Electronic Health Card

Case Study

Name of initiative

Electronic Health Card of Tencent Healthcare

Implementing organization

Tencent

Initiative type

Artificial intelligence (AI) system

About the Initiative

The Electronic Health Card is a digital-based solution that enables smart healthcare management for children through the integration of AI, data-analytics, cloud computing and other technologies. By using this e-health card, pregnant women and their newborns can access and benefit from online and offline healthcare services such as health education, medical consultation appointments, AI-led health risk assessments, and personalized healthcare management in an integrated system. The AI platform aims to provide a more equitable healthcare mechanism to help meet children's medical and developmental needs and provide them with better quality of life from infancy to adulthood.

Alignment with UNICEF Policy Guidance on AI for children

The initiative has aimed to:

+ Support children's development and well-being
+ Prioritize fairness and non-discrimination for children
+ Protect children's data and privacy

Location

China

Launched

2019

unicef
for every child

ABOUT THE CASE STUDY

UNICEF published a Policy guidance on AI for children in 2020 and updated it in 2021, with the support of the Government of Finland, and encourages the business sector to pilot this guidance in their field and openly share their findings. This is one of the two case studies developed to document how the UNICEF Policy Guidance on AI for children was used and describes the resulting journey in the form of a case study. They were developed by the Communication University of China (CUC) with the guidance of China Federation of Internet Societies (CFIS) and support of UNICEF China. They were authored by Eleonore Pauwels. Each case study illustrates how the principles of the Guidance can be embedded in AI system, making the whole process of development, design and adoption more child centred.

The AI systems illustrated are produced and owned by the company. UNICEF was not involved in any stage of the process. The reference to a specific company as part of this project does not imply endorsement by UNICEF of the company's policies and practices.

OVERVIEW

With the aim of providing children across China with equitable access to digital health resources and services, the Electronic Health Card was developed at the request of the National Health Commission to enable smart healthcare management for residents through the integration of AI, data-analytics, cloud computing and other technologies. Within the framework of UNICEF's Policy Guidance on AI for Children, the AI platform provides both personalised health risk evaluation and smart medical recommendations and services, which range from pregnancy test reminders, medical diagnostics and assessments, online consultations, and guidance. Efforts have been made to focus on newborns and infants (the first 1,000 days after birth) to provide a more equitable healthcare mechanism to help meet young children's medical and developmental needs.

The Electronic Health Card has been rolled out in cooperation with nearly 1,000 partners – such as health and medical software vendors – to provide health services adapted to different family situations and contexts. The AI-led digital health platform has covered 21 provincial-level administrative districts and more than 2,400 hospitals in China. This model, covering diagnosis screening, daily health management, and the 'QR code' for epidemic prevention, aims to use digital technology to support China's healthcare industry, and improve nationwide hygiene and health practices.

Aligning with the UNICEF Policy Guidance on AI for Children, a goal of this initiative is to use digital innovation to support children's healthy growth and well-being. Efforts have been made to address data privacy and security as one of the primary challenges to prioritize when scaling AI technologies. Furthermore, another priority challenge is to ensure that children across the country with equitable access to digital health resources and services.

CONTEXT AND PROJECT ORIGINS

The international medical journal, The Lancet, confirms that over the past 70 years, China has made substantial achievements in domains such as female reproduction and the special healthcare management of newborns and infants, children and teenagers. The core indicators that reflect health levels in populations of women and children have continuously improved. The maternal and infant mortality has decreased from 1.5 per cent and 20 per cent before 1949 to 0.0178 per cent and 0.56 per cent in 2019, respectively.[1]

However, an array of persistent health issues and trends are still preventing optimal and healthy development for some groups of children, including neonatal diseases (e.g., premature birth and birth defects), neonatal malnutrition, pathological myopia, childhood obesity, psychological conditions, unhealthy dietary behaviours and sedentary lifestyles. Across the country, pervasive inequalities between rural and urban areas remain, preventing families from accessing health information, resources and services and impacting potential for early-diagnosis and treatment, in turn affecting children's physical and psychological development.

