


Governing through big data: An ethnographic exploration of invisible lives in China's digital surveillance of the coronavirus disease 2019 pandemic

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Abstract

Introduction/Background: Since 2020, China has implemented unprecedented digital health surveillance over citizens and residents in response to the coronavirus disease 2019 pandemic. We explore the implementation of Health Code (*jiankang ma*), a contact-tracing and risk assessment app for coronavirus disease 2019, in China. By engaging with the concept of 'ocular ethics', we ask why and how some populations become invisible in China's Health Code surveillance system.

Methods: This study used an ethnographic approach to critically examine the role of digital technology in the coronavirus disease 2019 pandemic governance. Three months of participant observation and 20 interviews were conducted to understand the design of Health Code and the situation of homeless population.

Results: We find that China's digital health surveillance during the coronavirus disease 2019 pandemic has failed to cover the homeless population, who either fail to access Health Code or find ways to avoid its mandatory health surveillance. We further summarize four problems resulting in their exclusion, including the loss of ID cards, access to smartphones and phone numbers, problematic design and elastic surveillance, and the neglect of homeless community's precarious living situation.

Conclusion: Situating our work in the literature on theories of surveillance and anthropology of pandemics, we argue that without recognizing the structural problems embedded in homelessness, a large number of poor and homeless migrants are rendered invisible in this data-driven health surveillance, which further pushes them into social exclusion.

Keywords

China, biosecurity, coronavirus disease 2019 pandemic, digital health, migrants, surveillance

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Introduction

In February 2020, municipal governments across China started to work with teams from two of China's most ubiquitous apps—mobile payment service Alipay and messaging service WeChat—to launch a new digital tool known as Health Code (*jiankang ma*), the first contact-tracing and risk assessment app at the start of the coronavirus disease 2019 (COVID-19) pandemic. Health Code soon covered every province in China to build up a nationwide COVID-19 pandemic monitoring system.^a

Sina News, a local news platform, soon published an article¹ about computer engineers at Alibaba, one of the country's largest technology companies, who stopped

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quarantine at home and risked their lives to design and launch Health Code. Their working environment is outlined as follows in the article:

On February 11, dozens of Alibaba employees entered the office building by passing through layers of ‘checkpoints’: checking working certificates, taking body temperature, disinfecting with alcohol, and wearing facemasks.

This is Alibaba’s temporary war room to fight the pandemic. The administrative staff prepared everything in advance. The corridor was filled with various fruits and snacks. Toothpaste and toothbrushes, shampoo and shower gel, and camp beds for people to rest on were placed in the corner of the room.

This super project, Health Code, involved the lives of millions of people in this public health crisis. However, the ‘war room was not crowded, only dozens of computer programmers (*ma nong*, ‘code farmer’ in English) worked in the empty office building. While having their meals, each person sat separately and kept social distancing.

Everyone was on call 24 h via virtual conferences on their laptops or phone calls. Everyone’s computers and smartphones were kept charged, otherwise they would run out of power at any time.

These engineers have been praised as role models for using big data to tackle the pandemic. Health Code

claims to be able to evaluate public health risk based on self-reported information, including phone number, home address, travel history, and other sources of data from public institutions, such as transportation department, hospital, or public security agency. In general, each resident is assigned a corresponding QR code with colour: Green for free mobility, yellow for a seven-day quarantine, and red for a 14-day quarantine. People need to present or scan their green code to gain access to shopping malls, public transportation, office buildings, and other public venues. In the name of security and protection, showing Health Code has become a normalized practice in China. Living in a risk society faced with the continuous uncertainty of COVID-19, Health Code was designed to be a real-time health monitoring tool based on big data, which also allows pandemic prevention and control to become feasible by assessing the risk and segmenting the population into three colours (Figure 1)^b

According to a report conducted by the China Internet Network Information Centre (CNNIC 2021), Health Code has covered nearly 900 million people and has been used more than 40 billion times, supporting most areas of the country to achieve free mobility and safe access. The report also emphasizes that big data plays a prominent role in the resumption of work and production while maintaining the pandemic under control. However, this simplification of the complex reality has also produced unintended consequences. Despite evidence of the widespread use of Health Code among Chinese citizens, there is a large population in China that lacks access to Health Code, particularly among the elderly, rural migrants, the poor, and the



Figure 1. Shanghai’s health code in September 2020.

homeless. Some people might not be able to use smartphones, have trouble understanding digital technology, or fail to have ID cards to register their Health Code.

In this article, we explore how the homeless population is excluded from China's COVID-19 pandemic digital surveillance. Their precarious living challenges the efficacy of Health Code, which operates based on big data and algorithms to calculate individual risk. Digital technology has become the key element in the wider biosecurity apparatus of China's pandemic control efforts. Most citizens' health status has become more hyper-exposed and visible than ever in the pandemic surveillance, while some bodies are hidden and erased. Those excluded from data-driven health governance are more likely to suffer the worst consequences due to unresolved structural inequalities.

By tracing the process of Health Code's invention and homeless experience during the COVID-19 pandemic, we ask the following questions: How does this digital technology operate among the public during the COVID-19 pandemic? Who becomes neglected in this digital surveillance? What are the causes and consequences of such exclusion for homeless migrants? This study illustrates how this biosecurity technology – built by the government as well as private technology companies in China – has not resulted in effective health surveillance for those homeless bodies in the marginalized underclass. It contributes to the studies of ocular ethics through the ethnographic examination of the improvization and the exclusion of homeless populations in China's digital biosurveillance during the COVID-19 pandemic.

