STS Research Paper

Examine China's Standards in the Development of Telemedicine

FABLE OF TOMORROW

Once upon a time, life was thriving in this small college town in America. On weekdays, bustling buses crowded the streets, carrying hundreds and thousands of students wondering about the stories of Odyssey, or the speed of light in the water. Streams of people gathered in the libraries until midnight, boasting human's most cherished procrastinating instincts and enjoy the moment of zen after another exhausting day of classes. On weekends, streets near the college were lighten up, drowning anyone desired of "having fun" with alcohol and other substances with each fraternitie's various longstanding rituals. Or, crowded stadiums were filled with students and spectators that take pleasure of players knocking down each other, and advance the ball for more than two yards.

Then came the great plague. In the beginning, the shops were closed after the supplies had run out, starting with hand sanitizer and toilet paper. The bars and restaurants were all but deserted by their owners that fears the potentially contagious customers, taking away all the food and drinks except the corona beer. No more public transits, mass gatherings, or even the luxury of watching sports at home, the town has been brought to a stand still. In contrast, the local airport was full of guests returning from elsewhere, only to wait in hours of dread and despair for their temperatures to be checked, and luggages to be claimed. The hospitals, once rated the best in the commonwealth, has been overwhelmed with patients, forcing doctors and nurses to make the unfortunate choice of leaving the most vulnerable to die. The government has aggressively guaranteed citizen's universal human rights, such as freedom of movement and gatherings in this difficult times. However, it downplayed the severity of the disease as "just the flu", and implemented a disastrous "herd immunity" strategy that cause more than 60% the residents in this town infected with the disease, and struggling to recover from that despite of the government's promise of containing the disease.

Two months later, the municipal government was been thrown out by the town's angry citizens, and a new government was chosen by cities's residents from a cellphone app. The new government implemented much more draconian measures. Residents of this town were forced to quarantine at home for two weeks if returned from other disease epicenters in the country. Residents are forced to complete an application with their most private travel history, and health information, and are granted a QR code in this way based on AI-based algorithms running in a remote server. The QR code comes in only two colors, red and green, and people with a red QR code would be stopped in public spaces, work places, or interstate checkpoints from entering. In the medical front, new hospitals were constructed in empty private lands via eminent domain, with more beds able to treat more patients with very severe symptoms. People with mild symptoms were prohibited from entering the hospitals, but may only consult with doctors via virtual reality-based video calls, allowing the doctor to completely examine the patient's symptoms and give the most appropriate recommendation and treatment. Finally, doctors from elsewhere in the country utilize 5G to perform operations for patients in the local hospital virtually, hoping to save the most lives possible.

One week later, the situation remained dire, but there has been evidence that the measures implemented by the new government is working. The number of new confirmed cases have fallen by half from the peak on each day, and lower fatality rates and increasing cases of recovery has also been reported. The new government, who drew heavy criticism initially for such draconian measure, has now received more 70% approval rating by the citizens in a recent

poll for the new measurements that are working. But then the mechanisms that were based on the foundations of this country stepped in. The government was sued by owners of the private land that the government used to build hospitals, claimed that the constitution prohibit the illegal seizure of their properties, even though these land has remained vacant for many many years as the investors were waiting to sell these land for a huge profit as the land prices go up. In addition, another class-action lawsuit was filed by only a small fraction of the city's residents, who demanded the government to stop collecting citizens healthcare information immediately, arguing it infringed their 14th amendment that emphasized the rights to privacy. They also filed a separate lawsuit that demanded the hospitals to stop virtual consultation of patients but to consult all patients physically, citing the anti-discrimination law that says no citizens should be denied service by a busniess not only because of their race or gender, but also their health condition. The conservative radio host in this area argued the use of technology by the government greatly profited the tech entrepreneurs in the liberal silicon valley, while ignoring the hard working forgotten men and women, and even decried the measures as the beginning of communist rule, as the government know all the private personal travel and health information of its citizens, even for a benevolent intent, and urged the citizens to protest against the government.

The next week, a local judge issued an injunction that forced the government to close all temporary hospitals on private lands and collect citizen's private information, and also prohibited hospitals to utilize virtual consultation. Local Tea Party members, fired up by the conservative radio host, also protested in front of the city hall in defiance against city's order that restricts mass gatherings. And everything simply goes downhill after this. With the lack of hospital beds that was previously available in temporary hospitals, lack of consultation, inability to gather the health information from citizens, the pandemic infected almost the entire population of this town within weeks, and the fatality rate shot off the roof, with bodies in the streets, and mass graves recently digged to accommodate the sheer scale of deaths caused by this great plague.

INTRODUCTION

In the field of telemedicine, a subsection of healthcare that involves the cooperation between traditional medical services and the fast-involving Internet, China is making rigorous action in both policy implementation and technological development. The Chinese government encourages the development of telemedicine by implementing policies such as encouraging the application of medical big data since 2015 as well as rolling out policies dealing with Artificial Intelligence (AI) development in the healthcare industry (Kong et al., 2019). Such policies have stimulated technological advancements, enabling the telemedicine innovation such as the performance of the world's first remote brain surgery (Frost, 2019), and orthopedic surgeries through 5G wireless technology (Juan, 2019). Increasing public interest in telemedicine also reflected on the vital public-private partnership through which numerous technology startups such as Ping An Doctor are proposing digital medical platforms that integrates AI and healthcare to provide patients with remote clinical visits and easier access to prescription.

