China's innovation-based approach in the fight of Covid-19[1].

An estimation of China's impact for global health to come

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Abstract

When the infectious coronavirus SARS-CoV-2 broke out it resulted in a global crisis. In the fight of Covid-19, China's government relied on its strength to apply new technologies, i.e. for controlling and containment of the virus by tracing and tracking Chinese citizens. Relying on the trajectory of industrialisation, China has pursued a path of innovation. While it is reasoned that China's advantage might have origin in the experience of the SARS outbreak almost two decades ago, this article argues that mainly China's innovation- driven climate has favoured the application of new technologies in combatting the current crisis. Based on the innovation-driven trajectory this article explores China's pathway out the corona crisis and how this might strengthen China's role in global health governance. In order to pursue this aim, this article explores several areas, in which the next generation of technologies, such as AI-based diagnostic or intelligent robots were applied and concludes with an outlook based on the formulated political agenda, strategic considerations and initial international cooperation regarding China's impact for global health.

Keywords: Innovation; Covid-19; Healthcare; intelligent robots; telemedicine; Artificial intelligence; China.

Introduction

The outbreak of the infectious coronavirus SARS-CoV-2 led the world into a global crisis. This on-going pandemic crisis poses a health threat to people around the world and requires governmental action. The harsh reaction of the US government to terminate membership of the World Health Organization (WHO) showed the global importance of health policy and has thus possibly left a power vacuum in times of crisis that has become a window of opportunity for China's government to strengthen its emerging role in the world health sector. As assumed by experts from *Foreign Affairs* this decision of the US-administration under former President Donald Trump (*1946-, 2017-2021) gave China's government the necessary leeway to maneuverer

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[1] The author presented parts of the present text at the annual conference of the DVCS held on 13. November 2020 (Zürich/digital) on the topic "Innovativ aus der Krise" (German), which will be submitted for the annual Conference Yearbook under the title "Innovativ aus der Krise – Wie China mit Innovationstechnologien der Coronakrise begenet (German, forthcoming).

for International Leadership by propagating to "a global audience of the superiority of Chinese efforts and criticizing the 'irresponsibility and incompetence' of the 'so-called political elite in Washington'" (Campbell/Doshi, 2020). The innovation technology-driven approach of the People's Republic of China (PRC) to react on the infectious virus became a factor in the competition of systemic rivalry. Thus, the global corona crisis has not only represented a challenge to security and health policy, but has also created an opportunity for China to influence global health governance. In the context of system rivalry, the connection between innovation and political influence is said to grow stronger in the Age of Digitalisation (Yan, 2020). That begs the question of how did this innovation-driven pathway facilitate China's way out the corona crisis and how might this strengthen China's impact on global health governance?

Being a pioneer in digitalization and innovation-driven development, China's government relied on its strength to quickly apply new technologies in fighting the novel coronavirus. After decades of industrialization, the age of digitization has brought about new technologies, which seem to be the realization of the SCI-FI ideas from the 1970s. While the on-going development exceeds all expectations, the perfected robot soldier wouldn't probably come as a surprise at all. Needless to say, the digital transformation of society has already entered the way of living far beyond military means. Over the last decade, headlines reporting the merit of intelligent robots in medical diagnostic and treatment equipped with remote control and high-end sensors for navigation have increased.[2] Yet, China's pioneering role is not a coincidence: It is based on a clearly formulated agenda, such as the New Generation Artificial Intelligence Development Plan (X*in yidai rengong zhineng fazhan guihua*, AIDP)[3] that was launched in 2017. As the spread of the newly outbreak of SARS-Cov-2 progressed, China's State Council issued in June 2020 the action plan "Fighting Covid-19" which, in addition to conventional control methods, also favoured the application and development of technological solutions.[4] Although the challenging experience of SARS almost two decades ago has created an advantage, this article argues that it is mainly China's innovation-driven climate that has benefitted the application of new technologies in combatting the current crisis. Relying on the trajectory of industrialisation since the 1980s, China pursued the path of innovation for a future-oriented development.

Political science research forecast mixed effects from autocratic regimes and Innovation policy. Based on the theoretical assumption that autocracies provide a systemic advantage in innovation politics and the proclaimed increase of systemic rivalry in regard of digitalization,[5] this paper seeks to explore the impact of innovation

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[2] See for example the media coverage at The Robot Report at https://www.therobotreport.com/chinese-xiaoyi-ai-platform-passes-national-medical-licensing-tests/ [Accessed 15.06.2021].

[3] See the fulltext at http://www.gov.cn/zhengce/content/2017-07/20/content_5211996.htm [Accessed 18.05.2021].

[4] The State Council Information Office of the People's Republic of China. 2020. *Fighting Covid-19 China in Action*.

[5] (Yan Xuetong 2020)

politics in the field of healthcare. In contrast to avoid societal risk, China's autocratic regime might be prone to apply new technology solutions for filling the gap of input legitimacy by output legitimacy (Buzogány et al., 2016) and by doing so increase their global reputation. Hence, this paper assumes that, as challenging as it is, the innovative pathway to combat the corona crisis also harbours the opportunity for China to influence global health policy and governance in the not so far future.

