



# Transforming Healthcare through Collaboration

Impact Assessment of Connecting Sichuan Healthcare Program

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# Executive Summary

The people of Sichuan suffered great losses when a massive earthquake devastated their province in May 2008. In addition to significant loss of life, the earthquake destroyed many schools and hospitals located in rural, hard-to-reach areas. Cisco and the Chinese government saw an opportunity for renewal in the midst of the Sichuan destruction - an opportunity to rebuild better, together. That vision for a better future resulted in the creation of a unique public-private partnership, a three-year Cisco corporate social responsibility program called Connecting Sichuan.

Connecting Sichuan was designed to systematically transform healthcare, education, and the workforce through networking technology. The Connecting Sichuan partnership has been a springboard for innovation and an incubator for the development of sustainable, replicable, and scalable technology models in Sichuan and beyond.

Cisco invested over 50 Million USD (about 325 Million RMB) in manpower, networking expertise, cash grants, partner services, and equipment donations to Connecting Sichuan, while China pledged full cooperation at every level of the public sector.

Connecting Sichuan is a public-private partnership that worked to transform healthcare, education, and the workforce in China's Sichuan Province through the power of information and communications technology (ICT). The damage and loss of life caused by the 2008 Sichuan earthquake put tremendous pressure on Sichuan's social and physical infrastructure. Beginning shortly after the disaster and continuing for three years, Connecting Sichuan brought together more than forty partners dedicated to improving people's lives by restoring and renovating vital services in the region.

Connecting Sichuan projects were designed to align closely with the Chinese government's vision and reform policies. A key element for success was collaborating in innovative ways to generate synergies and pursue common aims. By using ICT to connect communities, rural and remote areas in Sichuan

gained access to some of the higher quality services typical in urban areas. The program also focused on building ICT capacity by expanding and enhancing technical education across the region.

The Connecting Sichuan healthcare initiatives aimed to create a collaborative 21st century delivery network that lets healthcare providers interact productively and share resources. The multilayer collaborative network promotes a more holistic approach to treating patients. It also raises the level of care by enabling medical workers in rural areas to receive professional training and guidance from urban health centers.

## The Study's Objectives

This study was conducted to evaluate the effectiveness of key Connecting Sichuan healthcare initiatives implemented on a network-based health collaboration platform. The study focuses on two key solution categories: collaborative technologies (including telehealth and intrahospital collaboration) and the regional healthcare cloud. It evaluates the impact of ICT on healthcare delivery and also looks at the broader influence of the program.

## Impacts of Connecting Sichuan Healthcare Solutions

**Patients receive high-quality care at an affordable cost.**

- In Wenchuan, the average patient saves 45USD (22 percent of the average monthly income) and 5.8 hours by using telehealth care at a distance. Case studies and interviews confirm that telehealth solutions have played an important role in treating complex and life-threatening medical conditions. They are now a critical component of day-to-day clinical care in the communities where they were implemented.

- Eighty percent of physicians and directors at township health centers judge the greatest impact of the solutions to be improved quality of care for patients. (Townships are the base-level administrative units in China, similar to municipalities.)
- Eighty percent of surveyed patients in Chengdu say that the greatest benefit of a network-based smart hospital solution is improvement in the overall care experience. Nurses also note an improvement in their relationships with patients, and a 20 percent increase in their work efficiency.

**Patients are satisfied and see value in the integrated health services provided by mobile clinics.**

- The mobile clinics provide integrated healthcare that complements and extends the coverage of healthcare services in remote regions. Cooperation between health service providers has maximized the impact of the mobile vans.
- Ninety-three percent of surveyed patients are satisfied with the services they have received from the mobile van, which include physical checkups and telehealth services. The convenience and availability of diagnostic equipment are the two most attractive features. More than 80 percent of surveyed patients are willing to pay the same or even higher fees than those currently charged by township health centers for virtual face-to-face consultations in the van.

**Training delivered over the network is a convenient and universally accepted way to improve medical skillsets.**

- 100 percent of surveyed physicians agreed that their medical expertise improved when they received training through collaborative technology (teletraining), contributing to higher quality patient care.
- Teletraining overcomes the challenge of inadequate resources that limit the number of physicians who can

receive regular training, without disrupting the normal provision of medical care.

- The average direct cost savings of using teletraining are significant: approximately 245USD per physician (equivalent to a physician's monthly salary in Wenchuan).

**The regional health cloud has brought about significant improvements in management and clinical care efficiency.**

- Having a single view of health information at township health centers has "enabled a revolution in management" and has fundamentally changed how health bureaus manage and govern township health centers. Instead of conducting tedious in-person spot checks, a health bureau can use the centralized system to track and monitor compliance to guidelines and policies. With the new system, Shifang Health Bureau is able to monitor over-prescription of antibiotics and compliance with the government's essential drug list.
- Ninety-five percent of physicians agree that the applications now provided by the regional health cloud have made healthcare practice more efficient and improved the management of township health centers. By speeding up healthcare processes, these applications allow physicians to focus more time and attention on their patients.

**Clinical effectiveness solutions have benefitted both patients and healthcare workers.**

- Eighty percent of patients agree that clinical effectiveness solutions such as the digital waiting system have made the healthcare experience more convenient and time-efficient.
- Nurses report saving one to two hours a day, or up to 20 percent of their workday, after the new systems were installed. They also felt their relationships with patients improved.

## Results of ICT Improvements

Users are satisfied with new ICT systems and recognize the importance of training to raise acceptance and utilization.

- Implementation of ICT systems has had a major impact at the township health center level. Physicians have experienced significant reductions in their workloads and higher work efficiency.
- Approximately ninety-five percent of directors and physicians agree that current ICT systems meet or exceed the clinical and management requirements of their organizations. Training provided by Connecting Sichuan (more than 3,000 sessions at township health centers) has helped to cultivate greater acceptance of the new solutions as well as improve ICT skill sets.

Connecting Sichuan has significantly advanced the ICT infrastructure and applications in the province.

- The infrastructure and medical applications have improved dramatically in Wenchuan and Shifang, enabling the region to leap forward technologically “10 to 20 years,” according to interview respondents.
- The quality of the equipment and its functionality has improved.
- The level of the applications that township health centers in Shifang can now access via the regional cloud is now above the general level in Sichuan, and even above the national average.

Regional ICT management capabilities now exceed the overall Sichuan level.

- ICT investments are now centrally planned and managed at the regional health level. This has resulted in more effective use of resources and greater consistency across community-level organizations.
- Operating costs have risen relative to pre-earthquake levels. However, directors of township health centers and hospitals agree that costs are reasonable, particularly considering the increase in functionality and positive effect on patient care
- Within Shifang and Wenchuan, there are now centralized hubs of ICT expertise. For instance, the number of ICT resources and degree of skills in Wenchuan People Hospital now

exceed the Sichuan average. Shifang Health Bureau today has six full time employees with professional ICT training, with two individuals having received Cisco Certified Internet Expert (CCIE) certification. Prior to the earthquake, there were only two professionals with limited training and no CCIE experts.

## Key Lessons Learned

- Implementing an advanced infrastructure and applications is useful even in rural areas. While healthcare organizations may choose to deploy different solutions at different stages, a reliable and stable infrastructure forms the basis for expansion of applications and greater usage. Local health bureaus in both Shifang and Wenchuan are planning to broaden their use of the network to further drive improvements in healthcare.
- It is important to consider the financial and skills limitations that face healthcare organizations in rural areas. Cost constraints can be overcome by employing less expensive alternatives - for example, making use of bandwidth from local cable TV bureaus instead of relying on more expensive commercial telecom carriers. The lack of computer experience and ICT skills in rural areas can be remedied by network-based training.
- When implementing advanced infrastructure and applications in rural areas, managing the human factor is a major prerequisite for success. People's skillsets rather than financial considerations were the major challenge to the adoption and sustainability of the ICT solutions. Another important obstacle was a lack of ICT skills and familiarity with collaboration technologies.
- Training was a critical success factor. Basic training targeted at end users helped to increase awareness and add to the proficiencies required to use the system and applications effectively. It was also important to develop skills for a group of advanced users. Teaching core users how to plan, manage, and operate the network is fundamental for long-term sustainability.
- The benefits of collaboration proliferate when multiple stakeholders are integrated at multiple locations. The installation of a multipoint telehealth network has made a significant difference for both patients and physicians in Wenchuan.
- High-quality video imaging has proved crucial for top-level care in both Shifang and Wenchuan. While efforts should be made to consider innovative alternatives to more expensive

telecommunication network equipment and services, the quality of the video cannot be sacrificed without affecting the healthcare experience.

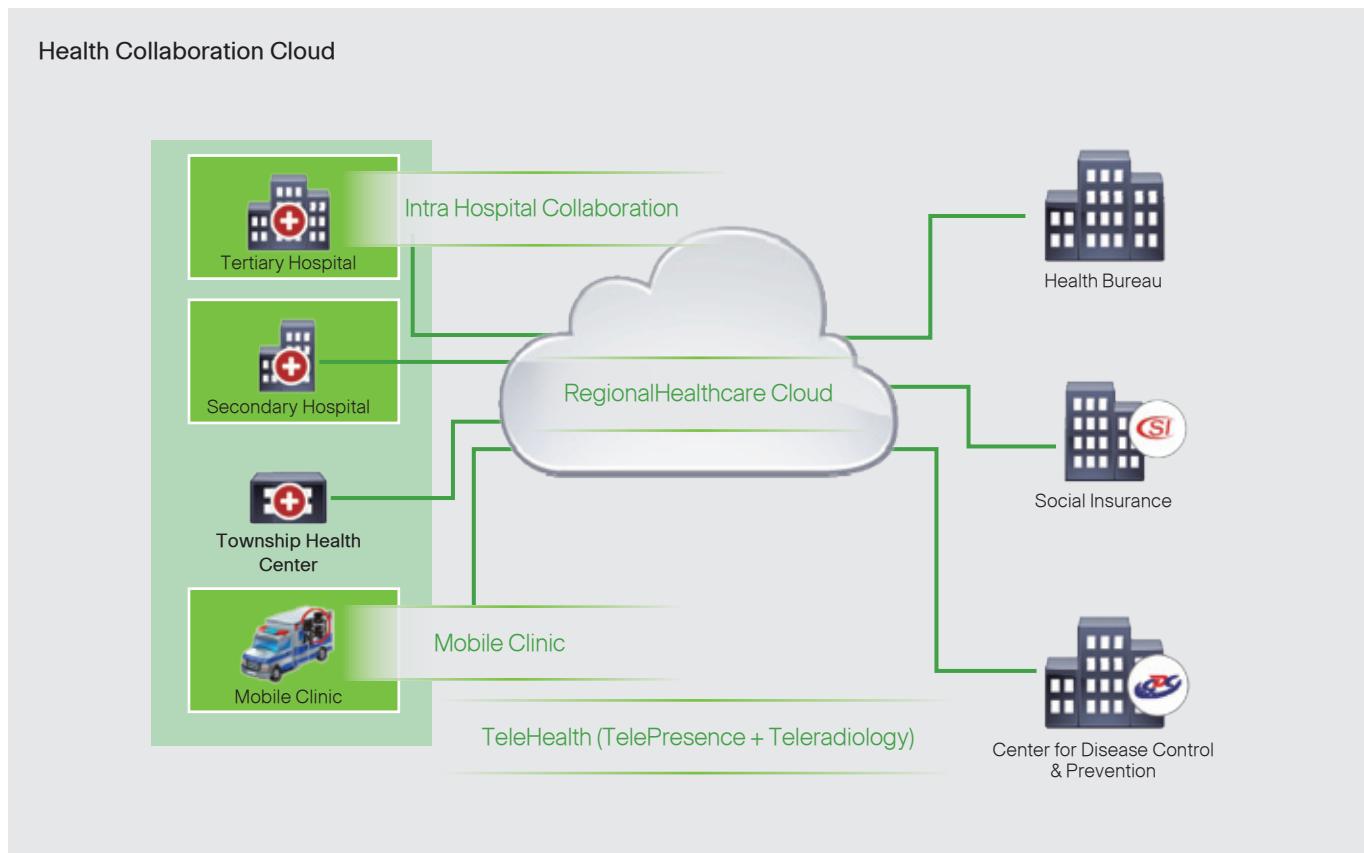
- A focus on improving physician-to-physician interaction has a broader impact on care than a focus on physician-to-patient interaction. A train-the-trainer approach has increased expertise in mental health and rehabilitation care, among other areas.
- Governments are now consolidating functions to reduce duplication and save money. In China, this takes the form of initiatives such as integrating teleconsultation charges into social insurance. Connecting Sichuan solutions can help further these initiatives.
- Leading-edge ICT has the potential to transform hospitals. Prior to the earthquake, Wenchuan People's Hospital was a struggling community-level (Tier 2B) hospital primarily serving residents in Wenchuan county. Implementation of ICT solutions has strengthened the hospital's ability to provide better care by reducing waiting time and integrating records with the social insurance system. Now recognized

as a regional (Tier 2A) hospital, Wenchuan People's Hospital is able to attract patients from outside their traditional service area by offering new services such as open-heart surgeries, gallbladder surgeries, and post-heart-surgery rehabilitation. Previously, these services were available only in academic medical centers (Tier 3A) in larger cities.

- Connecting Sichuan serves as a model for healthcare reform initiatives by demonstrating the value of regional health networks and telehealth in community-level care. This model has been recognized and may be duplicated in many areas of China.