China's rigorous efforts in telemedicine can be best manifested in the combat of COVID 19. Alipay Health Code, a QR code to track patient's location and health history during the 2020 COVID-19 pandemic in China, is a co-developed product between Alibaba Group, the giant E-commerce company, China and the municipal government of Hangzhou. In the US, similar programs were just launched by Google and Apple (Google, 2020).

The different innovation pace and societal acceptance between the US and China in terms of the innovation and deployment of telemedicine raise a series of interesting questions: What were the social, political, and cultural conditions that allowed the blooming of telemedicine in China? While building a telemedicine platform relies on a high level of coordination among IT industry, medical service provider, and government, how do Chinese innovators deal with issues on data privacy, sharing, and interoperability? This article attempts to address these research questions, from the perspective of "standards". I will analyze how China mobilizes and creates "standards" —including technical protocols/policy, cultural norms, and regulation--in facilitating the development of telemedicine. In addition, I will illustrate how the implementation of telemedicine is transforming China's existing healthcare infrastructure. Finally, using Health Code and China's response towards the COVID-19 pandemic as a case study, I will discuss the role of "standards" in telemedicine, to shed light on the future innovation of telemedicine in global health.

STS FRAMEWORKS AND RESEARCH METHODS

This research applies two theoretical concepts as the analytical framework to analyze how stakeholders from patients to governments influence the formation of various standards of telemedicine platforms.

First, Social Construction of Technology (SCOT), an approach that uses scientific facts and technological artefacts to understand The Social Construction of Technology (SCOT) approach was first developed by Pinch and Bijker in 1984. Its key idea is that meanings of technological artifacts are shared by social groups. Problems posed by artifacts for certain social groups are responded to by new designs (Pinch, 2009). SCOT emphasizes on Pre-existing social conditions, a decentralized and dynamic network with open boundaries, and enables stakeholder-centered analysis to help understand the impact any technical solution has on the broader society. The SCOT approach may be visualized with diagrams, in which artefacts, relevant stakeholders, problems, and solutions are displayed in a connected network for analysis.

Second, The Value Sensitive Design (VSD) is a theoretically grounded approach to the design of technology that accounts for human values in a principled and comprehensive manner throughout the design process. It employs an integrative and iterative tripartite methodology, consisting of conceptual, empirical, and technical investigations (Friedman, 2008). VSD may be visualized by using a Top-down hierarchy of values, norms, and design requirements, to enable a systematic approach for designers incorporate important ethical values into each detailed design specification, and address potential conflict in values to help the designer make better choices and tradeoffs.

This article seeks the address the research question with the following methods:

1. Document review and analysis to understand actors' perception and practice of telemedicine, including Chinese government's policy towards telemedicine, and examine China's application of telemedicine in response to the COVID-19 pandemic.
2. Case studies would be conducted about Ping An Doctor and Alibaba Group's Alipay Health Code with both SCOT and VSD methods to analyze how values such as accessibility, personal privacy, and public safety set the ethical and technical standards by these two products.

3. Surveys and questionnaires would be sent out to students enrolled in Zhejiang University in mid-March to understand their experience and interactions with Alibaba's Alipay Health Code during the COVID-19 pandemic. The results would serve as the primary evidence and focus on how telemedicine applications during special circumstances may change a broad range of existing standards in an ordinary Chinese citizen's daily life.
4. A brief social media analysis would be provided with public comments collected from weibo, a popular Chinese social media platform. The results would form the secondary evidence and focus on the potential problems and dangers as a result of the formation of new standards by telemedicine applications, and attempt to examine the broad public opinions or efforts to support or resist such standards.

CHINA'S TELEMEDICINE POLICY

Global Race in Telemedicine

According to a World Health Organization's recent report, telemedicine is defined as "The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities" (Ryu, 2012). This long and broad definition suggests that telemedicine, just the technology it relies on, is an open and constantly evolving subject, as new advances in both medical and informational technology open new possibilities to help address new and existing challenges for the health needs of societies and communities. Recent technological breakthroughs in Artificial Intelligence offers both government and private enterprises the opportunity to explore the economic and regulatory frontier of applying the concept of digital health to address existing and future challenges in healthcare (FDA, 2020). The combination of digital technologies and medical service has turned "healthcare" into a battle field for public and private sectors from the global IT, Pharma, and data industries; countries who failed to fully take advantage of this technology would be left years behind and unable to cooperate or compete with other countries in the future.

A Brief History of China's Telemedicine Initiatives

The Chinese government has endorsed the development of telemedicine since the very beginning of China's "Reform and Opening-up" period. The People's Liberation Army (PLA) of China established a telemedicine network in the early 1990s that covers more than 100 bidirectional satellite stations in the army, military hospitals, and some rural army clinics. In 2009, 2,956 teleconsultations were conducted, including 100 emergency and specialty cases. The telemedicine network of PLA serves military personnel free of charge, and serves civilians for a fee (Chen et al., 2013). Recently, following unveiling the "Made in China 2025" plan in 2015 (Kennedy, 2015), China has set the standard of the development of telemedicine as a policy priority, along with a broader push to upgrade China's economy with technology. On October 25, 2016, China formally passed the blueprint of "Healthy China 2030," working towards the national goal of reaching a health standard on par with developed countries by 2030. In this initiative, a shift in concentration from a previous "pursuit of rapid economic growth" towards "coordinated development of health-based economy" was underlined. The advancement of

telemedicine, a subsection of smart health which involves the practice of caring for patients remotely when the provider and patient are not physically present with each other, is therefore at the center of this new Initiative (Tan et al., 2017).