Taking the current corona crisis as an example, this article pursues an explorative approach to map fields of influence in the intersection of new technologies and medical health services beyond the institutionalized framework of the World Health Organization (WHO). In order to pursue this aim, this paper is structured as follows: first, the paper outlines the theoretical context of how innovation politics links to the systemic rivalry. Second, to display the innovation-prone environment, this paper summarizes China's trajectory of innovation-based solutions regarding the support/pathway of new technology agenda in general and in the subsection of healthcare in particular. Under the impression that the current corona crisis boosted the even more rapid implementation of new technology in fighting the infectious virus outbreak on behalf of the advantage in digitalization, a third section follows to explore those new technologies that were applied during the combat of Covid-19. The analysis focuses on three examples, i.e. telemedicine, AI-based image diagnoses and the use of intelligent robots. In order to estimate the outreach of China's governmental prescribed innovation-prone agenda to the global health politics beyond the setting of the WHO, this paper follows to outline the political agenda setting by analysing three scopes: first, the governmental guideline as formulated in the "Fighting Covid-19 China in Action", second, the expressed claims of the CIIS to (academically) support China's strategic agenda, and, third, international cooperation that show initial implementations of China's "Maneuvering for International Leadership".

System Rivalry and Autocratic Advantage: Frog leap to the Future?

In midst of the global corona crisis the Tsinghua based IR scholar Yan Xuetong published the paper "Bipolar Rivalry in the Early Digital Age" (2020). He argues that the driving force between the United States and China is the new digital dimension of strategic competition rather than the ideology during the Cold War. Yan grounds his argument on the development of digital technology that has created new ways of protecting national security, that also benefits the accumulation of national wealth, and furthers to obtain international support. He states that, "Ideology can no longer serve as a political base for strategic cooperation as it did during the Cold War" (ibid. p. 322) but that "future advances in digital technology will boost the influence of digital mentality on foreign policy-making in the emerging bipolar world" (ibid. p. 323). Hence, it is the digital economy that will become "the main engine of the global

economy" (ibid. p. 323) and with it the advantage in digitization, by i.e. rapidly applying new technologies for solving social problems. Therefore, this will most likely pose as a game changer in the race for international competition. In particular, when it is being linked to the paradigmatic turn in global health dynamics, where the causal connection of wealthier means healthier inverted to 'healthier is wealthy' (see Sparke, 2018; Pritchett / Summers, 1996). This turn emerged in the debate over the last decades and supports the importance of the intersection of new technologies on developmental advantages and medical health services to this bipolar rivalry and corroborates this research approach.

Innovation is not an end in itself but serves to solve problems. The current crisis is a health problem and social challenge. Leitner and Wegner (2019) argue "solving societal problems is becoming an important motivation for conducting research and innovation, for companies and research-performing organisations, as well as for individuals" (2019, p. 227). In that spirit, combatting the outbreak of the infectious coronavirus provides not only a health problem but also such a social problem to solve. In general, innovation systems are also in need for a favourable climate of scientific autonomy, intellectual openness and creativity combined with a reliable institutional framework. Yet, being an autocratic regime by comparison, this is not the expected strong suit of the Chinese Party-State. However, China's current government managed to increase its modernity of the innovation system in international comparison over the last decade (2010-2020) by over 1,6 as the recent published evaluation by C. Textor on statistica.com showed.[6] Although, China's innovation system is still ranked 2 points below average, the government is promoting innovation technology, such as AI-based facial recognition in traffic and by doing so intruding comprehensively in all aspects of living (see Andersen, 2020; Drinhausen /Lee 2021, p.43-45). Empowered by the political agenda that will change the *Lebenswelt* (as in living environment) dramatically and possibly create new societal problems to solve.

According to Buzogány, Frankenberger, and Graf (2016) autocracies even have an advantage in the field of innovation policy. In the study on policy-making and legitimation in autocracies, the authors outline autocratic legitimation strategies in innovation policy and distinguish between three possible sources of legitimacy in the policy process: input, throughput and output. One of their findings is that authoritarian regimes can increase their throughput legitimacy by involving regional actors into the political system (ibid. p. 273). In addition, they figure that the PRC in particular, seems to benefit from the regional differences by facilitate the involvement of large non-state actors or even large state-owned enterprises they try to allow

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[6] See the illustration and description to the score that ranks from zero (low innovation) to ten (high innovation) which places China two points below average at position 11th after Japan (6,43), UK (6.18), US (5.54), Germany (5.52), South Korea (5.27), France (4.1), Australia (3.66), Italy (2.87), Canada (2.87) and Spain (2.6) at https://www.statista.com/statistics/1274633/china-innovation-system-modernity-in-international-comparison/ [12.11.2021]

competition to emerge (ibid. p. 273). They conclude that autocracies can reinterpret policies in terms of maintaining power and stylise themselves as successful problem solvers and innovators, e.g., by selling large-scale infrastructure projects as a "leap into the future" (ibid p. 276). Yet, innovation policy in particular requires a great deal of flexibility and careful modelling of the throughput dimension of autocracies (ibid. p. 276). Therefore, the research interest focuses on Chinas innovation trajectory and how the government reacted during the crisis in regard of the application of new technologies.

Based on this theoretical perspective, this paper outlines China's innovation-prone trajectory in order to explore the benefitting framework of China's innovative pathway to combat the corona crisis with regard to the intersection of new technologies and medical health care. In doing so, it seeks to identify possible angles that support China's emerging role in global health and harbour the opportunity for China to shape global health policy and governance in the near future.

China's Trajectory for Innovation-based Solutions

China's government embarked on the innovation pathway for new technologies long before the infectious lung disease broke out. In fact, it seems to be the reasonable continuation of the reform and opening-up policy that was introduced in the late 1970 under Deng Xiaoping (1904-1997). When China set sail for an innovation-prone future, the main concern was to develop industry in order to be on par with the industrialized world. The technological development has become a core driver for the peaceful development path (Zhang/Feng, 2019). In the course of the 1980s and 1990s political measures were introduced, such as the "Golden Projects" (*jin gongcheng*) and institutions were founded, including the establishment of the Ministry of Information Industry, which was later succeeded by the Ministry of Industry and Information Technology (*Gongye he xinhihua bu*, MIIT, 2008). The 2006 Science and Technology Plan aimed to promote domestic innovation and to gain the greatest possible technological independence. According to Alberto Gabriele, technological progress has become one of China's most crucial areas to fulfil the development strategy and thus "it is necessary to attach the highest priority to foster a very sustained growth of R&D investment and to develop an advanced NIS [National Innovation System], capable to go beyond mastering and absorbing Western state-of-the-art technologies and to successfully engage in generating indigenous innovation" (Gabriele, 2020, p. 165). Hence, China's leadership has promoted new technologies and has furthered it by lavishing significant financial support.

