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Progress, Policies and Prospects for Internet Telemedicine in China

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Introduction

Around the world, the adoption of digital technologies in health care has accelerated remarkably in the wake of the COVID-19 pandemic. Health care providers and their patients have shifted from traditional in-person care to virtual care, embracing technologies such as telemedicine. This pivot towards virtual care played a vital role in facilitating the continuity of health care provision in the midst of mobility restrictions imposed to control the spread of the virus during the pandemic.

Prior to the pandemic's emergence, a technological evolution was unfolding within China's health system. Beginning from early 2010s, China embarked on a private sector technologyenterprise led creation of an innovative internet health care ecosystem. This new digital ecosystem encompasses a wide range of health care and related services from medical advice, prescriptions, health information, and health insurance. This has radically transformed how consumers access and receive health services and information.

In this article, we describe the evolution of China's internet health market, focusing on internet telemedicine. We trace its early origins from the establishment of information networks in the 1980s to the emergence of a fast-growing internet health market that leveraged the capabilities of technology enterprises in e-commerce, logistics, and payment systems. Through the process of transformation, private enterprises, particularly private health care platforms, played a dominant role in this market, and still do in the present day.

Early developments: information networks, teleconsultation, and telemedicine

In the 1980s, advancement in medical information systems paved the way for the use of videophone and satellite-based technology to establish teleconsultation networks. By 1998, teleconsultation systems were implemented in 20 hospitals in 15 cities across China (Hu et al. 2019). To address the lack of standardization in how this technology was applied, the government in 1999 published a set of guidelines to regulate its use for remote medical consultations. Among the recommendations was the formal definition of teleconsultation as the application of computer, network, and communication technology to carry out remote medical consultation activities, which must be carried out in licensed medical institutions. To address widespread public dissatisfaction on the lack of access to and the prohibitive costs of health care, China, in 2019 embarked on a major healthcare system reform aimed at providing its citizens with equal access to basic health care services with reasonable quality and adequate financial risk protection (Yip et al. 2019). Among the policy initiatives was increasing the use of information technology to promote cooperation between urban hospitals and community health service centers, and to develop remote health care services to cater to the needs of rural and remote communities (Central Committee of the Chinese Communist Party and State Council 2009).

With the increasing adoption of information technology to provide remote health care services, the National Health Commission in 2014 issued a set of policy guidelines ("Opinions on Promoting Telemedicine Services in Medical Institutions") for telemedicine (National Health and Family Planning Commission 2014). These guidelines encompass the development, management, and implementation of telemedicine, alongside regulations to ensure patient safety and maintain service quality. A new definition for telemedicine was issued, which was expanded to include remote pathological diagnosis, imaging diagnosis, and clinical monitoring and management.

Telemedicine was viewed as an effective instrument that can alleviate geographical barriers in access to health care, a challenge that was faced by many residing in remote parts of the country. Pilot telemedicine projects were initiated in 2015 between tertiary hospitals in Beijing (the PLA General Hospital, Peking Union Medical College Hospital, China-Japan Friendship Hospital) with health care institutions in five western (and more remote) provinces of Ningxia, Yunnan, Inner Mongolia, Guizhou, and Tibet, to develop hands-on experience in implementing telemedicine on nationwide scale (General Office of the National Development and Reform Commission and General Office of the National Health and Family Planning Commission 2015). Pilot institutions were encouraged to collaborate with private third-party enterprises to co-develop market-based telemedicine service models.

Emergence of a technology enterprise-led internet health market

Beginning in 2013, private technology enterprises began to invest significantly into digital health care, spearheading the creation of an internet health market. From 2013 to 2019, the total value of new investments (red line in Figure 1) in China's internet health market grew from 4.5 billion (US\$675 million; 41 = US\$0.15) to 437.9 billion (US\$5.7 billion) (Fastdata 2020). Leveraging on their capabilities in e-commerce, logistics, communications, and payment systems, internet enterprises such as Alibaba, Tencent, JD.com, played a pivotal role in driving the growth of the internet health market. This growth has brought forth new and innovative models for healthcare delivery, transforming the way consumers access and receive medical care and health information.

