# Application and Development Outlook of Next-Generation ICTs in Fighting Against COVID-19

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Since the outbreak of novel coronavirus pneumonia (COVID-19), the speed of its spread and the scope of its influence have been unprecedented, bringing huge challenges to China's public health emergency response mechanism and epidemic prevention and control work. To fight against the epidemic, the ICT industry has comprehensively launched its emergency response mechanism, and made all-out efforts to guarantee the efficient connection of communication networks and information services. We noticed that basic telecom enterprises have realized the communication connection in many important places, such as hospitals and disease prevention and control centers, in the shortest time through innovative technology applications. 5G integrated with cloud computing and AR has enabled us to together witness the miracle of China during the construction of the Huoshenshan and Leishenshan Hospitals in the form of "supervision on the cloud". The big data analysis of telecommunications has provided us with auxiliary prevention and control information, such as the flow of people back to work and roaming query. These innovative services targeting the epidemic prevention and control have inspired the national morale, and vigorously supported the prevention and control work. Internet enterprises also do their utmost to comprehensively serve the online life of Chinese people by means of various Internet platforms and information technologies, and provide online diagnosis and treatment, e-commerce platforms, remote office, online education and other services for the society and masses. They aim to avoid production suspension before work resumption and study suspension before school opening. They have also applied AI technologies and platforms to offer clinic diagnosis, drug research and development and medical services, thus making positive contributions to the battle against the epidemic.

In such a special war without smoke, under the severe situation of epidemic prevention and control and the tremendous task of social management, scientific and technological prevention and control have demonstrated the great power, and the next-generation ICTs represented by 5G, IoT, big data and AI have been widely applied in every aspect of epidemic prevention and control, and functioned as the key basic support. The next step is to bring the advantages of ICTs to full play, and strengthen R&D and application promotion, so as to play a bigger role in the summary and release of epidemic information, scientific prediction of epidemic development, innovative exploration of medical diagnosis and treatment, fairness and availability of supply allocation, powerful and orderly prevention and control of communities, etc.

## I. Next-generation ICTs begin to display their power in epidemic prevention and control

### (I) 5G+ integrated applications launch a counterattack on the epidemic

The 5G network is being rapidly deployed in core key areas. While addressing the needs of various parties for basic communication, it has boosted the launch of multiple innovative 5G+ application solutions for epidemic prevention and control through the deep integration with other technologies. For instance, the **5G-based remote diagnosis** has realized remote consultation and visit, so that top experts across China can remotely conduct centralized discussions and diagnosis analysis of the development course of typical cases, which has accelerated the discovery and promotion of latest treatment experience; **intelligent medical robots and patrol robots based on the 5G network** showed up in the frontline of epidemic prevention and control, engaging in nursing, delivery, cleaning, disinfection and other work, which have effectively reduced the risk of cross infection among the doctors and nurses, and improved the capability and level of ward isolation, management and control; **epidemic prevention and control drones based on the 5G network** appeared above the streets and communities to maximize the efficiency of inspection and quarantine work through video surveillance, aerial publicity, human body temperature detection and other functions.

### (II) IoT technology builds a safe and efficient treasure chest of "technical defense"

IoT technology has been applied to the development of applications in non-contact epidemic recognition, positioning traceability, automatic acquisition and remote monitoring, etc., and run through epidemic screening, monitoring, early warning, prevention & control, treatment, management and other links, thus promoting the replacement of "people's defense" with automated and smart "technical defense". For example, the **"non-inductive detection" service boosting the quick screening of public areas**, relying on the thermal imaging human body temperature detection system developed on the basis of IoT technology, has satisfied the needs of the high-density population in public places for rapid deployment and remote and precise temperature measurement; **grid supervision and community screening, management and control**, on the basis of IoT technology, has been implemented through the deployment of face recognition, access control, non-contact human body temperature measurement and intelligent door lock devices at the entrances of communities under epidemic prevention and control, so as to achieve the closed management of communities in a safe and efficient way; the innovative **smart home isolation management and control system and "electronic fence"** can learn about the relevant information of persons under isolation at home, such as the door opening & closing status, the door-opening demand and whether they left limited areas, and form one-key warnings and prompt reminders backstage, so as to achieve the high-efficient management and control of patients with mild symptoms under isolation at home; the **smart retail and market supervision in the special period** can effectively prevent cashiers from becoming the superspreaders by means of non-contact retail services, such as unmanned supermarkets, intelligent logistics cabinets and intelligent take-out cabinets, developed on the basis of IoT technology. Electronic price tags are used to remotely monitor the prices of protective supplies and daily necessities in urgent need, such as masks, disinfectant, rice and vegetables, so as to avoid malicious price hikes.