Artificial intelligence (AI) will become the most forward-looking new foci of international competition. Because China's situation of national security and international competition is getting more complicated "One must look at the world, put the development of artificial intelligence at the national strategic level, systematically

deploy and plan actively" (The State Council 2017), states the New Generation Artificial Intelligence Development Plan (X*in yidai rengong zhineng fazhan guihua*, AIDP). China's State Council published the AIDP in August 2017. The novelty of AI development and the importance of AI for international competition both are highlighted directly in the description of the strategic situation. According to AIDP, AI is not just triggering a new round of international Science and Technology (S&T) competition, becoming the core driver for a new round of industrial transformation but will also create the most significant competitive advantage regarding the strategic international situation. The acceleration of AI-technology is not only linked with finding technological-driven solutions for social problems and to sustain development, but also to fulfil the promise and regain former international glory. Yet, the broad use of technology that apply artificial intelligence is estimated to be a disruption to future societies (Girasa, 2020). Therefore, as a disruptive technology (*dianfu xing jishu*) AI-technology might most likely play the key game changer due to its comprehensive areas of application to social development and digital transformation alike (ibid, p. 24-67). In doing so, it can also lead to a change in the global balance of power (see Yan 2020). Hence, China has enhanced its prospects to become the world leader of AI.

This brief outline illustrates China's prevailing climate for promoting the development of innovative technology in order to meet new political challenges. The most important drivers for China's innovation-prone development are future technologies, such as smart, intelligent and data-driven (information) technologies. Yet, in 2018, President Xi emphasised China's science and technology sector problems. He pointed out the lack of innovative ability (*chuangxin nengli*), resource allocation (*ziyuan peizhi*), structure and politics (*tizhi zhengce*). Most importantly he claimed: "China lacks basic research and breakthroughs" and as a matter of fact, China "lacks of original knowledge" (Xi, 2020). The bottom line was, that the overall situation is not yet good enough and the interaction of the individual components is also not yet sustainable. In particular, "the global cooperation is not yet sufficient, the S&T skills are not yet strong" (Ibid.). Hence, the goal of establishing a *shijie keji qiangguo – a* science and technology superpower– has not yet been achieved. However, with the goal in mind to become the next *shijie keji quanguo*, "we have to advance the S&T sector in order to become "the world's largest science centre and innovation country" (ibid.).

Although, like Xi, specialists often have highlighted China's need to catch up, the previously taken course showed promising effects. As a result of the massive investments in research and development (R&D), for example, Chinese patent applications increased (see Wipo.int, 2020). One of the main requirements in order to become a science and technology superpower is suffice infrastructure. China's global networking agenda includes not only the connectivity of train stations and harbours, but also the fast development of powerful physical data routes for digital transmission.

In 2018, the launch of the 'digital silk road' (*shuzi sichou zhi lu*) contributed to that cause and consolidated the government's outward-looking digitalization strategy. As a matter of fact, powerful servers and data storage facilities are essential for operating big data and AI-based applications, which also became obvious in dealing with the corona crisis.

China's government has pursued a trajectory of an innovation-prone pathway for addressing societal challenges and problems. Expanding the infrastructure for e-governance (see Drinhausen/Lee 2021,p. 41-42; Chen/Göbel, 2016) counts to this trajectory as much as the most prominent example of the implementation of the social credit system for tracking and rating social behaviour (see Meissner, 2017; Kostka, 2019; Ohlberg, 2019).[7] This reflects China's approach to pursue a leadership role in global health. In the last decade, China not only desires to become a digital leader in S&T, but also increased its global responsibility as a public health provider (see Freeman III, 2011; Pak K Lee, 2014). In summer 2018, China and the WHO expanded their strategic partnership. On behalf of the Chinese Government, Minister Ma Xiaowei of the National Health Commission signed a letter of intent to expand global collaboration in malaria and schistosomiasis, and agreed to increase the number of dispatched health professionals seconded to WHO. [8] According to that web-entry, the Director-General Tedros Adhanom Ghebreyesus said that China's domestic healthcare reforms covering up to 95 per cent of the immense population, "serve as a model for universal health coverage, a bulwark against emergencies, and a reminder that transformations can be far-reaching" (ibid.). China's medical support in African countries has "become a flagship of China's contribution to global health" (ibid.). Later that summer, during the Ebola Crisis China strengthened its collaborative efforts with the WHO by supporting the response in the Democratic Republic of Congo (DRC) and dispatched "national health authorities to the WHO response effort".[9] As Kreuder-Sonnen and Hanrieder (2015) examined the Ebola crisis shaped the fragmented WHO from within and emphasised China's role in it. With their divergent practises and politics in conducting health diplomacy, emerging powers, like the PRC, constitute an alternative to global health Governance (Huang, 2018). Drawing from this, global health as a topic has become a major sector in the race of international competition.

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[7] For more detailed information on China's innovation-driven agenda see also for example the subsections Chapter 4 on "Strengthen national strategic scientific and technological strength" (qianghua guojia zhanlüe keji liliang) of the 14th Five-Year Plan (2021-2025), published by the Chinese Government, 13.03.2021, at http://www.gov.cn/xinwen/2021-03/13/content_5592681.htm [Accessed 22.11.2021].