## Implementation of Collaborative Technologies

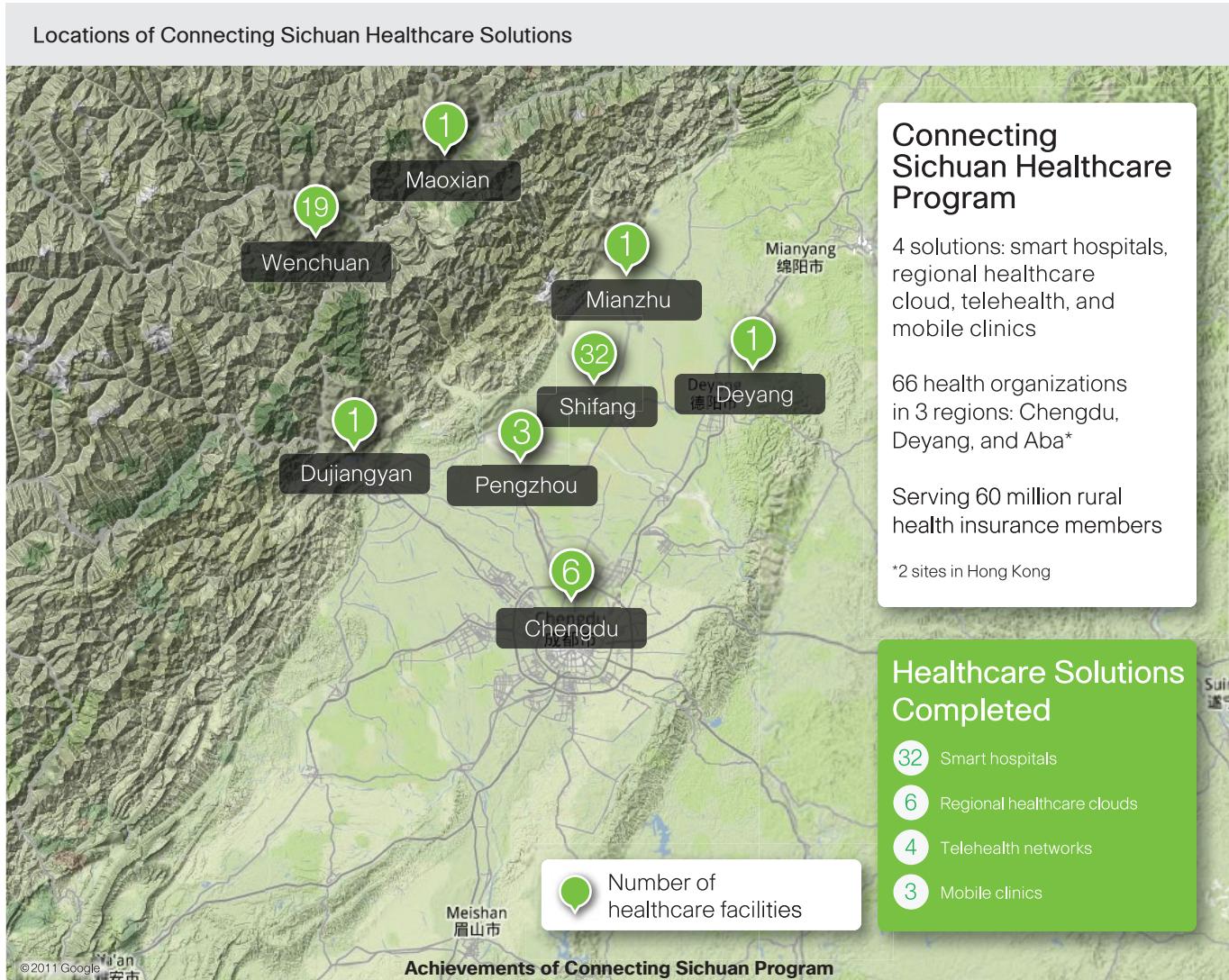
The Connecting Sichuan healthcare initiatives were designed with one paramount principle in mind: collaboration. Unlike traditional healthcare delivery models, the Health Collaboration Cloud enables interactions and resource sharing among a broad range of caregivers and other medical workers, at several levels of the healthcare hierarchy. The diagram below depicts the reach of the cloud.



This collaborative health platform promotes a more holistic approach to treating patients, ranging from preventive and wellness care to large-scale public health programs such as epidemic control. It also connects rural healthcare workers with caregivers in urban centers, making it easier for them to receive clinical guidance and professional training. Collaboration solutions have been implemented within hospitals, between hospitals, and across regions. All of these solutions are connected to each other through the

cloud, enabling exchange and flow of information, data, and knowledge.

The map below shows the locations for Connecting Sichuan healthcare solutions within Sichuan Province. The province consists of three autonomous prefectures, 18 prefecture-level cities, and one sub-provincial city, Chengdu. Wenchuan, a county within the western Ngawa Tibetan and Qiang Autonomous Prefecture, was the epicenter of the 2008 earthquake.



Connecting Sichuan made infrastructure and technology investments in 66 healthcare organizations, six regional healthcare data centers, two operations centers, an emergency response center, and an ICT training center. Healthcare facilities equipped with Cisco technologies are used by more

than 7,000 practitioners, supporting approximately 15,000 inpatients and 280,000 outpatients each month. Data centers support 60 million rural-cooperative medical insurance records and more than 400,000 electronic health records.

## The Study's Focus Areas

Connecting Sichuan program initiatives, which included solutions for diverse urban and rural environments and multiple organization levels, were designed to address factors such as availability of funds, quality and accessibility of care, and broader regional needs. Three population areas were selected representing a variety of economic and demographic profiles and existing healthcare infrastructures: Wenchuan, Shifang, and Chengdu. This program assessment focuses on these localities.

Wenchuan County exemplifies regions in rural China where high-quality, affordable healthcare services are often in short supply because village populations are widely dispersed and income levels are relatively low. Even before the earthquake, the ICT infrastructure in Wenchuan hospitals and township health centers was practically nonexistent due to financial constraints.

Shifang is a rapidly growing city with a strong economy supported by a solid industrial base. Local government entities have made significant investments in healthcare, offering better quality and accessibility than a typical rural

region. Larger hospitals had simple ICT infrastructure and applications in place, but there was a lack of technological integration in the region.

Chengdu is a large city in China that has a powerful economy and accounts for an increasingly large portion of China's GDP. Chengdu and other large cities support secondary and tertiary hospitals as well as thousands of community health centers and community health stations. Quality and availability of healthcare is relatively high, and medical costs can largely be reimbursed by social insurance for urban residents. However, even though leading hospitals have more advanced ICT infrastructures and systems in place, there is a lack of collaboration within hospitals and limited integration of healthcare providers citywide.

Chinese medical facilities are categorized into three tiers. There are also three class levels within each tier (C, B, and A). The lower-level Tier 1 facilities are called township health centers in rural areas and community health centers in cities. Tier 2 secondary-level hospitals include Tier 2B community hospitals and the larger Tier 2A regional hospitals. Tier 3 designates hospitals that offer the highest level of care, with Tier 3A made up of the top teaching hospitals in the country.

Comparison of Three Sichuan Focus Areas			
	Wenchuan	Shifang	Chengdu
Description of Region/ Municipality	Rural and remote villages in Aba County	Rapidly growing and emerging county-level city in Deyang municipality	Large growing municipality that includes suburbs, satellite cities, and rural areas; capital of Sichuan
Area (square km)	4,084	864	12,390
Population (1,000s)	106	430	14,047
GDP (billion Yuan)	3.36	13.58	555.1
GDP per capita (Yuan)	30,968	32,700	39,539
Average annual income (RMB)	3,970 (rural) 14,950 (urban)	7,324 (rural) 17,300 (urban)	8,205 (rural) 20,835 (urban)
Health Facilities			
Tier 1 (community level)	13 township health centers	16 township health centers	More than 4,000 primary level community health centers
Tier 2 (secondary level)	6; largest is Wenchuan People's Hospital	9; largest is Shifang People's Hospital	69
Tier 3 (Tertiary level)	0	0	15; largest is West China Hospital (4,300 beds)

Source: Wenchuan, Shifang, and Chengdu government statistics

The Connected Sichuan assessment included these types of healthcare solutions:

- **Intrahospital solutions:** Networked applications requiring installation of high-bandwidth, medical-grade networking equipment, including clinical effectiveness solutions. For example, at the newly built Chengdu Women's and Children Hospital, digital media solutions were integrated with traditional clinical ICT applications, enabling collaboration between departments, staff, and patients.
- **Interhospital solutions:** Networks linking telehealth centers equipped with Cisco TelePresence® video conferencing technology that enables teleconsultations, teletraining, and teleradiology. These solutions also include TelePresence capabilities in mobile clinics.
- **Regional solutions:** Cloud-based infrastructure that taps into a centralized data center to implement a wide area network connecting townships and villages in rural areas to full-service hospitals and the Department of Health. In Shifang, a regional healthcare cloud provides all the chief clinical care and management applications used by both township health centers and the local health bureau.

In gauging the effectiveness of each solution, the evaluators considered how the solution was used, the actual benefits, the users' level of satisfaction, and the impact on the healthcare system. The evaluation took into account multiple perspectives, including those of patients, physicians, and administrators. Case studies, operational data, and user surveys were used to conduct the evaluation.

Three key aspects of healthcare ICT implementation were evaluated:

- **End user perspective and satisfaction:** The aim was to understand how the perception of ICT in healthcare has changed among users. This includes how they perceive the benefits of ICT and whether they are inclined to make additional technology investments. Usability and skills development was also considered.
- **Improvements in technologies:** The study looked at infrastructure efficacy in terms of hardware installation and connectivity, and also in terms of clinical care and management applications.
- **Improvements in ICT management:** This includes assessing how organizations plan, invest in, and operate ICT. To measure sustainability, the study considered ICT operating costs and the current level of staff training.

## The Study's Methodology

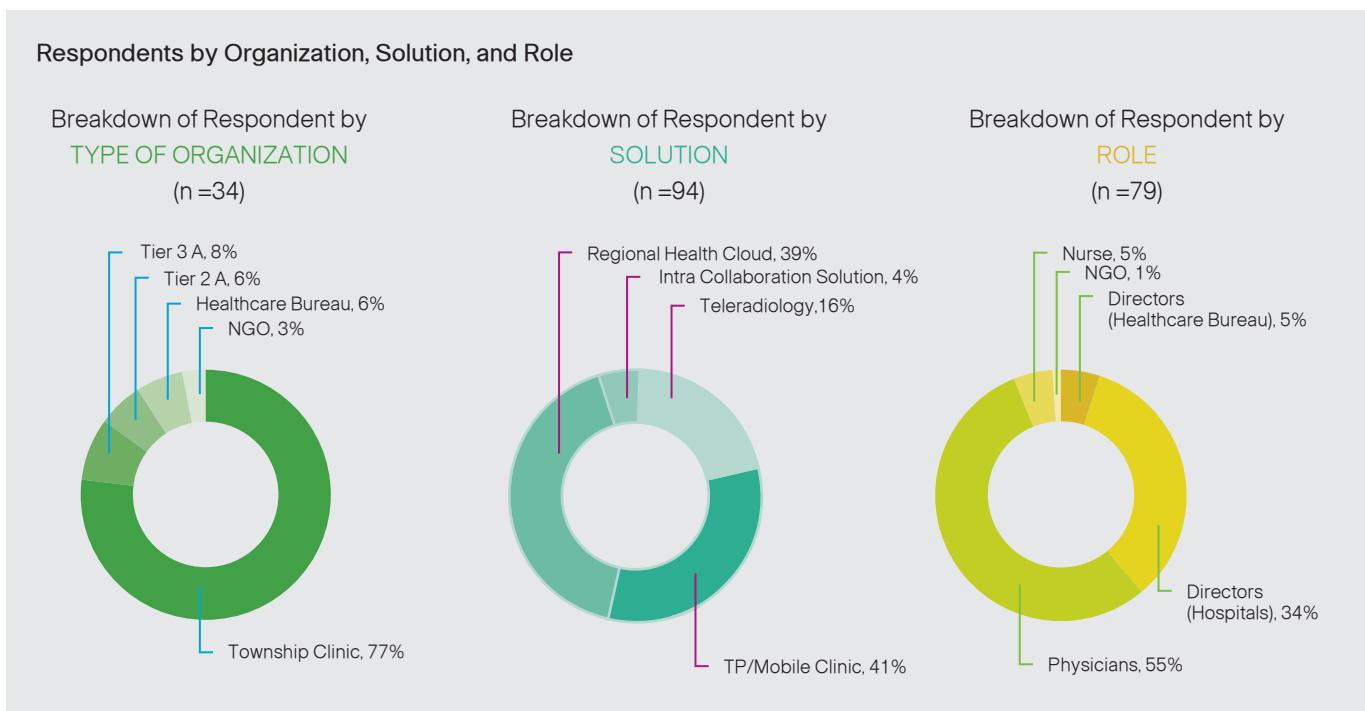
The assessment methodology combined quantitative and qualitative data collected from a wide range of stakeholders. Eighteen one-on-one interviews were conducted with physicians, nurses, directors, hospital administrators, and representatives of government health bureaus and non-governmental organizations (NGOs). In addition, five surveys were conducted involving 70 medical professionals at 34 different sites and 238 patients in Wenchuan and Chengdu. The table below gives a summary of these surveys.

Breakdown of Surveys by Respondent and Objective		
Survey Name	Number of Respondents	Main Objective
1. Organization survey	28 (Wenchuan 12; Shifang 16)	Collect key operational statistics about healthcare organizations before and after the earthquake
2. Director survey	27 (Wenchuan 11; Shifang 16); includes township health center directors and hospital presidents	Assess the impact and usage of ICT technology and understand strategic challenges and directions for healthcare organizations
3. Physician survey	43 (Wenchuan 22; Shifang 21)	Understand the impact and usage of ICT technology
4. Mobile clinic patient survey	148 (Wenchuan)	Evaluate usage, satisfaction, and sustainability level of mobile clinic services
5. Chengdu patient survey	70 (Chengdu Women's and Children's Center)	Evaluate satisfaction and impact of smart hospital solutions

Primary research was augmented by secondary research that included collection of patient case studies, and reviews of publicly released reports and speeches from hospitals and health bureaus. Benchmarking research was also conducted on major trends in ICT solutions. Operational data

was collected from hospitals and health bureaus and used to evaluate usage and impact.

The chart below shows how the study's respondents break down according to type of organization, healthcare solution, and professional role.



# Effectiveness of Collaborative Solutions

Collaborative solutions can be categorized into interhospital solutions that include telehealth and mobile health, and intrahospital solutions that promote clinical effectiveness between departments. The study evaluated the interhospital solutions implemented in Wenchuan and Shifang, and the intrahospital solutions implemented in Chengdu.

## Objectives and Scope of the Telehealth Solutions

The study focused on evaluating networks in Shifang and Wenchuan, namely the Shifang teleradiology network and the Wenchuan telehealth network that interoperates with the Sichuan–Hong Kong rehabilitation network.

The Shifang teleradiology network is relatively small in scale and specific in scope, linking six township health centers to the largest secondary hospital in Shifang, Shifang People's Hospital. Physicians use the network mostly for teleconsultation - collaborating at a distance. The Wenchuan telehealth network includes fixed Cisco TelePresence® sites in all 13 township health centers and in Wenchuan People's Hospital. It also includes mobile clinics equipped with TelePresence. This network is integrated with the Sichuan–Hong Kong rehabilitation network that links multiple sites in Hong Kong, Chengdu, and Wenchuan, plus mobile clinics. Together, these two networks are used for teletraining (education at a distance) as well as teleconsultations.