Intersection Between Technology, Policy, and Society

China's rapid growth in telemedicine is also benefited from its rigorous national AI innovation policy. China's State Council in July 2017 published "A Next-Generation Artificial Intelligence Development Plan", aiming to become the world leader in Artificial Intelligence in a domestic industry worth US$150 billion by 2030 (Estevadeordal et al., 2018). With these stated official policies, China may use such national initiative to encourage more students to study technology and medicine, therefore building a high-quality talent pool for domestic companies to develop state-of-the-art healthcare solutions based on telemedicine. In addition, to effectively transform industry's R&D products into public service, Chinese government has been leading and utilizing public-private partnerships (PPP) in China's healthcare sector. A survey of pharmaceutical enterprises in 2009 participating in PPP, including state-owned and privately owned pharmaceutical enterprises suggest that most agreed that such partnerships enhance their cooperation by increasing their control of the relationship through the use of formal and informal contracts (Zhang et al., 2009). To fulfill the policy agenda, China's unique state capitalism model means the Chinese government may engage in more PPPs with companies that specialize in the integration of healthcare and Artificial Intelligence to help these companies address the deficiencies in China's existing healthcare system. However, unlike similar PPP approach in other countries, the Chinese government also wants to enable such companies to better compete domestically and internationally to fulfill the "Made in China 2025" policy agenda.

Figure 1: Made in China 2025 Initiative

Finally, telemedicine has been incorporated into China's poverty alleviation scheme. In rural areas with inferior healthcare infrastructure, local governments have partnered with private or state enterprises to provide telemedicine-enabled hardware to disenfranchised patients to prevent them to fall into poverty due to medical debt and reduce the urban-rural healthcare disparities, and such initiatives have been endorsed by the official press of the central government (Xinhua, 2018).

In all, China's top-down policymaking which utilizes the central government's power to integrate digital and health research and regulation has created a fertile ground for the real-world

implementation of telemedicine. However, although small-scale experiments may have been successful, will the broader public trust these platforms? In a culture that values "interpersonal relationship" (guanxi), can telemedicine be accepted as a reliable tool?

TELEMEDICINE DURING CHINA'S RESPONSE TO THE COVID-19 PANDEMIC

Corporations Taking Social Responsibilities

In December 2019, a SARS-like virus COVID-19 emerged in Wuhan, China. Since its initial outbreak, the virus has infected at least 82,000 people and killed over 3,000 in China, and the Chinese government has imposed strict national lockdown measures in efforts to curb the spread of the virus. During the crisis, various local governments in China has forged PPPs with technology companies and startups to apply telemedicine in order to better respond to this public health emergency. In Beijing, the authorities deployed advanced artificial intelligence-powered temperature screening systems at various subway stations, powered by national AI champions Megvii and Baidu, which are both based in the nation's capital and responded to the call made by the administrator of Beijing's innovation parks. This method replaced the handheld temperature-measuring devices used by staff, which was slow, inefficient, and also put staff at risk of being infected (Feng, 2020). In addition, startup Orion Star has donated robots to multiple government-run hospitals that can help guide preliminary diagnosis and treatment, primary disclosure of medical information, and fixed-point delivery of medical supplies in hospitals. Such robots are designed to collect, store, and transmit data, photos, and videos concerning health barometers, including body temperature measurements, and medical staff can now use robots to communicate and perform routine examinations remotely, saving time and potentially keeping health workers out of harms' way (Nichols, 2020). It's also worth noting that during this crisis, Chinese technology companies have demonstrated remarkable cooperate citizenship, actively developing telemedicine-based products and services to respond to the government's call for help, or even supply the government with necessary equipments with little profit or even at a loss. Such private-public relationships set high ethical standards and stand in stark contrast with other types of healthcare-related PPP projects overseas, where the private companies would almost never respond to government contracts that would not project profits for the company.

Values and Norms underneath Ping An Good Doctor

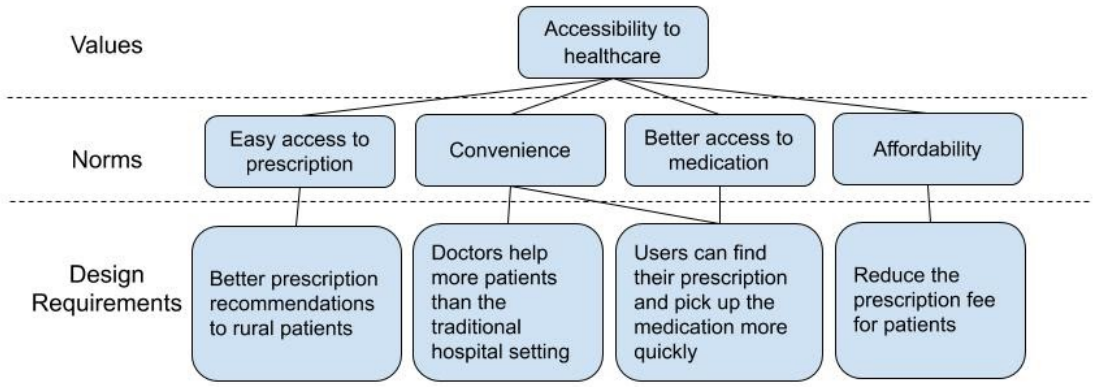
Ping An Doctor is a five-year old Chinese telemedicine startup that is also a subsidiary of Ping An Insurance, a Chinese state-owned enterprise(SOE). With annual fees ranging from $154 to $1127, Ping An Doctor users are entitled to unlimited online consultations, medical appointment services, health checks, discounts on medicines and accompanied hospital visit services for seniors (Ng, 2020). This platform has also developed "One-Minute Clinics", which combines a small waiting room about the size of a phone booth with an interactive AI-based system that solicits patient information, builds a medical history, and then communicates the relevant information to a remote cloud-based physician. The patient would then be able to purchase medicine from the adjoining "Smart Medicine Cabinet" or a nearby pharmacy (Price et al., 2019). During the COVID-19 pandemic, the platform – already China's largest by registered users – recorded an increase of 10 times in the number of new registered users every day on average than before the outbreak began in Wuhan. Its daily online consultations had also grown

nine times on average over the same period. The company also provides daily free online and telephone consultations to people concerned about catching the deadly virus.