**(III) Big data analysis technology solves epidemic development problems**

Since the epidemic outbreak, the widespread application of big data technology has played a positive role in epidemic traceability and monitoring, situational analysis and research, prevention and control, deployment, etc. Governmental departments **utilize data sharing platforms** to collaboratively calculate and verify confirmed cases, suspected cases, fatalities and other data, which, through the application of massive data query and validation technologies, have achieved the prompt and accurate acquisition of epidemic-related data and the release of epidemic statistics. The Ministry of Industry and Information Technology (MIIT) has organized related units to conduct the **big data analysis of telecommunications**, aiming to figure out the flow of people in key regions, particularly Wuhan and Hubei, analyze and forecast the dynamic flow situation of key groups, such as confirmed cases, suspected cases and persons in close contact with confirmed or suspected cases, and support the epidemic prevention and control deployment; epidemic prevention and control departments have **combined the big data analysis with the infectious disease model theory related with COVID-19**, aiming to explore the law of epidemic development, master the epidemic distribution and development trend, determine key areas, groups and scenarios of the epidemic prevention and control work, and provide the scientific decision-making support for supplies allocation and regulatory measures of the authorities.

**(IV) AI technology is making a powerful weapon for epidemic prevention and control**

AI technologies are displaying its algorithm advantages and platform capabilities in language recognition, image recognition, natural language processing and expert systems, particularly in vaccine R&D, medical hardware and voice screening, so as to accelerate the epidemic prevention and control in an efficient way. The AI algorithm developed by the Alibaba DAMO Academy is able to shorten the time for genetic analysis of suspected cases from several hours before to half an hour, which can significantly reduce the diagnosis time, and to precisely detect the mutation situation of the virus. Baidu's LinearFold algorithm is capable of shortening the time for the forecast on the secondary structure of genome-wide RNA of the novel coronavirus from 55 minutes before to 27 seconds. We can say that **AI technology has remarkably improved the efficiency of vaccine research and development and drug screening**. Intelligent devices like medical robots, logistics robots and intelligent temperature measurement system have successively showed up in the frontline of the battle against the epidemic. These **intelligent medical hardware have effectively addressed various kinds of doctor and patient needs amid the epidemic**, and ensured the efficiency and safety of the prevention and control work. Besides, AI **intelligent voice service** based on natural language processing technology can fulfill personalized information collection and interaction tasks, including epidemic progress notification, intelligent dialogue query and intelligent outbound visit. While increasing the precision and efficiency of information screening, this service can greatly lower the possible infection risk of information publicity and collection personnel due to the flow and contacts.

**II. Next-generation ICTs contain great potential for epidemic prevention and control**

China's battle against the epidemic demonstrates the strong execution and institutional advantages with Chinese characteristics, but also discloses a series of pain points of the public health prevention and control system in the country, such as epidemic prevention and control issues amid complex population mobility, scientific supplies allocation issues in urgent conditions, prevention and control capability deficiencies at grassroots levels, such as villages and communities, the failure of epidemic monitoring and warning information system to comprehensively address the decision-making demand, etc. Currently, new ICTs have played an obvious role in gradually promoting production resumption, reducing crowd gathering and interrupting epidemic transmission. However, as the country hopes to innovate and improve key epidemic prevention and control measures as soon as possible, these technologies have not yet met social expectations in many aspects. As a matter of fact, there is still much room for the application and development of latest ICTs in terms of epidemic monitoring and analysis, virus traceability, prevention & control and treatment, resource allocation, etc., and their potential for epidemic prevention and control urgently needs to be released.