We begin this article by examining the anthropological and sociological literature on surveillance, digital health, and their implications for global health. After presenting research methods, we lay out the background of China's digital health surveillance during the COVID-19 pandemic and problems that emerged from such practices, such as the exclusion of homeless population from digital health surveillance. Next, we describe the precarious living situation of homeless migrants in China and how the pandemic has influenced their daily lives. The third part analyses the four reasons which drive the invisibility of the homeless population, including the loss of identification cards, access to smartphones and phone numbers, problematic design and elastic surveillance, and ignorance of homeless living situation, which further contests Health Code's efficacy in monitoring the health and safety of all. Engineers who were involved in the design of the Health Code prioritized big data to control the pandemic and minimize the risk while neglecting vulnerable populations. Situating our work in the literature on theories of surveillance and anthropology of pandemics, we argue that such simplistic categorization and quantification fail to incorporate homeless bodies in large-scale disease control. Many homeless migrants were excluded from some life-saving opportunities due to their inability to prove their health status via

Health Code, demonstrating that technology can perpetuate or prolong the marginalization of the homeless living in the city.

Biosecurity, health, and exclusion

In the field of global health, previous scholars have asked how biological threats are defined so as to enable possible solutions and mitigate risk in daily life.^{2,3} Therefore, a series of surveillance systems have emerged in the past, from syndromic disease surveillance systems in the United States to detect new diseases,⁴ monitoring influenza among migratory birds in Asia,⁵ using big data to prevent and contain Ebola in Sierra Leone.⁶ COVID-19 pandemic has also given rise to a range of technological innovations. Previous studies of emerging technologies in the pandemic centre on distance learning,⁷ efficacy and accuracy of contact tracing,⁸ COVID-19 risk estimation in education setting,⁹ public perceptions and attitudes towards these digital tools,^{10,11} or the discussion of liberty and autonomy under the expanding digital surveillance.¹²

Emerging technologies – which instruct individual behaviours and protect the population's health during the pandemic – fall into the operations of 'security mechanism',¹³ which allows the disease to circulate by maximizing good circulation and minimizing damage through intermittent interventions. French philosopher Gilles Deleuze¹⁴ argues that humans are no longer subject to enclosed spaces like schools or factories, and that with the advent of computers, technology has allowed for the replacement of old discipline and the implementation of constant and unlimited control over individuals. Deleuze claims that humans are moving from what Michel Foucault described as a society of discipline to a society of control. With the advent of digital technologies, collecting and exchanging personal data has become an inseparable part of pandemic surveillance around the world. It also poses threat on individual autonomy, in emergency situations where privacy is no longer personal and might be disclosed to public health authorities or the public.

Biosecurity measures can make certain bodies visible as well as invisible. In the context of human security threats, the intensifying social control from the state makes bodies more visible than ever, and people also internalize such control as a normalized practice.¹⁵ Previous work in medical anthropology reveals a strong impetus for quantitative metrics and data to make sense of individual behaviours and public health.^{16,18} While some bodies become more visible under increasing health surveillance, others remain invisible.

Making these bodies invisible also suggests that these lives are not worth protecting and saving. Scholars have studied how certain communities and diseases remain invisible and neglected by the state, such as the most vulnerable communities during Brazil's human immunodeficiency

virus (HIV)/acquired immunodeficiency syndrome epidemic¹⁹ or cancer in Africa.²⁰ Monica Casper and Lisa Moore¹⁵ criticize how statistical measures and quantification, though valuable in many instances, hinder the effects of structural inequalities. In essence, those who have been *excluded* from the machinations of the biopolitical state are the ones who have suffered the worst consequences. We employ the concept of ‘ocular ethic’, an approach proposed by Casper and Moore¹⁵ to ‘measure’ the absent subject and ‘operationalise’ invisibility by focusing, magnifying, and visualizing. Ocular ethic asks critically how the vulnerable and marginalized bodies become missing and uses ethnography to reveal and resituate their embodied experiences.¹⁵

By engaging with the ocular ethic, we draw our analytic gaze to the invisible bodies and aim to develop new understandings of bodily erasure emerging from the COVID-19 pandemic. As Casper and Moore emphasize, it is also our ethical responsibility to magnify bodies that are hidden and concealed. We ask questions about the *excluded* in the biopolitical machine: Who is worthy of protection? Whom shall be neglected? This article presents the missing narrative of the homeless community during the pandemic. We are concerned with how the experience of homeless migrants has disappeared from the media coverage and how their existence cannot be captured by the increasing surveillance technologies.

When medical anthropologists study China’s responses to public health crises, they focus on topics like animal-human interactions, bioethics, migration, and social stigma.^{5,21,23} Digital technology has not been the focus of relevant scholarship, while it is becoming one of the most pervasive forms of public health governance in China and globally.^{24,26} By doing ethnography in digital health, we show how emerging technologies from the pandemic might not benefit but harm marginalized communities. In China, the belief in science and technology as a cure-all for the nation’s ills continues to gain prominence in the ideologies of the party-state,^{27,28} similarly under the impact of the COVID-19 pandemic. China is one of the most active countries in utilizing digital technology to control the pandemic. In this article, we offer new understandings of China’s response to the pandemic and issues of exclusion that emerged from such intensive health surveillance.