In the case of Ping An Good Doctor, applying a value-sensitive design approach, the value is the accessibility to healthcare, the norms are easy access to prescription, patient and physician convenience, access to medication, and affordability, and the design requirements are allowing users to efficiently find their prescription and pick up the medication quickly, enable healthcare professionals to help more patients than the traditional hospital setting, give better prescription recommendations to patients from rural areas than inferior rural hospitals and clinics, and reduce the extra fee incurred for patients during prescription. The first design requirement was satisfied by automating the traditionally time-consuming process of retrieving and analyze relevant patient information to AI to reduces patients' total wait time spent in the clinic, the second design requirement was satisfied by allowing one physician to handle more patients by remote connections to the mini-clinics, which reduce physicians idle time in the traditional hospital setting, the third design requirement was satisfied by help rural patients that may not be able to travel to world-class hospitals in China's major cities to prescribe directly

Figure 2: Ping An Good Doctor's One Minute Clinic

Figure 3: Value-Sensitive Design for Ping An Good Doctor



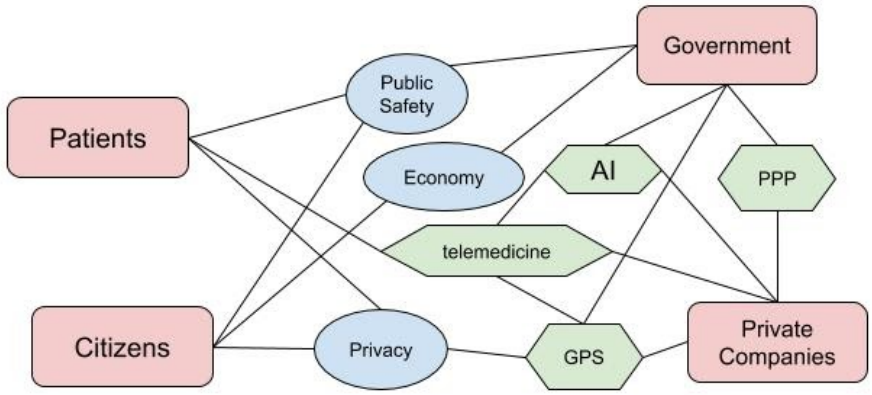
from the physicians in these hospitals online, which would often mean prescriptions that have better understanding of the exact ailment of the patient, and help the patient for a speedier recovery. At last, just like booking taxis with Uber using an app, such mini-clinic may reduce other necessities in a traditional hospital setting for prescription, which would mean cheaper prescriptions for patients (Martinez, 2020). As all the design requirements were satisfied, the values of the design to provide better access to healthcare for patients was achieved. In addition, from this example, it's apparent that the Chinese government's policy has succeeded in encouraging traditional state-owned enterprises to launch telemedicine-focused subsidiaries to adopt the integration of healthcare and Artificial Intelligence, which fulfills the government's healthcare policy agenda. It's also noteworthy, however, that the lack of privacy protection laws in China may also help Chinese medicine startups to achieve world-first innovations. In western democracies, it's very unlikely that the government would permit the use of people's medical records by just a startup company (Kang, 2018). However, it seems the Chinese government places the advancement in technology over an individual's privacy rights, which in this case did contribute to the otherwise unlikely success of this startup.

Social Implications of Alibaba Health Code

In response to the COVID-19 pandemic, China's technology giant Alibaba group partnered with the law enforcement authorities of Hangzhou, where it's headquartered, to create the Alipay Health Code (Xiao, 2020). This application uses big data to draw automated conclusions about whether someone is a contagion risk. After users fill in a form on Alipay with personal details, the software sends the person's location, city name and an identifying code number to a server. With the user's self-reporting of contact with an infected person, visited a virus hot zone or had symptoms in the sign-up form, along with the government data of information about COVID-19 cases and plane, train and bus booking records, the server generates a QR code in one of three colors. A green code enables its holder to move about unrestricted. Someone with a yellow code may be asked to stay home for seven days. Red means a two-week quarantine. More than 50 million people had signed up for health codes in Zhejiang Province, whose capital is Hangzhou. That is almost 90 percent of the province's population. Of these codes, 98.2 percent were green, which means nearly a million people had yellow or red codes. Zhou Jiangyong, Hangzhou's Communist Party secretary, recently called the health code system "an important practice in Hangzhou's digitally empowered city management" and said the city should look to expand the use of such tools (Mozur, 2020).