To tackle the remaining health disparity challenges, the National Health Commission rolled out the Electronic Health Card with Tencent's technological support in 2018. This card is a digital patient ID application that serves rural and urban residents throughout the country in accordance with uniform national standards. The electronic health card registers and manages – using QR codes – patients' health information generated by medical institutions and related to overall and primary medical care, including preventive immunization strategies as well as specific pregnancy, maternal and infant healthcare. The electronic health card is an AI and data-driven digital means that allows health facilities across the country to recognize one another and share information. It tries to provide urban and rural residents with tools to manage their health conditions and contribute to enhanced health infrastructure in China.

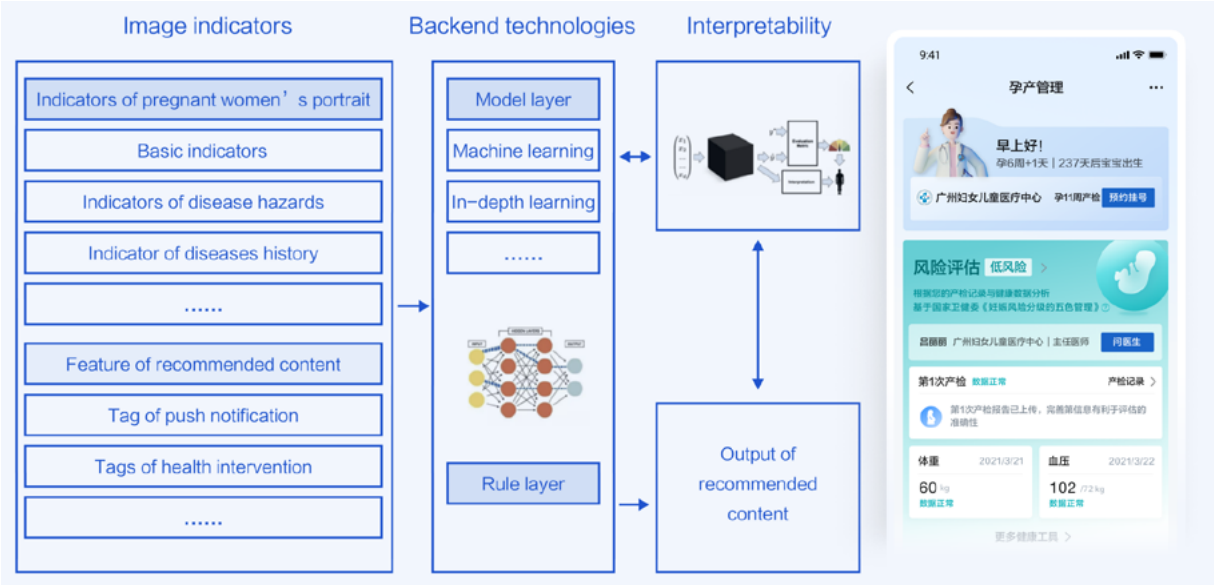
The e-health card offers two services in line with UNICEF's AI Policy Guidance to support child-centred AI to help improve reproductive, maternal and infant healthcare (principle 1, support children's development and well-being). First, the AI smart platform supports prevention by helping detect pregnancy risks, improving the safety of mother and baby during pregnancy and around birth. Specific AI technologies based on image, text and language recognition are used to extract and analyse written information in medical examination reports and reports about medical and discharge history. This analytic capacity is precise enough to analyse insights about foetal development, depth of amniotic fluid, and key health parameters related to pregnancy. By connecting and analysing such datasets, the AI platform generates a custom, personalized knowledge graph/tool (a personalised data summary) for each registered pregnant woman. With its capacity to detect anomalies in datasets and integrate them into diagnoses and risk assessment, the AI platform can evaluate in real time pregnant women's health condition. Second, the smart system will provide life-long health management that can support infants' and children's development through childhood and adulthood. The AI platform will timely remind parents of major milestones and concerns at different developmental stages, for example vaccination.

