different mobile applications have been developed using AI technology, which are used for diabetes risk assessment, prediction of cardiovascular risk and provision of medical care recommendations for patients based on the current Standards of Medical Care in Diabetes.⁵⁰



3.3 Focusing on early detection and diagnosis

Large-scale early screening of high-incidence cancer

The WHO estimates that 30–50% of cancers can be prevented by reducing risk factors and implementing evidence-based prevention strategies. Through early detection and appropriate treatment, many cancers have a high possibility of being cured.⁵¹ Nonetheless, very few developing countries have high-risk cancer screening programmes at the national level, and only a few countries – mostly high-risk countries – have national programmes that cover at least 70% of the population.^{52,53} These include prostate cancer screening schemes in Latin American countries such as Mexico, Brazil and Colombia, and a breast cancer screening programme in Egypt.

The Comprehensive Prostate Cancer Care Program (OPUS Program) initiated by the National Cancer Institute of Mexico, with the support of the federal government, provides preventive diagnosis (voluntary) for all men over the age of 40 through a collaboration among medical institutions, NGOs and private enterprises. The programme has raised public awareness of the disease and provides corresponding treatment and follow-up services.

In Egypt, as part of the 100 Million Healthy Lives Initiative launched by President Abdel-Fattah El-Sisi in 2019, women over 18 are offered free breast cancer screening services to raise awareness and allow early diagnosis.

Among the large-scale cancer screening programmes in these two developing countries, there are some commonalities worth noting that may serve as a useful reference for other developing countries:

- **Raising public awareness:** In Mexico's prostate cancer screening programme, serious promotional efforts have taken place on TV, radio, Spotify and social media platforms such as LinkedIn and Facebook. The programme has invited high-profile football players to events, as well as organizing the "Dale la Vuelta Al Cancer de Prostata" campaign. Breast cancer screening in Egypt has been publicized through government and hospital promotions. The initiative is set in three stages, gradually expanding from an initial nine provinces to 27 across the country to ensure it receives the maximum attention and positive outcomes.

- **Accessibility of screening services:** Egypt relies mainly on a large number of community hospitals and clinics to provide extensive screening service coverage. The country has 3,538 clinics offering breast cancer screening for women, with another 114 hospitals supplying additional services. Mexico, on the other hand, uses vehicles with testing equipment to provide a mobile testing service in the community. As well as screening programmes for prostate cancer, it also carries out screening for NCDs such as diabetes, cardiovascular diseases, and breast and lung cancer.
- **End-to-end management services after screening:** The results of early screening are meaningful only if treatment is readily accessible and available. In Mexico, if high-risk criteria are met, patients will be referred to the nearest laboratory for further testing and, based on

the results of the test, they will be referred to an appropriate hospital for treatment. In Egypt, suspected cases are referred for further examination and treatment for free, which is provided in 14 medical centres and 14 university hospitals overseen by the Egyptian Ministry of Health.

A variety of preparatory tasks need to be undertaken before launching large-scale early cancer screening work. Among them, assessing the epidemiological data on common cancers and their main risk factors is the first step in formulating a plan. Egypt, for example, began to establish its National Cancer Registry, which provides accurate and complete data for screening programme planning, in 2007. In addition, the cost-effectiveness of early screening and testing programmes need to be evaluated to determine the appropriate populations, criteria and targets.

Exploring innovative models of early screening

Experiences from countries such as Mexico and Egypt demonstrate that government support, community partnerships, identification of barriers to early detection, public awareness and media advocacy are all critical in establishing effective screening programmes. Access to services has largely affected the take-up rate for screening, and an exploration on how best to improve service access may be useful.

Mobile screening solutions in Mexico have proven to be successful, while in remote rural areas and isolated cities in China, convenient and flexible breast cancer and cervical cancer screening services are being provided to women

through screening vehicles that integrate digital mammography, colour Doppler ultrasound diagnostic systems and cervical HPV tests.

Another approach is to take advantage of rapidly developing internet technology to separate out sampling and testing. Sampling could be undertaken in community hospitals with trained medical staff (cervical cancer screening), or done at home by patients themselves under guidance (e.g. for colorectal cancer). The self-testing journey is straightforward: after ordering and receiving the sample collection kit, the patient collects stool samples according to the user guidance and sends it back to the processing laboratory for a testing report.