Figure 4: Alipay Health Code

Figure 5: SCOT Diagram of Alipay Health Code



In the case of the Health Code, applying a SCOT approach, the stakeholders are the patients, the citizens, the government, and the private enterprise. The patients may wish to submit the form with accurate personal information to prohibit themselves from interacting with the broader public to help protect public safety. However, some patients may wish to act irresponsibly and input incorrection information to this form, hoping to retain freedom of movement to protect their personal interests, such as be able to go outside, take public transportation, and retain their job positions if they would have been furloughed by the employees otherwise (Lin, 2020). The citizens would want to submit the form truthfully to retain their freedom of movement, while greatly reduce the danger of interacting with potential COVID-19 patients, who are supposed to be forced to be quarantined at home. The government would like to enable contact tracing with people that have COVID-19 or have interacted with known COVID-19 patients, and track such people's movements and location data in order to

protect the most people in society from any public safety hazard, and enable the workers to return to work such as commute via transportation to protect economical growth and reduce social unrest caused by a potential recession. The private enterprise, Alibaba, would like to use the technology to actively contribute to efforts to reduce the spread of COVID-19. In addition, government mandate to force all citizens to apply for such QR code would potentially boost the user base for their mobile applications, such as Alipay, and engage in PPP with the government would potentially win them more future contracts and reduced regulation from the government, even direct investment in the company, as the government wish to promote such "national championship" technology companies to help them repeat their success overseas, as the broader "Made in China 2025" suggests. The technology artifacts used in the implementation are big data, machine learning, and GPS, as Alibaba's servers are able to use information of existing COVID-19 patients to identify potential new patients or people with contact with existing patients. In addition, the GPS system in citizen's smartphones would report their locations to authorities for improved monitoring of citizens. However, such adaptation of a wide surveillance program technology would potentially infringe current ethical standards. First, senior citizens who are unable to access this technology would be unfairly banned from their normal lives, and people who are mistakenly classified with red or yellow codes would feel unfair and respond negatively to the implementation of this technology. These problems would violate the current norms of respect to the elderly, and the doctrine of innocent until proven guilty. In addition, inappropriate use of users' data, or even data breaches by the government or Alibaba, would seriously jeopardize personal privacy of all citizens. Finally, Alibaba has been criticized in the past by international observers for providing technology to enable the Chinese government to increase control on the society (Chen, 2020). As Alibaba engage in even closer relationship with the government with PPP contracts to collect the most private personal information, the existing standard of the separation between the government and private enterprises would again be questioned, as the company basically functions as an arm of the government during this crisis.

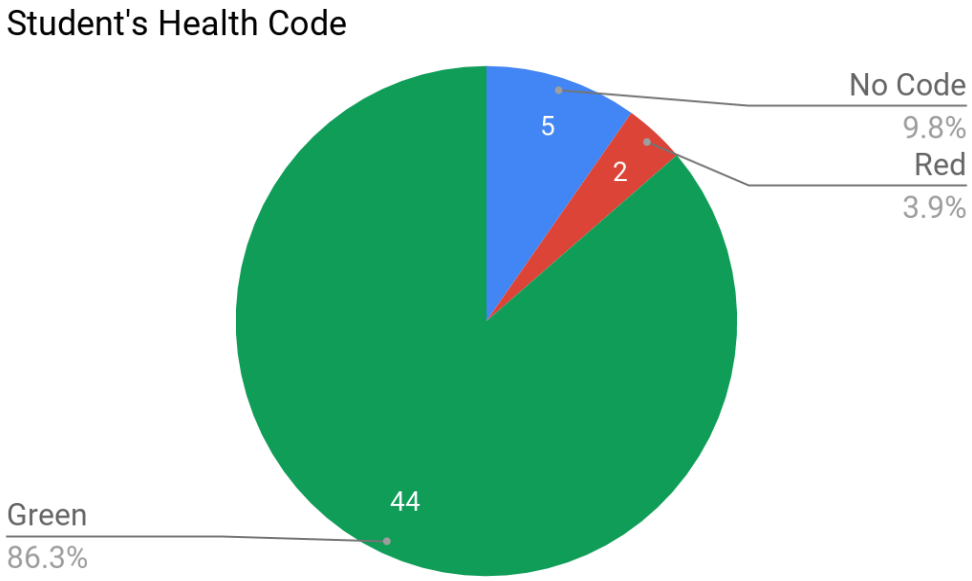
The Public Adopt New Standards

In total, a total of 51 student enrolled in Zhejiang University participated in the survey from March 26th to April 5th. The plurality of the students surveyed came from Zhejiang province, but students from other provinces in China were also present in the sample as well. The intended purpose of this survey was to ask the students about their experience and interactions with Alibaba's Alipay Health Code during the COVID-19 pandemic.

The first question asked the color of each student's Health Code (Figure 6). The intended purpose of this question was to validate the government's claims about the Health Code, as the New York Times reported, which were 90% of the residents have received a Health Code, and 98% of the Health Code assigned were green. Of the students surveyed, the vast majority of the students (86.3%) received a green code. Only 2 students received a red code (3.9%), 5 students have yet to receive a Health Code (9.8%), and no students received a yellow code. At first glance, the survey results appeared to validate the government's claims. However, there were two caveats to this assertion. First, this survey was conducted almost one months after the Times first reported about this new technology. Therefore, it's difficult to assess whether the government's claim was true at that time based on this survey data. In addition, students may experienced changes of color since they first received their Health Code. For example, the color of the Health Code may change from red to green once the 14-day mandatory quarantine period