To ensure privacy protection and data security, specific safeguard mechanisms have been integrated – including methods for distributed data storage, personal authentication and access authorization – within the design of the AI platform.

ABOUT THE AI SYSTEM

The overall architecture of the Electronic Health Card's digital health platform is designed to promote interoperability and data-sharing between medical institutions, hospitals and e-health programs and achieve these connective services through WeChat[2] ID authentication. The integration of digital health services with users' WeChat account aims to facilitate access to medical care: even amid a pandemic, families could benefit from preventive children healthcare (vaccination, diagnosis and treatment) and from an integrated reimbursement process with medical and social insurance.

The user interface of the Electronic Health Card



Electronic Health Card: Risk evaluation of pregnancy and birth

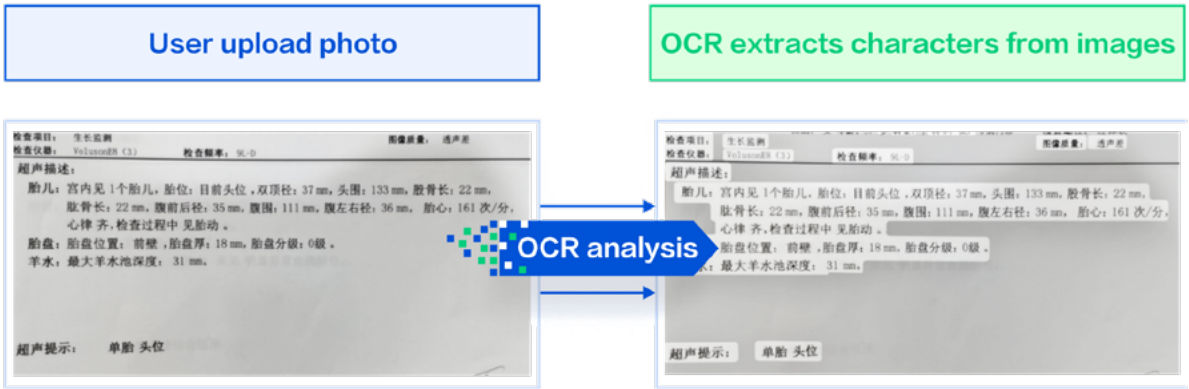
The Electronic Health Card is specifically designed to support reproductive, maternal and infant healthcare by adapting to relevant scenarios, including pregnancy risks detection, children's full life-cycle health management, and children's health management. This design focuses on supporting children's healthy development and is the result of multidisciplinary collaborations that involve experts in AI, clinical medicine, developmental psychology and social sciences. For instance, these experts have assessed several situations where adaptive and personalized care is crucial to serve the needs of pregnant women and mothers of newborns.

Narrowing the gap in different areas: In the post-pandemic era, the Electronic Health Card is required to follow policies and guidelines to expand application scenarios. After investigations and brainstorms, a 'family administrator' was rolled out. This is a new attempt to offer health services for communities. This enables children and parents to jointly use the system, which is a solution to children's inability to operate the system on their own. Today about 82 million people in Hunan province will show their personal health code on WeChat when receiving medical treatment, vaccinations and health services. Efforts are also being made to optimize the front-end and back-end interaction logic, iterate services, and satisfy user demands.