## Distinct Features of the Telehealth Solutions

The greatest obstacles to the provision of quality healthcare in China, as well as in many other countries, are a shortage of healthcare resources and the distances that separate healthcare providers from patients and other providers. With advances in ICT technology, telehealth has become a powerful tool for overcoming these obstacles. In the past year, the Chinese government has launched 12 national telemedicine pilot projects for Ministry of Health (MOH) affiliated hospitals,

each supporting one province in Midwestern China. The government also intends to launch 22 pilots linking Tier 3A (highest level) hospitals with five county-level hospitals.

While pilots have been implemented in several leading hospitals, actual usage is less than 20 percent of full efficiency. Major factors that limit usage include:

- High network operating costs make using the solutions too expensive.
- Insufficient bandwidth for video and image transmissions adversely affects image quality and the user experience.
- Closed systems only permit site-to site interaction, rather than supporting open multiple-site information sharing.
- Lack of legal and policy support can discourage usage. For example, there is no clear policy on medical responsibility for misdiagnoses or inappropriate treatment.

When Connecting Sichuan partners designed the telehealth solutions, they made an effort to avoid the limiting factors described above. They did this by:

- **Working closely with low-cost network partners:** High network bandwidth is critical for quality telehealth. But affordability is a major concern in many regions of China. Rather than pay for costly virtual private networks (VPNs) offered by traditional telecommunication companies, the health bureaus in Wenchuan and Shifang formed long-term partnerships with local cable TV companies that provide optical-fiber network connections to communities at lower costs.
- **Leveraging high-quality video:** To enhance the user experience and increase physicians' willingness to use telehealth, a high-resolution Cisco TelePresence® system was implemented at all the key Connecting Sichuan healthcare sites in Wenchuan and Shifang. The lifelike TelePresence experience helped win over both caregivers and patients to the telehealth solutions.

- Setting up a multiple point-to-point network:** Unlike traditional point-to-point communications involving two end points, the telehealth network in Wenchuan integrates multiple healthcare tiers and multiple points of access (nodes) within those tiers. Besides stationary nodes, the network also includes TelePresence nodes in mobile clinics to provide additional flexibility and geographic reach.
- Focusing on physicians-to-physician interactions:** Though physician-to-patient relationships are certainly important, many of the Connecting Sichuan healthcare initiatives concentrated on enabling medical professionals in rural areas to provide better care by giving them free access to medical experts at central medical facilities. Patients in turn benefit from these teleconsultations, even while appropriate guidelines are still being defined and implemented.

## BUILDING A SCALABLE TELECONSULTATION MODEL

In a traditional teleconsultation system, patients receive advice and treatment from a remote physician who is typically located at a tertiary hospital, with the physician-to-patient interaction enabled by collaborative technology. While this model allows the patient to obtain expert care not available locally, it can be limited by bandwidth restrictions and the caseload of the remote physician.

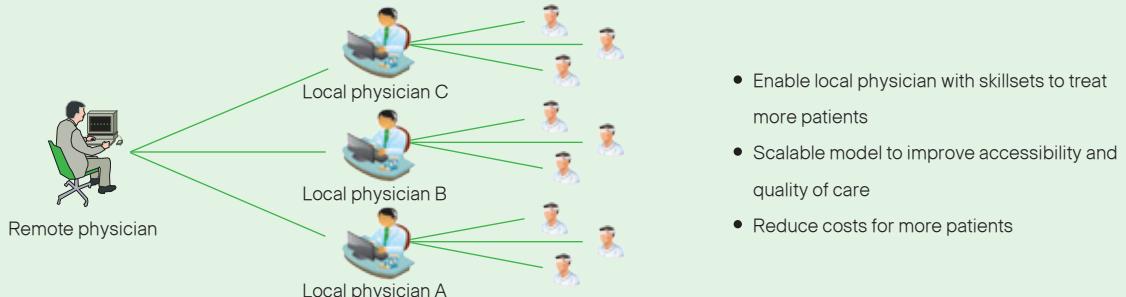
The model implemented by Connecting Sichuan focuses on a physician-to-physician interaction. The remote physician provides guidance and coaching to the local physician, but does not deliver care directly to the patient. This approach improves the skills of the local physician and makes it possible for that doctor to see more patients than the remote practitioner would have been able to serve. It promises to make care more accessible while at the same time reducing costs.

### Scalable Teleconsultation model

Traditional Teleconsultation model: Remote physician provides services and is responsible for patients



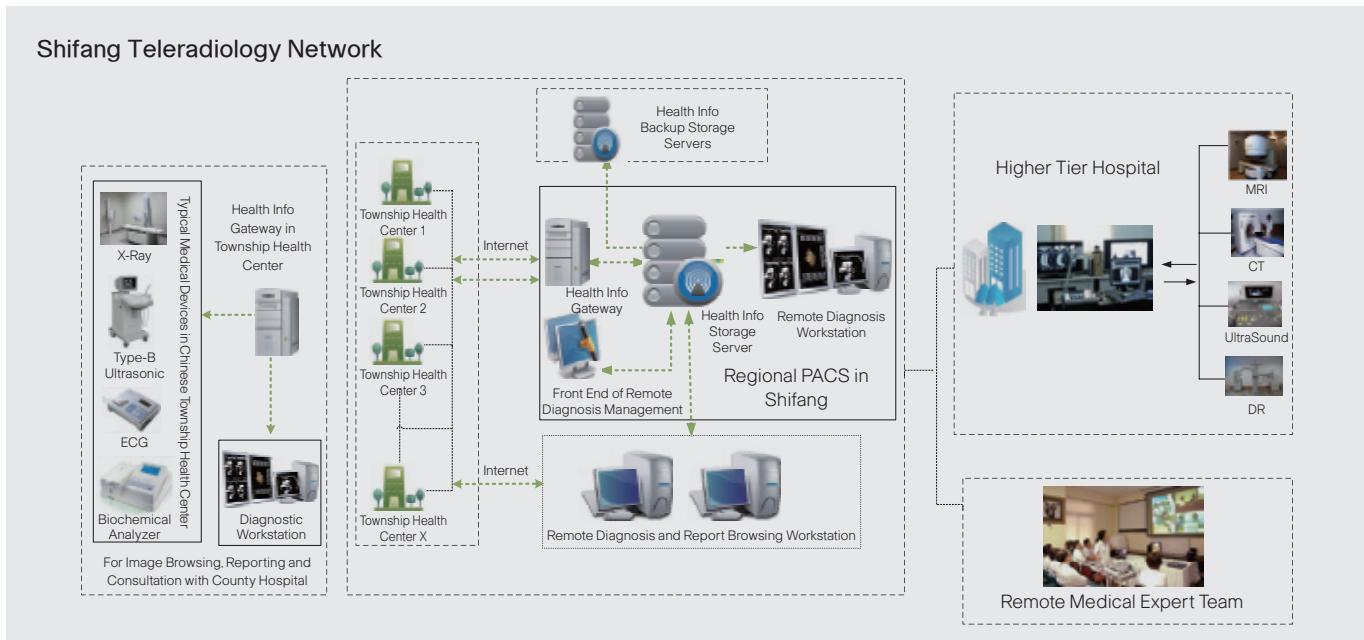
Scalable Teleconsultation model: Local physician is empowered to provide services and take responsibility for patients



## Teleradiology Successes in Shifang

The teleradiology solution in Shifang makes use of a healthcare cloud that links multiple township health centers

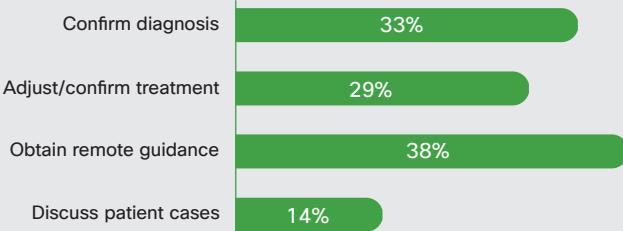
and the Shifang People's Hospital. The diagram below depicts this cloud deployment.



Here is how the teleradiology application works. When a doctor at one of six township health centers needs an expert to interpret medical images, the physician uploads the image files onto a centralized server and submits a request for a consultation. A senior doctor at the central Shifang People's Hospital receives an automatic SMS alert to review the case. The doctor at Shifang People's Hospital can provide comments through the system or, for more complex cases, initiate a real-time interactive conversation via a high-resolution video phone line with simultaneous interactive sharing of images. Since November 2010, more than 1,300 teleradiology sessions have been conducted in this manner.<sup>1</sup>

Physicians use the teleradiology system to receive expert guidance, confirm their diagnoses, and adjust/confirm treatment programs. The graph summarizes the primary reasons for usage. (Respondents could choose multiple reasons.)

### Reasons for Using the Teleradiology System



Source: Shifang physician survey, 2011 (n=21). Multiple choices allowed.

Physicians find the system to be most useful when patients cannot physically travel, or when they face a complex medical condition the doctor has not seen before. The system is especially effective for diseases that are typically diagnosed by x-rays, such as respiratory diseases and bone disorders. Physicians in township health centers are comfortable using x-rays to diagnose common conditions such as bone fractures.

<sup>1</sup> Source: Data from Shifang Health Bureau, November 2010 to September 2011.

But they lack expertise diagnosing complex lung disorders such as emphysema and pneumoconiosis (commonly known as miner's lung) and less common bone disorders. They also tend to need assistance in monitoring the healing process when bones and joints are involved.<sup>2</sup>

A case study involving Hongbai township health center illustrates the time and cost savings that can be achieved with teleradiology. Of the six townships served by the cloud, Hongbai is farthest away from Shifang People's Hospital. Hongbai township health center sees a high incidence of traumatic injuries such as bone fractures because of the mountainous terrain and the mining operations that take place in the area.

Prior to the earthquake, if local doctors were unsure of a diagnosis after viewing x-rays, the patient had to spend a day travelling to Shifang People's Hospital, often staying overnight in the city. Patients often incurred additional out-of-pocket medical costs because the reimbursement rate is lower for city-level hospitals compared to local township health centers. In cases where patients required long-term treatment, incremental medical costs could become significant. In emergencies or when the patient needed assistance, Hongbai township health center had to assign a doctor to accompany the patient to the hospital. This not only raised costs, it also kept the doctor from providing medical care to other patients.

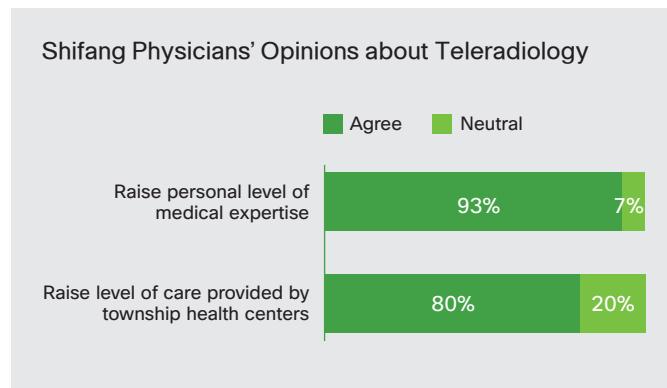
With the teleradiology network in place, local doctors at Hongbai town can now quickly contact experts in Shifang People's Hospital to confirm diagnoses or get directions for appropriate treatment without requiring either patients or physicians to travel. Successes have included diagnosing a rare bone tumor in a 12-year-old boy, and confirming treatment for a complicated respiratory disease identified through x-rays. As Director Lai Shipeng of Hongbai township health center remarked, "In my mind, the teleradiology system is the most beneficial application implemented after the earthquake. It saves a lot of time and is very economical for patients."

The assessment survey asked physicians to estimate the time and costs that are saved by using the teleradiology system. According to the respondents the average time saved per patient was 6.2 hours, while the average cost savings for each patient was estimated at 370RMB (57USD). This includes transportation fees (61RMB), accommodation fees (88RMB),

meals (68RMB) and other expenses (154RMB), but excludes incremental out-of-pocket costs. The direct cost saving is substantial, approximately 26 percent of the average monthly income of a Shifang resident.<sup>3</sup>

More than 93 percent of the surveyed physicians<sup>4</sup> agreed that the teleradiology network has increased their personal medical expertise, and 80 percent found that it has raised the quality of care provided by township health centers. A physician noted that patients are now more confident and willing to be treated locally because doctors with more training and experience are providing guidance and advice. As a result, local doctors have been able to build credibility and trust among their patients.

The graph below summarizes the physician survey findings.



Eighty-six percent of surveyed physicians agreed that they like using the system, mainly because the quality of imaging is high and it facilitates interaction between physicians.<sup>5</sup> The doctors opined that the network should be promoted more to increase use and acceptance. As one physician put it, "You will only use the system if you are aware of the benefit."

Shifang Health Bureau recognizes that medical professionals need to change their thinking regarding how they conduct patient consultations and interact with other medical colleagues. The bureau is now formalizing and clarifying policies that set forth medical responsibilities - for example, whether or not patients will be charged for teleradiology services and how the fee will be split among the healthcare providers. New policies will be necessary if the teleradiology network is to be integrated into everyday clinical care. The bureau plans to install and implement the teleradiology solution at all 17 township health centers.

<sup>2</sup> Source: Interviews with Shifang physicians

<sup>3</sup> Source: Deyang government website <http://www.deyang.gov.cn/>

<sup>4</sup> Source: Shifang physician survey (n=21)

<sup>5</sup> Source: Shifang physician survey (n=21)

## Teleconsultations and Teletraining in Wenchuan

Two important aspects of telehealth are teleconsultation and teletraining. Connecting Sichuan created pilots to test the efficacy of both technologies in Wenchuan.