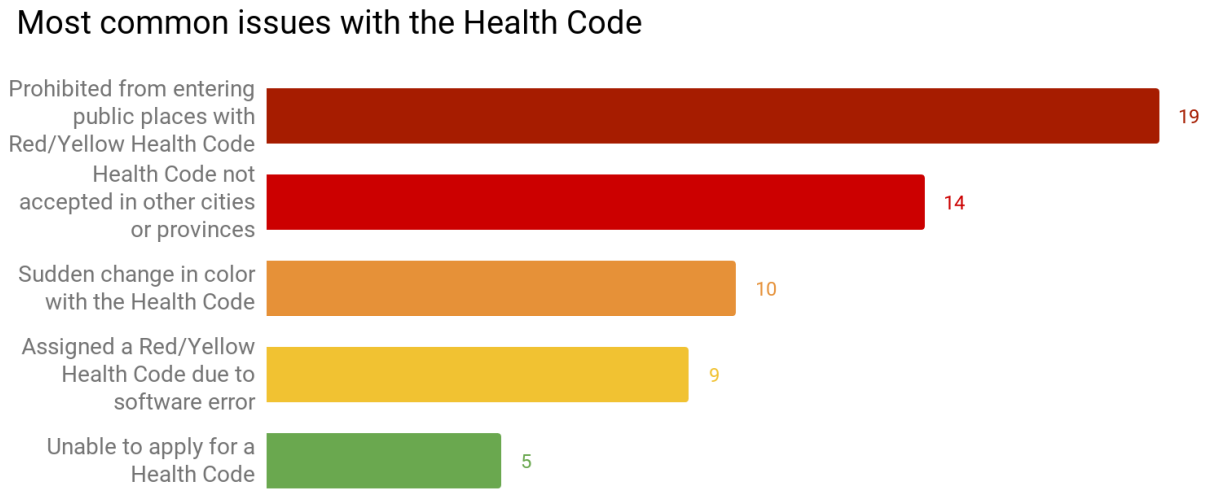
has ended, or the change of software algorithms resulted in change in color. Nevertheless, it was still impressive that vast majority of the students in the sample have applied and received a Health Code, either voluntarily or being forced to do so, and it was mind-blowing to see a technology that was made public only one to two months before established a new standard in the society in such a short period of time.

Figure 6: Color of the Student's Health Code



The second question asked each student about the complaints they have about the Health Code (Figure 7). The intended purpose of this question was to understand the challenges a new telemedicine-based technology may face when it attempted to establish a new standard in a such short period of time. Of these top five complaints, Prohibited from entering public places with Red/Yellow Health Code received the most votes (37.3%). This implied that either the student themselves, or the friends and relatives of the student were not able to commute to their workplaces or access essential government services at one point during the pandemic, due to them having a red/yellow Health Code. This would disproportionately affect the less affluent population in the society, as the norms and usual standards would be greatly disrupted, result in temporary furloughs and unable to get help themselves unless contacted by the government. The next most frequent complaint was Health Code not accepted in other cities or provinces (27.5%). This problem was caused by the lack of coordination between local governments, which failed to set a universal standard and created unnecessary burden for travellers or migrant workers. The last three most common complaints were Sudden change in color with the Health Code (19.6%), Assigned a Red/Yellow Health Code due to software error (17.6%), and Unable to apply for a health code (9.8%). These issues were mainly caused by erroneous software, which again just demonstrated how hard it was to create a telemedicine-based standard in the most populous country on earth in such a short period of time, that even technology giants such as Alibaba were not able to release stable software to help but not hinder people's return to their normal lives.

Figure 7: Top Complaints about the Health Code



The third and the forth question asked each student to rate their experience with the Health Code and their trust towards Alibaba and Alipay's handle of data security (Figure 8, 9). After all the complaints expressed by the students in the previous question, I expected the overall score to be just okay or even poor for these two questions. However, the average rating for the Health Code was astonishingly high at 8.37, with the trust towards data security being only about 0.5 point lower at 7.88. This implied that the new standard was almost universally popular among the surveyed students. Now, it's important to point out that the sampled students are all less than 30 years old, which younger people do accept technology much faster than the elderly, and Alibaba has the some of the best software engineers in the country or around the world, which the students may found it more trustworthy than other companies. Nevertheless, it was undeniable that the new standard has been acclaimed and trusted by much of the Chinese population.