SCENARIO 1
DETECTION OF PREGNANCY RISKS

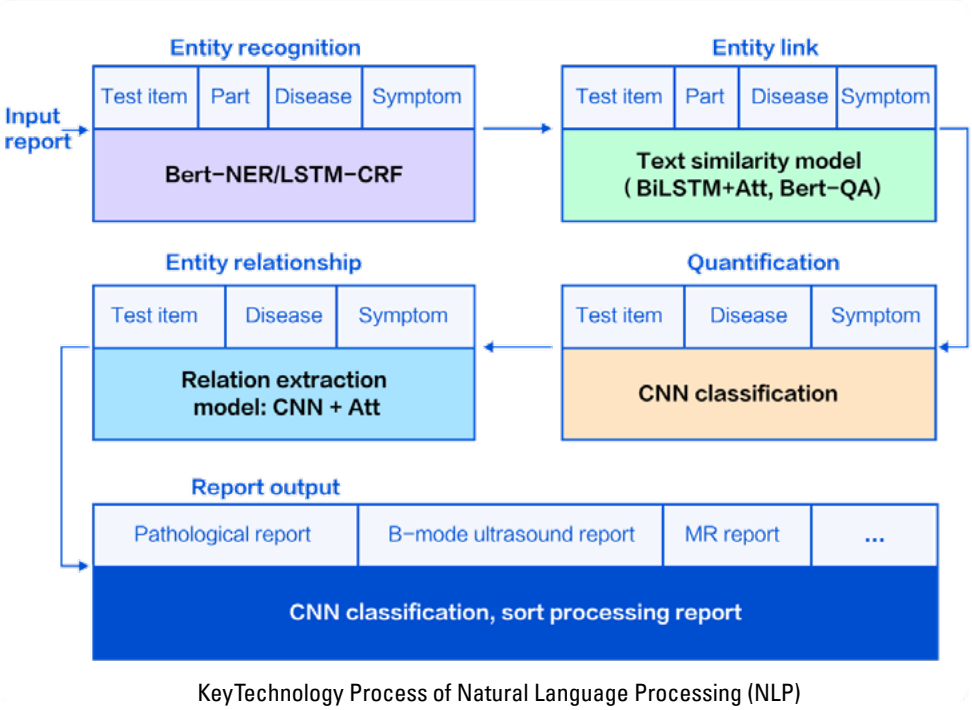
The AI platform operates by analysing the overall health condition of pregnant women and providing personalized health recommendations and health education resources. Specific AI technologies based on image, text and language recognition are used to extract and analyse written information in medical examination reports, including data about medical and discharge history. The AI platform provides a personalized data summary for each registered pregnant woman. It also provides recommendations based on this information and the woman's preferences and concerns.

The AI platform encompasses two crucial technologies: "Optical Character Recognition" technology (OCR) and "Natural Language Processing" (NLP) technology. OCR refers to the text extraction from images. Users can upload medical examination reports provided by medical institutions and hospitals which are diverse, including physical medical examination reports, discharge histories, medical histories, and inspection reports. Physical examination organizations and hospitals have their own page layouts. OCR can scan, copy and photograph all kinds of data. If images are askew or deformed, it can automatically revise and recognize the content.



Example: OCR extracts characters from images

The data structuring, based on NLP, machine learning and deep learning algorithm, can extract, classify, rectify and structure the contents after datafication and put them into a designated standard check item list. Later, the system can figure out omissions and exceptions in a few seconds, and improve the efficiency of machine processing and complete the subsequent calculation based on the fields extracted.



KeyTechnology Process of Natural Language Processing (NLP)

SCENARIO 2
SMART MANAGEMENT OF CHILDREN'S HEALTH CONDITION

In addition to congenital health risks, the electronic health card also pays close attention to children's growth and development after birth. The AI system will timely remind parents of major concerns at different stages, laying a solid foundation for children's lifelong health. For example, children can experience long-term negative health consequences due to overdue vaccination. The Electronic Health Card is equipped with a planned immunization module, which includes comprehensive information and educational resources on vaccines, instructions (the do's and don'ts before and after vaccination), customized vaccination plans, a detailed vaccination history, and the ability to book online appointments. The vaccine query module is provided by Tencent Security Anti-fraud Lab. The integrity of batches of vaccines is ensured by safeguards for privacy and security.

Vaccination of Electronic Health Card

APPLICATION OF CHILD-CENTRED REQUIREMENTS

Aligning with the UNICEF Policy Guidance on AI for Children, the main goal of this initiative is to use digital innovation to support children's healthy growth and well-being. Efforts have been made to address data privacy and security as one of the primary challenges to prioritize when scaling AI technologies. Furthermore, another priority challenge is to ensure that children across the country with equitable access to digital health resources and services.