Methods

Our analysis is based on three months of multi-sited ethnographic research conducted by the first author in Shanghai between October 2020 and January 2021. Our primary fieldwork site is Revival Station, an organization that provides services for the homeless population in Shanghai while going through the official registration process to become an NGO. Revival Station aims to help displaced

migrant workers gain employment, stability, and permanent homes. Its basic services include a good meal, a hot shower, a change of clothes, and the use of free laundry facilities. The first author conducted weekly participant-observation during service hours and their fundraising events, for a total of 40 h. Apart from the observations, the first author conducted informal and semi-structured interviews with fifteen homeless migrants, from about 25–72 years of age, and three social workers at Revival Station. All participants provided verbal consent for participation in the study, and NYU Shanghai Institutional Review Board (IRB) approved the verbal consent. All participants’ names were anonymized. Because the first author’s voluntary work put her in frequent contact with the homeless and social workers, she was able to build rapport to discuss a sensitive topic regarding the life of being homeless in Shanghai. In addition to observing and interviewing homeless migrants, questions surrounding the design side of Health Code became more pressing as our research progressed.

We conducted formal interviews with two computer engineers to supplement our research regarding the role of digital technology in pandemic control. One was employed by the government, the other by Alibaba. They both took part in the Health Code project. Due to the sensitive nature of our research and time limit, our research in this part met several obstacles, including the failure to conduct extensive field observation and interviews in the relevant tech companies and government. We also conducted additional desk research on relevant reports, media articles, and policy documents to fill this gap. In the following section, we discuss the background of China’s digital response to the pandemic and the development and implementation of the Health Code.

The logic behind health code

The birth of Health Code is strongly tied to the reopening of cities after lockdown. Since economic recovery is contingent on lifted restrictions and population movement, in early February 2020 government officials began to plan how the population should be governed after lockdown. A double degree holder in computer science and communications, Qinyu Zhou led one of the earliest teams to produce the crude prototype of Health Code.^c By then, he was Section Chief of Communication at one of the district governments in eastern China, ‘We were thinking: what would happen after the lockdown? Which method should be adapted to allow one’s mobility? The solution should not be to control everyone forever’. Qinyu said they needed a more effective approach to improving their defence capabilities, ‘Well, Health Code has offered great help in this area’.

The implementation of Health Code cannot be separated from the state’s support for information technology to fight against the pandemic. Since January 2020, the National Health Commission (NHC) issued a series of protocols

and laid the foundation for promoting the in-depth application of digital technology in pandemic prevention and control. It also transformed the old forms of contact tracing and screening by manual labour through ‘door-knocking’ and telephone calls since the outbreak in Wuhan. A comprehensive survey conducted by Shuja et al.²⁹ shows that many COVID-19 digital technologies are data-driven, and data sets have been extensively used for a variety of purposes, including diagnosis, transmission estimation, emotional and sentiment analysis.

Although contact tracing and screening for infection have been intensive since the COVID-19 outbreak in China, data collections were highly decentralized and problematic. Municipal governments actively required citizens to submit their health information and travel history, either through paper-based registrations or electronic forms on their smartphones. However, there was no universal way to aggregate those large amounts of information collected from multiple sources. Different places collected data but seldom shared it, which created numerous ‘Isolated Data Islands’ where quality data was stored in a place without external connectivity to other databases. Such a large-scale project ought to be supported by a wide scale of data to make health evaluations. As Qinyu emphasized, ‘the goal is to set up, share, and use the database together. Use big data to solve problems’. What Qinyu’s team proposed was to aggregate these data

islands and evaluate them to calculate one’s health status (Figure 2).

According to *People’s Daily Online*, Health Code system generates authoritative and reliable results based on checking and matching with various national databases, such as the database of close contacts, confirmed and suspected cases, and data from different government agencies from public health, public security, transportation, and other departments.³⁰ A person also needs to report information to the Health Code system, including phone number, ID card number, address, and other epidemiological survey information.

To identify and track suspected cases and high-risk people during the pandemic, tech developers and government officials have taken a keen interest in smartphones. Mobile phone triangulation can precisely pinpoint a person’s location and tracking phone signals entails following that person. The person’s identity information can be captured through ID card number. Living outside of health monitoring seems to be impossible, and three-colour categorization is further developed to govern the population.

