



mHealth in China and the United States:

How Mobile Technology is Transforming Healthcare
in the World's Two Largest Economies

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Executive Summary

Health care represents a major challenge for many countries. Governments around the world must address rising health care costs, aging populations, access disparities, and chronic illnesses. These issues present serious dilemmas for policymaking, budgets, and service delivery.

In this paper, we explore ways mobile technology can help with these difficulties. Specifically, we look at avenues through which mobile devices boost productivity, aid communications, and help providers improve affordability, access, and treatment. Using data drawn from China and the United States as well as global trends, we look at recent developments and emerging opportunities in mobile health, or mHealth.

We argue that mobile technology assists patients, health providers, and policymakers in several different respects. It helps patients by giving them tools to monitor their health conditions and communicate those results to physicians. It enables health providers to connect with colleagues and offers alternative sources of information for patients. It is also an important tool to inform policymakers on health delivery and medical outcomes.

A number of challenges and difficulties remain. mHealth remains in an early stage of development in many countries. Hospitals, telecommunications operators, and health professionals ought to incorporate mobile medical devices and applications into health diagnosis and treatment. Changes in operations and policy practices are necessary in order to facilitate mHealth development.

We suggest four ways that public authorities can speed the development and adoption of mHealth. First, mobile devices offer the potential to improve affordability of health care by lowering disparities

based on geography and income. Policymakers should encourage the use and adoption of cellphones, smartphones, and tablets in medical care.

Second, these devices improve administrative efficiency by reducing errors and streamlining reimbursement procedures. Public officials should reimburse health providers who offer consultations, diagnoses, and treatment through remote monitoring devices and other types of mobile technologies.

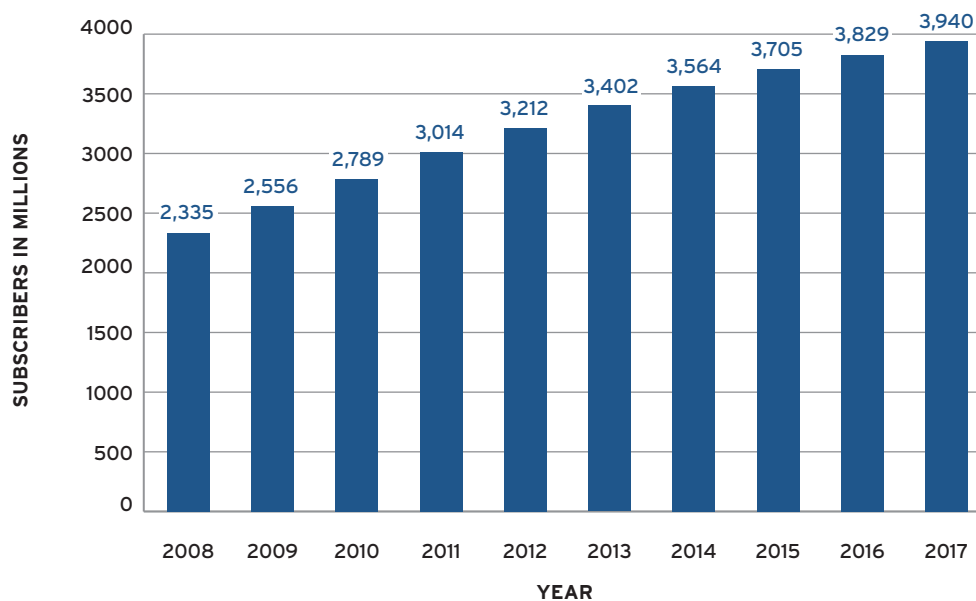
Third, mobile phones aid the patient experience by providing a means to deliver medical reminders and diagnostic information to patients and physicians. Reminders via text messages or mobile phones can encourage patients to take medication at the suggested time and dosage, and this will improve the quality of patient care. And devices such as smartphones can enable customized applications for use by health providers and patients who are dealing with long-term or chronic illness.

Finally, mHealth helps policymakers by encouraging better health data collection and analysis. Figuring out what works and doesn't work is one of the biggest challenges in health care. Undertaking research on health care data can help public officials make better decisions.

Growth in Mobile Broadband

There is no doubt that mobile broadband usage is rising rapidly throughout the world. According to a GSMA Wireless Intelligence report, the number of mobile Internet subscribers has risen dramatically since 2008 and is expected to grow even further in the next few years (see Figure 1).¹ It has gone from 2.3 billion in 2008 to 3.4 billion in 2013 and is predicted to rise to over 3.9 billion by 2017.

Figure 1
Total Worldwide Subscribers



If one examines the number of mobile devices, the figures are even more dramatic. Many people have more than one cellphone, smartphone, or tablet. The total number of cellular connections was more than 7.4 billion in 2013 (see Figure 2). That figure is expected to increase to 9.7 billion by 2017.²

China and India represent the areas with the largest number of mobile devices. China had 1.17 billion devices in 2013, while India had 864 million (see Figure 3). Much of future growth is expected to take place in the Asia Pacific region.³