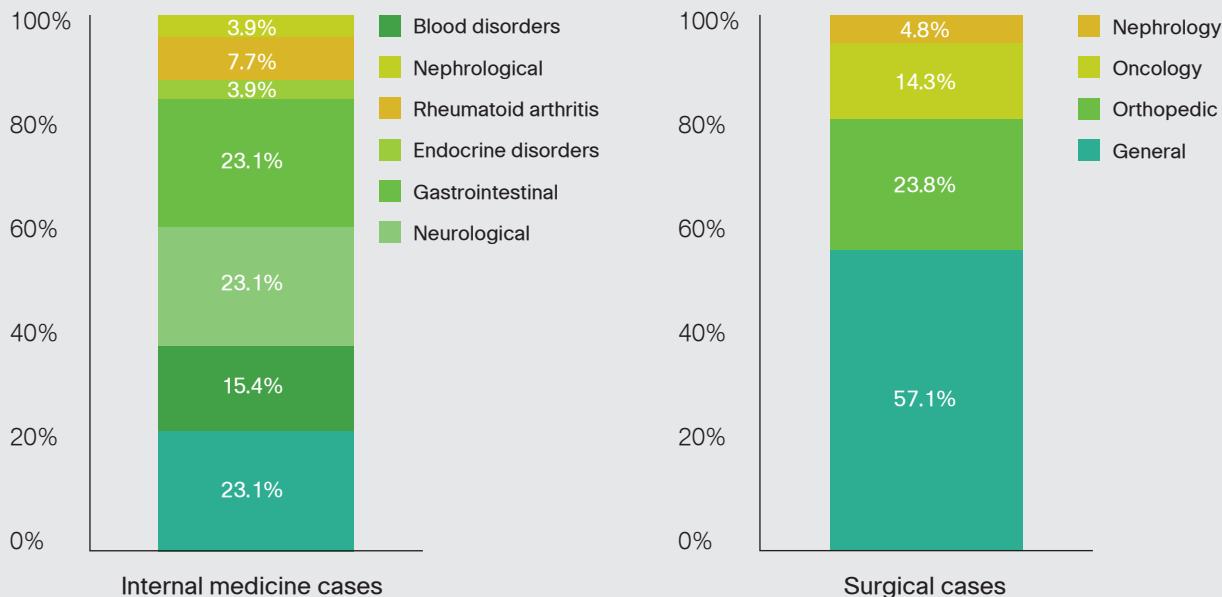
### A Teleconsultation Option for Difficult Cases

The telehealth solution is being used by all levels of healthcare organizations within Wenchuan. Wenchuan People's Hospital serves as the hub for teleconsultations within the network. The study found that half the teleconsultations take place between

Wenchuan People's Hospital and township health centers, while the rest are conducted with tertiary hospitals in Chengdu and Hong Kong.<sup>6</sup>

The majority of physicians note that teleconsultations are most suitable for complex chronic diseases such as coronary heart diseases that require long term treatment. Other physicians recommend teleconsultations for rare, critical, or severe medical conditions that require urgent diagnosis and treatment, or for cases where the patient is paralyzed or severely injured and cannot travel safely. The chart below shows how the teleconsultations break down at Wenchuan People's Hospital.<sup>7</sup>

Breakdown of Teleconsultation Cases



Source: Data from Wenchuan People's Hospital (includes teleconsultations with township health centers and tertiary hospitals).

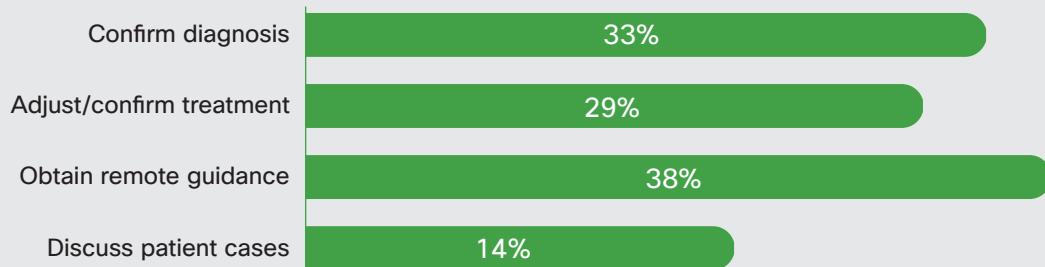
In 2009, most teleconsultations at Wenchuan People's Hospital involved mental and physical rehabilitation. Today,

however, it is used for many medical purposes. The graph below provides an overview.

<sup>6</sup> Source: Data from Wenchuan People's hospital

<sup>7</sup> Source: Data from Wenchuan People's hospital

### Purposes of Teleconsultations



Source: Data from Wenchuan Physician Survey (n=22). Multiple responses allowed.

## TELECONSULTATION CASE STUDIES

### 1. Diagnosis of a rare case of placenta accrete.

A 37-year-old Qiang ethnic patient was transferred to Wenchuan People's Hospital when the patient suffered a pregnancy complication. She experienced major blood loss when her placenta remained in the uterus and could not be taken out by clamps.

Despite working as a physician for twenty years, the ultrasound doctor had never seen such a situation and was uncertain about the diagnosis and appropriate treatment. With the consent of the patient, a teleconsultation was set up with the chief doctor in the Obstetrics and Gynecology Department at Sichuan People's Hospital. After reviewing the patient's history, physical condition, and ultrasound results, the chief doctor helped to confirm the placenta accrete diagnosis. He proposed using drugs to control bleeding and antibiotics to prevent infection. However, if the patient suffered additional blood loss, an emergency hysterectomy would be required. The patient responded to the drug treatment and was discharged 12 days later.

When interviewed, the patient indicated that the teleconsultation system was very useful because the continual blood loss would have required a blood transfusion that her family could not afford. Timely intervention helped her to recover and regain her health.

### 2. Confirming treatment for complex gout arthritis.

An 90-year-old male patient suffering from acute arthritic pain due to gout was admitted to Wenchuan People's Hospital. The drug treatment to control secretion from the nodules and to control pain was not effective. The patient also suffered from other medical complications, including coronary heart disease and chronic bronchitis. His condition worsened as the creatinine level in his blood rose rapidly.

Although doctors at Wenchuan People's Hospital were certain of their diagnosis, they were hesitant to use steroids because of the patient's age and medical complications. During an hour-long teleconsultation, experts at Sichuan People's Hospital shared their clinical experience and determined that using certain steroids would be an effective yet safe treatment. The patient's condition stabilized after he received the recommended treatment.

The patient's family members stated that the teleconsultation had greatly increased convenience of care. The patient's children were reluctant to transfer their father to Chengdu because they were concerned about his ability to tolerate a long drive exacerbated by emergency road closures. It was also difficult for the children to leave their jobs to care for their father in Chengdu. The teleconsultation thus proved beneficial to both the patient and his family.

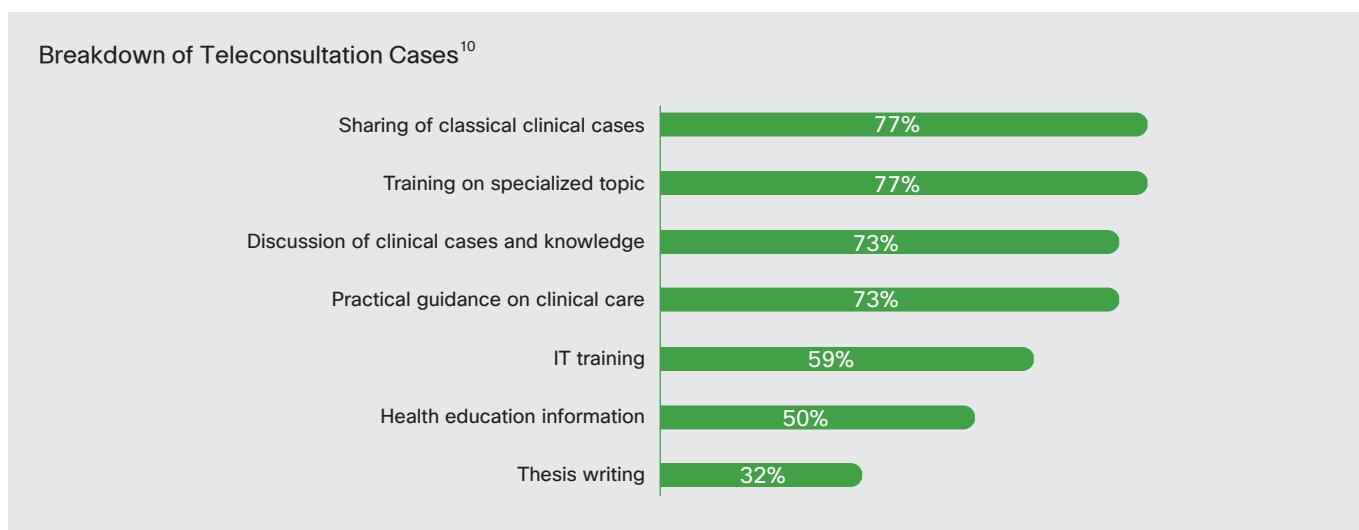
The study asked physicians to estimate time and cost savings for patients using the telehealth system, compared to a conventional system. The average time saved per patient was 5.75 hours, and the average cost saving was 280RMB (45USD) per patient.<sup>8</sup> These costs include travel and lodging expenses (from township health centers to Wenchuan People's Hospital), but exclude incremental medical costs. For comparison, the average income of an urban resident of Wenchuan is 1246RMB (191USD) per month.<sup>9</sup> Eighty-five percent of surveyed physicians agreed that teleconsultation has reduced costs for patients and 80 percent judged that the solution has improved accessibility of care.

### Teletraining for Better Healthcare Outcomes

Prior to the earthquake, Wenchuan, like other rural areas in China, lacked qualified medical professionals. There was an urgent need to train these professionals to raise the quality of care. However, aside from budget constraints, it was difficult to find a way to provide regular and frequent training for all medical professionals located in rural and remote areas.

Connecting Sichuan telehealth technology enables more physicians to receive training without interrupting the provision of clinical care at their home locations or at the locations where the trainers reside. For instance, prior to the earthquake, Longxi township health center in Wenchuan was only able to send a maximum of two physicians for training outside the county annually. With the telehealth system in place, all six physicians can now receive training on a regular basis. According to Ming Yi, Deputy Director of the Wenchuan Health Bureau, "In an area where medical resources are already scarce, this implementation allows township health centers to operate normally while medical professionals develop their skills and expertise."

Today, the telehealth network connects medical professionals in Wenchuan to specialists across Sichuan, throughout China, and in Hong Kong. It is now being used an average of 4.5 times per month for training purposes at each site within Wenchuan. Physicians are receiving training in a variety of topics, ranging from clinical case studies to ICT applications. The chart below gives an overview of teletraining usage.



All of the surveyed physicians agreed that collaborative technology has improved their medical expertise and that this has contributed to better patient care. Ninety-five percent of the physicians also agree that this has reduced the healthcare quality gap between rural villages and major cities. Physicians noted that teletraining is very convenient and will likely be

used more frequently in the future. Some of the survey respondents suggested developing an integrated training program that allows them to complete all their required core medical education in addition to receiving ad hoc training sessions covering the latest medical developments.<sup>11</sup>

<sup>8</sup> Source: Wenchuan Physician survey (n=22). Data from township health centers only.

<sup>9</sup> Average annual income for rural resident in Wenchuan is 3,970RMB, and 14,950RMB for urban resident in Wenchuan. Source: Wenchuan government website <http://www.wenchuan.gov.cn>

<sup>10</sup> Source: Wenchuan physician survey (n=22)

<sup>11</sup> Source: Wenchuan physician survey (n=22) and interviews with Wenchuan physicians and directors

Average direct cost savings that have resulted from adopting teletraining are approximately 1,600RMB (245USD) per physician, equivalent to one month's salary for a physician in a township health center in Wenchuan.<sup>12</sup> This includes travel and accommodation costs, as well as the cost of lost productivity when the doctor has to leave his job to be trained.

The time saved per participant per training session was six hours.<sup>13</sup> Trainers also save considerable time by delivering the training remotely. For example, it used to take trainers at Wenchuan Women's and Children's Hospital at least three days to travel to all 13 township health centers in Wenchuan to deliver sessions. With the telehealth network in place, they were able to reach the medical professionals in all the township health centers with just one training session lasting three hours.<sup>14</sup>

## TRAIN THE TRAINER MULTIPLIES EXPERTISE

One of the original objectives of the Connecting Sichuan telehealth concept was to enable the province to respond to immediate humanitarian needs in the aftermath of the earthquake. In part, this meant providing psychological and physical rehabilitation service not available locally. The Sichuan - Hong Kong rehabilitation network was launched in July 2009 and subsequently linked to the Wenchuan telehealth network. It enables Sichuan medical professionals to participate in rehabilitation training programs that originate at a hospital in Hong Kong.

Since 2008, the Hong Kong Youth Foundation has been implementing a "train the trainer" program, instructing more than 200 core trainers that include psychiatrists, hospital administrators, and psychological counselors.

These core trainers have in turn trained more than 600 volunteers across Sichuan. More than 511 patients have received psychological screening, counseling, and rehabilitation as a result. The trainers continue to make extensive use of the network, including a specialized mobile clinic, to reach schools and volunteer stations across Sichuan.<sup>15</sup>

Today, teletraining has become a fixture at all township health centers and Wenchuan People's Hospital, and is now an integral part of clinical care. In addition, the network is used by all levels of healthcare organizations within Wenchuan, with Wenchuan People's Hospital serving as the hub.

### New Services at the Local Level

The telehealth network has enabled Wenchuan People's Hospital to deliver new services that were not available to patients previously. For instance, the surgical department can now perform more complex operations, such as open chest surgeries. This capability developed from teleconsultations that took place when a patient sustained injuries in an accident and required emergency treatment. Local surgeons sought advice and guidance from experts at Huaxi hospital in Chengdu. A combination of scheduled

training and teleconsultation cases has enabled Wenchuan People's Hospital to offer other new services as well, including gallbladder surgery.

The Rehabilitation Department at the hospital has also benefited greatly from the telehealth connection. Sponsored by the Hong Kong Red Cross Society and HongKong Prince Wales Hospital, doctors in Hong Kong deliver regular training and practical supervision via the telenetwork as well as in person. Doctors in Wenchuan also receive updates on new techniques through the network.

<sup>12</sup> Source: PKU Healthy Wenchuan baseline evaluation report, May 2011

<sup>13</sup> Source: Wenchuan physician survey (n=22)

<sup>14</sup> Source: Interviews with Wenchuan People's Hospital, 2011

<sup>15</sup> Source: Data from HK Youth Organization, 2011

Dr. Tan Gang, head of the rehabilitation department, observed that doctors are not only more confident and skilled, they have changed some of their attitudes toward care. For example, in the past patients with major amputations were considered immobile and homebound. But with the latest rehabilitation treatments, these patients are now able to go back to work and enjoy a better quality of life. In addition, the doctors in Wenchuan have added various western physiology techniques to complement traditional Chinese medicine.

With medical expertise now more accessible locally, Wenchuan patients can receive a full spectrum of services, ranging from diagnostics to postoperative rehabilitation, without incurring a cost premium. This value proposition has allowed Wenchuan People's Hospital to attract patients outside Wenchuan county. The hospital also serves local patients who have major surgeries performed in Huaxi hospital in Chengdu, but want to return to their community for long-term rehabilitation.<sup>16</sup>

### Less Quantifiable Benefits

Some telehealth benefits are less quantifiable than costs, but important nonetheless. Take psychological rehabilitation, for example. To provide these services to Sichuan, the Hong Kong Youth Foundation sought assistance from multiple specialists with expertise in various areas. Specialists in tertiary hospitals in Hong Kong and Chengdu were willing to volunteer their services, but they would have had to fly into the area to visit patients at frequent intervals.