Each citizen is assigned a coloured QR code, showing one’s health status based on an algorithmic evaluation of various data sources. A person without any abnormalities is marked as low risk and is given a green code. The green code on their smartphones works like a digital passport, allowing a person to access different spaces and services freely. A person is considered high risk if the

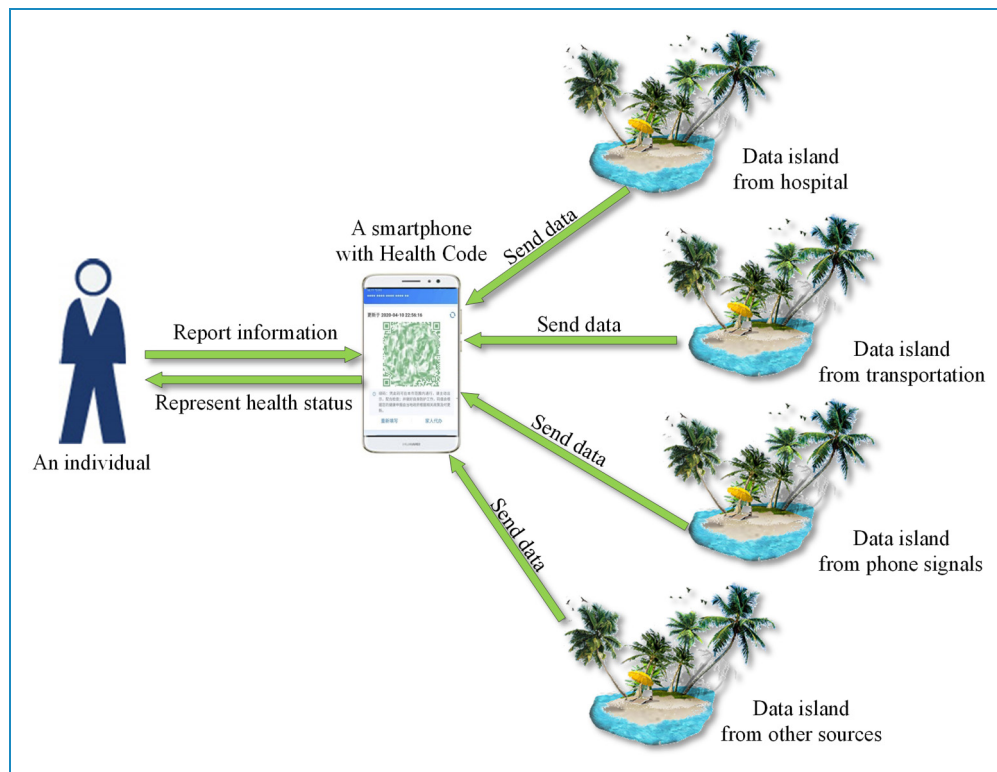


Figure 2. The concept of data island in Health Code.

person has tested positive, is a suspected case or close contact of an infected person, or has visited a location where there has been a recent outbreak.

Although many people in China seem to be free simply by holding the green code, they still live under the constant control and surveillance of state and non-state institutions, from government departments to private tech companies with access to public information. It resonates with Haggerty and Ericson's³¹ concept of 'surveillant assemblage', operating based on a few discrete technologies or social practices to form a larger whole and monitor different populations. Each human body is abstracted from territorial settings and reassembled into a series of discrete flows as "data double" of pure virtuality'.³¹ Thus, individuals can be divided into 'dividuals' – endlessly subdividable collections of data points from various facets of their lives.¹⁴

Health Code allows a person to be broken down into different components for observation and intervention in case of potential outbreaks. The colour of Health is determined by various databases covering people's health and geographical locations, in addition to more intrusive information about their private lives, such as the purpose of travel, occupation, residential address, etc. If one component is identified as a high risk for COVID-19, the colour of Health Code can be turned to yellow or red, thus controlling the spread of the virus as soon as possible. Citizens in China have heavily relied on Health Code for social life to access residential communities, office buildings, buses, and supermarkets. A subsequent result of increasing surveillance is that human bodies have become more visible than ever, even for some hidden ones. A man who absconded from murder for 24 years chose to turn himself in Hangzhou; without Health Code and smartphones, he found himself unable to hide his personal information and make a living after the pandemic.³²

The Chinese public has embraced Health Code, and public health surveillance techniques have received relatively little resistance there, notwithstanding some debates concerning digital health surveillance. The public was generally supportive of the application of the Health Code and highly acknowledged its contribution to pandemic prevention and control.³⁰ Previous research demonstrate that some Chinese citizens even considered the Health Code should be applied more aggressively.³³ In the meantime, other technologies have been deployed at the same time to monitor the public. For instance, drones were sent to warn people who broke the self-isolation rules to keep social distancing, stay at home, and wear facemasks; facial recognition technology and infrared cameras were adapted to detect people with high temperatures and suspected cases.³⁴ Compared with Western countries' poor early response to the pandemic, the Chinese public considered that 'surveillance in China became evidence of a caring government that respects science'.³³

Jie Song works at Alibaba as a computer engineer and participated in the Health Code project before. He

considered the creation of Health Code a good matter: 'For the first time, people across social classes can clearly know what the government or we [technical experts] have decided and what the impact is'. According to Jie, Health Code helps the citizens understand pandemic-related policies and regulations decided from the top. Citizens become aware of their health status, and their mobility is also controlled in a way to protect themselves and others. Health Code's colour informs and directs everyone's life in the pandemic, either moving freely, self-monitoring, or quarantine. Jie views that everyone within the Health Code system is the same without differences in status, and technology is a tool to lessen social disparities.

Apart from the benefits, previous study reveals that citizens are often exposed to all kinds of errors, breakdowns, and exclusions created by Health Code.³³ The normalcy of Health Code's implementation continues to be challenged by multiple incidents on the ground. In December 2020, Health Code in Chengdu experienced 'network error' due to a sudden increasing number of visitors, who were concerned about the local outbreak and their status in Health Code. Similar situations also happened in other provinces, and this kind of breakdown usually can be solved quickly by computer engineers.³³ There is also a lack of concern for migrants, the elderly, and people with lower education and socioeconomic status, which results in a negative impact on their mobility and access to public spaces and services.