[8] See the WHO web-entry, 18.07.2018, on „Building from Strength: Expanding the Strategic Partnership between WHO and China" at http://www.wpro.who.int/china/mediacentre/releases/2018/building-from-Strength/en/ [Accessed 22.11.2018].

[9] See the WHO web-entry on "WHO and China Sign New Agreement on Ebola Response", 31.08.2018, at http://www.wpro.who.int/china/mediacentre/releases/2018/WHO-and-China-Sign-New-Agreement-on-Ebola-Response/en/ [Accessed 22.11.2018].

Innovation-prone health system at the intersection of digitalization and healthcare

In the aftermath of the previous SARS crisis, China's government initiated several health reforms. The healthcare system of the post-Mao era was put to test. In case of SARS, the Chinese reporting system with a parallel military structure had provoked strong criticism. Investigations by WHO inspectors on the ground had revealed that the surveillance network set up to track suspected cases was not functioning. The WHO inspectors had also assumed that China had probably hardly invested in public health in the past 30 years and expressed concern about the financially weak sections of the population.[10] Once being praised internationally for the advanced public health services, the economic constraints led to an ailing system, which failed the poor mostly in remote areas and risked dragging middle-income households into poverty (Müller, 2017; see also Lin / Zhao, 2015). As Müller states, the New Rural Co-operative Medical System (NRCMS) was introduced as a counter measure, which also provided a broad reform including the public health insurance in China today. In October 2016, President Xi presented the blueprint for further development of public health and launched the "Healthy China 2030" (*Jiankang Zhongguo*) action plan. According to the WHO web-entry on that agenda themed "Healthy China 2030 (from vision to action)", multisectoral cooperation and innovation would play a key role in this agenda.[11]

Institutional reforms have also been carried out in the health sector. From a political perspective, that was an upgrade to public health and healthcare institutions. In 2018, three health authorities were merged and the *Guojia weisheng jiankang weiyuanhui* was established as a National Health Commission. The following development of legal framework for smart healthcare can be viewed as a result of the strategy by the government to apply innovation technologies for addressing social problems. The amalgamation of the formerly three responsible administrative authorities to form a higher-level national authority for medical products has underpinned the institutional upgrade and has promised increased efficiency. In September 2018, the health commission announced measures for the recognition of treatment by telemedicine. This policy supported both, the upcoming healthcare service platforms and the so-called 'Internet hospitals' (*hulian wang yiyuan*). The National Healthcare Security Administration (*Guojia yiliao baozhang ju*, NHSA), which was also reformed in 2018, developed guidelines for a combined digital payment model through which online purchases and digital health services are processed via the state health insurance. For the first time, the amended legal regulation allowed the sale and dispensing of drugs,

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[10] See the WHO web-entry (2003) on "Case Definitions for Surveillance of Severe Acute Respiratory Syndrome (SARS)." *World Health Organization - Health Promotion* at https://www.who.int/csr/sars/casedefinition/en/, [Accessed 02.06.2021].

[11] See the WHO web-entry (2016) at https://www.who.int/healthpromotion/conferences/9gchp/healthy-china/en/ [Accessed 13.05.2021].

including drugs available only on prescription. In the health sector, too, institutional and legal foundations were set before the outbreak of the coronavirus.

As for the intersection of digitalization and healthcare, the applications based on AI will accompany humanity into the future: Apps and Big Data-driven software tools will intervene in future's mobility and in the private sphere alike. AI-based technologies thus not only affect spaces, in which it is designed to improve human interaction, for example, it will reduce travel time or the likelihood of traffic accidents, but also, it will affect, i.e. by the establishment of an "all-seeing digital system of social control" (Andersen, 2020) alter the very living. While the traffic improvements might be widely seen as a merit, those AI-based technologies that will invade areas of the most sensitive intimacy might not be seen as such uncontested merits after all. Regarding medical applications in particular, it is no longer just about the interaction between humans and machines, but also about their entanglement (See Becker, 2020). In doing so, the question of who owns the data and the right to access and use will become a future area of conflict.

In addition, advances in facial recognition software are not only desired for security, but also elementary for the improvement of decentralized health treatment. Intelligent robots or healthcare services applications will also rely on facial recognition to support the diagnosis of diseases; in range from more common diseases, such as diabetes, to rare genetic diseases.[12] Therefore it is not a surprise at all, that Xi has found willing commercial partners in China's most prominent AI start-ups (Andersen 2020). Several of them are strong partners in the development of medical software and equipment, such as iFlytek, Yitu Technology or CuraCloud.

In sum, the reforms and political agendas over the last decades created a favourable framework for pursuing China's innovative pathway. In addition to China's chosen path of innovation-technological problem solving the introduced reforms in the health sector, also favoured crisis management. In the attempt to establish itself as a science and technology superpower, China's government focused more on upcoming technologies. At the latest, when President Xi came to power, the PRC no longer simply had to catch up with industrial backwardness and align itself primarily with the West, but actively pursued the fast lane. Apart from the clear systemic difference caused by the autocratic one-party rule of the Communist Party, China started from an advanced position that can be characterized by two different streams: on the one hand, China's government has already embarked on a course of massive innovation promotion in the preceding years and has also consolidated this institutionally. On the other hand,

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[12] See the web entry by Jeannine Mjoseth on "Facial recognition software helps diagnose rare genetic disease" (23.03.2017) at https://www.genome.gov/news/news-release/Facial-recognition-software-helps-diagnose-rare-genetic-disease [Accessed 29.05.2021].

after further environmental and health scandals, China's government again initiated a comprehensive health reform in 2016, promoting an outgoing health care policy.

