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Weiquan Wang[a], Li Sun 🅾 [b], Tao Liu[c,d] and Tian Lai[a]

[a]School of Political Science and Public Administration, East China University of Political Science and Law, Shanghai, People's Republic of China; [b]School of Sociology and Social Policy, University of Leeds, Leeds, UK; [c]School of Public Affairs, Zhejiang University, Hangzhou, People's Republic of China; [d]Center for Social Welfare and Governance, Zhejiang University, Hangzhou, People's Republic of China

**ABSTRACT**

Globally, the use of e-health has accelerated dramatically during the coronavirus pandemic. Based on both quantitative and qualitative data collected in China's Hubei province (i.e. the first epicentre of COVID-19), this research explores how the pandemic influences the practices of e-health from the perspective of users. Through analysis of 1,033 surveys and 14 in-depth interviews, we find that e-health has played a crucial role in residents' healthcare during the COVID-19 pandemic. Certain external factors influence the choice of digital health, including the high risk of infection outdoors, the shutting down of transport systems, and dysfunctional healthcare facilities that neglect non-COVID-19 patients' clinical demands. Against this backdrop, we argue digital health acts as a functional equivalent to traditional medical treatment and has largely satisfied patients and users in the crisis period. Additionally, the COVID-19 pandemic has unintentionally sped up the diffusion of digital medicine over the long term as respondents expressed their willingness to continue use of e-health in the post-COVID-19 phase. However, we assert that despite the increasing use of e-health, it cannot fully substitute traditional offline treatment. Thus, we suggest a combination of online and offline healthcare will be more commonly practiced in the future.

## Introduction

Since the outbreak of the coronavirus in 2020, scientific studies on COVID-19 have mushroomed both in Chinese and international academia. Amid this pandemic-related crisis, a special social phenomenon deserves more academic investigation, namely, the remarkable increases in the application of e-health across the world (Webster, 2020). The World Health Organization (2005) defines e-health as the 'use of information and communications technologies (ICT) in support of health and health-related fields, including

**CONTACT** Li Sun ✉ L.Sun2@leeds.ac.uk 🏫 School of Sociology and Social Policy, University of Leeds, Woodhouse Lane, LS29JT, Leeds, The United Kingdom; Tao Liu ✉ Taoliu1975@zju.edu.cn 🏫 School of Public Affairs, Zhejiang University, Yuhangtang Road 866, 310058, Hangzhou, People's Republic of China

health-care services, health surveillance, health literature, and health education, knowledge and research'. It includes diversified forms of healthcare communication, such as telemedicine, internet-based inquiry and interrogation, online-therapy, and the use of apps and software to trace and collect abundant medical information. Existing studies highlight the vital role of e-health for healthcare in both developed (e.g. the use of internet health) and developing countries (e.g. the use of telemedicine) (Edworthy, 2001; Reiners, Sturm, Bouw, & Wouters, 2019; Suziedelyte, 2012).

Such digital health is an alternative form of healthcare, existing on the other side of traditional outpatient and inpatient treatment in physical medical institutes (Cotten & Gupta, 2004). It commonly uses advanced technical methods to fulfil the tasks of interrogation, diagnosis, and treatment, without the physical presence of patients in clinics, hospitals, and other medical institutions. E-health facilitates a form of communication without face-to-face interaction between patients and physicians in a physical space earmarked for medical diagnosis and treatment by a professional group (Lupton, 2013; Powell, Lowe, Griffiths, & Thorogood, 2005). Thus, digital medicine has essentially changed the communication patterns and styles between medical clients and physicians and the ways in which patients obtain access to medical information (Weiner & Biondich, 2006). Furthermore, it has also changed the state-society interaction concerning issues related to health and illness among a large population.

With the surge in the use of e-health during the COVID-19 period (Wosik et al., 2020), it is essential to understand how the pandemic influences the practice of e-health from the perspective of users. Based on empirical data from China's Hubei province, known as the first epicentre of COVID-19 (Gao & Yu, 2020), this research aims to explore why the use of e-health has accelerated during the pandemic, what the user experience of e-health entails, and how the pandemic shapes user perceptions towards e-health over the long term. In April and May 2020, 1033 quantitative surveys and 14 in-depth qualitative interviews were conducted with residents in Hubei province and participants were asked questions related to the use of e-health, for example, whether and why they have used digital health, how and through which channels, to what extent the digital medicine is or isn't able to replace traditional face-to-face treatment, what are the special social functions of e- health in a crisis like COVID-19, and what are the general attitudes of residents towards the use of digital medicine in the future.