Citizens have reported the issue of regional prejudice: it is harder for people to apply for a green code if they come from a high-risk area for COVID-19. In the outbreak from northeastern China, Heilongjiang Province turned the Health Code of *hukou* holders from Heihe City yellow, even those who were living or working elsewhere.³⁵ Although many old people in China own smartphones, they have trouble navigating the digital interface and are excluded from using Health Code. In June 2020, a middle-aged rural migrant travelled from Anhui Province to Zhejiang Province without a smartphone and green code, and later encountered several obstacles in public transportation and got lost on his way.³⁶ The homeless community faces similar exclusion as the cases mentioned above. Their exclusion reveals that not all bodies are equally visible to the data-driven health surveillance, or control is not a sign for everyone during the pandemic. The following section elaborates on the homeless population's precarious lived experience during the pandemic and sets the context for their invisibility in health surveillance.

Precarity as a way of living

Rising inequality in China after economic reforms

The economic downturn, job insecurity, loss of housing, and similar cascading events following the pandemic make people rethink what stability means while facing an

uncertain future. Or does precarity denote a normative form of living in this increasingly indeterminable world? How should humans cope with precarity? Nearly all lives at the Revival Station are precarious. Yifan, a young homeless migrant, emphasized how precarity meant in his life: 'Life outside, you know, is just precarious. When you have work to do, you work. When you don't work, you do nothing. My earnings have never been secured. My place to sleep is always precarious'. Many homeless visitors came by and left the Revival Station week by week in endless circulation. Although the director Boxin has run this organization for ten years, he could only help a small portion of the visitors to stop being vagrants on the streets.

Given the poor economy due to the pandemic, the rising number of unemployed homeless people was visible at the Revival Station. One social worker added, 'People are coming back again. Many were fired because of the pandemic; many cannot find a job in the current situation. I haven't seen some of them for a long time, now they return and ask for help again'. Amid the pandemic, Revival Station received more unemployed workers, but their old-time visitors – the homeless, the mentally ill, the aged, and the abandoned ones by their families – remained coming. Most arrived in Shanghai as rural migrant workers and became homeless, only a small portion of the visitors were Shanghai locals, who were typically old, impoverished, and had no family members to rely upon. Like *Vita* in anthropologist João Biehl's³⁷ arresting ethnography, this place was filled with unproductive bodies, with no one accountable for their condition. 'Better off' for the homeless means that one can rent beds in tenement housing during the winter months; but in the summer, they still choose to sleep on the streets to save money. The conditions of precarity and insecurity seem inseparable from their everyday lives. Life remains static without any progress and improvement.

The loss of security has been accompanied by the rise of China since the introduction of 'reform and opening-up' policy in 1978. The disciplinary regulations to manage employment and control rural-urban migration produced in the Mao era fell apart. Society began to operate through market dynamics, and the logic of the market belittles human lives who are no longer useful and productive. The reforms of state-owned enterprises forced millions of workers to leave their lifelong occupation, also called the 'iron rice bowl'. With the economic reforms, rural-urban migration became possible after decades of mobility restriction. Peasants began to work in the cities as the cheapest labour, mostly in informal employment. As geographer Kam Wing Chan³⁸ sharply points out the indication of such change, 'By moving the disfranchised and unprivileged underclass of peasants to the cities and export processing zones, China guaranteed an almost infinite supply of manual labour at extremely low wages for domestic (including the state) and global industrialists for many years'.

The dramatic social changes that China has gone through since the 1980s also give rise to social inequalities, and the increasing number of homeless people in urban areas has only appeared in recent decades. The loss of belonging and security in a metropolitan city is common for migrants who are cast as 'outsiders'. Social workers at Revival Station told us that migrants were easy to get tricked, lose things, and pick up bad habits. Gui, who came from the countryside like other homeless visitors, said that 'today Chinese have to be self-dependent' and they had no one to rely on except themselves.

Homelessness amid COVID-19

Undoubtedly, the pandemic has accelerated the unstable living conditions of the homeless. Having no place to live, the homeless were left on the streets without being protected. When almost all the public facilities were shut down during the lockdown, the homeless population in Shanghai experienced hardship surviving without income, masks, and food. 'The biggest trouble was access to masks. We didn't have masks at that time, so you could not protect yourself ... You could request masks from the neighbourhood, but you had to have a room number and address to register. I don't even have a place to stay', Jun muttered while staring at his smartphone. Jun was a silent person and seldom expressed his opinions. While on this matter, he suddenly outspoke his difficulty. Although the lockdown suspended population flow and production, basic services within the neighbourhoods were mostly well-organized with the help of community grid staff and volunteers, who supported residents to obtain necessities during the lockdown, including the facemasks. It is necessary to acknowledge how grid governance – a community management programme – became instrumental in China's lockdown effort, but those who lived on the streets and fell out of the grid governance were excluded from such services. According to the visitors at the Revival Station, a small portion of homeless people stayed at the shelters and hotels in Shanghai to stay safe. Overall, the health surveillance of the homeless population was limited and passive.