Figure 2
Total Mobile Connections

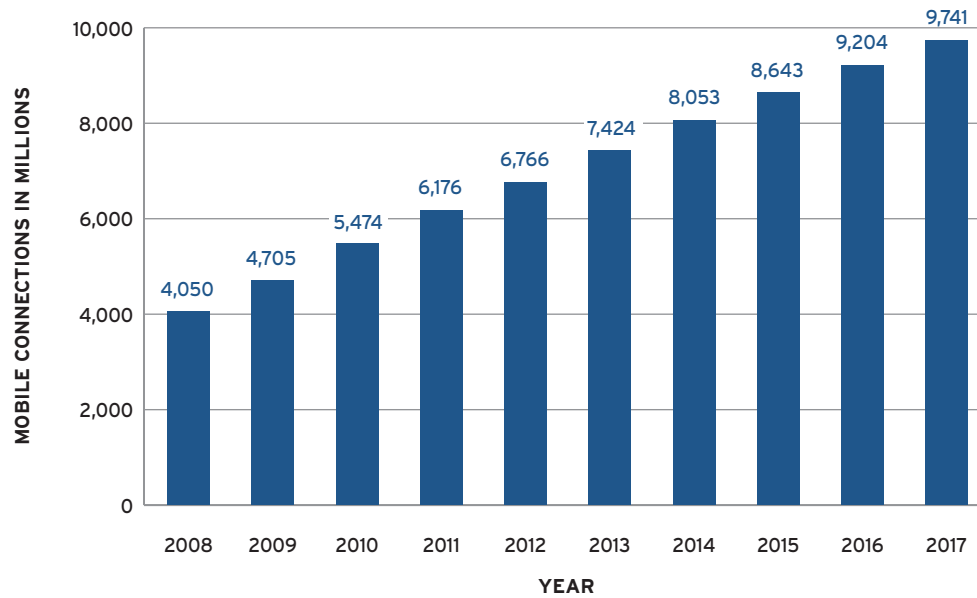
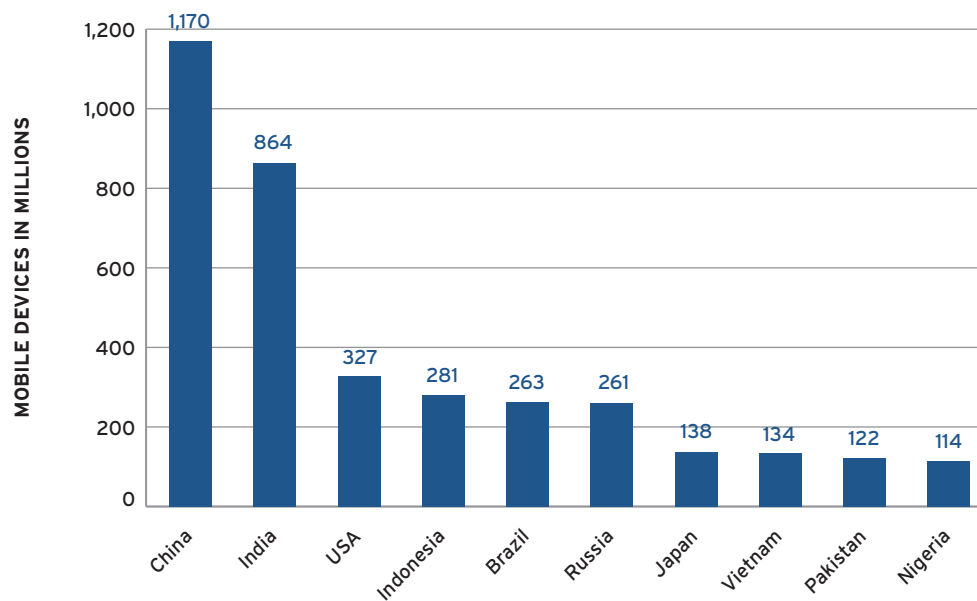


Figure 3
Number of Mobile Devices by Country



When looking at mobile phone users as a percent of the overall population, Russia has the highest penetration level with 180 percent, followed by Vietnam at 150 percent, Brazil with 140 percent, and Indonesia at 120 percent (see Figure 4).⁴ These are all places where individuals have more than one device, which boosts the device total above the number of subscribers.

Next generation mobile broadband growth also continues as a result of LTE commercial networks, which have also spread rapidly. According to a GSMA report, there were 176 million LTE connections worldwide at the end of 2013. Due to growing demand the number of LTE users has increased rapidly.⁵

The Cisco Visual Networking Index projects that global mobile data traffic will increase by more than ten times between 2012 and 2017 (see Figure 5).⁶ Analysts also forecast substantial increases in mobile traffic for China and the United States.