Fighting Covid-19 China in Action

The outbreak of the SARS-CoV-2 virus in Wuhan became a social and socio-political stress test: media reports showed alarming announcements of overcrowded hospitals, an entire province was militarily sealed off and quarantined, doors of private homes were barricaded with square timbers. The pandemic became a good example, as James J. Chriss argued for how social problems can rapidly spread and evolve global reach (2020, p.22). The Fear of infection or contagion with the unknown Wuhan pneumonia (*Wuhan feiyan*) –that is, Covid-19 lung disease– spread even more quickly.

The Chinese government launched the largest medical assistance operation in the history of the People's Republic of China. In June 2020, the State Council Information Office published the action plan "*Fighting Covid-19 China in Action*" (State Council Information Office 2020).[13] The 60+ pages document first presents a chronological history of events with initial successes of the containment strategy and it is divided into four subsections. Due to the location of the outbreak, the medical resources concentrated in Wuhan, (Hubei Province). According to this action plan, between January 24th and March 8th 2020, 346 national medical teams were rallied, including 42,600 medical workers and over 900 public health professionals (ibid. Subsection III, p. 47). While the People's Liberation Army (PLA) contributed with more than 4, 000 medical personnel, the PLA Air Force delivered medical supplies. In addition, China increased the efforts to build emergency hospitals and engaged over 1.8 million sanitation workers for waste disposal and disinfection of public spaces (ibid. Subsection III, p. 54).

Besides the "Centralized and Efficient Command" and "A tight Prevention and Control System Involving All Sectors of Society" one aspect focuses on S&T in particular. But what does the action plan prescribe in terms of China's comprehensive agenda? The vey first sentence in the action plan of Chapter Five regarding science and technology seeks to emphasize China's efforts by stating that "Science and technology are the sharp blade that humanity wields in the battle against disease" (ibid. p. 42). Further on it elaborates that China has pushed its 'pioneering role of science and technology' (ibid. p. 42) by directly applying the recent achievements of the innovation sector in order to fight against the viral spread and infectious lung disease. The fact that this action plan is published in English stating this positive notion on China's policy agenda supports the addressed argument of foreign policy authors that China's government is presenting its achievements by highlighting "the effectiveness of its model of domestic governance" (Campbell/Doshi, 2020). Without presenting further evidence, the action

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[13] The following page numbers refer to the pdf file for download provided at http://fj.china-embassy.org/eng/xw/P020200607430003210125.pdf [Accessed 18.09.2020].

plan praised the efforts made and states that "China has exploited the pioneering role of science and technology and fully applied the results of scientific and technical innovation in recent years" (State Council Information Office 2020, 42). The action plan also highlights, in addition, that societal resources have been pooled from actors, such as enterprises, universities, and research institutes, to concentrate on five main areas of activity, which are: "clinical treatment, new medicines and vaccines, testing techniques and products, viral etiology and epidemiology, and animal model construction" (Ibid. p. 43). At the time the plan was issued, 83 emergency Research and Development (R&D) programs have been initiated. The following subsection of this article on innovation technology to combat the Corona Crisis below, traces by an explorative analysis to what extend this guiding agenda was implementated.

One subsection addresses the usage of big data and artificial intelligence in regard of the epidemic control. One example for the containment of the coronavirus spread is the application of new technologies, such as health QR codes and digitally registered travel records. In this way, an epidemic map could be created in order to enable the better assessment of the occurrence of the infection. Over the past year, local governments offered solutions based on a traffic light system using QR codes.[14] In doing so, China's government relied on its previous experiences for societal control, such as the Social Credit System, which is a big-data-fuelled mechanism for monitoring Chinese Citizens' behaviour (Shi-Kupfer/Ohlberg, 2019, p. 24). Based on these collected data, citizens were treated differently.

Apart from the rapid implementation of a digital infrastructure for tracing and tracking, new technologies were applied in other areas, such as for medical treatment as will be outlined below. While the action plan emphasises that "China has fully utilized big data, artificial intelligence, and other new technologies in research and analysis to forecast the trend of Covid-19 developments" (ibid. subsection III.5, p. 43), however, little is said about the application of new technology in other areas. Yet, the proclamation that "China will adopt a series of important measures to reinforce weak links" (ibid.), including to "strengthen the new strategy of pooling nationwide resources for breakthroughs in core technologies" (ibid.), give reason to explore which 'core technologies' came to play in more detail below.

Innovation Technology to Combat the Corona Crisis

As the report on China Internet published in June 2020 by South China Morning Post Research showed, the use of digital usage has increased due to the Covid-19 crisis (SCMP, 2020). The health sector in particular has benefited from platforms such as the Ping An Good Doctor or Tencent Trusted Doctors for online consulting, especially

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[14] See the Netzpolitik.org web-entry (04.03.2020) by Dominic Lammer at https://netzpolitik.org/2020/china-setzt-im-kampf-gegen-das-virus-auf-farbcodes/ [Accessed 15.05.2021].

in Wuhan. The following explores three areas of the intersection of digitization and healthcare, i.e. telemedicine, AI-based image analysis and intelligent robots.