Although no large outbreak in China has been reported to be caused by the homeless population, their risk of contracting the virus and infecting others has been commonly considered high. The governments announced several actions to promote the living conditions of homeless population during the pandemic, including allowing them to live in temporary shelters and hotels and offering support services. However, most did not receive social assistance, and the services were limited and sometimes inhumane.

Zhenhua told us that he was put into quarantine in March 2020. 'I was near People's Square and slept there at night. The police found me, and I was quarantined for 14 days. Nothing bad happened eventually, it turned out to be

okay', Zhenhua spoke with a sigh of relief as if initially he had imagined something bad would happen, as if he was put into prison by the police. Despite the free services, Zhenhua and others felt being treated like criminals during quarantine, some were rather more willing to be on the streets. Zhenhua's quarantine was not a planned government action. Sleeping outside a neighbourhood, Zhenhua was reported by a nearby resident as being too dirty and dangerous to spread the virus. Zhenhua's quarantine was for the containment of the epidemiological risk vectors rather than the protection of the vulnerable ones. In response to a citizen's request, it is necessary to isolate Zhenhua; otherwise, no life-saving interventions are made for the homeless population when the complaints from citizens remain absent. A recent study conducted in Guangzhou finds that humanitarian aid provided by the government towards the homeless population even decreased during the pandemic, and the majority were unwilling to seek support from the government.³⁹ Haihe, a homeless migrant in his 40s commented on the government actions during the pandemic: 'I can see the government did a great job in controlling the virus, but what about our difficulty?'

This practice thus fosters two constructions of life: Life that is worth saving and life that is worth abandoning. The divergence between citizens and noncitizens echoed anthropologist Katherine Mason's²² concept of 'biological noncitizenship'—the migrant population in southern China became biological threats due to their poor hygiene and disease, and they were unfit for inclusion into the civilised common and denied citizenship claims. Similar discourse like 'this service is provided for residents or citizens' was frequently mentioned by them. When we asked about the use of Health Code in their daily life, one of the homeless migrants started to get bored and answered: 'That is designed for citizens, not for us'. The use of big data to manage the population's health shapes the life of the majority in China, but it excludes the homeless bodies and marks them as absent in the digital system.

Technologies of invisibility

Neglecting structural issues rooted in homelessness makes it challenging to implement the Health Code. Living on the streets is accompanied by high mobility and insecurity. There are four problems that are found to explain why the homeless community becomes invisible in digital health surveillance: Loss of ID cards, access to smartphones and phone numbers, problematic design and elastic surveillance, and neglect of the homeless. The first two issues are associated with homeless community's precarious living situation. The frequent experience of being stolen and losing belongings makes it difficult for them to maintain a stable association with ID cards and smartphones. The third explanation highlights serious flaws in Health Code's design because it permits homeless people to

constantly avoid using it or provide false information to its surveillance system. The last problem arises from the design side, where computer engineers ignore homeless living situation in creating and implementing the function of Health Code.

The loss of ID cards

Losing ID cards is common for the homeless. In a few rare cases, people never had an ID card or *hukou* registration since they were orphaned or abandoned at a young age, while most dropped their ID cards while being homeless, or their ID cards were stolen by others and sold for money. For rural migrants working in the city, an ID card is the most essential document that allows and legitimizes their employment in the urban area while holding rural *hukou*. The loss of ID cards could put restrictions on all sorts of social activities, including transportation, formal employment, and access to Health Code. The absence of ID cards is a loss of citizenship evidence, and the failure to register Health Code also makes it hard to prove their health status.

Besides, a new ID card requires a series of bureaucratic procedures. In 2013, the Chinese government issued a mandatory switch to second-generation ID cards; therefore, all first-generation ID cards became invalid. The switch from the first-generation ID cards to second-generation ones requires people to return to their place of birth (*hukou suo-zaidi*) to renew their ID cards. Several long-time visitors at the Revival Station still held first-generation ID cards, and they never returned home for decades. Changyu, a weekly visitor at Revival Station, has lived in Xuhui Park for more than twenty years; his family erased him from their *hukou* registration long time ago. For second-generation ID cards, citizens are allowed to apply in any province, but it also adds additional requirements for the migrants, such as providing residential evidence issued by the neighbourhood. Yifan once complained to me: 'I needed to apply for another ID card, but I didn't have a place to stay. I have to follow their requirements, right? There was no proof that I lived in this city'. Since most homeless migrants live on the streets, they never belong to any neighbourhood. It becomes impossible for them to submit residential evidence and request another ID card.