Figure 4
Mobile Phone Users' Percentage of the Population, 2013*

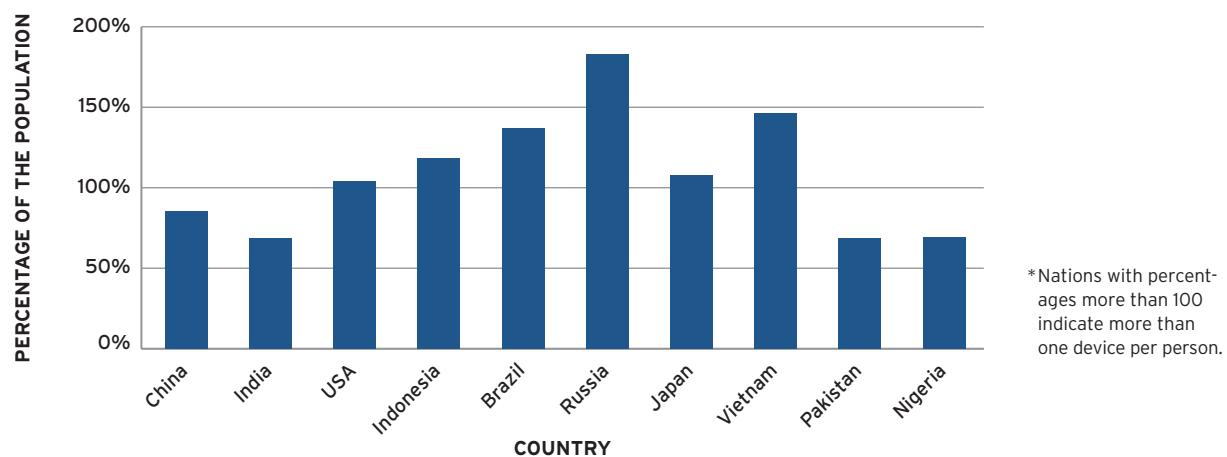
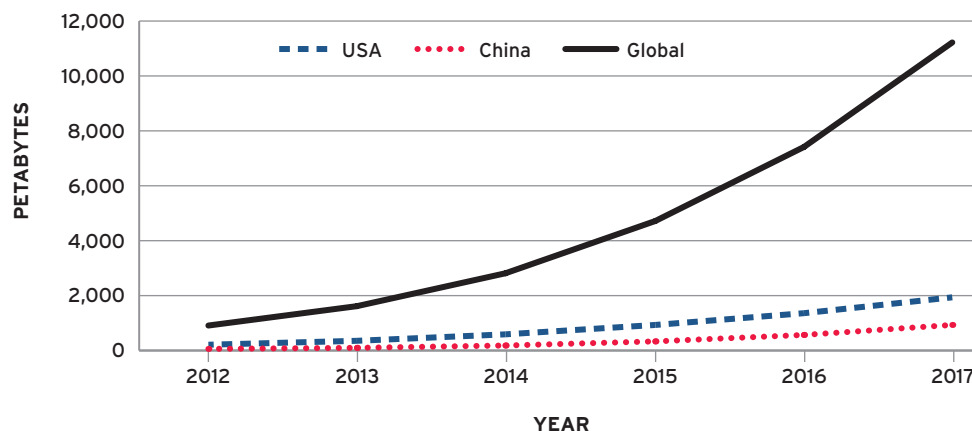


Figure 5
Growth in Mobile Petabytes, 2012-2017



The Economic Contributions of Mobile Broadband

Mobile broadband contributes many things to the overall global economy. There are multiplier effects that lead to the growth of consumption. Mobile devices also stimulate a feedback effect due to their impact on investment in related industries. Finally, we see spillover effects that lead to the improvement of production efficiency.

Data from the OECD from 1998 to 2010 show that among developed nations, a 10 point increase in broadband penetration is associated with a 0.035 percent in economic growth.⁷

Mobile applications and devices allow firms to act more efficiently. The LECG Corporation researched the connection between broadband penetration and productivity. They found that a 1 percent increase in broadband penetration was associated with a productivity increase of 0.1 percent.⁸

Using new panel data that included 200 countries from the years 2008 to 2012, the Chinese Academy of Telecommunications Research (CATR) reexamined the LECG results. Its work found a 10 percent increase in fixed broadband penetration was associated with a 1.3 percent increase in worker productivity (Total Factor Productivity) and a 10 percent increase in mobile broadband was associated with a 4 percent increase in TFP.

CATR found that increased broadband conductivity both creates and eliminates jobs but the net effect is positive. Mobile broadband benefits rural communities. The proliferation of mobile broadband has driven down prices for consumers, and this has benefited rural Internet users. In China rural residents primarily use mobile phones to access the Internet. According to the survey of China Network Information Center (CNNIC) in June 2013, 78.9 percent of Internet users in China's rural areas rely on mobile phones. Many more rural Chinese use mobile phones than desktop computers (58.8 percent) or laptops (32.4 percent). As of June 2013, 27.9 percent of Chinese Internet users (165 million people) lived in rural areas.⁹

These data suggest there are major opportunities for using broadband to improve a wide range of services. Research by Miguel Tirado suggests that mobile technology can improve health care through better access and medical service delivery.¹⁰ Mobile devices offer the potential to improve affordability of health care and more efficient reimbursement for health-related services. Cell phones provide a means to deliver medical reminders and diagnostic information to patients and physicians. Finally, protocols for mobile health enable better health data collection and analysis, which contributes to the overall system.

Rising Health Care Costs

In both China and the United States, the cost of medical care is growing rapidly. In China during 2011, medical care accounted for 5.15 percent of GDP.¹¹ Figure 6 shows the annual health expenses for China in 2006 to 2011. The cost has risen from 0.98 trillion RMB (US \$ 0.16 trillion) in 2006 to 2.4 trillion RMB (US \$ 0.396 trillion) in 2011.

In the United States, health care costs total around \$2.9 trillion in 2013 and are expected to rise to nearly \$4.8 trillion by 2021 (see Figure 7).¹² Health care spending as a percent of GDP is expected to rise from 16.2 in 2006 to 19.6 percent in 2021.