Telemedicine

During the last year, telemedicine infrastructure has been expanded. In China, online platforms based on novel 5G-technology were created in the context of epidemic control to reach epidemiological teams in remote mountainous regions and take part in expert dialogue. Also, telemedicine platforms, such as Ping An Good Doctors or Tencent Trusted Doctors for individual consultation, have been in greater demand by the public. According to an annual report of the platform Ping An Good Doctors, the number of users increased by two and a half times to more than 500 million compared to the previous year. An annual average increase of 8.5 per cent was recorded. In total, the company employed more than 1,800 people to provide healthcare services, such as online consultations, referrals and prescription medicines via the AI-based healthcare system. In addition, a regional Internet hospital platform was set up in Fuzhou by the end of 2019 that became operational in mid-July 2020. Drawing from this, the company hopes to connect even more local online insurance platforms in order to accelerate the broad establishment of Internet hospitals.[15]

Telemedicine applications have also been integrated into clinical care. The brief report from August 2020, "How telemedicine integrated into China's anti-COVID-19 strategies: case from National Referral Center" evaluated the use of the telemedicine mobile device app Huayitong at West China Hospital of Sichuan University. Patients were registered with the app at the time of admission and agreed to release their personal data. Registered users were able to access free online consultation through this app. In addition, the app supported the identification of disease states (method for triaging) to ensure targeted care and save resources. First, potentially infected individuals filled out a questionnaire with demographic information, temperature, and epidemiological history and symptoms. Then, a video assistant was used by the hospital's medical staff to provide an assessment within a day to figure the health status, focusing on critical symptoms. The potentially infected could be assessed remotely and be separated from the potentially sick: Targeted viral testing (nucleic acid detection) was then performed on the conspicuous individuals, and all others were sent to quarantine at home (Li et al. 2020, p. 2). The seven-member team of authors emphasized the important role of patient data for the effectiveness of the intervention and pointed out the need to also promote such platforms through the media in order to reach all age groups (ibid. p. 3). In conclusion, the study recommends the use of telemedicine in particular for countries with low and middle income in order to ensure better health care.

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[15] See the web-entry at https://www.prnewswire.com/news-releases/ping-an-healthcare-and-technology-company-limited-reports-revenue-of-rmb-2-747-billion-for-h1-2020--301115866.html [Accessed 12.06.2021].

AI-aided Image analysis

Another field of application of innovation technology crisis management concerns diagnosis and treatment. AI-supported analysis methods require large amounts of data, which were initially not available. In order for machine evaluation to be trained at all, mostly via Deep Learning, Chinese science teams added old computer tomography images of former SARS patients to make up for the missing data sets. On this basis, rapid advances were made in diagnostics and early detection. As early as February 2020, the Alibaba Group's research and innovation institute DAMO launched an AI-enabled system for fast-track diagnosis with an overwhelming accuracy of 96 per cent.[16]

The scientific review titled on "A Survey on Artificial Intelligence in Chest Imaging of COVID-19" (Chen et al., 2020) published in November 2020 in the online journal *BioIntegration* lists studies that performed AI-assisted image analysis procedures of chest radiographs in Covid-19 patients. In total, they reviewed 15 studies worldwide on image analysis of radiographs (CXR) and 12 studies on computed tomography image analysis procedures. They concluded with the recommendation to establish a database in order to identify certain types of lesions more precisely (ibid). Another team of Chinese researchers with a background in information technology developed an early diagnostic procedure (Wu et al., 2021). A new large-scale dataset with patient-level and pixel-level annotations was created and the authors introduced a Joint Classification and Segmentation (JCS) diagnostic procedure to provide explainable diagnosis results for medical staff. A joint paper from researchers of the Academy of Medical Engineering and Translational Medicine and the Tianjin Key Laboratory of Brain Science and Neural Engineering both based at the Tianjin University published a paper on AI-aided Disease Prediction focus on the merit of visualized medicine and its benefits for treatment (Liu et al., 2020).

Intelligent Robots

Intelligent robots are another example of the use of smart innovation technology. The *zhineng jiqiren* have a wide range of applications: they are used as disinfection robots or to support diagnosis and treatment. Even before the outbreak of the corona virus, they have become an integral part of the modernisation of intelligent hospitals.[17] According to media reports, the main area of application for intelligent robots is space and surface disinfection of contaminated treatment rooms, such as the Saite Intelligence's the Saiterobot. This Chinese produced intelligent robot is an intelligent medical disinfection device that can navigate autonomously in the room, perform

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[16] See GMCC coverage at https://gmcc.alibabadoctor.com/alibaba-actions [Accessed 18.05.2021].

[17] See the MedSci web-entry (20.06.2020) at https://www.medsci.cn/article/show_article.do?id=b8b6196188ef [Accessed 25.04.2021].

multi-mode disinfections and is used for user-friendly interaction between man and machine.[18] As the producers webpage declares, the device was originally developed by Saito Intelligence in January 2020 to contribute to the governmental fight against Covid-19. Therefore, they also called it the disinfection and epidemic prevention robot or *gaoxiao xiaodu fangyi jiqiren*) when presented at the China Medical Equipment Fair (CMEF).[19] Especially, the possibility for patient's interaction in remote treatment provided benefits in dealing with an infectious corona virus.[20]

While dealing with a respiratory-infecting virus, remote consultations, in particular, have advantages. Intelligent robots can carry out contactless interactions between doctors and patients via medically used robots. One of the most prominent non-human team members is the model Ruijin Xiaobai. Its colleagues said that he works 12 hours a day without closing an eye and he doesn't have to wear protective clothing, in addition, he doesn't have to fear infection with the new coronavirus".[21] The intelligent robot was developed in cooperation of the Shanghai Ruijin Hospital and the Shanghai Jiaotong University School of Medicine (Shanghai Jiaotong daxue yixue xueyuan). It is equipped with integrated lidar software, infrared-radar for automatic driving and remote driving technology. The remote interaction can avoid the risk of an infection during contact and reduce the expenditures of resources, since time and material for changing medical suits are minimized. The robot is directly connected via a 5G-network to the hospital. Hence the obtained information can be transmitted more quickly for interdisciplinary medical consultation. By now, Ruijin Xiaobai has become a permanent team member at different hospitals.