The empirical findings of this research reveal that e-health has played a crucial role in the pandemic period. The high infection risks in the outside environment, the drastically deteriorating traffic situation during the outbreak of the pandemic, the administrative decrees stipulating temporary curfews, exit restrictions, and even lockdowns of entire cities, have jointly overshadowed the traditional offline model of diagnosis and treatment in physical medical institutions like hospitals, clinics, and outpatient departments, which has made e-health a highly attractive and alternative option in a risky and insecure period. Moreover, the temporary suspension of hospital operations and this kind of 'abnormal state' in the medical organisational system have largely impeded patients from selecting the 'normal' model of visiting doctors in physical locations. Against this backdrop, we assert digital health acts as a functional equivalent to traditional medical treatment and has largely satisfied the healthcare needs of residents whose capability of free mobility has been considerably constrained. In addition, the COVID-19 pandemic has unintentionally sped up the diffusion of digital medicine over the long term; a large

number of respondents expressed their willingness to continue using e-health in post-COVID-19 phase. Despite the vital function of e-health during the pandemic, we argue that it cannot act as a full surrogate for traditional offline treatment in clinics and hospitals since some critical and severe illnesses cannot be treated through digital medicine. Thus, we assert it provides a complementary form of diagnosis and treatment to traditional methods.

## An overview of e-health in China

China is ranked as the frontrunner in the experience of e-health technology compared to countries such as the United States, the United Kingdom, Germany, and France, among others (Future Health Index, 2019). Between 2011 and 2018, the demand for e-health in China increased by 30% annually, according to a recent report by the health research institute in China (2020). Scholars have pointed out several factors driving the rise of e-health in China, including the aging population's increasing healthcare needs, the inadequate supply of medical resources (i.e. the imbalance in the ratio of patients to physicians), and unequal allocation of medical resources across the country (Tang, Yang, & Shao, 2019).

The development of e-health in China can be divided into five stages, including emergence, adoption, facilitation, regulation, and promotion (Zhongtai Securities, 2020). First, 2001–2010 saw the emergence of online medical websites such as *39 jiankang* in 2000 and *haodaifu online* in 2006. Second, 2010–2014 represented the adoption stage. With the prevalent use of smartphones, several apps were launched (e.g. *chunyuyisheng* in 2011), which have been widely adopted by users since then. The facilitation stage followed in 2014–15; for example, in 2015, the State Council issued the publication, Guiding Opinions on Actively Promoting the Internet plus Action, to facilitate e-health practice. Fourth, in the regulation stage, in 2016–17, governments started to regulate and formulate policies explicitly concerning e-health. Finally, from 2018 onwards represents the stage of promotion. For instance, in 2018, the State Council issued a publication entitled Guideline on the Development of Internet plus Healthcare (Zhongtai Securities, 2020).

At the beginning of the pandemic period, in early 2020, the significance of promoting e-health was highlighted by the government, with the National Health Commission issuing the report Opinions on E-Health Consultation and Service in the Pandemic Period. The demand for e-health has dramatically increased since then. For example, in the spring of 2020, the use of online e-health apps for medical consultations increased by 20 times compared to one year prior (Sina, 2020). The average number of daily consultations was 100 patients per doctor at Ali health, which is led by Alibaba (Health Research Institute, 2020). Ping An Good Doctor, the most popular online e-health app in China, had 67.3 million users monthly during the pandemic period (Financial Times, 2020).

## Conceptual framework: digitalisation, society, and healthcare

One universal phenomenon conceived both by policymakers and scientists is that digitalisation has accelerated the transformation of our natural world and social world, which has precipitated a series of reactions and changes in various social (sub-)systems including politics, the economy, finance, governance, health, etc. The

use of digital and internet-based devices has altered the functional patterns and coherent dynamics of different social fields (Jarke, 2018). Naturally, the medical field is not an outsider to the tide of digitalisation. Extensive and intensive use of electronic and digital methods, devices, and instruments have caused not only immense technological advancement and innovation in the arena of health and medicine, but also a fundamental change in social relationships within this special field, such as the doctor–patient relationship (Cotten, 2001); thus, digitalisation represents a potential driving force for medicine-related social transformation in the long run.

By incorporating digital methods into healthcare, like telemedicine, internet-based medical consultation and diagnosis, online medical courses, and seminars and lectures for patients and other interested parties, the comfort level among medical clients and other participants has been remarkably improved, communication speed has significantly increased, and receivers of medical resources have saved much unnecessary effort, since physical co-presence of patients and medical personnel is no longer mandatory. Benefiting from the increased convenience triggered by the spill-over effect of digitalisation, medical clients have been increasingly relieved from physical registration, excessive waiting periods, and long queues in the treatment departments of institutions like hospitals. A doctor's 'visit' has transcended time and space limitations and can be achieved via a home-treatment model (Fotheringham, Owies, Leslie, & Owen, 2000; Steinhubl, Muse, & Topol, 2015; West & Miller, 2009).