Director Choi of the Hong Kong Youth Foundation says that the video "highway" provided by the telehealth network has made a major difference in how his organization provides care and training to the region. Because psychologists need to be able to see subtle changes in facial expression to treat patients, high-quality video capabilities are critical if the telehealth approach is to be effective. Director Choi stated that, "Without the telehealth network, we would not have been able to deliver our mandate so effectively."

## TRANSFORMING MENTAL HEALTHCARE IN SICHUAN

The Connecting Sichuan telehealth solution has facilitated a new approach to delivering continuous medical education in China, with the area of mental health showing the potential for some of the greatest impact.

Psychological rehabilitation is a new healthcare discipline in China. The traditional Chinese approach to training practitioners is to conduct written examinations, which means that the caregivers often lack practical experience and supervision. The large number of people traumatized by the earthquake underscored inadequacies in treating mental health problems.

The telehealth network enabled the Hong Kong Youth Foundation to provide hands-on supervision to medical practitioners in Sichuan, with the understanding that psychological rehabilitation is not a short-term proposition. There is also a need to focus on prevention by conducting

screenings for high-risk populations.

The Hong Kong Youth Foundation has also worked with local health organizations to make structural changes. For instance, there is now a teacher in charge of mental health in every school and a medical doctor dedicated to psychological care in every health center and hospital. This recognition of the importance of mental health is a major psychological change in its own right—mental illness was often a taboo subject in the past.

"After three years, Sichuan has leapfrogged far ahead of the rest of the nation in terms of psychological health," according to Director Choi. In fact, some of the core individuals trained in Sichuan have been asked to support other psychological rehabilitation initiatives, such as the relief efforts that followed the 2009 earthquake in Yushu, China.

<sup>16</sup> Source: Interviews with physicians at Wenchuan People's Hospital, 2011

## Policies Must Change to Support Innovations

To encourage greater use of the network, telehealth will need to be integrated into government policies. Physicians and government officials alike recognize that sustainability depends in part on the fees charged for teleconsultation, and whether or not they can be reimbursed. While doctors in tertiary hospitals have been supportive by sharing their expertise, their time must still be paid for. This is particularly critical as the volume of teleconsultations increases, and partnerships with other hospitals proliferate in the future.

Patients are now charged a fee for a teleconsultation that varies depending on telecommunications charges and the expert being consulted. To date, patients have been willing to pay the fee. However, to encourage further use of teleconsultation technology, Wenchuan Health Bureau is working to have these charges reimbursed by the social medical insurance program.<sup>17</sup>

Furthermore, almost all the physicians who were surveyed indicated that greater awareness by patients and physicians will encourage usage. The more people know about the network and its benefits, the more that organizations and stakeholders will patronize and support it.

## Mobile Clinics in Wenchuan

In addition to stationary network nodes at the various medical facilities, Wenchuan is served by two vans equipped as mobile clinics. One mobile unit has Cisco TelePresence® technology installed to facilitate psychological rehabilitation and training in rural areas. Besides TelePresence, the other mobile clinic is equipped with diagnostic devices that include an x-ray machine, ultrasound, and a biochemistry analyzer for blood work. This second van operates out of Wenchuan People's Hospital and visits township health centers and health facilities across Wenchuan.

### Supplementary Care for Remote Residents

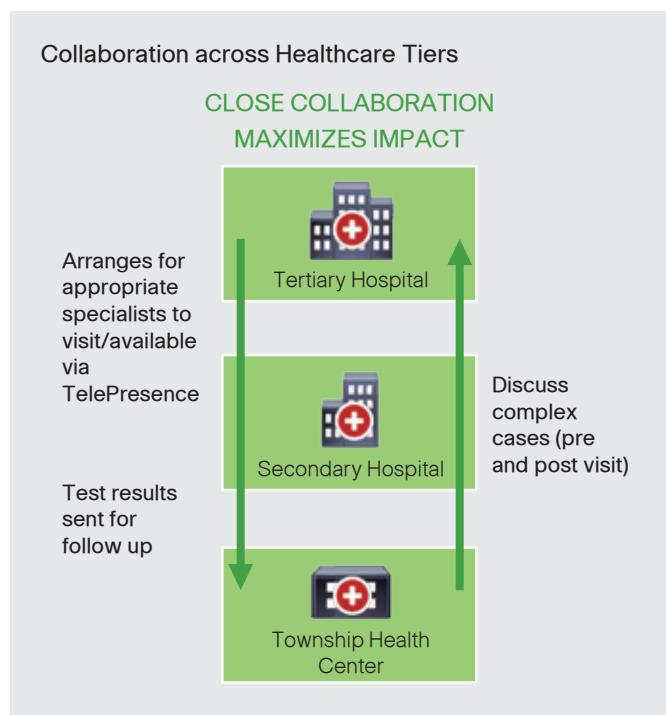
Working closely with the local township health centers, the Wenchuan People's Hospital mobile clinic provides services such as teleconsultations and remotely conducted

physical examinations to residents in remote towns. The mobile clinic leverages the existing infrastructure network to minimize operation costs. As an example, the van uses cable connections at local township health centers instead of more expensive satellite links when teleconsultations are required.

Between November 2009 and September 2011, the Wenchuan mobile clinic made 48 trips, serving more than 10,000 patients in Wenchuan.<sup>18</sup>

Wenchuan People's Hospital has set up a process to maximize the use and efficiency of the mobile clinics. Working with local clinics, the hospital schedules visits on a monthly basis. Each township health center puts up posters to notify residents about the visit, and doctors inform particular patients who will benefit from a consultation or other mobile service. Health center staff discusses patients in advance with Wenchuan People's Hospital staff, so the hospital can assign appropriate specialists either to the van itself or to a TelePresence session. This process ensures that the mobile clinic serves as many patients as possible.

The diagram below illustrates how close collaboration maximizes treatment across the healthcare hierarchy.



<sup>17</sup> Source: Interviews with physicians at Wenchuan People's Hospital and Wenchuan Health bureau

<sup>18</sup> Source: Data provided by Wenchuan People's Hospital

Of the patients surveyed, 73 percent visited the mobile clinic after being notified by the township health center. Twelve percent of the patients visited because they saw the van in the area, and the others were visiting the health center and ended

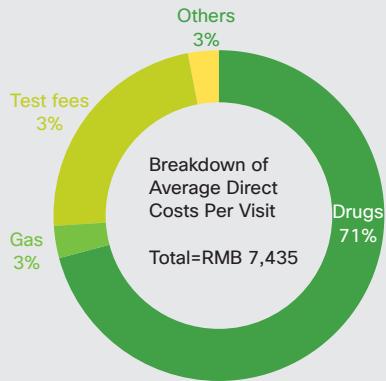
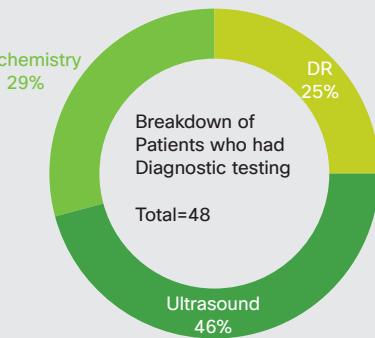
up using the mobile clinic. More than 80 percent of patients had chronic diseases requiring treatment, while 12 percent were there for checkups.<sup>19</sup>

## SPOTLIGHT ON MOBILE CLINICS

Each mobile clinic visit has a number of objectives. The most obvious activities include providing face-to-face consultation services, physical examinations, and teleconsultations for local residents and physicians. But another objective is to increase public health awareness. During each visit, the mobile clinic broadcasts health education programs using the digital media system, and distributes flyers and brochures to patients.

An average of eight medical professionals and four support staff are assigned from Wenchuan People's Hospital to support each visit. A mobile clinic serves an average of 215 outpatients per visit, with about 22 percent of patients getting some sort of diagnostic test. The mobile clinic also dispenses drugs free of charge to patients who require them.

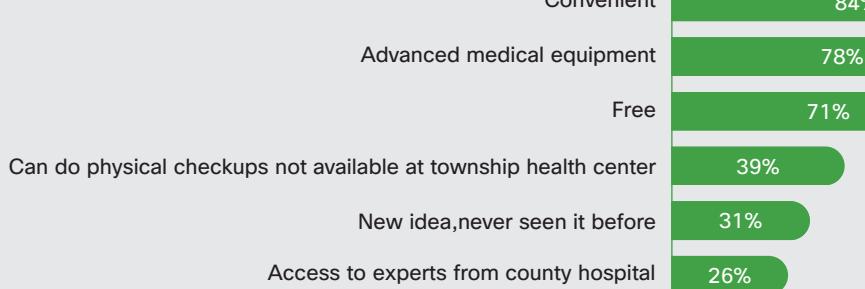
**Breakdown of Key Services Per Mobile Clinic Visit**



As indicated in the chart above, Wenchuan People Hospital incurs direct costs of approximately 7,435RMB (1,143USD) for each mobile clinic. This excludes personnel costs, but includes test fees, free medication provided to patients, and transportation costs.

Overall, 95 percent of the patients surveyed indicated they like the mobile clinic, with the top three reasons being that it is convenient, it gives them access to advanced medical equipment, and it is free of charge.<sup>20</sup>

**Patients' Reasons for Liking the Mobile Clinic**



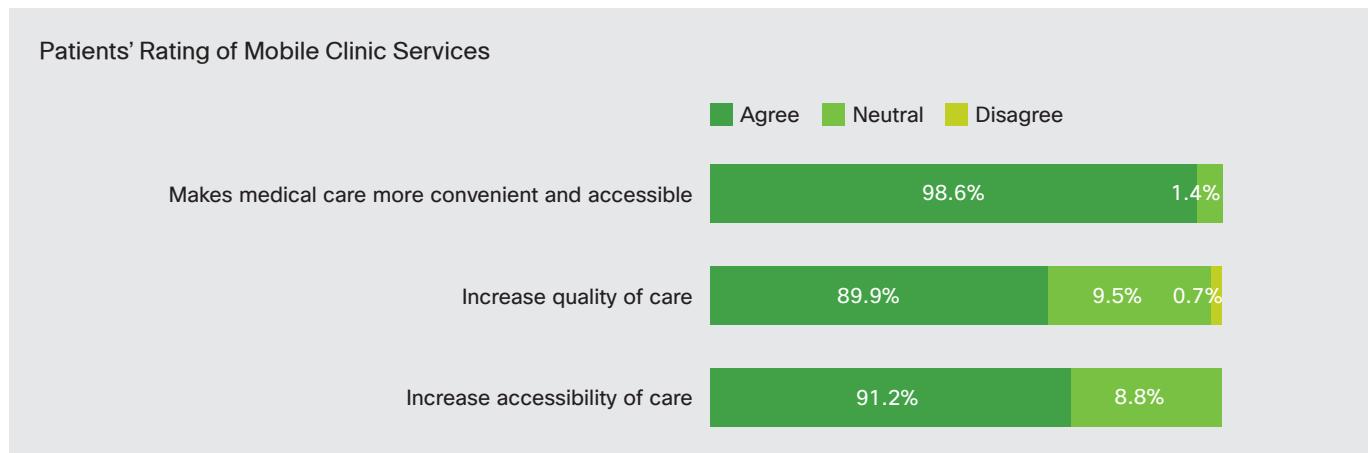
<sup>19</sup> Source: Wenchuan mobile clinic survey 2011, n=148

<sup>20</sup> Source: Wenchuan mobile clinic patient survey, n =148

Ninety-three percent of patients agreed that the mobile clinic provides a satisfactory level of medical services, while 71 percent felt that mobile clinic services are better than those offered in township health centers. The main reason for patient satisfaction is the mobile clinic's ability to conduct medical tests otherwise not available locally. These findings emphasize

the importance of having diagnostic and testing equipment onboard the van.

In terms of impact on the healthcare system, patients agreed that the mobile clinic has improved convenience, accessibility, and quality of care. Patient ratings are shown below.



All of the patients who experienced the Cisco TelePresence® technology on the mobile clinic said they liked using it for teleconsultations, primarily because they do not need to travel to see a specialist. Ninety percent of patients surveyed preferred TelePresence over telephone consultations, the conventional alternative. However, while 90 percent of those surveyed indicated that TelePresence is basically the same as a face-to-face consultation, only 10 percent actually preferred the TelePresence alternative.<sup>21</sup> These patients' comfort level will probably rise as they become more familiar with the mobile program and what it has to offer.

To test the sustainability of the mobile clinic approach, patients were asked if they were willing to pay for the services. Ninety-three percent of patients indicated they will visit even if there is a charge, and more than 80 percent are willing to pay 100 percent or more of standard township health centers charges. Another key sustainability factor is the regularity and frequency of visits. A hundred percent of patients surveyed would like the mobile clinic to visit at regular intervals, with 56 percent expecting a visit once a month and the rest preferring a visit at least biannually.

The longer term viability of the mobile clinic in Wenchuan requires that the local health bureau address some issues, particularly clarifying what fees will be charged, whether they

will be reimbursed by social insurance, and how fees will be split between Wenchuan People's Hospital and local township health centers. Setting up a regular schedule will also be necessary.

## Intrahospital Solutions in Chengdu

Clinical effectiveness solutions were implemented at the new Chengdu Women's and Children's Hospital, an institution that was established through the merger of three older hospitals. Networked clinical applications were installed on a medical-grade network. (A medical-grade network provides a high-bandwidth infrastructure for reliable, secure healthcare applications.) In addition to traditional hospital ICT applications<sup>22</sup>, digital media technology was installed at strategic locations throughout the hospital to display information.

A smart patient-guiding system was implemented to handle the flow of patients waiting to see doctors and coming in to get diagnostic reports. The system also informs family members waiting outside surgical rooms about the status of patients. A Cisco Unified Communications system allows parents to view their newborns in the hospital's neonatal intensive care unit. All these solutions were designed to facilitate collaboration between departments, and between patients and staff.

<sup>21</sup> Source: Wenchuan mobile clinic patient survey, n =148

<sup>22</sup> Traditional applications include hospital information systems (HIS), picture archiving and communications systems (PACS), electronic medical records (EMR), laboratory information systems (LIS), clinical information systems (CIS), and radiological information systems (RIS).

## Nurses Reduce Their Workload<sup>23</sup>

The merger of the hospitals required a much larger facility that must accommodate a high patient volume. Integration is still underway, with new staff rosters and personnel assignments causing efficiency problems and high stress levels for hospital nurses as they struggle to maintain quality care while dealing with a greater number of patients.