**(I) Accurate predictions of epidemic development urgently require overall utilization of big data technologies and resources**

The national automatic early warning system of communicable diseases the country has established after SARS plays a limited role in this battle against the epidemic, mostly because this system only collects and analyzes the data of known infectious diseases, but fails to give rapid alerts to the outbreak of unknown epidemics through big data. To bring big data prevention and control to full play, China urgently needs to establish a big data analysis model that can comprehensively utilize data in many aspects, and apply it to the early warning system. In addition, telecom big data analysis helps with the calculation of personnel flow and distribution results, but its accuracy still needs to be increased. It should enhance data sharing and linkage analysis with big data from departments of health and disease control and management, so as to further elevate the pertinence and accuracy of data analysis for epidemic prevention and control, such as playing a bigger role in the quick search of patients and close contacts through big data as well as epidemic analysis and early warning. The next step is to establish a more intelligent, three-dimensional and active early warning system for the prevention and control of infectious diseases. This requires the linkage of data systems in many fields, including healthcare, telecommunications, meteorology, transport, population and Internet platforms, the building of a sharing channel for emergency data resources and the establishment of a more accurate analysis model. By doing so, it can achieve the overall utilization of epidemic data resources in the whole society, and allow big data technologies to better support and serve the prospective epidemic prevention and control work.

**(II) Improvements and breakthroughs urgently need to be made in scientific allocation of epidemic prevention supplies with the introduction of blockchain technology**

The epidemic prevention supplies were in short supply when the epidemic broke out. At that time, it was saddening to see many painful news reports: Reclaimed, expired and inferior masks flooded the market; susceptible people, including senior citizens, could not buy a mask, disinfectant and other protective articles; medical care personnel in the forefront used garbage bags as protection suits, but a lot of supplies were allocated to private hospitals in the Putian Group. In the news coverage, many problems were disclosed, such as deficiencies of medical supplies, slow allocation, complex procedures, unordered allocation and overstocking during the allocation of medical supplies. In special periods, it is very important to achieve the scientific allocation of scarce supplies, but it is difficult to realize the sharing and opening of comprehensive real-time information about social resources across departments and sectors through traditional technical means. Therefore, the introduction of new ICTs is urgently needed. Blockchain technology can exactly distinguish itself thanks to its features, such as unforgeability, non-marking in the whole process, traceability, openness & transparency and collective maintenance. The industry proposed an idea of building a chain of supplies with blockchain technology, used to prop up the delivery of medical supplies, in which the relevant information is clearly visible and can be monitored by the whole society. In the goods tracing sector, blockchain can be also combined with AI, IoT and other technologies. For instance, chips can be implanted into the packages of masks and other medical resources to realize the whole-process information tracing in the transfer process, so that users will feel relieved to buy products. Blockchain technology can be also introduced to such links as Internet fundraising, third-party contribution solicitation and network transactions, aiming to effectively crack down on donation corruption, and strengthen social mutual trust.

## (III) Digital twin technology urgently needs to be applied and developed for social management in the anti-epidemic battle

The epidemic outbreak, which originated from the illegal wildlife trading, disposed environmental improvement and supervision issues in the public areas of cities. During epidemic management and control, the "access card" used in grassroots units, such as resident communities, becomes an effective move to fight the epidemic, but its management mode varies in different things and persons, leading to different effects. This reflects regional differences of the social management level. The overall prevention and control level is relatively high in large cities, while the emergency management experience and capability is relatively scarce in counties and rural areas. Besides, elements like personnel, supplies, information and funds flow at a high speed across regions, bringing great challenges to urban mobile personnel management, community management, epidemic management and control and other social governance work. Digital twin technology can help cities deeply integrate urban fundamental data, governmental business data, and real-time dynamic data about healthcare, transport and logistics with urban entities, so as to effectively make up for the deficiencies in traditional urban management means, and elevate the building of new smart cities to new heights. For example, digital means can be used to achieve wildlife sale monitoring, environmental renovation and intelligent alarming in public areas, including farmers' markets, and effectively prevent the sources of infection; digital mapping can be used to carry out real-time visual monitoring and forecasts on influence scope protection for

confirmed and suspected cases; data from information models, IoT-perceiving sensors and Beidou positioning can be used to realize the visualized remote supervision and high-efficient delivery of emergency supplies transportation vehicles; digital twin technology will carry out intelligent, real-time and digital grid management, help with the handling of major emergencies, and significantly improve the urban governance level.