From the angle of obtaining access to medicine-related information, medical clients and users of medical resources like patients or lay people outside medical professional groups, experience novel opportunities to change their unfavourable position as passive recipients of such information. Through different online channels such as the Internet, smartphones, apps and other software, patients who lack professional medical knowledge are able to collect as much information as possible, altering their knowledge deficit in the knowledge market. Medical clients can enlighten themselves within the explosion of digitalised knowledge. The asymmetrical structure of medicine-related knowledge between lay people and medical professionals has shifted in favour of the former (Cotten & Gupta, 2004; Powell, Lowe, Griffiths, & Thorogood, 2005). Based on the information-related 'self-enlightenment' of the medical public and laypeople, some studies have also noted changes in social relationships and the power structure between patients and physicians (Petracci, Schwarz, Sanchez Antelo, & Mendes Diz, 2017; Weiner & Biondich, 2006). Through additional gains in information by non-professionals, the monopoly of expertise by medical staff and professional groups and their absolute authority has been partially broken, potentially leading to more equal communication between patients and physicians. Traditional hierarchical interaction patterns between patients and physicians have been corrected in many cases through mutual consultation on treatment and recovery plans, pointing to a new model of core decision-making involving both sides. Increased involvement of patients in co-decision processes concerning medical treatment means more sharing of the burdens and responsibilities (Gerber & Eiser, 2001; Mandl, Kohane, & Brandt, 1998; Weiner & Biondich, 2006). Digitalising medicine breeds new opportunities for health-related democracy and mass emancipation (Gil de Zúñiga, Veenstra, Vraga, & Shah, 2010). Through the 'empowerment' of ordinary people and patients, medicine-related knowledge stratification is further flattened (Lupton, 2013; Topol, 2019).

## Research focus

This article focuses on the use of digital health in China amid the outbreak of the COVID-19 pandemic. Our primary theoretical interest concerns the special role and function of e-health during a pandemic in a society that has reached a crucial threshold of crisis. Epidemics and pandemics represent special crisis events that pose an acute threat to the existing social and political order in a country, overshadowing the normal functionality of bureaucratic organs, economic units, and social organisations, challenging the current public and social administration over the short and long terms (Abeysinghe, 2013; Dingwall, Hoffman, & Staniland, 2013; Shehu & Rao, 2020). Even 'normal' medical institutions and organisations may be partially suspended and temporarily transformed into rapid emergency response mechanisms, as in a quasi-wartime state (Finlay, See, & Brunham, 2004). Since medical resources are overwhelmingly devoted to preventing acute infectious pandemics, hospitals and other health facilities are rapidly reorganised to cure patients suffering from COVID-19, and regular medical resources will be overloaded and even exhausted. The dysfunctionality and abnormal state of pre-existing medical institutes may cause a temporary medicine-related vacuum for patients and others, creating drastically increased demands for digital diagnosis and treatment. Since the medical institutions in offline physical locations (clinics, hospitals, rehabilitation centres, etc.) no longer work in crisis periods, patients and those in need must turn to help from online medical channels. Special emergency management measures such as lockdowns, curfews, and travel bans may act as a driving force to indirectly compel patients and others to expand their uses of digital medicine. Thus, a pandemic-related crisis can foster and accelerate the circulation of digitalising medicine.

In order to unpack the use of e-health during the COVID-19 pandemic in China, three research questions are addressed. Firstly, why have residents chosen to use e-health and through which channels? Secondly, how have they experienced digital health usage and what are the relationships between online and offline healthcare? Thirdly, what are their perceptions towards e-health?

## Research methods

As the first epicentre of the global COVID-19 pandemic, Hubei province was selected as the research site for this study. Hubei is located in central China with a total population of 59.02 million. Until 31 May 2020, there were 68,135 confirmed coronavirus cases in the province. Hubei is divided into 18 administrative divisions including prefectures, cities, and forestry areas (NBS, 2018). On 23 January 2020, Wuhan, the provincial capital city, was locked down and, soon after, all other administrative divisions in Hubei province imposed a lockdown (Yang, Bin, & He, 2020). Citizens were urged to stay at home as public transport was suspended and public spaces, including leisure centres (e.g. cinema, theatres, internet cafes), restaurants, and hotels, were shut down (Huang, Peng, Wu, & Xie, 2020). On 11 February, a curfew was enforced in Wuhan mandating that residents were not allowed to leave their residential compounds and non-local residents were not allowed to enter the neighbourhoods of others. Only one member of each household was allowed to go out for essential shopping once every three days, and

their temperature was checked at the gate of the residential compound. Meanwhile, online working and online teaching/learning were carried out. Such strict lockdown regulations were partially eased on 19 March in some areas of Hubei province. After 76 days of lockdown, on 8 April, Wuhan was the last city to lift the strict regulations.

In April and May 2020, data collection was carried out in three administrative divisions of Hubei: Wuhan city, Huanggang city, and Enshi city. Mixed methods were employed during the data collection, including a quantitative survey and semi-structured qualitative interviews. In total, the valid sample size of the survey was 1033, and 14 in-depth interviews were conducted. Under the guidance of the authors, data collection was conducted by seven undergraduate and postgraduate students at East China University of Political Science and Law. The hometowns of the seven students were located in Hubei province. As the universities were closed due to the pandemic, these students were in Hubei during the lockdown and the period of data collection. In order to avoid face-to-face interactions and ensure the safety of respondents and students, we used an online survey and telephone interviews. The questionnaire was transformed to the website format at Wenjuanxing (www.wjx.cn), one of the most used online survey platforms in China. The survey link was distributed and circulated through WeChat, the most widely used social networking application in China.