Third-party technology platforms play a central role in the internet health market. These platforms serve as intermediaries, bringing together patients and providers in a virtual health care marketplace. Among the largest platforms are Haodf.com, WeDoctor, Ping'An Doctor, AliHealth and JD Health. Platforms facilitate the delivery of wide range of health care services and products including medical consultations, scheduling of hospital appointments, prescription drugs, health management information, and health insurance. Each platform caters to different segments of the market and offers different products and services. For example, Haodf.com, WeDoctor, Ping'an Doctor offer direct-to-consumer (DTC) telemedicine consultations, on different patient populations (Fu et al. 2022); AliHealth and JD Health,

leveraging on their supply chains, focus primarily on the sale of medicine. On the peripheral of the market for products and services is a burgeoning market for medical and health information, as more people look to the internet for this purpose. Tencent Healthcare and ByteDance are two enterprises focusing on medical and health content services for consumers and professionals; Dxy.cn serves as an online community for medical professionals. The search engine company Baidu, in 2019, launched the Baidu Health Medical Directory publishing medical and health science content on the internet.

Platforms set the rules on how patients and providers interact in the virtual market, fulfilling the role that an insurer – either government or private – would otherwise perform in a traditional health care market (Mankiw 2017). Platform determines the financing rules, namely how patients pay for services which are predominately via fee-for-service with prices posted on the platform's portal (Figure 2). Some platforms operate a subscription fee-based model where patients are entitled to a pre-specified number of consultations in exchange for a fixed fee. Platforms decide on the payment rules: e.g., defining contractual relations, revenue sharing arrangements, and provide guidance on setting fees. The major providers of telemedicine on private platforms are public hospital doctors, working on platforms as independent contractors, and sharing a pre-negotiated percentage of their earnings from internet work. The access rules determine patients' access to services. Patients can access telemedicine care without the need for a referral (hence no gatekeeping) and pay per service as per the fee-for-service model. An innovative feature of China's internet health market is in the use of reputational and feedback systems, which are now a common feature in online markets (e.g., eBay, Airbnb) (Tadelis 2016). Platforms collect and publish user feedback, permitting users to assess the quality of their providers in a similar way that hospital report cards do in traditional physical markets.

On the DTC telemedicine platforms, patients access services using proprietary applications (*apps*) or internet portals. Users are required to create a user account which gives access to a host of information including past and upcoming appointments, prescriptions, and medical records. Through these apps, patients can shop for a telemedicine provider by browsing and searching for doctors using proprietary apps and access a host of provider information, including a menu of prices, and physicians' professional characteristics (e.g., medical training, specialty, hospital affiliation). Patients can also assess and compare providers' service quality and interpersonal skills using popularity ratings and user feedback that are published together with provider information. Patients usually have the choice of four different types of online services: image-text consultations, telephone consultations, video consultations, and a (once-off) Question and Answer. Image-text consultations, which a patient and her chosen doctor communicate through exchanging texts and images over a stipulated timeframe (e.g., 48-hour) is the most popular service mode.

Private & Public 'Internet Hospitals'

The first 'Internet Hospital' emerged with the establishment of the Guangdong Internet Hospital in 2014. This online hospital, which received strong support from the Guangdong government, is composed of the Second People's Hospital in Guangdong, an online platform, and a network that includes rural village clinics, community health centers, and pharmacy chain stores (Tu et al. 2015). In 2015, the Wuzhen Internet Hospital was established in Tongxiang City in Zhejiang province, is a collaboration between the Tongxiang Municipal Government and the internet technology company WeDoctor Group. This initiative developed an online platform that enables patients to see medical advice, obtain prescriptions, and when necessary, schedule follow-up appointments at hospitals.