Figure 6
Annual Health Expense in China, 2006-2011

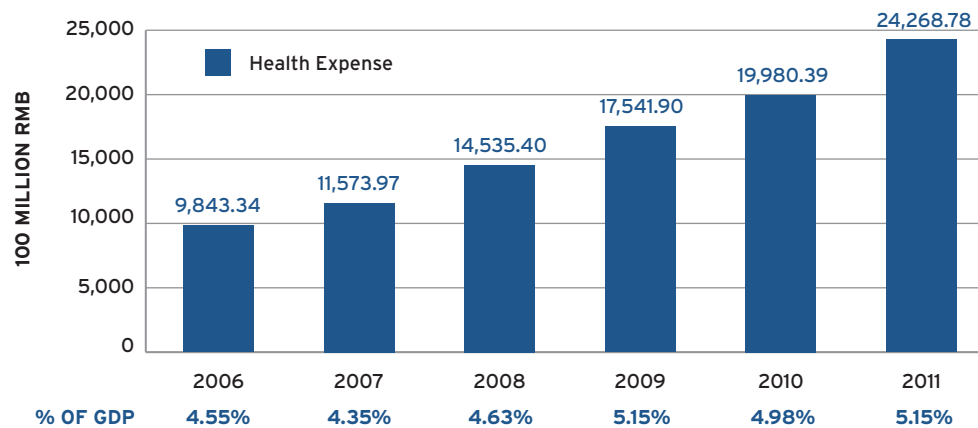
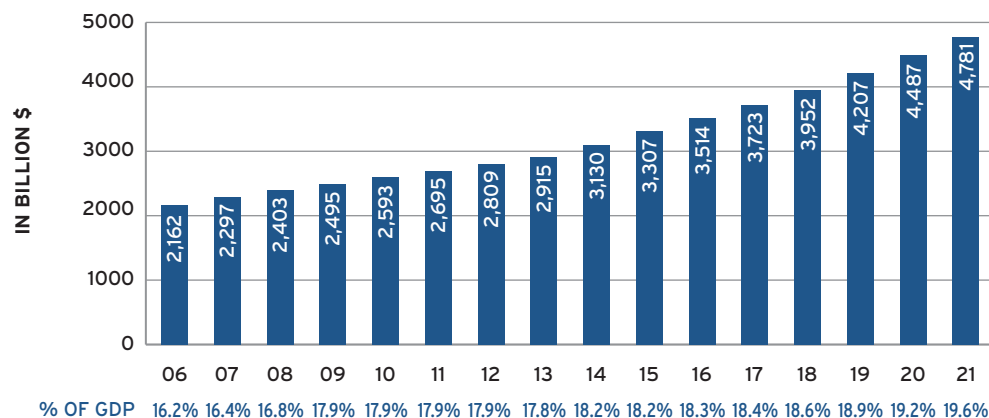


Figure 7
Health Care Costs in the United States, 2006-2021



Aging Populations

Both China and the United States face aging populations. In the former, about 8 percent of the current population is 65 years or older (see Figure 8).¹³ In the latter, 40 million of the 310 million people (12.9 percent) are over the age of 65 years.¹⁴ As the Baby Boomer generation retires, this percentage is expected to rise to 20 percent in America.

Researchers there anticipate that 20 percent (about 88 billion people) will be over 65 years old by 2050 in the United States (see Table 1) and 33.3 percent of people will be over 65 years old by 2050 in China (see Table 2).

Figure 8
Proportion of the Population in China, 1982-2010¹⁵

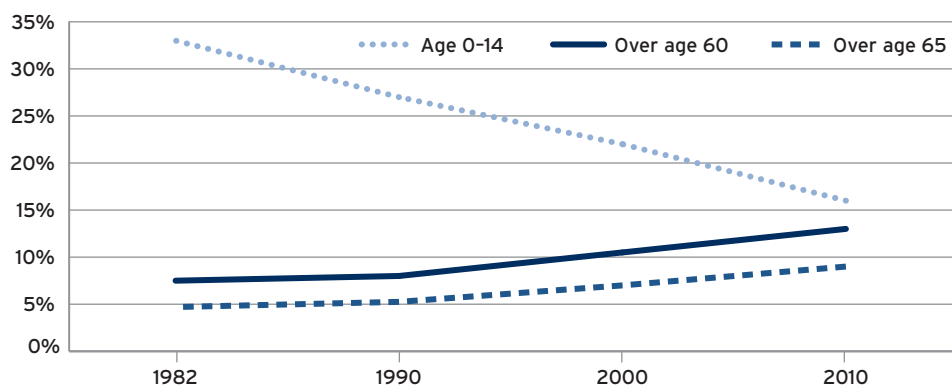


Table 1
Number of People Over 65 Years in United States, 2010-2050

YEAR	2010	2020	2030	2040	2050
Total Number (million)	310	341	373	405	439
Number Over 65 (million)	40	55	72	81	88
Percent Over 65	13.0%	16.1%	19.3%	20.0%	20.0%

Table 2
Percentage of the Population Over 65 Years in China, 2000-2050

YEAR	2000	2002	2005	2010	2012	2050
Over 65	6.96%	7.3%	7.7%	8.87%	9.4%	33.3%

Sixty years ago, life expectancy in China was about 40 years. Industrialization and rising living standards in China have led to huge increases in average life expectancy. Today the average Chinese person lives to an age of 75 years (See Figure 9).¹⁶

In 2000, 10 percent of the world population was 60 years or older. But now, the world has entered an “aged” state with more elderly people in most nations around the globe. The population in China has followed a similar pattern. Around 2015, a large portion of Chinese people will reach the age of retirement. This means that the size of the working age population will decline rapidly. Figure 10 shows the working versus non-working age population for China from 1950 to 2050.¹⁷