In total, 1143 questionnaires were received, and the valid sample size was 1033, including 510 respondents in Wuhan, 316 in Huanggang, and 207 in Enshi. Among the 1033 respondents, 59.73% were female, and 40.27% were male. A total of 78.02% of respondents were between 20 and 49 years old, 10.94% were below 20 years old and 11.04% were above 50 years old. As regards educational background, 9.1% only received the compulsory education required by the law, including primary and junior high school. A total of 16.55% completed senior high school, 22.85% received occupational training and diplomas from vocational colleges, 39.11% obtained undergraduate degrees from universities, and 12.39% had postgraduate degrees (see Table A1 in Appendix A).

After screening the survey sample, some questionnaire respondents were invited to take part in qualitative interviews via telephone, for example, those with underlying health conditions who frequently used e-health services during the lockdown. Eventually, 14 in-depth interviews were conducted among patients with different types of illnesses such as hypertension, breast cancer, chronic heart disease, diabetes, gastritis, goitre, and cerebral infarction. Table A2 in Appendix A provides an overview of the characteristics of interviewees. In order to protect interviewees' confidentiality, pseudonyms were used when presenting the interview quotes in the following findings section.

## Findings

Based on both quantitative and qualitative data, this section elaborates the usage of e-health in Hubei province during the COVID-19 pandemic along three dimensions: reasons for choosing e-health, the experience of e-health use, and perceptions towards e-health.

### *Reasons for choosing e-health*

Existing studies have pointed to the various advantages of using e-health, including convenience, immediacy, efficiency, anonymity, and privacy (Bischof & Kelley, 1999;

Skinner, Biscope, & Poland, 2003; Tang, Yang, & Shao, 2019). Normally, using e-health is a voluntary choice. However, during the pandemic period, certain external factors induced patients to use digital health passively due to the lockdown, such as the high risk of infection outdoors, the shutting down of transport systems, and the partial closure of some healthcare facilities (e.g. hospitals, clinics, pharmacies). When asked about their reasons for choosing e-health, 79.52% of respondents indicated 'avoiding going out and minimizing the infection risk', 59.34% answered 'the shutting down of transport', 57.83% noted the immediacy of e-health, 35.84% cited the purpose of optimising healthcare resources, 21.08% spoke about reducing medical expenses, and 16.87% highlighted healthcare facilities exclusively for COVID-19 patients (see Figure 1).

Figure 1 clearly indicates that safety concerns represent the main driving factor leading to patient use of e-health, which was also evidenced by the interviews. For example, David said, 'I have been suffering from ordinary pneumonia, but I don't dare to visit hospitals due to the high risk of coronavirus transmission there; thus, I used online medical consultancy in February'. Further, the shutting down of transport was regarded as a constraint for accessing offline clinical services and treatments. On 16 February, the Hubei provincial government (2020) imposed measures of temporary traffic control, mandating that all vehicles are prohibited to drive on the road except for anti-pandemic vehicles, official vehicles, public transportation, and special vehicles such as ambulances, and firefighting, emergency rescue, and police vehicles. Janet mentioned, 'I had shingles in February, but the nearby hospital had closed. I cannot visit other hospitals because of the transport control; thus, I had to turn to online consultations'.

During the outbreak, hospitals were overwhelmed by the large number of coronavirus patients, which resulted in neglecting non-COVID-19 patients' clinical demands (BBC, 2020). Only 7.07% of respondents indicated that healthcare facilities near their residences functioned normally, 29.43% replied that healthcare facilities only admitted patients with the coronavirus, 18.78% responded that healthcare facilities were only open to patients with non- COVID-19 diseases, 15.2% noted that healthcare facilities had closed, and 29.04% answered 'unknown'. With reduced offline healthcare options, some patients with non-COVID-19 illnesses regarded online health as an alternative option. Nancy noted,

> I have had hypertension for years and am taking medicine on a daily base to control my blood pressure. However, the clinic I regularly visited for medicines was closed during
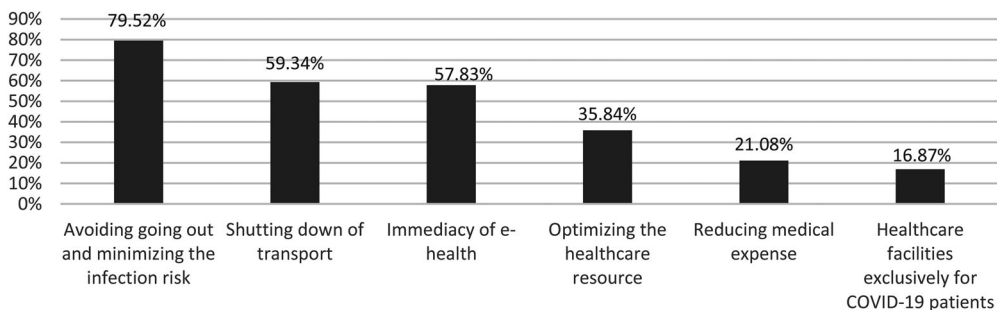


**Figure 1.** Reasons for choosing e-health.

the pandemic period. Therefore, I chose to e-consult doctors for medicine prescriptions and then purchased medicines online.