The nurses reported that the digital media system has helped to reduce their workload. Previously, nurses had to spend considerable time calling patients when their reports were ready and providing patients and family members with status updates during surgeries. With the new systems in place, nurses estimate they save a total of their workday, or up to 20 percent of their time.

### Patient Are More Satisfied

As for the patients, 91 percent of survey respondents find the system easy to use and 90 percent are satisfied with the information displayed on the digital waiting system. While most felt that no further system improvements are required, some patients suggested that the information could be updated more frequently, and that an increase in font size would make the displays easier to read.

Eighty percent of patients felt that the digital waiting system has improved their overall patient experience, making the care process more convenient. Seventy-five percent of patients agreed that the system should be implemented at more locations within the hospital. Parents at the neonatal intensive care unit indicated satisfaction with the new service that lets them view their baby by means of high-quality video. Being able to see their infant reduces anxiety and relieves nurses and physicians from having to give parents continual updates.

Nurses found that their relationships with patients, and thus patient satisfaction, have improved. Patients still ask nurses questions, but the queries now mostly involve medical matters rather than wait times and the like. This is a more effective use of nurses' time, and serves patients better as well.

## Summary: Collaborative Solutions

- The telehealth network has improved the level of medical expertise and quality of care in both Wenchuan and Shifang. This improvement is not limited to a few localities, but rather has occurred on a large scale across the region. This is an important step toward reducing the gap in care between the rural and urban populations.
- Patient assessments indicate that patients enjoy a higher quality of care at lower costs than before, with better accessibility at the local level. Patients in Wenchuan have demonstrated the value of these benefits by their willingness to pay for services such as a mobile clinic
- Mobile clinics are a valuable extension to the fixed-point Cisco TelePresence® network, particularly when they provide local residents with resources such as diagnostic testing otherwise not available locally.
- Intrahospital collaborative solutions implemented in Chengdu have improved patients' satisfaction levels and the overall care experience. Nurses also report reductions in their workloads, freeing their time for more important tasks that benefit patients.

### Key Success Factors

- As evidenced by the initiatives in Wenchuan, single point-to-point interactions limit sharing of resources, while a multisite open platform creates maximum impact by serving multiple healthcare tiers and locations.
- High-quality video imaging helps ensure a good user experience, prompting greater acceptance and repeated use by both physicians and patients. Traditional telemedicine is limited by conventional web cameras on the desktops. While a high-resolution TelePresence system is more expensive and has higher bandwidth requirements than standard teleconferencing, the high-quality imaging is critical for medical purposes. In Shifang, TelePresence video technology provides a virtual experience that makes interactive radiology more effective.

<sup>23</sup> Source: Interviews with nurses at Chengdu Women & Children Hospital, 2011

- Healthcare organizations must collaborate to make the most of telehealth solutions such as mobile clinics. Planning and coordination between the Wenchuan People's Hospital and township health centers has ensured that more patients are alerted and served on each visit from a van, increasing efficiency.
- Solutions need to be aligned with government reform policies. Because the telehealth solution supports China's, Sichuan's, and local governments' goals of improving accessibility and quality of care, authorities were motivated to cooperate with Connecting Sichuan partners to facilitate implementation of solutions and resolve issues.

### Ensuring Sustainability

- Communication promotes awareness and builds acceptance of healthcare solutions. When people know

about the technology and its benefits, they are more likely to use it and be satisfied with the results.

- Government policies are key to long-term sustainability. As seen in both Shifang and Wenchuan, healthcare policies need to be adjusted to adequately integrate teleconsultations into daily clinical care. This includes clarifying medical responsibilities to avoid conflicts and disputes and how costs can be covered by social insurance programs
- Charging patients for teleconsultations is essential for long-term sustainability of the program. Medical professionals should be compensated for their time or they will lose incentive to continue supporting the initiatives. Policies such as reimbursing treatment fees with social insurance will help reduce out-of-pocket expenses for patients and encourage usage.

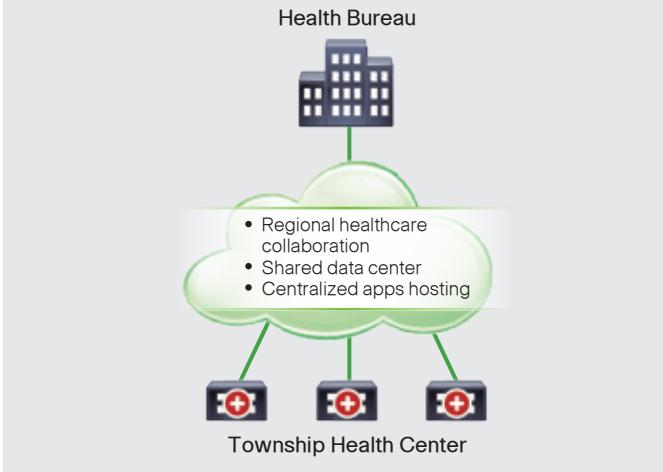
## Effectiveness of the Regional Healthcare Cloud

The regional healthcare cloud that was built in Shifang connects township health centers, regional hospitals, and the Health Bureau. Supported by a regional data center, the cloud (shown in the diagram below) provides all the clinical care and management applications required by township health centers. This allows these centers to access high-quality services delivered at a relatively low aggregated total costs for ownership (TCO). Without the cloud, it would be too costly to deliver these applications locally. The Shifang regional healthcare cloud plays an important role in the effort to improve community-level care by leveraging ICT, an avenue that had been neglected previously.

The key applications supported by the cloud include:

- Supporting daily clinical care and management operations at the health center level. Primary clinical applications include registration of patients, fee payment, and inpatient management. Management applications are devoted to pharmacy operations, inventory control, finance, and reporting.

The Shifang Regional Healthcare Cloud



- Enabling the sharing of patient health and medical records across all health organizations in the region.
- Supporting management and governance at the health

bureau level. This includes collection and reporting of statistics, integration with social insurance plans, and supervision and performance measurement in township health centers. Township health centers and health bureaus can also use the information to perform data analytics.

## Improved Healthcare Management

Physicians are using the cloud to access applications that support the entire clinical care process. The major impact has been to improve the efficiency of clinical care workflow, saving time for both physicians and patients. Ninety-five percent of surveyed physicians<sup>24</sup> agreed that the healthcare ICT system is easy to use and has made significant improvements to their daily work. For example, the shift from a paper-based system to a paperless system has made it much easier to calculate inpatient expenses prior to discharge. In the past it took 8 to 10 hours to manually track and calculate various test fees, drug costs, and other expenses. With the new system, this calculation can be done in 15 minutes.<sup>25</sup>

Ninety-five percent of surveyed physicians concur with the statement that the regional healthcare cloud has improved the management of all aspects of the township health center, from financial tracking to drug inventory. The directors surveyed mention that they now have all the information they need on hand, as opposed to having to wait for each department or physician to provide the data. This has improved timeliness and reduced data errors.

One example of greater efficiency is the process of ordering drugs. In the past, doctors had to manually count drugs to determine which ones needed to be restocked. Then they had to call separate distributors to order the drugs. The entire process took two days. Today, they can check the inventory level, place an order, and arrange for drug delivery in 30 minutes. The system has reduced administrative workload and given the physicians more time to spend with patients.

## A Single View of Information

Liu Jing, Deputy Director of Shifang Health Bureau, said that “the regional healthcare cloud has enabled a revolution in management.” The cloud allows for much more systematic and objective management and governance of township health centers, eliminating human subjectivity and variability across the region.

For instance, prior to the earthquake, the health bureau would send individuals annually to inspect and evaluate each of the township health centers, providing ratings of their performance. It was very difficult to standardize evaluation criteria and ratings among the different inspectors, and it was impossible to do a comprehensive check because inspectors could only do spot checks due to resource constraints. It was very difficult to ensure that township health centers were acting in compliance with policies. With cloud technology, inspections are now real time, data driven, paying the way for objective analysis and timely remediation.

## CHINA'S INITIATIVES TO REFORM COMMUNITY-LEVEL HEALTHCARE

In 2009, China announced a major reform of its healthcare system that included revamping and developing community care. The government has since made significant investments in the communities—providing basic medical equipment, training professionals in grassroots health organizations, and subsidizing care at these organizations with higher social insurance reimbursements. Township health centers are now shifting away from providing simple acute care to taking on more comprehensive functions, including preventive care and chronic disease management.

To encourage healthy development of community-level organizations and to control excessive healthcare

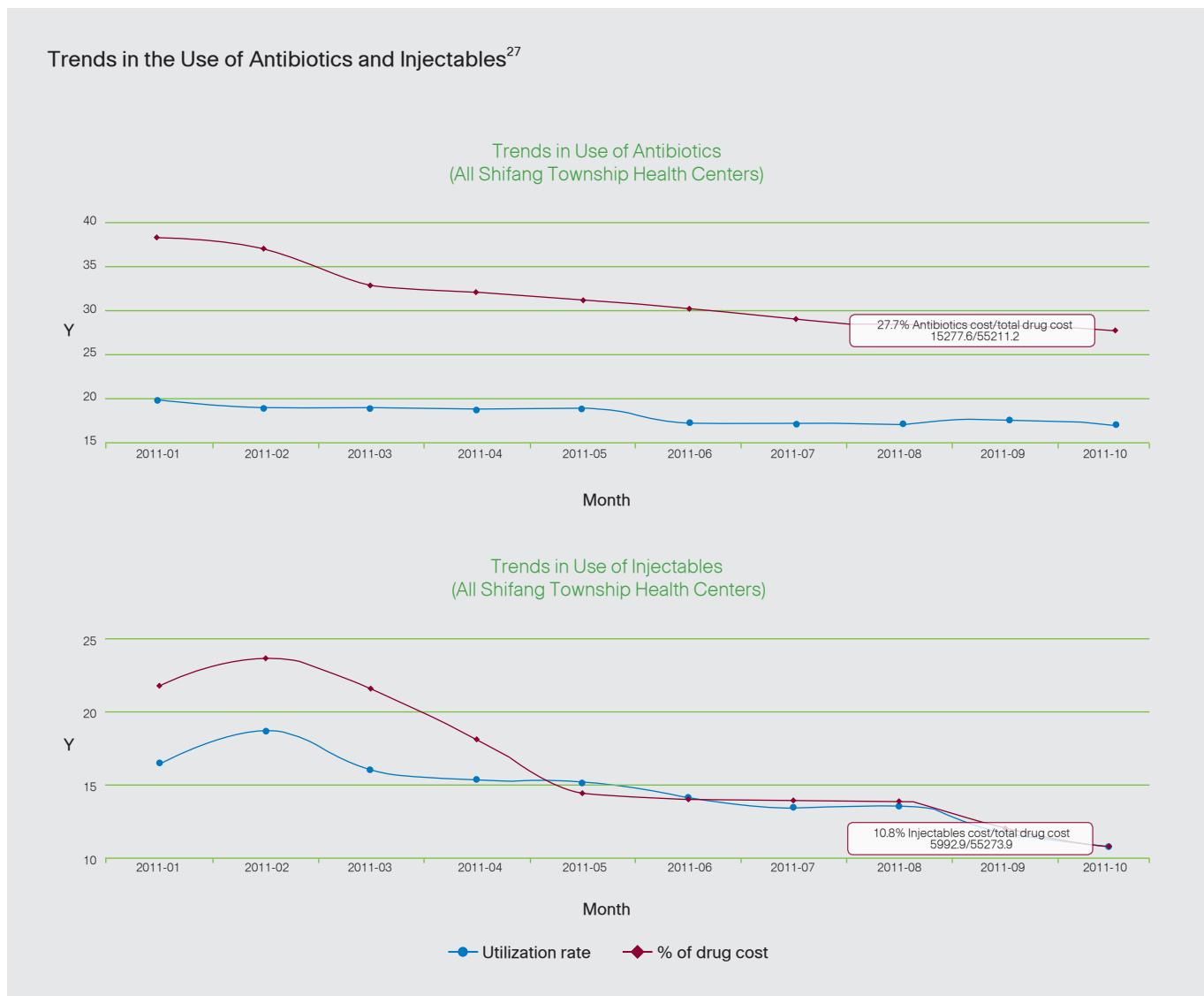
costs, local governments adjust the level of subsidies according to the workload and performance of individual centers. For this reason, an accurate and fair evaluation of the performance of township health centers is critical. To improve quality of care, local governments also monitor whether community-based organizations are using appropriate clinical practices, such as curbing the tendency to overuse antibiotics and expensive injectable drugs. This overuse started when community organizations struggled to generate revenue to sustain operations. However, with more government funding, local governments are making efforts to stop such unwarranted and unhealthy practices.

<sup>24</sup> Source: Shifang physician survey (n=21)

<sup>25</sup> Source: Interviews in Shifang, 2011

Today, management applications running on the cloud monitor prescription trends, testing, fees, and reimbursements. This makes it simpler for the Health Bureau to manage and govern the township health centers. For example, the bureau checks the price of drugs being sold at township health centers. Without the system, the bureau had to spend up to a week to do spot checks at the 17 township health centers. However, the cloud makes it possible to gather pricing information in a few minutes.<sup>26</sup>

Shifang Health Bureau has ensured that close to 100 percent of all drugs prescribed at township health centers are from the essential drug list, in compliance with China's healthcare reform guidelines. The cost of antibiotics has been reduced as a percentage of total drug costs, from about 40 percent in January 2011 to 27 percent in October 2011 (see the graph below). The bureau has also controlled prescriptions of injectables, reducing costs as a percentage of total drug costs from approximately 25 percent to 11 percent.



With the time saved in conducting manual inspections and processing administrative paper work, the Health Bureau is now able to reassign resources to focus more on resolving issues. As

Director Liu Jing noted, "In the past, the bureau spent the majority of time on identifying the problems. Today, the system has allowed us to spend our time solving problems."

<sup>26</sup> Source: Interviews with Shifang Health Bureau

<sup>27</sup> Source: Data from Shifang Health Bureau

## Gaining Acceptance through Training

While 86 percent of surveyed physicians said they liked using the cloud to access key applications,<sup>28</sup> efforts had to be made to overcome physician resistance during the initial implementation of the technology. Some older physicians not comfortable with computers were very concerned and resisted using the system, since it was a major change in how they practiced clinical care. Shifang Health Bureau noted that the ICT training provided by Cisco helped a lot in getting these doctors to use the system. There are now efforts to train local "ICT champions" to troubleshoot minor system errors so the local facilities do not have to rely on the Health Bureau to provide support.

## Continued Cloud Evolution

The Shifang Health Bureau is starting to expand the regional healthcare cloud to track and manage chronic diseases - for example, ascertaining the number and status of patients with diabetes, high blood pressure, and severe mental conditions. Data about the number of revisits and physical checkups can be leveraged to create more responsive public health policies. The system will also be an important platform for maintaining patient health records at community level health organizations, a major goal of healthcare reform.