Global Agenda for "A Community for Health for All"

The previously introduced action plan "Fighting Covid-19 China in Action" also addresses China's role in global cooperation. Three points are made: China Appreciates Support from the International Community, 2. China conducts active international Exchange and Cooperation, 3. International Solidarity and Cooperation in Fighting the Pandemic (The State Council Information Office 2020). The action plan emphasises President Xi's personal commitment. Accordingly, in over 50 meetings and phone calls he set out China's agenda in detail and offered help in striving to build "a global community of shared future". As stressed on May 18th at the 73rd World Health Assembly, he pointed out that

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[18] According to the company's description, the epidemic prevention robot has two modes of disinfection: one uses UV lamps and the other applies atomised hydrogen peroxide. For more details see the company's information at https://www.saiterobot.com/dongtai/122.html [12.06.2021].

[19] For more Information on the CMEF that takes place twice a year see the fair's website at https://www.cmef.com.cn/en/Information?cid=13 [12.06.2021].

[20] For example see Vivek Kumars article in *Analytical Insight* on "How Technologies like AI, Robots, Drones Help China to Fight against Covid-1?", released on 22.May 2020 at https://www.analyticsinsight.net/technologies-like-ai-robots-drones-help-china-fight-covid-19/ [11.11.2021].

[21] See Wenhui.com (23.02.2020) „Yiliao dui mingdan zhi wai de ‚yuan e duiyuan' [The Medical Team members outside the staff list]" at https://www.whb.cn/zhuzhan/yiliao/20200223/327409.html [13.05.2021].

China will "support the WHO in leading the global response, to provide greater support for Africa, to strengthen global governance in public health, to restore economic and social development, and to strengthen international cooperation" (ibid. Subsection IV.2, p. 58). For example, he stressed to support the global fight by financing the establishment of a "global humanitarian response depot" (ibid.) and that China in cooperation with the United Nations establishes "a cooperation mechanism for Chinese hospitals to pair up with 30 African hospitals" (ibid.). That mechanism shall also support the distribution of Covid-19 vaccine, as it is seen as a "global public product one it is developed and deployed in China" (ibid).

As a matter of fact, Chinese entanglement overseas increased over the last decades and so did their outreach to the diaspora community. As outlined in the action plan, China's government has stated its responsibility for citizens overseas and calls for "governments of other countries to take effective measures to ensure the safety of Chinese students, the personnel of Chinese-funded institutions, and other Chinese nationals" (ibid. Subsection III, p. 46). While offering health kits to overseas and dispatching medical expert teams rather counts as conventional support, China declared also to offer telemedicine services platforms in order to "provide scientific and professional guidance on Covid-19 prevention and control for Chinese citizens in other countries" (ibid). In order to fulfil this agenda, the government partnered up with telemedicine providers, such as the former introduced Ping An Good Doctor or WeDoctors and Tencent Trusted Doctors, and increased their support for overseas Chinese and foreign nationalities by providing multilingual services or joining with foreign partners.[22] In synch with the China's global outreach agenda is getting the innovation-prone approach in health care recognised by international institutions, such as the WONCA certificate for high standards in AI-health technologies.[23] As the Ping An Doctors annual report of 2020 informs, the platform even made first prizes in six global medical imaging contests.[24] In sum, it seems that China's government aims to pursue the presented innovation-based approach globally to reshuffle the future of global health architecture.

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[22] For example, Ping An Good Doctors partnerd with Singapore-based GRAB to enter the Southeast Asian market, see the entry of Health Advances Blog at https://healthadvancesblog.com/2021/06/30/tencent-backed-wedoctor-is-going-public-what-are-the-next-steps-for-chinese-digital-health-companies/ [12.11.2021].

[23] WONCA refers to The World Organization of Family Doctors, which was founded in 1972, totals to 118 Member Organisations, and operates under the WHO, see https://www.who.int/workforcealliance/members_partners/member_list/wonca/en/ [25.05.2021]. See also the company's announcement at http://www.pagd.net/newsPage/newDetail/1-0-0-0-2-5?lang=EN_US [12.11.2021].

[24] See the English summary of the annual report's page 18 at http://www.pagd.net/media/pdf/us/2020an/2020_AN_US.PDF [24.02.2021]; for the full report in Chinese see https://staticpacific.blob.core.windows.net/press-releases-attachments/1289469/HKEX-EPS_20210317_9661234_0.PDF [15.05.2021].

The CIIS' Strategic considerations

In the spirit of the shared community of common destiny (*Renlei mingyun gongtongti*), a think tank study from the China Institute of International Studies (CIIS)[25] titled "How COVID-19 is Changing the World Order" estimates the effects of Covid-19 on international relations and propagates ways, in which the world order should be adapted. The common sense of a think tank study underlines the need for international cooperation (CIIS 2020). A cursory analysis of the texts on their attitude to the potential for China to influence the global health architecture underlines that against the background of the current crisis the position hardened. For example, Qin Yaqing criticises the US 'America First'-Policy and emphasises that "this pandemic is yet another manifestation of a serious failure of global governance" (Qin, 2020, p. 15). For several years now, as the Foreign Affairs authors Campbell and Doshi assumed, is Xi Jinping pushing its foreign policy apparatus to come up with "leading reforms to 'global governance" (Campbell/Doshi 2020), so does this CIIS report reads as an answer for that request. For example, Yang Jiemian who is Chairman of the Council of Academic Affairs and Senior Research Fellow at the Shanghai institutes for International Studies (SIIS) strongly recommends the "restructuring of international power" (2020, p.20) and in doing so "to ensure sustainable evolution of the world order thereafter" (ibid. p. 23).[26] He clearly states his discontent with the current global governance by stating that this "pandemic is another attack on Western ideological hegemony" (ibid. p. 21). Regardless the outcome of the current crisis, systemic change seems inevitable for his Colleague from the China Foreign Affairs University, Qin Yaqing "whether or not a consensus on cooperation and mechanisms for cooperation can be reached as a result of the crisis will not only directly affect the success or failure of the fight against the pandemic, but will also have profound impact on international relations and the world order in the post-pandemic period" (2020, p. 17).