Figure 9
Life Expectancy, China and World, 1950-2050

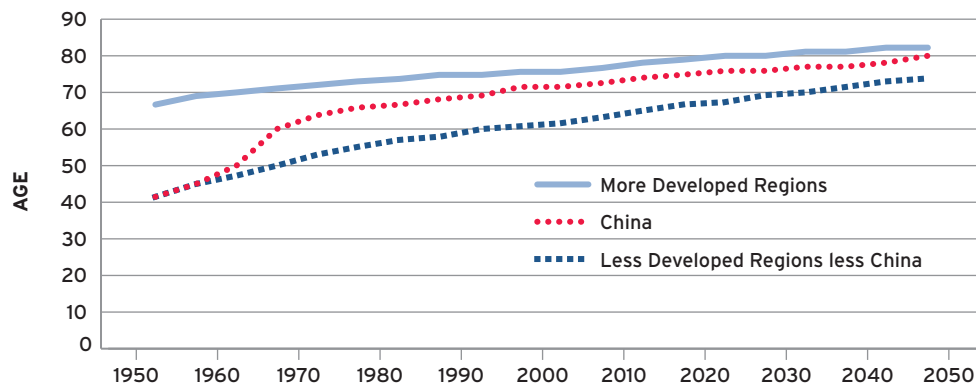
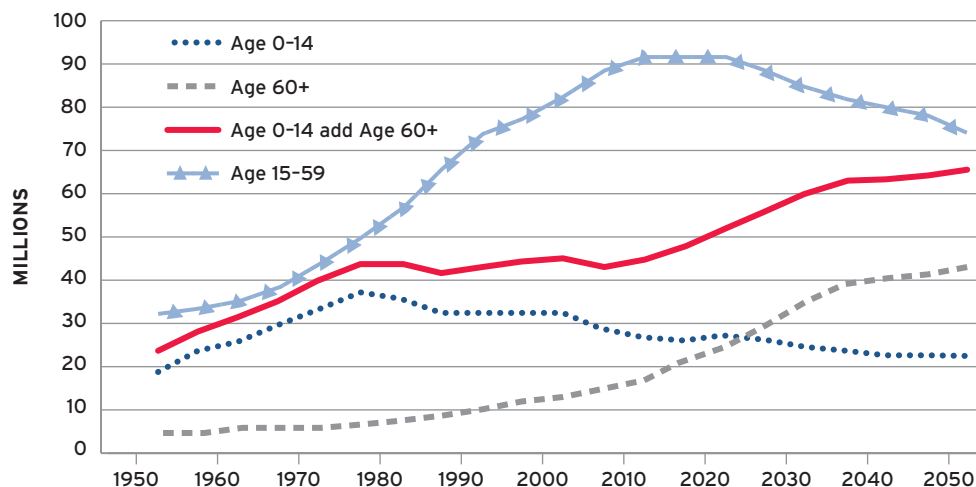


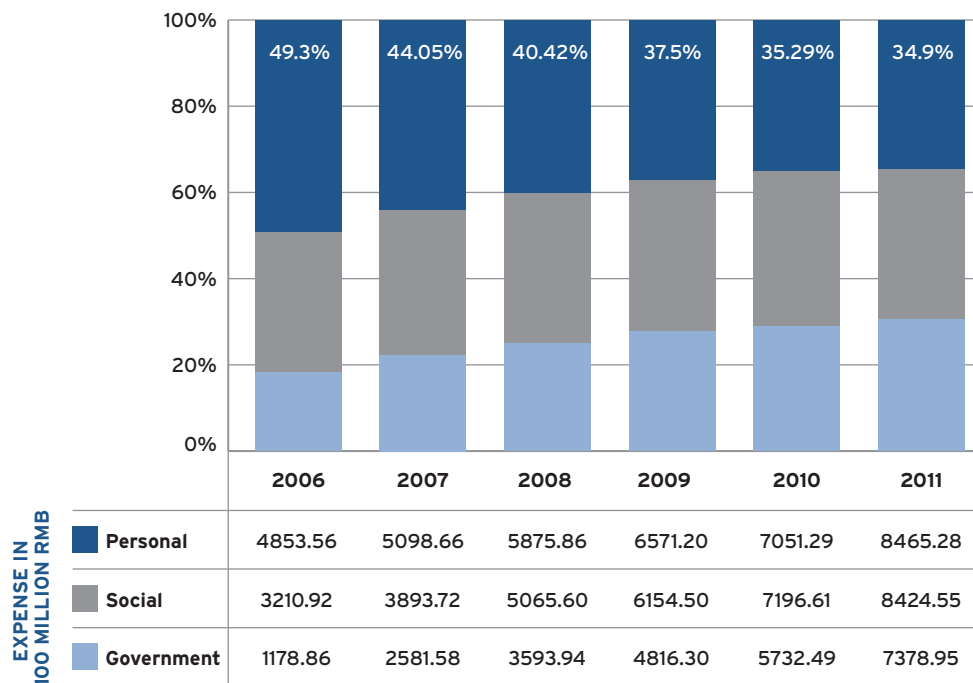
Figure 10
Working/Non-working Age Population, China, 1950-2050



Affordability Challenges

Although science has made great progress in medical care in recent years, there are still many people who cannot afford the cost of personal medical care. For China, the ratio of medical expenses to resident's average income demonstrates the burden medical expenses have placed on Chinese citizens¹⁸ (see Figure 11). In recent years, people have paid from 35 to 50 percent of their health care costs through their own means.