With the rapidly evolving landscape, government directives issued in 2018 sought to redefine telemedicine into two types (National Health Commission and National Administration of Traditional Chinese Medicine 2018). The *first* type involves a partnership between medical institutions to provide medical services, utilizing information communication, computer, and network technology. The 2015 telemedicine pilots between Beijing, and the five western provinces, fall into this category. The *second* type is Internet Hospitals – medical institutions that provide treatment and follow-up services remotely directly to patients through a service platform or provider. There are two categories of Internet Hospitals. The first is private third-party platforms that provide DTC telemedicine. Public internet hospitals are a second category of Internet Hospitals. These are internet hospitals established, owned, and operated by public hospitals providing DTC telemedicine services, diagnosis and management, and sale of drugs.

Prior to 2020, DTC telemedicine was predominately delivered by private Internet Hospitals. During the COVID-19 outbreak in 2020, public hospitals – through the directive of the government - began establishing internet service platforms to provide pandemic related online medical consultations, home quarantine advice, and health assessment services (General Office of the National Health Commission 2020). As such the involvement of public hospitals in the DTC telemedicine space grew. From 2016 to 2019, the total number of Internet Hospitals in China increase ten-folds, from 32 to 315, and further tripled to over 1000 after the outbreak of the COVID-19 pandemic in 2020 (blue bars in Figure 1).

In 2022 there were over 1700 internet hospitals (National Health Commission et al. 2022). Public hospital-operated internet hospitals make up the majority (over 70 percent), while the remaining are comprised of private third-party platforms. Despite their smaller number, private third-party platforms provide a significantly higher volume of online services compared with public internet hospitals. Public internet hospitals attend to an average of 55 patients a day, whereas a private third-party platform can serve more than 20,000 patients daily (National Telemedicine and Connected Health Center 2021).

Public Hospital Physicians Providing In-person and Online Care

The majority of doctors who provide DTC telemedicine on private third-party platforms are employees of Chinese public hospitals. These doctors undertake internet-based work concurrently with in-person onsite work in public hospitals, in a dual-practice capacity. More than 90 percent of doctors registered on Haodf.com and WeDoctor – two of the largest healthcare platforms in China – are employees of public hospitals (Fu et al. 2022). Doctors' hospital affiliations and seniority (or titles, e.g., chief physician, associate chief physician), are explicitly displayed on their internet profiles on the private platforms. These serve as signals of quality and reputation (particularly among doctors working in reputable and highly sought after public hospitals), which helps in attracting patients.

Nationally, roughly over 16.5 percent of public hospital doctors in China are estimated to also be engaged in internet work (Xu et al. 2022). While internet work mainly occurs outside of the official working hours in public hospitals some consultations do take place through the workday particularly during lunch breaks. Asynchronized modes of telemedicine services, such as image-text consultations, provide doctors with the flexibility on when, and where, to respond to their online patients, including on their daily commute, in the evenings or into the night, or between seeing patients (Xu et al. 2022).

Internet health is popular among physicians as it confers a range of professional and financial benefits (Liu et al. 2019, Wu et al. 2021, Xu et al. 2022). Doctors use internet work to improve the efficiency of their public hospital work, allowing them to save time on repetitive tasks (e.g., better preparing their patients for their visits), as well as improve continuity of care by offering virtual follow-up appointments. Internet care offers doctors the opportunity to exert greater control over the patients they see: treating patients with minor ailments through the internet, reserving in-person appointments at public hospitals for those with more complex needs. This improves the efficiency of the health system by reducing unnecessary hospital visits as it is common that patients bypass the primary care system and directly seek treatment at large public hospitals for common conditions.

Internet care is perceived to help with career advancement, allowing doctors (especially more junior ones) to build their reputation through online work, contributing to attracting more patients. There are also direct and indirect financial rewards. Doctors are usually paid fee-for-service for their internet work and derive higher incomes directly through professional fees. Given that public hospital doctors' earnings are calculated based on the level of profits public hospitals make, higher incomes are accrued indirectly through additional patients channeled into public hospitals from DTC telemedicine platforms.