Rather than aiming to strengthen the sovereignty of the fragmented WHO, Chinese scholars promote the complete opposite. Qin also suggests rebuilding of the G20+1 Model in order to establish "a sound and effective global multilateral cooperation mechanism" (ibid. p. 15). He claims that the "era of hegemonic cooperation is over" and thus promotes a "collective leadership" (ibid. p. 16). The main objective of a newly established cooperation mechanism should fulfil the two functions of "political leadership" and "advisory implementation" (ibid). While he foresees the G20 as "the central leadership body", "multilateral (!) organizations", such as the WHO, have the task of collecting important information in order to derive advice and recommendations. They are merely intended to "serving as a solid scientific basis for the G20 to propose global guiding principles" (ibid.).

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[25] For further information see the Think Tank's webside at http://www.ciis.org.cn.

[26] Yang, Jiemin. 2020. "The COVID-19 Pandemic and Its Impact on Contemporary International Relations." In *How COVID-19 Is Changing the World Order*, edited by CIIS, 18–26. Beijing. http://www.ciis.org.cn/english/2020-05/25/content_41162811.html.

International cooperation beyond Institutions

The innovation-based approach accompanied Chinas agenda to fight out of the corona crisis. Well known IR scholars, such as Qin and Yang even targeted the restructuring of the world order as a result of the management of corona crisis, but how does innovation-tech transfer into supporting this changing role of China in global health? Beyond international research communities, also joint ventures and transnational operating Foundations, such as the Jack Ma Foundation and the Alibaba Foundation are in the game. In cooperation the two foundations established the Global MediXchange (GMCC, *Quanqiu feiyan shizhan gongxiang pingtai*) to fight against Covid-19 lung disease.[27] Supported by Alibaba Cloud Intelligence and Alibaba Health, the GMCC program acquired digital data for analysis. The GMCC was primarily created to enable the international exchange between physicians and medical staff internationally. Hence, the core of the project is an online communication platform that facilitates cross-border collaboration between the scientific community and the medical staff at the front line. For this purpose, GMCC provides a protected communication channel and offers its real-time services in eleven languages. The European research network "The Federation of European Microbiological Societies" (FEMS) based in the Netherlands is a strong supporter of this China-based platform.[28] This is a good example for the going-global strategy of China's Party State and further legitimacy by means of both throughput and output. In addition, Alibaba Cloud also offers in conjunction with DAMO Academy and DingTalk several AI-technologies and cloud-based solution to support organisations and companies worldwide.[29]

By donating medical supplies, the big innovation-tech funded Foundations become a global health player themselves. In April 2020 the Jack Ma Foundation and Alibaba Foundation announced their support for Africa.[30] Although, the donated products, such as in ventilators, face shields, gloves and so on, are rather conventional in terms of innovation technology, they will also contribute to China's global reputation.

Concluding outlook

In the context of system rivalry, the connection between innovation and political influence will grow stronger. The progress in the advanced application of telemedicine, AI-based technology and the application of intelligent robots has benefitted China's innovative pathway in fighting Covid-19. During the course of the corona crisis, the PRC

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[27] For more information see the GMCC websesite at https://gmcc.alibabadoctor.com/?locale=zh-cn&entry=aliyungmcc_re_20200420__ [Accessed 14.05.2021].

[28] For more informationon on FEMS go to https://fems-microbiology.org/about_fems/organization/ [Accessed 14. 05. 2021].

[29] See the GMCC website at https://gmcc.alibabadoctor.com/alibaba-actions [Accessed 14.05.2021].

[30] See the CGTN report at https://africa.cgtn.com/2020/04/23/african-nations-to-get-300-ventilators-from-jack-ma-foundation/ [Accessed 12.06.2021].

has propagated its application of Science & Technology as capability and its strength: the constant mutability that drives the path of innovation-driven growth. The enormous economic and technological successes of the past decades lead to China's rise. Yet, the global involvement also revealed during the first SARS outbreak of 2003/2004 the shortcomings of the health sector. The political path that followed applied innovative-prone policies and might have created a favourable starting position for fighting the crisis. To deal with the corona crisis caused by the SARS-Cov-2 outbreak, China quickly turned to innovative solutions, such as the use of mobile device applications for QR code. In particular, advances in medical applications such as intelligent robots or AI-based image analysis techniques have contributed to deal with the scarce resources. In addition, other AI-based technologies were applied in combating the Covid-19 crisis, such as training predictive models to forecast the spread of the virus – local and global. The governmental policy integrated big start-ups in the fight against the novel coronavirus and by doing so boosted the throughput legitimacy.

In addition, the acceptance of diagnostic support through telemedicine platforms in selected hospitals as well as in the broader society have both led to containment and helped relieve the burden on overworked medical staff. However, little is known about the societal effects of the massive data collection, and at this point, the long-term impact might be even impossible to seize. Yet, through the upstream of vast amounts of medical history, a possible outbreak allocation could be spotted in advance. Whether it is the AI-based monitoring and diagnostic applications or the training of intelligent robots, China's approaches to innovation technology in tackling the crisis provide an example with global reach and thus might impact China's role in global health and in the global health Governance. Especially, telemedicine platforms could have a lasting effect by providing services to the growing Chinese diaspora. Tencent Trusted Doctors, for example, is pursuing projects with hospitals in partner countries along the Silk Road. These brief examples alone show how Chinese-initiated international collaborative research, telemedicine platform providers or the innovation technology development, in general, might influence the global health structure beyond the within and beyond the framework of the WHO.

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