Supporting Children's Development and Well-Being

Through integration of the WeChat electronic health card, facial recognition and WeChat full-process payment (medical insurance), an 'all-in-one card' system has been developed that covers healthcare management for pregnant women, mothers, infants and children.

The design of the e-health card focuses on supporting children's healthy development and is the result of multidisciplinary collaborations that involve experts in AI, clinical medicine, developmental psychology and social sciences. These experts have assessed several situations where adaptive, digital technologies can be crucial to serve the healthcare needs of children.

In China, to prevent cross infection during the COVID-19 outbreak, hospitals limited in-person visits and the size of crowds within hospitals. Many children and families were confronted with difficulties in accessing medical services and were required to take Nucleic Acid Test (NAT) before entering a hospital. The result was that many children had to postpone their routine vaccination plan. To solve these problems, the Electronic Health Card launched a 'three-color code', allowing online appointment and offline QR code scanning. Hospitals could therefore resume outpatient services as soon as possible. Patients could make contactless appointments to avoid crowding and waiting. When mass testing (NAT) campaigns were necessary, parents could help children claim and show the health QR code and complete identity verification.

Prioritizing Fairness and Non-Discrimination for Children

The Electronic Health Card aims to promote equity so that most children can benefit from lifelong preventive and personalized care. Research has shown how birth defects are closely related to children's access to subsistence, health and development. Lack of access to preventive, optimal healthcare not only increases infant mortality rates and potential disabilities but also exacerbates economic burdens on families and society.

Integrating personal digital services (WeChat and its ID authentication technology) with medical infrastructure, the electronic health card allows substantial progress in interoperability and equitable access: sharing of health data, and real-time analysis of medical diagnostics and treatments is drastically improving the quality and efficiency of services for women and children across regions in China. For instance, this new AI-based model for digital health connects and optimizes a wide range of services adapted to pregnant women, such as personalized health education, pregnancy tests, pregnancy risk evaluation, online appointments with doctors, and other forms of online consultation and guidance, and interventions are provided.

The Electronic Health Card is open to all medical establishments of all levels and regions so that they can be connected. Urban and rural areas are still exposed to unbalanced medical resources with significant differences in diagnosis and treatment. The Electronic Health Card includes registration, application and supervision of medical establishments, which allows the administrative departments concerned to provide general, handy and safe WeChat channels for establishing and issuing cards. Supported by AI technology, the WeChat electronic health card provides free, efficient, equitable and inclusive AI-led digital services for children and families from underserved regions.

Protecting Children's Data and Privacy

Interoperability and connectivity between medical datasets throughout the country are complex challenges. Without digital services, children are required to apply for a physical medical card if they see a doctor in different hospitals, and they must reapply for another card if it is lost. Parents have to queue up, see a doctor, get the report, pay the fees and take the medicine while taking care of a sick child. The electronic health card allows ID authentication and data-sharing across departments, agencies and regions. The information sharing and coordinated services among all prefectural and municipal health organizations at the provincial level is a commitment to implement human-centred healthcare service for more children and families.

Privacy protection and information security is a priority and a challenge for information platforms. The ID authentication can verify the validity of users; the access control can regulate and manage users and their access permission; the cryptographic service can protect data transmission and storage from end-to-end; and the safety and cybersecurity audit can defend and detect intrusions or insidious system bugs. Facial verification technology is used to confirm identities while registering the electronic health card. This not only lowers the technical difficulty but also protects users' data and privacy. Users upload a video (selfie) and photo (an ID card or previous selfie) for comparison via face verification and detecting in vivo[3] (see 1.1 on figure) to determine whether the current user is real.

Facial verification technology mainly consists of:

Static facial verification
without detecting in vivo
the comparison of two photos

A user uploads a selfie and photo (ID card or previous selfie) for comparison to determine whether the current user is real. This includes ID card OCR (alternative) + face comparison.

Video facial verification
detecting in vivo
the comparison of video and photo.