Pricing and Prices

On private third-party platforms, doctors have the freedom to set their own prices. Prices vary by the type of service (e.g., image-text, video), specialty, doctors' seniority, popularity ratings, hospital tiers, and location (Jia et al. 2023). Mean prices for image-text services rendered on Haodf.com differ considerably by specialty, ranging from 81 CNY (USD\$11.34, 1 = US\$ 0.14) for an orthopedic surgery (outpatient) consultation, to 205 CNY (USD\$28.70) for a gynecology consultation (Figure 3, Panel a). Fees charged by senior doctors are considerably higher compared with more junior doctors (Figure 3, Panel b). Generally, public hospital doctors work on platforms as independent contracts, and the revenue generated from their platform work is shared between doctors and platforms.

In contrast, prices for services rendered through public internet hospitals are heavily regulated. Under the guidelines issued by the National Healthcare Security Administration in 2019, provincial healthcare security departments are responsible for setting the upper limit on prices for internet services delivered by public institutions (National Healthcare Security Administration 2019), and set with reference to the prices for onsite in-person (or offline) care. The guidelines also stipulate that prices for services delivered by private internet hospitals are left to be determined by the market. In practice, prices of services in public internet hospitals are set at the level of the "general outpatient consultation fee", the fee that is stipulated under the country's social health insurance scheme. Prices of public internet hospitals are generally lower than those on private platforms; for example the consultation fees charged by public internet hospitals in Beijing is 50 CNY (USD\$7.00), and is fixed regardless of the seniority of the attending doctor (Fu et al. 2022)

Recognizing and Strengthening Internet Health Care

In 2018, a major policy outlined a comprehensive framework ("Internet + Medicine and Health") recognizing the potential of internet health, calling for the integration of the Internet and information technologies into health care, and fostering the growth of the Internet health care ecosystem (General Office of the State Council 2018). The framework covered a wide range of domains: medical services, public health, drug supply, health insurance settlement, medical education, and artificial intelligence. Its goal was to improve the standards of health and medical management, optimize resource allocation and efficiency, improve accessibility, lower costs, and introduce innovative service delivery models. Among the measures proposed was to support the development of internet platforms for telemedicine and health management services, a directive for medical institutions to develop an integrated online-office medical service model and encourage the use of artificial intelligence in telemedicine to enhance partnerships within and across different levels of medical institutions.

The COVID-19 pandemic accelerated the introduction of pricing and reimbursement policies aimed at integrating internet health into China's health system and facilitating access to

internet services. To facilitate access to medical services, pharmaceutical drugs, and pandemic related health services amid the lockdown measures introduced to curb the transmission of the COVID-19 virus, medical institutions that provide internet services were permitted to enter into contractual agreements with medical insurance agencies, effectively paving the way for these services to be reimbursed under the country's national social insurance (SHI) program (National Healthcare Security Administration and National Health Commission 2020). The policy permitted the reimbursement of medical examination fees and drug expenses, beginning with chronic conditions and gradually expanding its scope to cover common diseases.

There were also policies and regulations aimed at strengthening the internet health system in a range of domains, including registration, the management of medical institutions, personnel, and business operations; and quality and safety standards and its regulation (General Office of the National Health Commission and General Office of the National Administration of Traditional Chinese Medicine 2022). For example, only registered Internet hospitals with licensed medical personnel were permitted to provide online consultations and issue prescriptions, and that these institutions also need to have a physical presence. To maintain safety and quality standards, doctors are required to evaluate the appropriateness of using internet care by reviewing patients' records; if and when online care is deemed as inappropriate, patients are to be directed to a medical institution for an in-person visit. To enhance the standardization of care, provincial-level regulatory departments have been established to improve oversight of medical institutions. Medical institutions also have dedicated departments to manage and monitor the quality and safety of internet health care and pharmaceutical services, as well as information technology and management systems.