Figure 8: User Rating of the Health Code

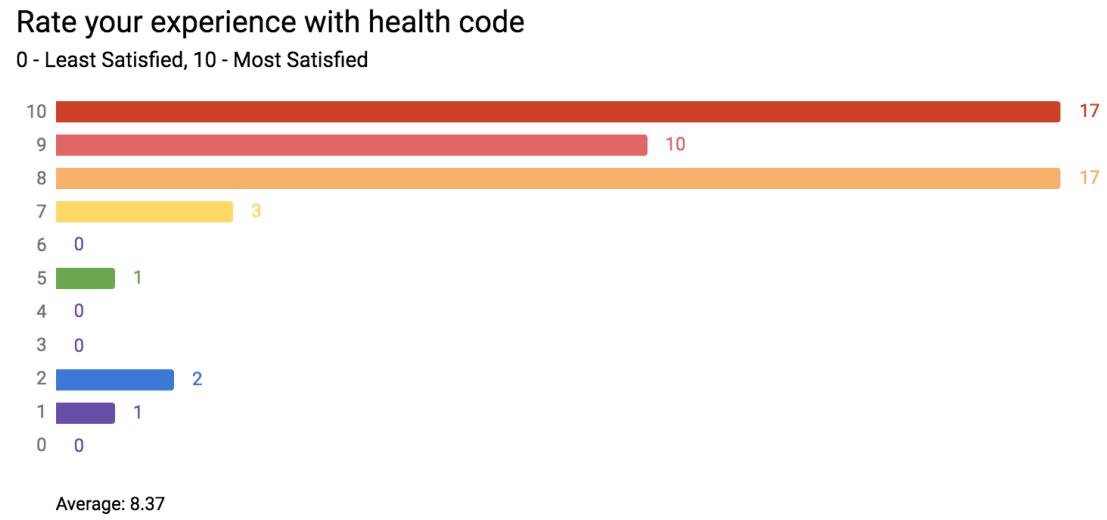
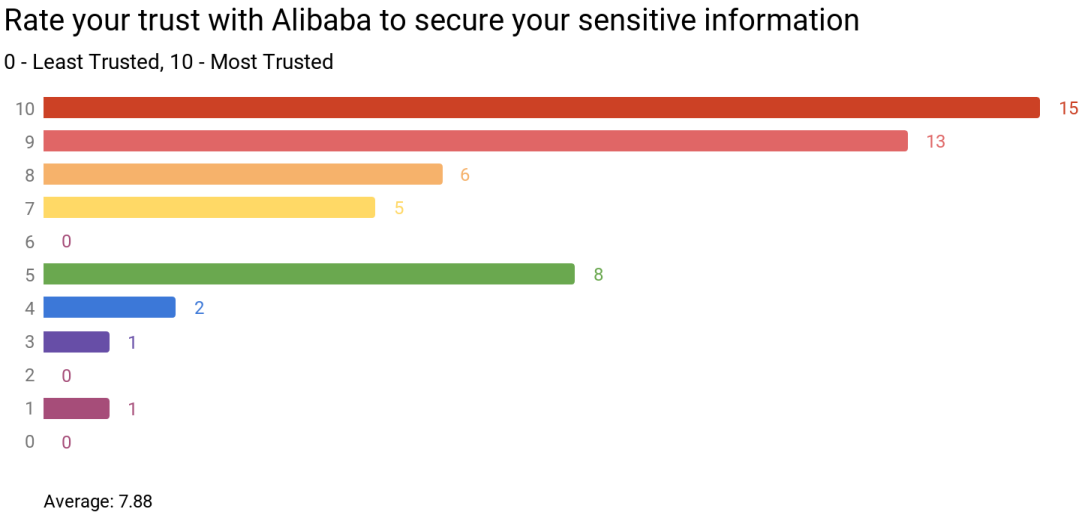


Figure 9: Trust in Data Security



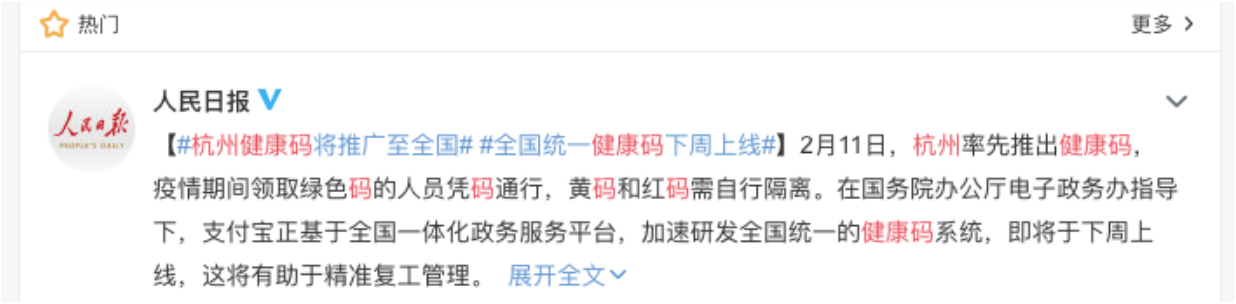
In all, it's apparent that China has successfully established a standard for rapid pandemic response with the Health Code in a very short period. Although the standard had many flaws initially, most people became adapted to the new standard very quickly and overwhelmingly approve the new standards, seemingly with very little concern about issues such as Data Security. However, the students surveyed only represented a tiny sample of the overall Chinese population, and their opinions may be biased due to their social and economic background. How would the general public in China perceive this standard? Besides, what are the consequences when people are slow or unable to adopt this new standard?

New Standards Generate Controversy

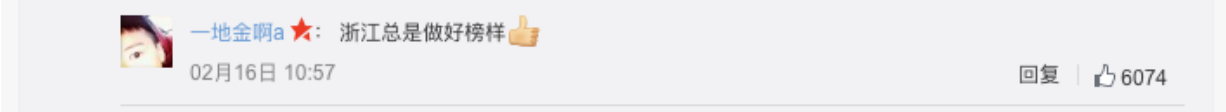
To collect further data about average Chinese people's perception towards the Health Code implemented during the COVID-19 pandemic, a large number of "tweet", "retweet", and "reply" on China's twitter-like platform, weibo, have been collected and translated. Although weibo contents were highly regulated by the government, it still offered limited insights about Chinese people's attitude towards this new standard.

In a tweet (Figure 10) intended to promote the deployment of the Health Code nationwide by People's Daily, a state-run newspaper, the comment section was mostly comprised of weibo users who approved the implementation of Health Code. The most liked comment, who approved the establishment of this new standard and praised the local government of Zhejiang for its cooperation with Alibaba, received 6074 likes. In contrast, the most liked comment about the flaws in this new standard, only received 651 likes. This indicate that the general public in China did mostly support the new standard.

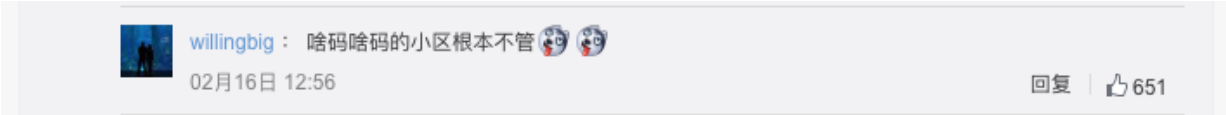
Figure 10: Replies with the Most Likes for "For" and "Against" the Health Code



"The Zhejiang government is always a role model for the rest of the country." 6074 Likes



"Our residential district never checks for our Health Code." 651 Likes



However, many weibo users also expressed their frustration with the implementation of the Health Code. The "tweets" I examined include common issues expressed by the students from the survey, such as code from one region may not be accepted in another region, server crash during the application for the Health Code. However, users also reported issues such as the Health Code not accepted by the local authority at all, suspicion of fraud due to the self-reporting nature of the Health Code, and even mandatory checks of the Health Code causing severe overcrowding in train stations.