Many migrants ended up like Yifan returning to their rural hometowns to obtain a new ID card, but many chose not to return. It is not only the lengthy application process and high application fees that are problematic; more importantly, necessary familial links at their rural origin are also required for assisting ID card applications. Homecoming has never been easy for the homeless community: some have complex relationships with their family members; others might feel homecoming shameful without making a fortune while losing everything they had when they arrived in Shanghai. The fear of losing

their ‘face’ (*mianzi*) without becoming successful in the city further pushes them away from home and makes them reluctant to acquire another ID card. A social worker added, ‘No matter whether the ID card is stolen by others or lost by himself, he has no ID card and no money. It is just too embarrassing to go home’. Living without ID cards reveals the homeless population’s disconnections from their families. ID card loss is a result of their precarious life in the city, and it also exacerbates their vulnerable living conditions in a vicious circle. The absence of an ID card deprives one’s citizenship, reinforcing their marginalization and disconnection from society. Many homeless migrants in Shanghai continue to live without ID cards, making it impossible for them to use Health Code.^c

Access to smartphones and phone numbers

Furthermore, the uncertain relations between homeless people and their smartphones also make the dynamics of contact tracing more complicated. Take Weiguo as an example. His smartphone was stolen before the COVID-19 lockdown began. Although purchasing another smartphone did not need to go through complex procedures compared with ID card acquisitions, this process was associated with financial constraints. Weiguo was only able to purchase another smartphone with a new phone number in April. At that time, the real-time monitoring from Health Code had already been implemented for more than a month. Weiguo’s loss of the smartphone made him an absent person in Health Code’s database. The frequent switch of smartphones and phone numbers made the system unable to trace a person continuously in real-time. The social life of smartphones is more complicated than what the technical experts imagined. A homeless person can have multiple access to smartphones and phone numbers; in the meantime, their stolen phones might be used by others. In the case of the homeless, smartphones fail to represent individual identities.

Problematic design and elastic surveillance

Homeless migrants can navigate their lives to avoid the mandatory Health Code checks. In fact, surveillance is rather ‘elastic’ in informal spaces, but people still need to show their green Health Code to enter well-bounded locations, such as supermarkets, hospitals, office buildings, etc.³³ Although the exact rules might vary from place to place, homeless migrants seldom associate their everyday life with these places. The systematic exclusion of rural migrants in urban areas has long existed in China since the introduction of *hukou* system.⁴⁰ Migrants’ medical expenses at urban hospitals are typically not covered by health insurance due to their rural *hukou*. Unless medical emergencies arise, they never visit hospitals. Occasionally, the way migrants dress is unfit for them to enter

Shanghai’s glitzy shopping malls. The restricted amount of money they can spend is another concern. Since they left no traces on the public services, there was little doubt that extracting and accessing their data presented difficulties for engineers.

Beyond the absence of data, Health Code might also collect random and inaccurate data from the homeless population. Yifan returned to Shanghai in June after staying in his hometown for almost half a year. He was afraid of being put into quarantine like Zhenhua if he returned to Shanghai early and continued sleeping on the streets, and job opportunities were limited when the city just reopened. Without any earnings for almost half a year, he arrived in Shanghai and applied for Health Code, but found it impossible to fill in the self-report form without making up a lie. Although Health Code reassembles data from other institutions, everyone still needs to report personal information within the system when applying for Health Code. ‘You have to fill in a lot of information. One is the destination you arrive at, and the other is your residence address. Just like when I first came to Shanghai, there was no fixed place to live. I just filled in randomly. I said I lived in Xuhui, but I slept on a different street almost every day’, Yifan pointed out the flaw in the design, showing how such surveillance cannot account for every aspect of a homeless person’s life and might not produce useful public health measures.

Neglect of the homeless

Without recognizing the structural problems embedded in homelessness, the health surveillance system failed to cover the entire population as it wished. The existence of homeless population was devalued and invisible, while they were exposed to a higher risk of infection. The problem of exposed bodies that become hidden in plain sight also exists in other contexts of biological catastrophes. The seemingly universalised access to life-saving HIV therapies in Brazil was not available to the most improvised and vulnerable people living with HIV, who was made absent in the epidemiological surveillance and erased from the official statistics.¹⁹ We also questioned our informants in terms of those who were excluded from using Health Code. Jie used ‘friendly fire (*wushang*)’ to explain ‘when you design a system according to the COVID-19 policies, I cannot take care of everyone. It does not mean that I don’t have a solution. But in the initial consideration, the system was unable to cover every detail, and some people just didn’t exist in our data sets’. As anthropologist James Scott argues, the production of statistical knowledge about the population is also a process of simplification, and the lack of context and particularity almost become inevitable in large-scale planning exercise.⁴¹

A continuous process of corrections, as Jie emphasized, is necessary to fix all the loopholes and include more people. ‘You may never know exactly what is happening

today and how many people there are, but you can become more and more accurate. This is the logic of big data: you keep revising, improve your method, and set up the adjustment of the overall structure'. Health Code needs a process of fixing the loopholes like the software, which needs engineers' constant maintenance to fix the bugs and publish new updated versions. Considering the COVID-19 pandemic was rapidly changing, it required rapid response to develop Health Code. Jie kept faith that problems ought to be fixed in the end. However, clarification from Jie to discharge them from all the loopholes in Health Code does not apply to the homeless population. In fact, when the prototype was first tested in two neighbourhoods by Qinyu's team, the homeless who were hopelessly wandering on the streets were already excluded from their testing population. In the very beginning, the homeless bodies were missing in the digital surveillance.

This mandatory policy to check one's health status excludes homeless migrants from public services, and more importantly, constrains their opportunities to earn money for survival. Many visitors told us that even some loosely regulated temporary jobs in the past now required workers to provide Health Code. To maintain a minimum source of income, they needed to enter spaces such as office buildings and hotels to carry out physical labour. The failure to have green code limited their access to these places, and they were easily recognized as virus carriers without the necessary health evidence. They were forced to find opportunities in small-sized private companies that might recruit them without requirements to check Health Code.