Assessing the Impacts of Telemedicine on China's Health System

Among the stated aims of "Internet + Medicine and Health" is to leverage internet health to improve accessibility to health care services and enhance the efficiency in how care is delivered (General Office of the State Council 2018). One area that telemedicine has had significant impacts is on improving access to care especially in alleviating geographical barriers in access to health services. Rural and remote communities often experience chronic shortages of skilled medical providers and telemedicine allow patients to access high quality medical professionals that are located predominately in metropolitan cities. Many Chinese hospitals have established telemedicine networks, connecting medical institutions for remote consultations, diagnosis, and medical education. A national survey of 161 Chinese tertiary hospitals in 2018 found that 94% of hospitals undertook business-to-business telemedicine, providing telemedicine services to doctors from another medical institutions (Cui et al. 2020). A survey of patients who used telemedicine services at rural sanitary stations in Guangdong in 2015 found that the technology was able to be used on common diseases that inflict the rural population and that patients were generally satisfied with telemedicine although there were challenges with communication through language barriers, poor computer literacy and unstable internet connectivity (He et al. 2018). In metropolitan areas, DTC telemedicine provides patients with the convenience of a

virtual appointment with doctors without having to visit hospitals, saving time and travel costs, freeing up resources in overcrowded public hospitals and reducing waiting times.

Whilst there are benefits, telemedicine also throws up concerns on affordability and equitable access. Fees for telemedicine services delivered on private third-party platforms are borne by individuals and households, and hence there is the issue of unaffordability especially among low-income households. Inequity of access could exacerbate if patients with greater resources, and who can better afford the private fees, are able to secure appointments in tertiary hospitals (especially in popular ones) through referrals via internet platforms. As prices for telemedicine services on public internet hospitals are regulated and are considerably lower than those on private platforms, doctors have financial incentives to spend more time on private platforms, and less time on public internet hospital work (and possibly onsite work in public hospitals). This would further exacerbate inequalities in access to care, especially if patients find themselves having to pay for treatment on private platforms.

Internationally, telemedicine has been instrumental in facilitating the continuity of access to medical care, as patients sought out virtual care amid the strict anti-contagion measures that were imposed to control the spread of virus (OECD 2023). To minimize large gatherings of people and the transmission of the virus, the Chinese government urged its citizens to use online healthcare services instead of visiting hospitals (State Council 2020). Access to telemedicine services surged during the 2020 phase of the COVID-19 pandemic in China. For example, on Haodf.com one of China's largest telemedicine providers, the volume of text-and-image consultations and phone calls increased by 75% in March 2020, compared with December in the preceding year (Cheng et al. 2022), a pattern that is consistent nationwide (Fastdata 2020).

Telemedicine has had some impact on improving the efficiency of service delivery and reducing costs. Public hospital doctors use internet care to streamline their workflow, allowing them to reduce repetitive tasks and better prepare their patients in advance for their visits (e.g., by providing medical information ahead of time), hence freeing up their time for other tasks (Xu et al. 2022). For example, an analysis of data from an online health community and one tertiary hospital found that doctors who provide online health services recorded a higher number of outpatient visits, and have patients that experienced shorter in-hospital waiting times and demonstrated higher satisfaction (Wu et al. 2021). Internet health allows individuals living in rural areas to seek care within their local communities and travel to larger hospitals in urban centers only when necessary. Not only are outpatient costs lower compared with a hospital visit, the cost of medicine is also substantially lower as these are dispensed in community facilities compared with hospitals (Wu et al. 2019).

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Exhibits



Figure 1: Total value of new internet health investments and the number of internet hospitals, by year

Figure 2: Interactions between platforms, providers, and patients



Figures 3a and 3b: Mean prices of image-text telemedicine services on Haodf.com, by specialty (a) and doctors' seniority (b)



Notes: Reproduced from Xiang et al, (2023). CNY = Chinese Yuan; estimated conversion, 1 = US\$0.14. Price data were extracted from Haodf.com in January 2021 using a web-scrapping tool. Mean prices are weighted by the number of patient ratings a physician has, to account for differences in patient volumes.