Figure 11: "I'm angry, I still can't to apply for Health Code after trying for two to three hours."

Figure 12: "I have a green Health Code, but because I came from Hubei Province (the Epicenter of COVID-19 in China), I was still banned from entering my residential unit."

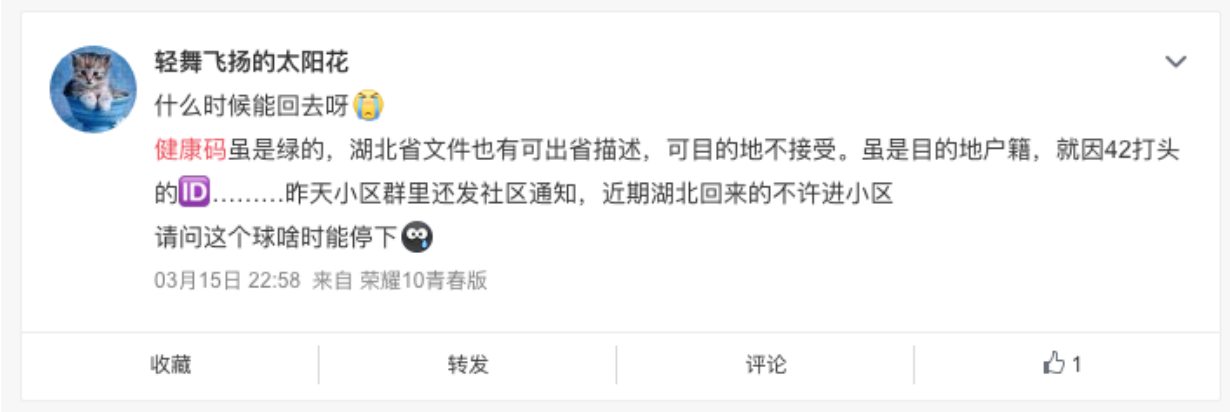
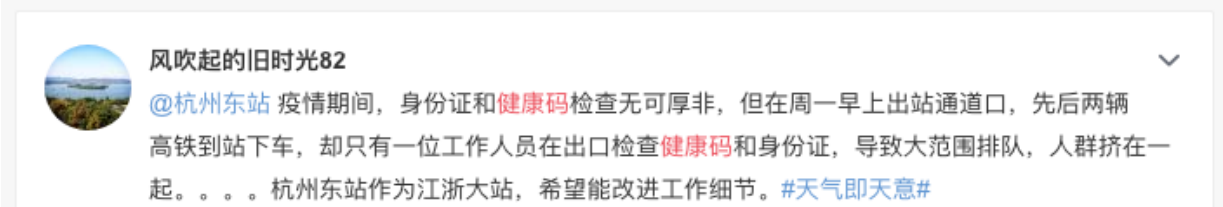


Figure 13: “Health Code is based on self-reported data. What if people are lying? Also, Health Code creates a burden for people without mobile phones. Isn’t using ID card plus temperature check a better method than the Health Code?”

Figure 14: “The county government building requires the Health Code. The server crashed this morning and I still couldn’t enter the building.”

Figure 15: “I understand ID card check and Health Code check during the pandemic. However, only one staff was checking such identification for arrival passengers from two high-speed trains. This caused huge congestion, and I hope the Hangzhou East Railway Station can do better in the future.”



DISCUSSION

When Alibaba announced the concept of Health Code to the world in early February, it was met with skepticism both domestically and internationally. Would the system actually contain this pandemic? Is this just a slippery slope towards increased government surveillance? Instead, after two months living with this newly created telemedicine-based standard, Chinese people are beginning to gradually return to work and travel like ever before. This standard was implemented by the softwares engineers at Alibaba, but its success didn't just originate from Alibaba. It required a local government willing to partner with private companies and trust it with the most sensitive health and location information of its citizens. It required a central government long endorsed the development of Artificial intelligence and telemedicine with sound policy to encourage the spirit of innovations from entrepreneurs. And most important of all, it required a population willing to experiment with new and advanced standards, trusting their governments and technology companies, and tolerate the flaws of the standards initially to exchange for a better future. As different countries around the world began to recover from the pandemic, countries that intended to use technical solutions similar to the Health Code, such as the UK's contact-tracing scheme (Syal, 2020), could benefit greatly from examining China's creation of this new standard, and adapt this standard with local and regional characteristics to protect the health and safety of that country's citizens.

CONCLUSION

In this thesis, I employed document review and analysis to understand Chinese government's policy towards telemedicine, conducted case studies about Ping An Doctor and Alibaba Group's Health Code with both SCOT and VSD methods to analyze how values influenced the creation of ethical and technical standards, conducted surveys from students enrolled in Zhejiang University to gain first-hand experience the Health Code during the COVID-19 pandemic, and conducted brief social media analysis that focus on the potential problems and dangers as a result of the formation of new standards by telemedicine applications. I hope this thesis would help better understand the history of telemedicine development in China, and the background and consequences of the development of telemedicine-based standards during the pandemic.

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