Figure 11
Medical Expenses in China, 2006-2011



There are major affordability challenges in the United States as well. The costs of insuring a typical family are rising dramatically. According to the Kaiser Family Foundation, health insurance premiums have nearly tripled between 1999 and 2012 (see Figure 12).¹⁹

Health care costs in the United States are projected to consume increasingly larger percentages of family income. American researchers have estimated that by 2037, average health care costs will exceed median family income (see Figure 13).²⁰ This analysis uses data from the Medical Expenditure Panel Survey from the Department of Health and Human Services and the U.S. Census Bureau to project future trends.

Figure 12

Average Annual Premiums for Single and Family Coverage in the United States, 1999-2012

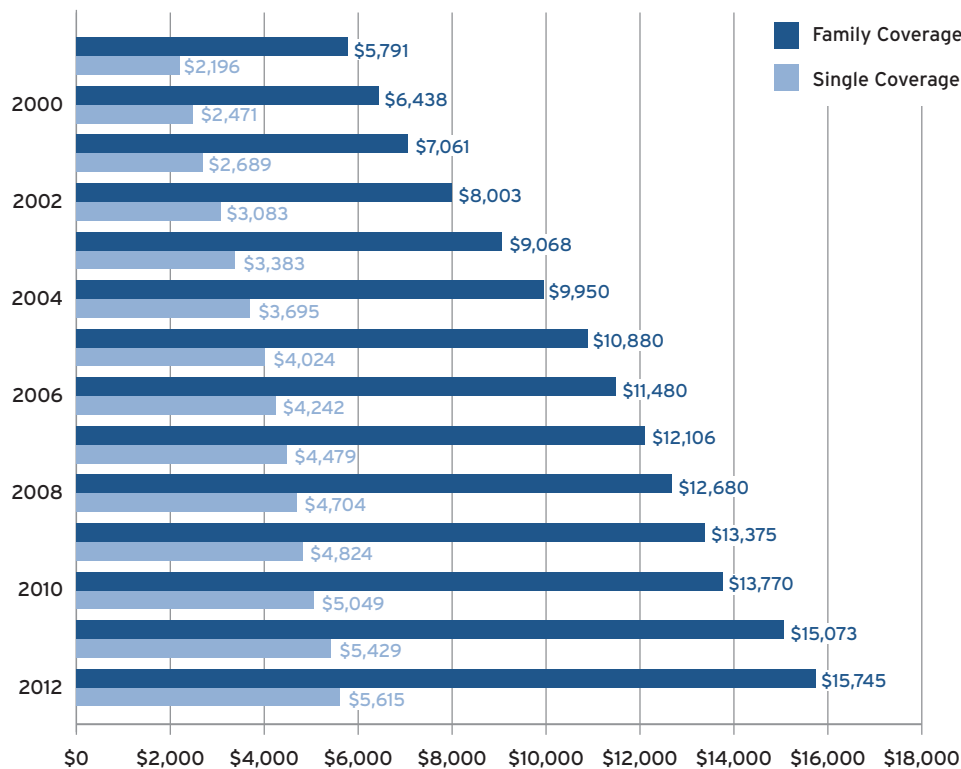
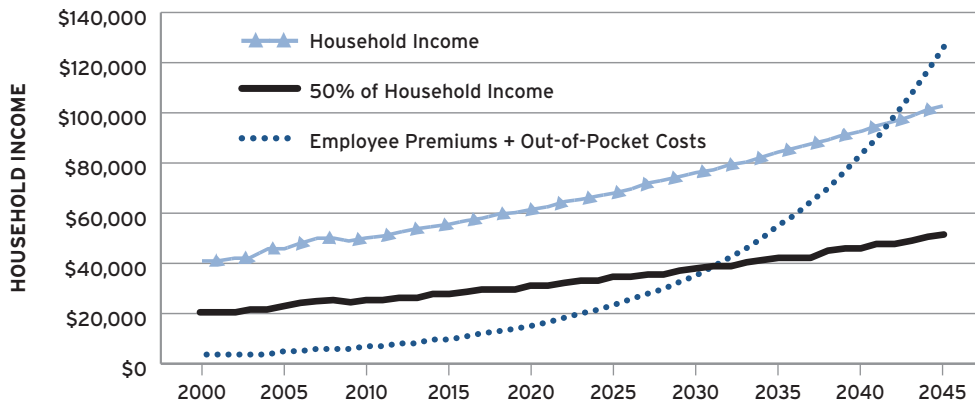


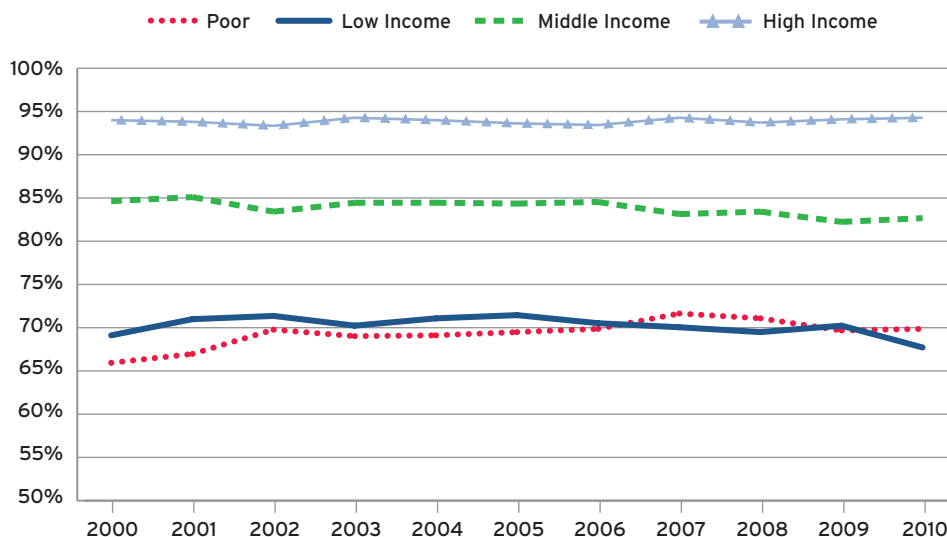
Figure 13
Projected Annual Family Income and Health Care Costs in the United States