## (IV) Upgrading and updating of anti-epidemic protective products provide more opportunities for in-depth development of AI+ technology

Since the outbreak of novel coronavirus, people have paid much attention to personal protective articles, including masks, goggles and protective suits, and experts have repeatedly introduced the scope of protection and way of wearing for various types of masks, but the general public failed to truly understand the terminology, such as filtration efficiency. Aside from the general public, medical care personnel also find it not easy to put on professional protective devices as there are several layers. It often takes them half an hour to put on and off protective suits, leading to a waste of time. Besides, the wrong wearing may even endanger lives, bringing them huge pressure. The whole society is expecting new intelligent protective products that are easy to wear and boast versatile functions. The development of material technology, along with the introduction of ICTs, including AI, IoT and cloud computing, will find a new direction for the upgrading and updating of anti-epidemic protective goods. For instance, fool-type masks, with the addition of pressure sensors, can automatically judge whether they are correctly worn. Intelligent masks, with the addition of relevant sensors and communication modules, can realize the automatic acquisition and analysis of air data, and judge the source and risk of infection. Particularly, as AI is deployed to the edge side, we can further utilize AI algorithms and platform advantages, including mass data analysis, real-time decision-making and quick response, to achieve quick positioning of virus host, infrared body temperature detection and warning, overall life trajectory analysis of infections, accurate tracking of the history of contact with the crowd and other functions, thus greatly improving the personal protection capability. In the meantime, the huge amounts of data stored in personal devices can better boost the R&D of precision epidemic prevention apparatuses.

## (V) Digital existence in the anti-epidemic battle points out the direction for the application and development of related technologies

Since the epidemic outbreak, Chinese people have been isolated at home, and remote education, online office, online grocery shopping and online traveling have witnessed the rapid development and begun to flourish. However, most people found that the experience such as attention, interaction and social intercourse from on-site office and classroom teaching is hardly replaced by current online services. There are many complaints in the society: "Online office has lowered the efficiency of communication with my colleagues", "Online education has put more burden on parents and our kids, with poor learning effects", etc. Why do people tend to reject the online digital life, which used to be favored in the past? The truth is the difference between the actual performance and public expectations, so the

online experience needs to be further improved. With the deployment of Dual Gigabit network, the technology portfolio consisting of AR/VR, cloud, 4K/8K and AI expects to significantly improve the experience of online services, including office, education and traveling, in the era of digital subsistence. Paired with holographic projection and camera technologies, online meetings expect to bring as three-dimensional and immersive experience as face-to-face discussion with colleagues, and online education will also allow you to feel like the teacher stands beside you. Meanwhile, as 5G has given a boost to the speed of transmission, most contents and computing functions are centered on the cloud. AR/VR terminals will become lighter and thinner and the prices will further decrease, while online contents will become more abundant with more realistic rendering. By then, the life on the cloud will be truly chosen by the public, and the home-related economy will take on the explosive growth.

## (VI) More innovative digital health solutions need to be launched to upgrade Internet medical services

During the epidemic, remote medical products are booming, and online inquiries are quickly growing, but some products have begun to expose defects. For example, remote video diagnosis and treatment can only diagnose, but can't conduct remote examination; online medical expenses can't be reimbursed by insurance companies due to the difficulty of collecting evidence; after diagnosis, patients can't get drugs promptly; etc. Comprehensive digital health products and services based on next-generation ICTs should play a bigger role in this sector. For example, by means of VR+4K panoramic HD cameras, hospital experts can conduct remote examination and testing through remote dermoscopy, stomatoscope, stethoscope and wearable devices; blockchain technology can make remote medical platforms, medical insurance reimbursement platforms, hospitals and pharmacy management platforms get access to the unified cloud platform, expecting to realize real-time settlement, reimbursement, drug delivery and other services of online medical care; it will become a future trend to utilize ICTs, including cloud computing, big data, IoT, 5G, AI and AR/VR, to help doctors and experts across the country to provide patients with remote medical care, online consultation and treatment, rural treatment, drug security, 5G+AI intelligent diagnosis and treatment and other services. This will effectively ease the offline pressure of hospitals, reduce the risk of cross infection, and increase the efficiency, effect and safety of the medical care work.

Next-generation ICTs have begun to rise prominently, played a big role and earned the widespread recognition in the society, but their weaknesses should not be ignored. Focusing on the present, we should optimize and develop related systems, platforms and tools as soon as possible, aiming to win the epidemic prevention and control battle in a scientific and accurate way; looking into the future, we should rely on technical innovation, and fully utilize the new capabilities of ICTs, so as to make more contributions to the country's institutions and mechanisms for the prevention and control of major outbreaks as well as its public health emergency management system.