## Summary: Regional Healthcare Cloud Solutions

- The Health Bureau has taken advantage of the regional healthcare cloud to change how community-level health organizations are managed and governed. The time savings and increased operational efficiency have enabled the bureau to move to a higher value management role, solving problems instead of just identifying them.

- Applications supported by the regional healthcare cloud have improved work efficiency. Patients experienced a reduction in wait time, while physicians are able to offload some of their administrative work so they can focus more on patient care.

- Enforcing compliance with the government's reform initiative is much easier with a single view of all the information.

### Key Success Factors

- The regional healthcare cloud enables high-quality ICT services to be provided to all community-level health centers at affordable costs (acceptable aggregated TCO). The cloud also enables quick application rollouts and upgrades.
- Training is key to developing ICT skillsets, a weakness among medical professionals in rural areas. The training sessions also help to overcome user resistance, as users experience the benefits and convenience offered by the new system.
- An all-in-one integrated platform is necessary. Physicians and directors find it useful and convenient that all the applications they need are resident on the cloud.

### Ensuring Sustainability

- The design of the system should be flexible enough to allow continual updates that reflect changes in government policies and evolving requirements.
- It is critical to provide regular training to build ICT skillsets. ICT champions with more advanced skillsets can act as first-level ICT support within township health centers. All the centers will be supported by a team of ICT professionals within the Health Bureau, responsible for maintaining the ICT platform and making continual improvements and updates.

<sup>28</sup> Source: Shifang physician survey (n=21)

# The Overall Impact of ICT on Healthcare

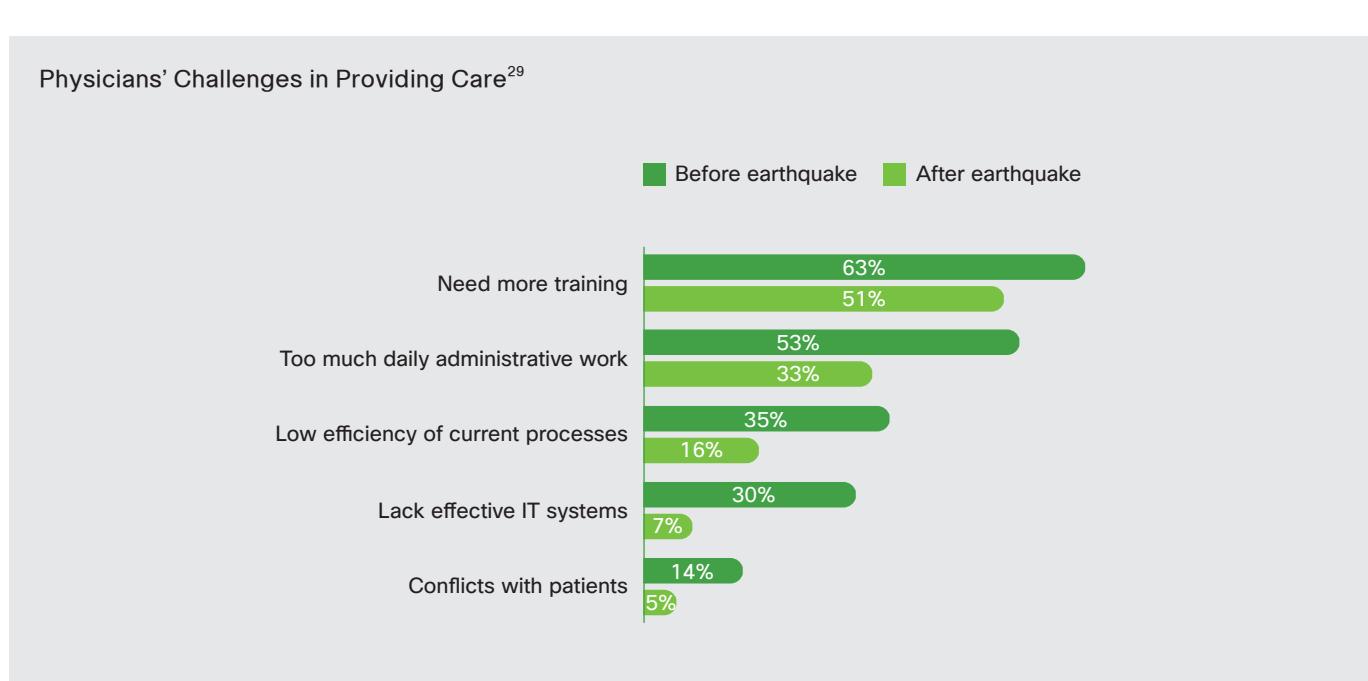
Criteria for evaluating the impact of ICT include:

- **End-user perspective and satisfaction with ICT:** The objective here is to understand how perception of ICT in healthcare has changed among users. This includes how they perceive the benefits of ICT, and whether they are willing to make additional investments. The effectiveness of end-user training is also considered.
- **Improvements in technologies:** This includes hardware installation and degree of connectivity. Applications include both clinical care and management.
- **Improvements in ICT management:** This involves how organizations plan, invest, and operate their networks. Other important elements that affect sustainability of the program are ICT operating costs, staffing levels, and skill building.

Because ICT challenges and implementations vary for different types of healthcare organizations, the evaluation considers community, hospital, and regional levels where appropriate.

## User Perception

The installation of ICT systems has clearly had a major impact at the township health center level. Physicians in these centers were asked to describe the challenges they faced in their day-to-day work before and after the earthquake (see the graph below). There were noticeable improvements in workload reduction, efficiency, technology effectiveness, and training.

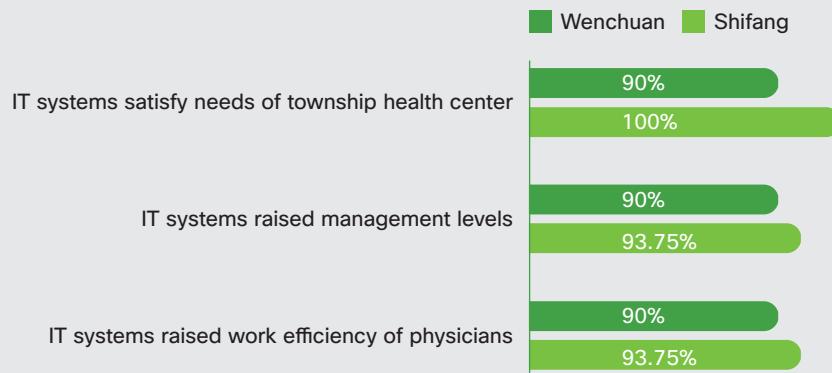


Directors of township health centers in Wenchuan and Shifang agreed that the ICT systems meet their needs. Directors in Shifang also rated the system highly in terms of improvements to work efficiency and management. This is probably because the ICT system implemented in Shifang is much more comprehensive, and participates in almost all

clinical care and management processes. The Wenchuan respondents rated the system highly for accessibility, reflecting more comprehensive use of the telehealth solution. The graph below summarizes the directors' responses.

<sup>29</sup> Source: Physician survey (n=43, Wenchuan and Shifang combined)

### Rating ICT Impacts (Directors in Wenchuan vs. Shifang)<sup>30</sup>

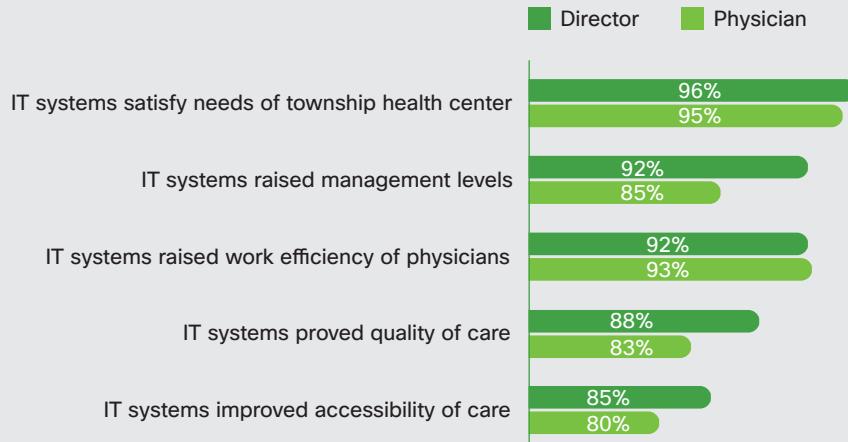


On a personal level, 92 percent of directors and 83 percent of physicians agree that they are comfortable with using ICT systems in conducting their day-to-day work. Ninety-five percent of directors and physicians concur that current ICT systems meet the needs of their organization and are easy to use.

In general, directors awarded consistently higher rating for ICT impact, as shown in the graph below. As one director puts

it, "I now recognize that ICT usage has a major impact on the development of our township health center, and it is a key trend in future development." Other directors stressed the value of having timely information to manage the health centers, and that management has now been greatly improved after implementation of the systems.

### Rating ICT Impacts (Directors vs. Physicians)<sup>31</sup>



Directors of township health centers assert that the greatest challenge in using the ICT systems lies in raising the level of ICT skillsets and professional capabilities. Mentioned by 60 percent of respondents, this problem is particularly pronounced in Shifang, where almost all activities in both management and clinical care require some interfacing with the systems.

To address the lack of ICT capabilities among users, Connecting Sichuan has conducted more than 3,000 training "person-times" at township health centers alone. About 150 individuals were trained to use the healthcare information system, 1,300 people were taught how to use IP telephone systems, 206 received instruction for the Cisco TelePresence® system, and 356 learned how to use digital media systems.

<sup>30</sup> Source: Director survey (n=27, Wenchuan and Shifang combined)

<sup>31</sup> Source: physician survey (n=43) and Director survey (n=27); Wenchuan and Shifang combined

## MEETING THE ICT TRAINING CHALLENGE

Enhancing ICT expertise in the region was critical as a prerequisite for an effective implementation of the advanced healthcare solutions. A tiered program was implemented to provide training of various types and levels to a range of different user groups.

### Training Program by User Group

	<b>ICT Intro (3 days)</b> Basic computer & HIT skills	<b>Cisco Product Business Training (3 days)</b> Scenario usage	<b>IT Leadership Awareness (Forum)</b> Key ICT concepts	<b>IT Service Management (3 days)</b>	<b>Network Operations (9 days)</b> Cisco TelePresence System intro
Users	✓	✓			
Admin/IT Leaders	✓	✓	✓	✓	
Network Administrators	✓	✓			✓

Connecting Sichuan end-user training focused on basic computer skills and introduction to health information technology (HIT) concepts. End users also learned how to use new systems and applications through scenario-based training. Administrators, hospital directors, and ICT directors in hospitals and health bureaus were invited to small-group training and workshops. In addition to learning ICT concepts, this group received instruction in how to manage ICT systems more effectively. Network administrators got specialized training, and some later achieved the prestigious Cisco Certified Internetwork Expert (CCIE) certification.

In designing the training program, certain practical challenges had to be resolved to maximize effectiveness. For instance, staff shortages and heavy workloads meant that large, periodic classroom training sessions were not a practical option. Frequency of training was increased to accommodate multiple groups. In addition, Connecting Sichuan leveraged web training as well as a mobile van to reach more trainees locally. The web-based portal includes interactive and user-friendly features such as progress tracking, integration with instant-messaging tools, and centralized archive space for coursework. Mobile training not only expands geographical coverage, it also reduces travel expenses and classroom setup overhead.

## Networking at Wenchuan People's Hospital

From a management perspective, ICT systems have dramatically changed how administrators manage and govern the hospital. "In the past, our management model relied on people," according to President WangSongbai "Now, we manage using information, leveraging systems and applications. This new model allows us to track and manage the entire process, from when patients enter the hospital to when they are discharged. There is visibility into the entire process."

President Wang strongly believes that the hospital's ICT systems have enabled Wenchuan People's Hospital to become a leading hospital within Aba Prefecture, solidifying its value as an integrator of healthcare service providers in the region.

The hospital has also seen many improvements in clinical operation, particularly from the patient's perspective. A digital registration card saves patients time when they check in and when they pay for services. Plus, integration of the hospital system with social insurance cuts down on paperwork. Clinical care applications such as picture archiving and communications system (PACS) and laboratory information system (LIS) allow physicians to spend more time on patient care.

The hospital plans to increase the scope of its ICT investment by:

- Strengthening collaboration and increasing data sharing among hospitals, including Huaxi Hospital and township health centers
- Building on links with the Center for Disease Control and women's and children's health organizations to make patients' records operational
- Promoting the public health mandate by collecting and sharing public health information

## Impacts at the Regional Level

A major aim of the Connecting Sichuan partnership was integrating the various levels of healthcare organizations across the region, strengthening the ability of healthcare

professionals to make correct decisions based on factual data.

Yue Hongchun, director of Wenchuan Health Bureau, commented: "We now plan for ICT using a regional approach, rather than focusing on individual hospitals. This regional model takes in the comprehensive needs of public health, as well as health service delivery, social insurance, and the essential drugs list. It connects three levels of healthcare service providers, from the regional hospital to the county hospital and village township health centers. This concept of an integrated network is inspiring, and is now our guiding principle."

## Improvements in ICT Infrastructure and Applications

The ICT infrastructure put in place in township health centers has made a significant improvement in information capacity in both Shifang and Wenchuan. Interviewees said that Connecting Sichuan has advanced ICT by 10 to 20 years, compared to where they were before the earthquake. The level of access to telehealth solutions and the integration brought about by the regional health cloud far exceeds the standard for township health centers in Sichuan, and even exceeds the national average as determined in a survey conducted by China Hospital Information Management Association (CHIMA) in 2008. Director Liu Qiang of Shifang Health Information Center stated that the advancements made to integrate regional infrastructure was something they could only dream about in the past.

It is important to note that the quality of the equipment has improved along with the functionality. For instance, township health centers and Wenchuan People's Hospital are now using high-quality Cisco TelePresence® systems instead of conventional web cameras for teleconsultations. Township health centers have access to state-of-the-art network connectivity through 100Mbps dedicated fiber optics cabling. The network server is enabled for virtualization and has abundant storage capacity. This has increased the reliability and stability of the infrastructure, an important factor when ICT is used to deliver healthcare.

Typically, a township health center has a simple financial management system, and perhaps an HIS system. With the focus on using ICT at community level hospitals, the clinical

and management applications available at Shifang township health centers make Shifang a paragon within Sichuan and China today. The clinical and management applications at Wenchuan People's Hospital are on par with leading tertiary hospitals in major cities. To make greater use of the infrastructure, both the Wenchuan and Shifang health bureaus plan to deploy even more advanced and comprehensive applications in the future.