It is worth noting that on 17 February, the Wuhan government (2020) announced that there were six hospitals open exclusively to non-COVID-19 patients in need of essential medical treatments, including haemodialysis patients, severely chronic patients, pregnant women, and children.

When asked how these e-health users obtained information and located specific e-health channels, 60.24% answered that they had found e-health information by themselves, 45.78% received recommendations from families and friends, 30.72% knew such information through social media, and 20% were informed by governments. The answers varied from one age group to another. For instance, most elderly people became aware of e-health because of information received from their adult children. Tina, 58-year-old, explained,

> On 25 February, I felt discomfort caused by diabetes. My daughter told me to try telephone consultations, which I had never heard of. With the help of my daughter, I managed to consult with the doctor via telephone for half an hour.

Previous research has also noted that older persons are generally less likely to use e-health, but their family members play a vital role in encouraging and helping them to do so (Drewes et al., 2016; LaMonica et al., 2017).

### *The experience of e-health use during the lockdown*

Tang and colleagues (2019) have highlighted that e-health users in China can access various services, such as online registration, online payment, and medical and health consultations. Among the survey respondents who had used e-health services during the pandemic period, 52.04% had purchased medicine online, 51.01% had received online consultations, 44.51% had used online registration and payment, 23.20% had engaged in a phone consultation, and 8.78% had used psychological counselling. It was common to find that users combined these services; for example, John, a 69-year-old coronary heart disease patient, said,

> My heart felt painful at the end of February. Due to the lockdown, my family helped me to use online health services. We first used the online consultation for some basic information, and I was asked to register and pay in order to get the consultation from a specialist. After online registration and payment, a specialist phoned me for 20 minutes.

Patients' online payments are regarded as economic returns for the doctors providing e-health consultations, which enhance their financial position (Guo, Guo, Fang, & Vogel, 2017). Most interviewees believed the charges for online medical services were reasonable and affordable, and they could, in some cases, be reimbursed through their medical insurance. On 26 February 2020, the Wuhan government announced that medical insurance coverage would include internet-based healthcare, the first Chinese city to launch this practice. However, several interviewees expressed their concern about the financial risk of online payment. As Patrick mentioned,

> When I was asked to pay for further online consultation by a specialist, I noticed the payment detail I received was a personal account instead of an official account. I worried

that this may not be reliable, so I inquired about my concern. The reply indicated that with the increasing use of digital health during the pandemic period, some volunteers were recruited to assist with e-health services, but they had no access to an official payment account. Therefore, their personal accounts were used. After knowing this, I paid the fee and later, one specialist contacted me.

Thus, patient trust played an important role in influencing the use of e-health, which has also been addressed in existing studies (Gefen, Karahanna, & Straub, 2003; Zahedi & Song, 2008).

When asked about the advice patients had received from the e-consultation, 36.45% were told by the doctor to take medicine, 29.22% were advised to wait and observe for a few days and told that there was no need to take any medicine in the meanwhile, 13.86% were asked to visit hospitals, and 20.48% received 'other advice'. The advice varied based on the type of disease. In general, patients with mild symptoms were advised to continue with medication and the e-health doctors helped to prescribe the necessary medicine, while patients with severe symptoms were directed to visit hospitals. Julia noted, 'The doctor asked me to continue with my hypertension medication and prescribed the same medicine I have been taking for years. With his prescription, I bought the medicine online'. In contrast, Karen, a breast cancer patient, was told by the doctor to visit the hospital for further diagnosis.

Thus, we have found that due to the constraints of the lockdown in the pandemic period, e-health has acted as a functional equivalent to offline healthcare, especially for patients with mild symptoms. For other patients, the use of e-health was regarded as a primary source of information and advice that helped patients to have a basic understanding of their health; afterwards, further offline treatments would be needed. Such a combination of online and offline healthcare was practiced by some patients. Several scholars have highlighted that e-health is complementary to traditional offline healthcare (Smith et al., 2015). Additionally, it was interesting to find that e-health consultation had provided an intangible impact on psychological comfort among patients. Nina expressed this sentiment, 'I am grateful to the e-health doctor because after talking to him, I didn't only get the prescription note for medicine; I was also no longer panicked and calmed down psychologically'.