Disparities in Health Care

Disparities in health insurance represent one of the most significant factors contributing to healthcare service problems in the United States.²¹ Low income Americans generally have less access to health care than middle or upper class Americans. Figure 14 shows the percentage of people under age 65 with health insurance by income levels for 2000-2010.²² Around 95 percent of high-income Americans have health insurance, compared to around 70 percent for those with low incomes.

Figure 14
U.S. Health Insurance by Income Level, 2000-2010



Americans also have disparities in access between metropolitan and non-metropolitan areas.²³ As shown in Table 3, 83.3 percent of those living in metropolitan areas have health insurance, compared to 80.2 percent in 2011 living in non-metropolitan areas.

Access differentials sometimes have consequences in terms of actual health outcomes. In the United States, rural areas with higher levels of uninsured people also tend to have a higher percentage of people who report fair or poor health outcomes.²⁴ Table 4 shows that American rural areas have about half the physicians (122 per 100,000 people) compared to urban areas (270 per 100,000 people).²⁵

Rural areas also have fewer medical personnel (see Figure 15). Rural areas have about 852 registered nurses and 318 licensed nurses per capita, compared to 934 and 205 nurses per capita for urban areas.²⁶

The gap in medical services between urban areas and rural areas is apparent in China as well. According to the China Health Statistics Yearbook, urban areas have more medical personnel and sick beds than rural areas.²⁷ As shown in Figure 16, urban areas have about twice the number of medical personnel compared to rural areas.

Health insurance coverage increased dramatically in China from 2009 to 2011. Government interventions improved access to health care, with particularly positive impacts on rural areas. The percent of Chinese people who had medical insurance coverage rose sharply from 85 percent in 2009 to over 95 percent in 2011.²⁸ The Chinese government used the new rural cooperative medical care system (NRCMS) to improve the insurance coverage in rural areas.

Table 3
Percent with Health Insurance in Metropolitan and Non-Metropolitan Areas in the United States, 2008-2011

	2008	2009	2010	2011
Metropolitan	83.6%	82.9%	82.2%	83.3%
Non-metropolitan	80.9%	79.8%	79.6%	80.2%

Table 4
Physicians per 100,000 by Type and Practice Location in the United States, 2008

	URBAN	RURAL	RURAL/URBAN
All Physicians	270	122.2	45%
Primary Care Physicians	104.5	65	62%
OB/GYNs	12.9	58	45%
Pediatricians	19.4	6.7	34%
Surgeons	55.1	24.5	44%
Other Specialists	94.8	28.5	30%
Psychiatrists	15.6	4.2	27%
Dentists	68.9	36.2	53%

Figure 15
Nurses per 100,000 Residents in Rural and Urban Areas in the United States

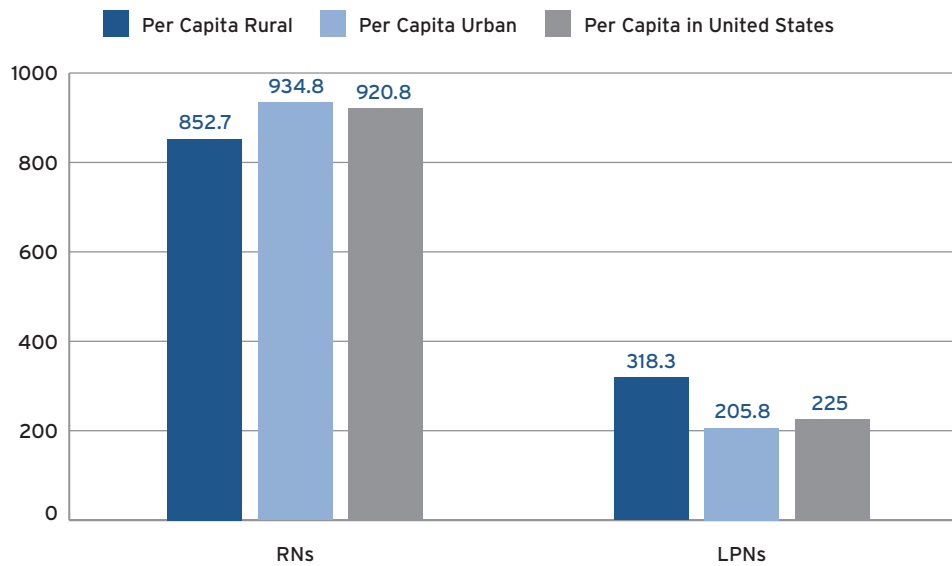
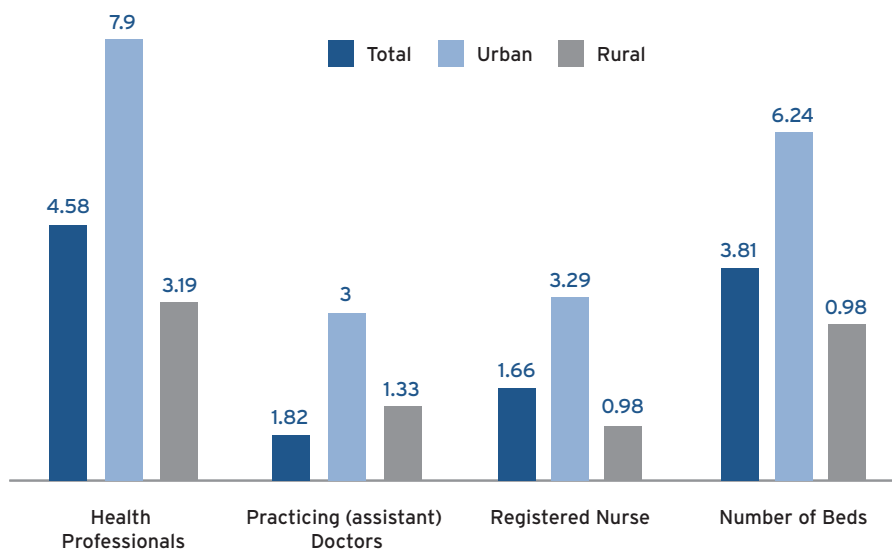