Discussion

Making people invisible has become an indispensable tool of containment within infectious disease governance. Anthropological studies of infectious diseases have shown the development of modern technologies in pandemic preparedness and control.^{4,5,42} Numerous technologies have been deployed to detect, monitor, and simulate future disease outbreaks. Instead of impeding an unforeseen health crisis, this study offers unique perspectives on the use of digital technology to prepare and control the unfinished COVID-19 pandemic.

Haggerty and Ericson³¹ take exception to George Orwell's prediction in *1984* that the 'proles' would largely be exempt from surveillance, and our research shows that people from the lower rank can be 'exempt' from health surveillance and become almost erased from the state's control. We use the concept of 'ocular ethic' to rethink how bodies are made visible or invisible through novel technologies.¹⁵ While most citizens in China are under Health Code's daily monitoring, the homeless migrants become invisible to the health surveillance. Although they appear to have regular contact with the police or social assistance programmes, however, none of

these institutions produces detailed data about the homeless migrants or links them directly to the Health Code or other forms of digital health surveillance. Rather, as normal citizens, the numerous institutions they are in contact with, produce an abundance of data for analysing their risk and health status in the Health Code system.

In contrast to what Jie said, people were not equal in the system of Health Code. Although Jie believes that Health Code allows citizens to become clearer about their health status and the impact of COVID-19, such benefits are not universal. The failure to incorporate homeless bodies manifests how technical experts mistakenly conceive the public to be homogenous and passive. Engineers were assigned an authoritative position to design the digital tool according to their perceived public interests and needs. The role that the technical experts took on behalf of the public resulted in the inclusion or exclusion of different groups, and they failed to acknowledge the real situations on the ground.

Compared with other countries, socialist countries' responses to COVID-19 vary country by country. Similar to China, Vietnam has deployed a wide range of digital health applications from surveillance, risk communication, diagnosis, to treatment of COVID-19; but these practices were also constrained by insufficient digital health developments in Vietnam.⁴³ In other Asian countries, both Singapore and South Korea adapted aggressive digital contact tracing and managed to successfully contain the spread.²⁶ It demonstrates the commonality for capable countries to introduce some digital health programmes, but none of them have implemented such widespread, long-term, and mandatory digital surveillance as China has in response to COVID-19. Health Code may have been effective to a certain extent, but it also exacerbates the inequalities caused by digital divide and makes the excluded vulnerable. Homeless migrants without valid Health Code have been seen as risk subjects. Such practice magnifies the stigma and prejudices against migrants as virus carriers in Chinese culture. This points out that underlying structural inequalities matter when designing solutions because if not factored in the interventions, biosecurity technologies could produce fear, exclusion, and vulnerability.

Although this study contributes to the area of digital technology during the COVID-19 pandemic using ethnographic methods, it suffers from limitations such as a small sample size and short time duration. We were unable to conduct in-depth research on the design side due to the sensitive nature of this study. Despite the limitations, this article uncovers the life of the homeless under pandemic surveillance and calls for actions to address inequality resulting from digital technology.

Conclusion

This article explores how the homeless population becomes invisible in China's COVID-19 pandemic digital

surveillance. To make these claims, we draw upon our research on the lived experiences of homeless community in Shanghai to elucidate their exclusion from COVID-19 surveillance technologies like Health Code. While the state promotes digital technology as an effective tool for pandemic control and engineers create the corresponding surveillance technologies like Health Code, they fail to take the homeless into consideration. The precarious realities of homeless life challenge the efficacy of Health Code. We argue that biosecurity technologies not only render the homeless community excluded from health surveillance but also compound their precarious lives. Health Code can inadvertently set up barriers for the homeless and shrink their avenues for life and work.

In this vein, this study sheds light on who are left behind in digital health and how socio-economic status contributes to the rising inequality for rural-to-urban homeless migrants. It makes a contribution to a body of science and technology scholarship that examines the way in which biotechnological solutions while claiming to include diverse populations in its governmental embrace, not only serves to extend state power but augments existing inequality along the fault lines of class, residency, and demographic status.

This article also serves as a timely reflection on the rapid innovations that have supported countries in dealing with a fast-evolving pandemic. In an age of heightened digital technology, the balance between care and surveillance during the COVID-19 pandemic is also deeply cultural and political. This ethnography reveals a lack of clear regulations and policies regarding the digital technologies rapidly produced during the COVID-19 pandemic. Social science researchers should develop comprehensive research projects to understand the homeless population in urban China and propose policy suggestions to improve their living conditions during the pandemic and generally. Future research should address whether and how similar problems during pandemics may be arising in other local places around the world.

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Notes

- It is worth noting that the versions of Health Code (*jiankang ma*) differ in cities and provinces. The name of Health Code also changes based on the local culture or region name.
- Due to concern over privacy, images of the QR code are manipulated and redesigned to be unscannable.
- Note that this prototype is different from the final version of Health Code that citizens in China are using today, its key elements remained.
- Social workers at the Revival Station supported many visitors' ID card acquisition. They would travel with the visitors back to their rural homes and support them to reestablish their relationships with their families. However, such support was also selective and hard to implement.

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