Being at the first epicentre of the COVID-19 pandemic, the psychological wellbeing of Hubei residents was negatively affected during the lockdown period. Among 1033, 727 respondents answered they had experienced psychological anxieties, accounting for 70.38% of the sample size. Online information and peer-to-peer support via digital tools played a vital role in relieving such anxieties. When asking how they had eased their psychological anxieties, 62.31% of respondents had discussed them with family and friends via the Internet, 62.31% had searched for information online, 55.85% had engaged in face-to-face conversations with family, 52.96% had telephone conversations with family and friends; only 5.36% had received counselling from a psychologist via the Internet, and 3.58% had spoken with a psychologist via telephone (Figure 2). It is clear that professional psychological counselling was not widely sought out by respondents. Although psychological assistance measures were implemented by the government to provide mental health care for coronavirus patients and health professionals at the frontlines (Wang et al., 2020), we would suggest that such services should also target ordinary residents in regions heavily affected by the pandemic.
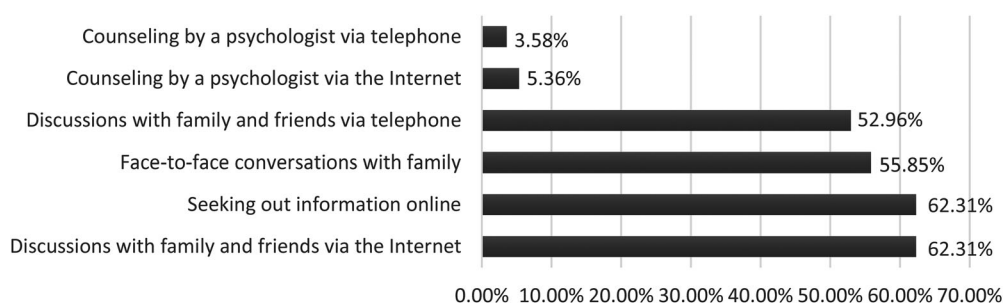
Figure 2. How psychological anxieties were eased during the lockdown period.

## Perceptions towards e-health

We argue that due to the COVID-19 pandemic, Hubei residents' understanding of e-health has evolved and their behaviours and perceptions of online and offline healthcare have been reshaped in the short and long term, as evidenced by their answers regarding the usefulness, satisfaction level, and perceptions towards e-health in the post-COVID-19 phase.

When asked to what extent they found e-health useful during the lockdown period, 29.49% respondents answered 'very useful', 47.53% answered 'useful', 14.35% answered 'neutral', and 8.63% answered 'not useful'. Interviewees also appreciated the usefulness of e-health. As Janet noted:

> By using online health, I had some understanding of my illness under the guidance of the doctor, who also prescribed me some medicine. Without the doctor's help, I would probably buy the wrong medicines based on my own unprofessional judgment. Therefore, the online consultation was useful for me.

However, some interviewees (i.e. Nina, Helen, Austin) emphasised that the usefulness of e-health was necessarily short-lived, as they would still need to visit a hospital after the lockdown was lifted.

Digital health users in this research were largely satisfied with the healthcare services provided through digital technologies (Figure 3): 14.46% users answered 'very satisfied', 41.57% were 'satisfied', 2.41% were 'dissatisfied', 0.3% were 'very dissatisfied', and 41.27% were 'neutral'. The reasons for their satisfaction levels included convenient procedures, great service attitudes, doctor professionalism, and reasonable fees. The doctor–patient relationship has been discussed by existing studies on e-health (Alpay, van der Boog, & Dumaij, 2011; Cotten & Gupta, 2004). Several interviewees in this study also explicitly addressed e-health as being patient-centred and promoting patient empowerment; for example, the easy availability of patient-clinician communication was acknowledged by patients. Patrick noted,

> If I have any doubts after getting an e-consultation from one doctor, I could always do the online registration and payment again to get a second and even third opinion from other doctors. The financial cost of e-health is cheap, and I could afford to do multiple consultations if needed.
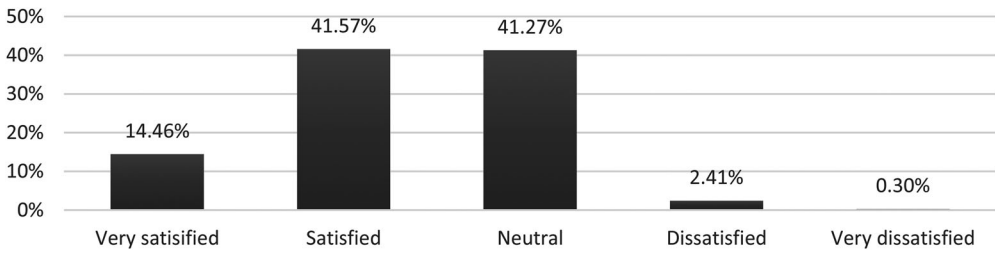
**Figure 3.** Users' satisfaction level with e-health services.

With their use of digital health during the pandemic period and relatively high satisfaction levels with the experience, it was unsurprising to find that respondents were willing to continue using e-heath in the long term. Among 1033, 430 respondents (41.63%) answered that the pandemic had motivated their increased use of e-health in the post-COVID-19 phase, and only 153 respondents (14.81%) said the pandemic didn't prompt their intention to use e-health in the future; 450 respondents (43.56%) answered unsure. We further found that the higher the educational background of respondents, the greater the chances of continuing the use of e-health were (Figure 4). For example, among respondents receiving postgraduate degrees, 54.69% confirmed their willingness to continue using e-health, while among respondents with primary and junior high school, only 23.4% expressed such intentions. Thus, our data support the argument of previous research that the usage rates of e-health may vary substantially among social groups with different social-educational backgrounds (Gortzis, 2009).