## Improvements in ICT Management

In both Shifang and Wenchuan, ICT planning decisions are made centrally by the local health bureaus. Deployment of applications over the regional healthcare cloud enables standardization and efficiency across the region, minimizing costs.

The Shifang and Wenchuan health bureaus have developed plans to extend use of the existing ICT infrastructure, including expanding the implementation of electronic health records. There is an important perception that Connecting Sichuan has built a strong infrastructure for township health centers and health bureaus, but much needs to be done to get more use from it.

As Ming Yi, deputy director of Wenchuan Health Bureau, noted, "The basic infrastructure is already provided. The issue

is how to maximize usage at the township health center level." Wenchuan Health Bureau has started to deploy centralized applications across the network (similar to what is operational in Shifang) to all health centers. Shifang Health Bureau also intends to increase the number of clinical care applications available at township health centers.

In terms of planning for future hardware and systems, staff members at Wenchuan People's Hospital feel that Connecting Sichuan has laid the fundamental infrastructure for what they need in the next three years. Their key task will be to execute well on what has already been put in place.

In both Shifang and Wenchuan, the majority of ICT costs are funded centrally - for instance, through the local health bureau or Wenchuan People's Hospital. This includes application maintenance fees, ICT personnel costs, and hardware investments made in addition to those provided by the Connecting Sichuan program. Township health centers might occasionally incur capital costs in purchasing hardware such as hard drives. The major operating costs include cable and electricity fees.<sup>32</sup> A larger township health center such as Shigu township in Shifang might assign one full-time employee to maintain systems. The table below shows the breakdown of annual operating costs before and after the earthquake in two Shifang township health centers.

Annual Operating Costs in Shifang Township Health Centers <sup>33</sup>		
Example 1: Bajiao Township Health Center	Before earthquake in 2007 (10 beds)	After earthquake in 2010 (99 beds)
Electricity (RMB)	60,000	70,000
Cable (RMB)	8,700	8,200
People (RMB)	7,200	9,600
<b>Total annual operating costs</b>	<b>75,900</b>	<b>87,800</b>
<i>ICT operating costs as % of revenue</i>	<i>13.1%</i>	<i>5.2%</i>
Example 2: Shigu Township Health Center	Before earthquake in 2007 (20 beds)	After earthquake in 2010 (99 beds)
Electricity (RMB)	260,000	350,000
Cable (RMB)	17,000	13,000
People (RMB)	30,000	30,000
<b>Total annual operating costs</b>	<b>307,000</b>	<b>393,000</b>
<i>ICT operating costs as % of revenue</i>	<i>12.0%</i>	<i>4.8%</i>

<sup>32</sup> Data from Shifang township health centers as lack of sufficient data from Wenchuan to break down ICT operating costs separately Source: Organization survey ( Shifang n=17)

<sup>33</sup> Insufficient data from Wenchuan to break down ICT operating costs separately. Data from Bajiao Township Health Center and Shigu Township Health Center in Shifang. Revenue data from organization survey.

The increase in operating costs is expected due to the significant increase in applications and the move from manual to paperless systems. Bajiao Township Health Center actually doubled the number of beds after the earthquake. It is noteworthy that in Shifang, ICT operating costs as a percentage of total income has decreased, from 12-13 percent to 5 percent.

The operating costs at Wenchuan People's Hospital have increased, from 429,000RMB (66,123USD) prior to the earthquake in 2007 to 718,000RMB (110,461USD) in 2010.

This increase is not surprising, given that the hospital has evolved from a Tier 2B institution with 120 beds to Tier 2A with 220 beds. In terms of ICT infrastructure and applications, the hospital has moved from a simple financial management system to an infrastructure and applications typically found in a Tier 3A hospital. It is also important to note that the operating funds are used to meet regional needs in addition to hospital costs, including data center and operating center expenses. The table below gives a breakdown of the annual operating costs before and after the earthquake.

Annual Operating Costs at Wenchuan People's Hospital <sup>34</sup>		
	Before earthquake in 2007 (120 beds)	After earthquake in 2010 (220 beds)
Electricity costs (RMB)	390,000	650,000
Cable costs (RMB)	14,800	18,000
People costs (RMB)	25,000	50,000
Total operating costs (RMB)	429,800	718,000
<i>Operating costs as percentage of total revenue</i>	<i>2.53%</i>	<i>2.99%</i>

While the increase in operating costs seems high compared to the past, President Wang explains that "the increase in ICT cost is really not significant compared to the increase in revenue and increase in function provided to the hospital." The 2010 revenue has in fact increased by 41 percent compared to 2007. In 2007,<sup>35</sup> total ICT operating costs were 2.5 percent of total revenue, whereas in 2010 these expenses rose to only 3 percent of total revenue.

Over the next two years, Wenchuan People's Hospital intends to make additional investments in ICT. The hospital plans to transition to a paperless workplace by adding 90 desktop computers, 60 printers, and 3 scanners. The estimated investment will be approximately 800,000RMB (about 123,000USD) in the next two years. The hospital also plans to increase the size of the ICT department from 2 full-time employees (FTEs) to 5 FTEs to better support and maintain ICT systems.<sup>36</sup>

At both the Shifang and Wenchuan health bureaus, there is no clear tracking of ICT operating costs. Asides from direct

personnel costs, the bureaus have historically not separated operating costs from total ICT investments, and are also unable to clearly account for all costs. Both bureaus are looking forward to implementing improvements in accounting and budgeting procedures using the network.

It was recognized early on that there was a need to establish a group of advanced ICT users to own and manage the ICT infrastructure and applications. To lower aggregated TCO, these advanced ICT users located in Shifang Health Bureau and Wenchuan People's Hospital will provide centralized ICT services for township health centers. This means that the individual health centers will not need to keep dedicated ICT personnel onsite.<sup>37</sup> Special efforts were made to enhance staff capabilities at Shifang Health Bureau and Wenchuan People's Hospital. As of August 2011, Connecting Sichuan has conducted more than 65 training sessions for advanced technical users.

Prior to the earthquake, Wenchuan People's Hospital had 0.5 FTE in the Equipment Maintenance Department assigned to

<sup>34</sup> Source: Data from Wenchuan People's Hospital

<sup>35</sup> Source: Data/interview with Wenchuan People's Hospital

<sup>36</sup> Source: Data/interviews with Wenchuan People's Hospital

<sup>37</sup> Some larger township health centers in Shifang (e.g. close to 100 beds) might have half or one FTE assigned to support ICT services

maintain ICT systems. Today, it has 3 FTEs who report directly to the president of the hospital.<sup>38</sup> All these individuals have ICT training. This puts the hospital above the Sichuan average for resident ICT expertise. An assessment in 2009<sup>39</sup> indicated that 30 percent of health organizations in Sichuan do not have any ICT FTEs, 40 percent have 1 to 2 FTEs, and 40 percent have more than 2 FTEs.

Each ICT employee now receives an average of 12 training sessions devoted to maintaining equipment and systems

donated by Cisco. The main challenge is retaining these experts, since ICT skills are highly marketable. With almost all healthcare processes dependent on the network, operations can suffer when ICT issues arise.

Shifang Health Bureau today boasts six professionals with ICT training, with two having receiving CCIE certification. This contrasts sharply with the situation before the earthquake, when there were only two such employees. As in Wenchuan, the challenge will lie in retaining the people with specialized skills.

## TRAINING A CADRE OF ADVANCED ICT USERS

As part of the program's long-term objective to develop local ICT talent, Connecting Sichuan implemented a rigorous training program for advanced users who would eventually be tasked with supporting network operations. These individuals would not only maintain the existing network, but also help plan for future ICT applications and system upgrades.

Healthcare organizations were asked to nominate talented and motivated employees to undergo intensive

"boot camp" training. The training spanned four months, including two full months in Beijing devoted to quickly acquiring technical knowledge. Upon completing the training, two of the students received Cisco Certified Internetwork Expert (CCIE) certification and five received the higher level Cisco Certified Network Professional (CCNP) certification. These attainments are a major achievement for residents of Wenchuan and Shifang, where ICT experts are scarce.

## Summary: ICT Solutions

- ICT systems have improved work efficiency and reducing administrative workload. Networking has improved both clinical care and management of township health centers.
- Although directors and physicians at township health center agree that work efficiency and quality of care has gone up, directors place even greater value on their improved ability to manage the centers.
- Wenchuan People's Hospital now provides better care and new services for patients, and it is positioning itself to serve patients beyond Wenchuan county.

- The infrastructure and applications deployed in Wenchuan and Shifang put them significantly above other township health centers in Sichuan, and above the national average. Shifang's regional health cloud serves as a model for the rest of Sichuan.
- Training was critical to developing the knowledge needed to maintain and support advanced ICT systems. There is now a solid core of ICT support centralized at Shifang Health Bureau and Wenchuan People's Hospital. Shifang has a particularly skilled team.

## Key Success Factors

- ICT infrastructure and applications must be integrated with

<sup>38</sup> Interviews with Wenchuan People's Hospital, 2011

<sup>39</sup> Source: Joint assessment of Sichuan Health ICT As Is by Cisco and Sichuan Provincial Department of Health, 2009.

major aspects of day-to-day operations in a health center to have the greatest impact. In Shifang township health centers, all aspects of clinical care operations and management activities are now conducted over the network.

- Training is essential to implementation and long-term sustainability of the program. Training provided to end users helped increase awareness and comfort level in using the systems. This is important in regions such as Wenchuan where ICT involvement is generally low.

### Ensuring Sustainability

- ICT operating costs have increased for township health centers and Wenchuan People's Hospital. However, the costs are considered affordable and reasonable by township health center directors and the hospital president in view of the many benefits.
- Developing the skills of a group of advanced ICT users is critical, as it enables them to serve the entire regional network at a relatively low aggregated TCO. This also helps ensure the sustainability and cost-effectiveness of the network.

## Deeper Impacts of Connecting Sichuan

In interviews with key stakeholders and organizations, “change in mindset” was the phrase mentioned most often when asked to describe the most resounding impact of the program. Respondents provided many examples of how attitudes have changed, ranging from how healthcare is delivered to how decisions are made within local government.

### Changes in Healthcare Delivery

“The most valuable aspect that Connecting Sichuan has provided is to set up a new collaboration model for us,” according to President Wang of Wenchuan People’s Hospital. “We have formed partnerships with new business partners, and all this is enabled by technology.”

The “Wenchuan model,” which promotes collaboration and integration of hospital resources within the local region, has received attention both within Sichuan and in other regions of China. It is seen to be a viable example for collaboration among different levels of healthcare service providers. Aligned with the national healthcare reform program now underway in China, the Wenchuan model has enabled caregivers to work more closely together to provide better care to patients. The model also allows rural healthcare service providers to extend their reach and cooperate with experts outside the region.

In addition, the Wenchuan model exemplifies the value different healthcare organizations can offer within such

a network. Secondary-level hospitals such as Wenchuan People’s Hospital are able to transcend their previous missions and evolve to become “centers of collaboration” within a region, playing a key role in integrating primary- and tertiary-level healthcare providers to offer a continuum of care for patients. Wenchuan People’s Hospital now attracts increasingly more patients from outside Wenchuan, and is aiming to solidify its positioning as the leading hospital for the entire Aba Prefecture. This serves as a viable template for other secondary-level hospitals that are struggling to create new value propositions in the healthcare system.

### Changes in How Local Governments View ICT

The influence of the Connecting Sichuan program has changed how local governments view ICT, particularly with respect to decision making. Director Liu Jing from Shifang Health Bureau commented that the bureau is now positioned as a model for using ICT systems and, more importantly, for employing information systems to bring about management innovation.

For instance, in order to improve social services, the local government in Shifang urged each bureau to identify and execute management innovations. While other departments were only able to offer conceptual proposals, the health bureau provided concrete suggestions based on data

collected from the ICT system. Such a scientifically driven approach to decision making was a refreshing change for local government.

In Wenchuan, the local government is now embracing the network as a way to implement the ideal of a Digital Wenchuan. For example, as part of its effort to encourage tourism Shuimo, a town in Wenchuan county, the local government is working to provide tourists with information about locally available services and attractions.

## A Reference Point for Healthcare Reform in China

When Connecting Sichuan began three years ago, key concepts such as focusing on community care and using regional health networks to integrate care were still new in China, and had yet to be implemented. Healthcare reform initiatives announced by the government since then have endorsed the shift toward community care, regional health, and telemedicine. Connecting Sichuan can continue to serve as a strong reference point for pilots that include use of telemedicine in areas such as Midwestern China, as well as automation of township health centers and community-level hospitals throughout the country.

## Conclusion

This assessment concludes that ICT solutions implemented by Connecting Sichuan have had a positive effect on patients, physicians, and healthcare organizations. Doctors report an increase in the level of their medical expertise, resulting in a concomitant increase in the quality of patient care. Network-driven solutions such as telehealth applications and mobile clinics have broadened accessibility to care, and patients enjoy better outcomes at reasonable cost.

The assessment also found that certain key factors have to be considered when implementing ICT solutions in rural areas. These include leveraging less-costly alternatives (for example, obtaining bandwidth resources from local cable TV bureaus instead of from commercial telecom carriers), dealing with low ICT awareness and computer literacy, and providing training to overcome a lack of ICT expertise. Training is required for end users as well as ICT experts who will be charged with maintaining and providing shared ICT services. These measures help ensure the sustainability of the program.

This assessment evaluates the effects of Connecting Sichuan programs in the near term. Longer-term studies need to be conducted to track behavioral changes over time. For instance, a survey could be conducted to determine whether patients have permanently changed how they

obtain medical care—whether they are getting their healthcare locally or are still going to nearby cities for treatment. Another example would be to assess satisfaction levels as they relate to physician retention. It takes a long time for sustained changes in healthcare delivery to occur, even after implementing such a comprehensive and innovative program.

Future studies should look in detail at other features of Connecting Sichuan and its relevance as a model for healthcare reform. For instance, researchers could examine the Wenchuan model in detail, discovering how it alters healthcare service delivery in ways other than those examined in this study. The role of providers should also be evaluated further. Issues such as how malpractice can be prevented might be a good subject for study. More comprehensive and objective studies to evaluate the improvement in healthcare quality are also required. In addition, future assessments should consider how organizations are making other uses of the ICT infrastructure and applications. As more applications are implemented on the existing infrastructure, the value of integration will certainly increase.

A comprehensive and more far-reaching evaluation in the future promises to provide further insights that can contribute greatly to the success of ongoing healthcare reforms and innovations in China.