4

Recommendations

As COVID-19 transitions, developing countries will have a leapfrogging opportunity to improve the equity, accessibility, quality, efficiency and resilience of their health systems. At the same time, universal health coverage is a global priority as it is

the key to achieving the health-related Sustainable Development Goals. In order to achieve the goals of UHC and the SDGs, developing countries also need to further optimize and improve their health systems.

4.1 Lessons learned from COVID-19 for health service models

COVID-19 has put enormous pressure on health systems globally, yet society progresses by learning from past experiences. This is the optimal moment for collective reflection and for action on lessons that can be applied in the future. Some positive practices include:

- “Grid-style” management (municipal governments administratively dividing urban areas into “grids” for better management and information sharing)
- Mobilizing community participation
- Encouraging individuals to practise self-health monitoring
- Conducting health education and peer education through social networks
- Continuing to refine long-term prescription guidance and reimbursement policy for NCD patients

Further strategies include: using and optimizing infrastructures and capabilities developed during the pandemic to strengthen community-level primary care systems; making temporary health service facilities permanent to strengthen primary healthcare services at the community level; using PCR testing laboratories for early detection and diagnosis of other diseases, especially NCDs.

The challenges countries face in maintaining their COVID-19 response while addressing competing public health priorities are clear. Consolidating COVID-19 clinical care pathways with primary healthcare systems and installing better coordination mechanisms among medical institutions are two ways to achieve the overarching goal of “integrating medical treatment service and public health services”.

4.2 Optimizing diagnosis and treatment pathways to improve efficiency

Though each disease is unique, there are commonalities in diagnostic and treatment pathways. The success of China’s CPCs has been replicated in other disease areas, resulting in heart failure centres, atrial fibrillation centres, hypertension compliance centres, cardiac rehabilitation centres and heart valve disease intervention centres. Standardization is the key. With standardized

diagnostic tools, key indexes and processes, accuracy will improve across all areas, reducing redundancy to save costs and improve efficiency so that patients receive timely diagnosis and treatment. Developing countries should therefore prioritize diseases with the highest burden and gradually expand to additional diseases areas.

4.3 Building a health ecosystem and improving the continuity of health services

Screening for high-risk factors, early disease diagnosis, standardized treatments and longer-term follow-up mechanisms are critical factors for the health of individuals and populations. Though doctors and medical institutions are the main gatekeepers, it is equally important to provide patients with evidence-based and cost-effective

tools. A successful patient journey requires full ecosystem engagement, from developing diagnostic tools to working with monitoring and management tools. It is also crucial to explore and establish a well-functioning financing mechanism to support digital tools, which are an important pillar of the system.

4.4 Integrating digital health technology with primary healthcare to improve accessibility

The COVID-19 pandemic has once again demonstrated the significance of primary healthcare institutions, and the shortcomings of current capabilities. There is an urgent need to strengthen primary healthcare to ensure more resilient health systems and achieve universal health coverage. Developing countries will have to increase their investment in capacity building at the primary healthcare level, including strengthening the training of medical staff. Digital technology

provides the foundation for leapfrogging – a large number of administrative tasks can be automated by digital solutions, while AI-assisted diagnosis and treatments enhance service quality provided at the community level. A well-defined regulatory framework is also required to ensure data security and patient protection. Governments should also actively engage in creating a global framework for better regional and global collaboration.

4.5 Strengthening global public and private collaboration with an open and inclusive mindset

Non-communicable diseases are an urgent global health challenge. Governments, private-sector industries and international organizations must work together to strengthen cross-regional, cross-industry and interdisciplinary collaboration. Global health collaboration should come not only in the form of foreign aid, but also provide equal opportunities for countries to voice specific challenges and difficulties, share learnings and best practices in peer-to-peer exchanges, and highlight achievements in policy innovation, health system

integration, health workforce education and training, and innovative medical technology development. Global health cooperation 2.0 must place learning and sharing at the heart of this ethos.

There is no better time for the world to unite and align efforts under these principles, using our collective wisdom and resources. Only by doing so can we tackle NCDs as well as preparing for any future health crises that we may face.



Appendix:

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