Additionally, some interviewees pointed out the advantages and disadvantages of online health care compared to offline health care. Obvious advantages included reduced time and monetary cost, while one disadvantage was that the diagnosis and treatment of some diseases relied on medical equipment in hospitals. For example, some noted that digital diagnosis makes visual observation (of the physical state) of patients difficult and the diagnosis is thus not always accurate and/or sophisticated. One interviewee was even concerned about potential misdiagnosis. Other users pointed to some of the realistic problems of online medicine, such as the lack of
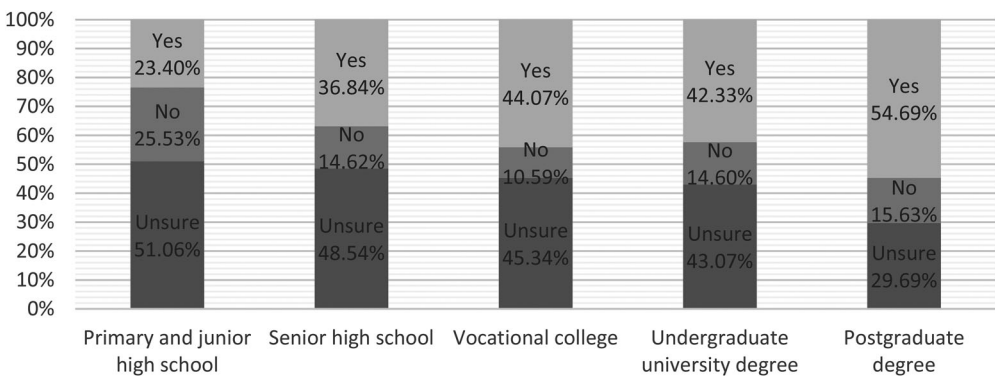


**Figure 4.** Educational background and the willingness to continue using e-heath.

possibility to obtain a blood test or an EEG-test. Thus, the advantages and disadvantages of digital medicine must be comprehensively considered and reconsidered so that an objective and balanced judgement can be achieved.

## Conclusion

Based on both quantitative and qualitative data collected in China's Hubei province, our research has demonstrated that e-health played a unique and distinctive role in residents' healthcare during the COVID-19 pandemic. Through the use of digital health, patients avoided going out, which reduced their infection risk. Meanwhile, lockdowns and curfews were imposed by the government, constraining offline healthcare seeking. Furthermore, due to the closing of some health facilities or exclusively treating coronavirus patients, non-COVID-19 patients' offline clinical demands have been neglected. In this context, digital health has been widely used as an optimal alternative which provides safety and convenience for users. For example, 79.52% of e-health users responded that 'avoiding going out and minimizing the infection risk' was one of the main reasons for choosing e-health during the pandemic. Additionally, during the pandemic, lay people gained health- and illness-related information from e-health tools, which empowered ordinary citizens with medical understanding and knowledge. Such online information and peer-to-peer support via digital tools have significantly relieved residents' psychological anxieties during the lockdown: 62.31% of respondents regarded discussions with family and friends via the Internet as a method to ease their psychological anxieties.

These environmental, administrative, and institutional factors amid the crisis have created a mandatory external condition for increased use of online medicine; it has been a 'must' for many patients to firstly rely upon online medicine if community-based hospitals were closed or were reoriented towards targeting patients and suspected patients suffering from the coronavirus. We argue that the COVID-19 pandemic created a de facto 'medical vacuum' in physical spaces amid the crisis. Therefore, e-health has acted as a 'functional equivalent' to temporarily suspended and dysfunctional offline medical systems. The pandemic crisis has fostered digitalisation in the medical system, and this unusual and surprising development reveals the significant role of digital devices and methods in an age of enforcement of social distancing and sharp control over interpersonal, face-to-face interaction. While offline treatment has temporarily retreated, online medicine has been thriving.

We assert that the pandemic-related crisis acted as a 'driving force' and 'accelerator' for the diffusion of digital health. In early 2020, the Chinese government launched policies explicitly promoting the use of e-health during the pandemic. Diversified forms of digital medicine became accessible, including telemedicine, smartphone- and app-related online registration, payment, consultancy, interrogation, diagnosis, and treatment. Despite the increasing use of digital medicine, our survey has revealed a range of differentiated views on e-health, including positive, neutral, and critical judgements. Although most e-health users in Hubei province were satisfied with the digital health services they received, and they acknowledged the efficiency and professionalism of e-health doctors and relevant medical staff, some users found online diagnosis problematic.