A user uploads a personal video and photo (ID card or previous selfie) for comparison to determine whether the current user is real. This includes IC card OCR (alternative) + facial comparison + detecting in vivo.

RESULTS, FINDINGS AND IMPACT

Creating children-friendly digital health environment:

The Electronic Health Card has been applied at the Guangzhou Women and Children's Medical Center. The electronic health card makes medical services more available. This new model of smart, adaptive medical services that cover diagnosis screening, daily health management, and the QR code for epidemic prevention, has supported China's healthcare industry and nationwide hygiene and health practices. Parents can generate and activate the electronic health card via manual registration, and they can use the Guangzhou Women and Children's Medical Center official WeChat account and self-help terminal and make an appointment for children. Patients can register at nurses' stations by showing their health code, which reduces the need to wait in queues.

LESSONS LEARNED

The Electronic Health Card is based on AI's capacity to connect health resources with more users and promote equitable access to healthcare knowledge, resources and services. An increasing number of children can then be protected, and their rights to health and welfare can be realized. To ensure data privacy and security, the e-health card process relies on distributed data storage and privacy authorization. In the context of the pandemic, Tencent has strived to overcome challenges related to the health crisis by promoting inclusive and responsible AI innovation in the domain of health and medical care. People-centred family health management helps parents and guardians care for children through a sustainable support system. Next-generation AI and digital technologies allow interoperability and connectivity of information and resources, which serves not only developed areas but also underdeveloped and remote areas.

FUTURE CHALLENGES

At present, the promotion of online medical care is confronted with difficulties as the infrastructure for medical care needs to be improved in most areas. In addition, the Electronic Health Card has not yet covered the whole country. Because of lack of interoperability and the digital divide, children's health information, image reports, history of diagnosis and treatment, medication records and so on are not completely shared and connected. In the future, The Electronic Health Card is expected to offer more primary services. It can be defined as a uniform authorization certificate that residents can use to access their e-health files and obtain medical services from family doctors and public hospitals.

Data security and privacy protection are also major challenge for the electronic health card. In accordance with Data Security Law, Personal Information Protection Law and other laws and regulations, it is paramount to ensure data security and management, privacy protection and safeguard patients' medical and personal information. On this basis, ID authentication and verification through the WeChat electronic health card allows residents to consult their personal health files at the hospital or doctor's office while protecting their data. Other remaining challenges include building AI and digital technologies that operate with transparency and meet openness requirements.

More efforts need to be made to ensure that AI and other technologies are better aligned with the UNICEF policy guidance on AI for Children. For example, the blockchain will be used to promote the connectivity and information security and sharing among systems, organizations and areas. These efforts will be conducive to sharing information among medical establishments nationwide, reducing hospitalization costs, increasing efficiency of diagnosis and treatment, lightening medical burdens and improving children's and families' experience. The blockchain technology is characterized by decentralization, tamper-proofing and traceability, which complies with the high requirements for the security of sharing medical data across domains. At present, the basic conditions of the Electronic Health Card have matured in Shandong and Anhui and other provinces. On the basis of local characteristics and conditions, efforts are being made to lay down the scheme to consult electronic health card and blockchain health file electronic medical record among hospitals. With the support of connectivity, health agencies of all levels are mutually authorized to share electronic health files, medical records, inspection results among medical treatment alliances and medical service communities. Such technological advances will enable more children to enjoy AI and protect children's information and privacy.

ENDNOTES

1 Qiao J, Wang Y, Li X. A Lancet Commission on 70 years of women's reproductive, maternal, newborn, child, and adolescent health in China. Lancet. 2021 Jun 26;397(10293):2497-2536. doi: 10.1016/S0140-6736(20)32708-2. Epub 2021 May 24. PMID: 34043953. https://www.sciencedirect.com/science/article/abs/pii/S0140673620327082

2 WeChat is a Chinese instant messaging and social media app developed by Tencent. As of 2022, it had 1.313 billion monthly active users.

3 'In vivo' refers to tests, experiments, and procedures that researchers perform in or on a whole living organism, such as a person, laboratory animal, or plant.