## Discussion

Notwithstanding the increasing significance of digital medicine, we have noticed that even during the crisis, online medicine cannot fully substitute for traditional forms of offline medicine. Digital medicine has rather played a complementary role to traditional methods based on face-to-face interactions between patients and physicians. Our data further point to the differentiated substitution levels between online and offline medicine among different types of illness. Slight indispositions and minor aliments usually imply a strong substitution effect, for patients with mild symptoms or psychiatric diseases, which can be effectively diagnosed and treated via online medicine. In this case, online medicine can play a highly significant role in treating patients, making additional offline treatment in hospitals redundant. Concerning certain diseases (e.g. chronic heart failure), the biological regeneration and recreation of a state of health are most relevant issues for patients, which need a long-range recovery plan and adaptation of living habits; in such cases, online medicine can partially substitute for offline medicine through internet-based interrogation and consultancy as well as online prescription of medication (Kvedar, Fogel, Elenko, & Zohar, 2016). Additionally, because mental and psychological health are largely based on emotional support and private consultancy, e-health can function well and can also partially crowd out offline medicine. Previous studies have verified the achievements and success of e-health in the arena of psychological interventions, playing an important role in suicide prevention (Christensen, Batterham, & O'Dea, 2014). However, in cases of critical and severe illness, online medicine shows its limits, as comprehensive physical examination, device-based therapy, and surgeries can only be undertaken by doctors in treatment departments within clinics and hospitals. Hence, treatment of critical illness can hardly be achieved via online medicine.

As a large number of participants in this research pointed out, they intended to continue using e-health in the post-COVID-19 phase. The pandemic-related temporary changes in the offline physical medical system and facilities have in fact served as an 'invisible hand' driving more offline users and patients to online spaces over the long term. Notwithstanding such a trend, it is worth noting that e-literacy in a post-modern society is a significant factor in deciding to what extent patients and citizens would like to use or not use this new technology. 'E-illiterates', or those people who do not use or dislike to use smartphones, or who lack basic e-related knowledge are precluded from using digital medicine, including the elderly, the disabled, and citizens with a low educational background. For example, elderly people, suffering mostly from serious diseases, are proportionally the group who use digital medicine the least; they require help from others – middle-aged adults or the young generation at home – to allow them to communicate digitally. E-literacy and e-illiteracy may become central factors that generate inclusion and exclusion in the arena of digital medicine. Post-modern society still needs to find a way to avoid exclusionary effects, which will be vital for the future development of e-health in China.

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No potential conflict of interest was reported by the author(s).

## ORCID

*Li Sun* 🆔 http://orcid.org/0000-0002-0102-8801

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# Appendix A

**Table A1.** Demographics of the survey sample.

| Characteristics | Category | Number | Percentage (%) |
|---|---|---|---|
| City | Wuhan | 510 | 49.37% |
| | Huanggang | 316 | 30.59% |
| | Enshi | 207 | 20.04% |
| Gender | Male | 617 | 59.73% |
| | Female | 416 | 40.27% |
| Age | <20 years old | 113 | 10.94% |
| | 20–49 years old | 806 | 78.02% |
| | >50 years old | 114 | 11.04% |
| Educational background | Primary and junior high school | 94 | 9.10% |
| | Senior high school | 171 | 16.55% |
| | Vocational college | 236 | 22.85% |
| | Undergraduate university degree | 404 | 39.11% |
| | Postgraduate degree | 128 | 12.39% |

Source: Authors' own compilation based on the survey (*n*=1033).

**Table A2.** Characteristics of interviewees.

| Pseudonym | Age | Gender | Types of illnesses | Medical history of this illness | Treatment or advice from e-health doctor | Satisfaction with e-health experience |
|---|---|---|---|---|---|---|
| Nina | 21 | Female | Asthma | Yes | Prescribe medicine | Satisfied |
| Patrick | 35 | Male | Gastritis | Yes | Prescribe medicine | Satisfied |
| Helen | 41 | Female | Goitre | Yes | Prescribe medicine | Satisfied |
| David | 45 | Male | Pneumonia | No | Wait and observe | Neutral |
| Karen | 47 | Female | Breast cancer | Yes | Visit hospital | Satisfied |

**Table A2.** Continued.

| Pseudonym | Age | Gender | Types of illnesses | Medical history of this illness | Treatment or advice from e-health doctor | Satisfaction with e-health experience |
|---|---|---|---|---|---|---|
| Austin | 50 | Male | Cerebral infarction | Yes | Prescribe medicine | Satisfied |
| Janet | 50 | Female | Shingles | No | Prescribe medicine | Satisfied |
| Tina | 58 | Female | Diabetes | Yes | Prescribe medicine | Satisfied |
| Nancy | 61 | Female | Hypertension | Yes | Prescribe medicine | Satisfied |
| Julia | 64 | Female | Hypertension | Yes | Prescribe medicine | Satisfied |
| Frank | 66 | Male | Covid-19 | No | Visit hospital | Dissatisfied |
| John | 69 | Male | Coronary heart disease | Yes | Prescribe medicine | Satisfied |
| Jennifer | 70 | Female | Chronic heart failure | Yes | Prescribe medicine | Satisfied |
| Barbara | 70 | Female | Hyperthyroidism | Yes | Prescribe medicine | Satisfied |