Figure 16
Medical Personnel and Sickbeds in China, 2011
(per thousand people)



The Challenge of Chronic Illness Incidence and Mortality

The increase in the number of elderly people has corresponded with an increase in the mortality rate and prevalence of chronic illness. The growth in the number of Chinese people suffering from chronic illnesses along with the increased costs of treatment and longer recovery times have pressured the Chinese healthcare system. The treatment of chronic disease is now a major public health issue in China.

According to The State Council Information Office of the People's Republic of China, doctors diagnose 260 million people with chronic illnesses every year. Chronic diseases account for 85 percent of the deaths in China every year.²⁹ The diseases that account for the most deaths are: cancer (27.79 percent), cerebrovascular disease (20.22 percent) and heart disease (21.3 percent) (see Table 5).³⁰

Chronic diseases also represent a major problem in the United States. Chronic illnesses account for about 75 percent of total health care costs.³¹ 11.3 percent of Americans have suffered from heart disease, 6.4 percent have coronary heart disease, 3.2 percent have had a heart attack, 2.6 percent have suffered a stroke, 8 percent have cancer, 21.9 percent are afflicted by arthritis, and 8.6 percent are diabetic (see Table 6).³²

Table 5
Incidence of Chronic Diseases in China

Years	Heart Disease	Digestive disease	Cerebrovascular disease	Cancers	Arthritis	Diabetes
2008	17.6%	24.5%	9.7%	2.0%	10.2%	10.7%
2009	18.3%	24.2%	9.6%	2.4%	11.0%	11.7%
2010	18.5%	24.3%	9.5%	2.0%	10.5%	11.9%
2011	18.9%	23.8%	10.2%	2.2%	11.6%	12.4%

Table 6
Incidence of Chronic Diseases in the United States

Years	Heart Disease	Coronary Heart Disease	Heart Attack	Stroke	Cancers	Arthritis	Diabetes
2009–11	11.3%	6.4%	3.2%	2.6%	8.0%	21.9%	8.6%
2006–08	11.3%	6.2%	3.4%	2.6%	7.4%	21.0%	7.7%
2003–05	11.5%	6.3%	3.3%	2.5%	7.0%	21.5%	6.9%
2000–02	11.4%	6.1%	3.3%	2.4%	6.9%	NA	6.3%
1997–99	11.7%	6.0%	3.2%	2.2%	6.5%	NA	5.4%

Like America, China has many people who suffer from cardiovascular issues as well as hypertension and diabetes. According to the Chronic and Non-communicable Disease Prevention and Control Center of Chinese Center for Disease and Prevention³³ 33.5 percent of adults received diagnoses of hypertension and 9.7 percent were told they had diabetes. The number of people afflicted with hypertension and diabetes has increased in recent years placing pressure on the health care system and the government to respond to the crisis.

Chronic disease negatively impacts the labor force. According to the Fourth National Health Services Survey, Chinese workers took off 3.6 billion days in 2008 due to chronic illness, accounting for 65 percent of the total days taken off work.³⁴

The increased incidence and spread of chronic diseases has prompted a serious response from the government. To combat chronic diseases the government created the “Chinese Chronic Disease Prevention Work Plan (2012-2015).” A centerpiece of this plan is using monitoring devices to treat chronic diseases.³⁵

Human and Financial Losses from Chronic Illnesses

Chronic diseases are also expensive to treat. The treatment of chronic diseases accounts for 70 percent of health care spending.³⁶ The World Health Organization predicts that heart disease, stroke, and diabetes will cost China 3.91 trillion RMB (US \$558 billion) from 2006 to 2015.³⁷

Chronic disease may result in even higher costs in the future. The National Health and Family Planning Commission of the PRC, estimates the total cost of the medical care in 2012 at 2.891 trillion RMB, an increase of 456.85 billion RMB over 2011.³⁸ Despite the large medical bills many Chinese people do not receive adequate care for their chronic diseases. In the future it is likely that chronic disease will consume more resources.

The Chinese government is currently working to provide all citizens with basic medical insurance. However, the growth of chronic diseases has made this endeavor more costly than predicted. Therefore, it is critical the government adopt policies to better treat and prevent chronic illness.

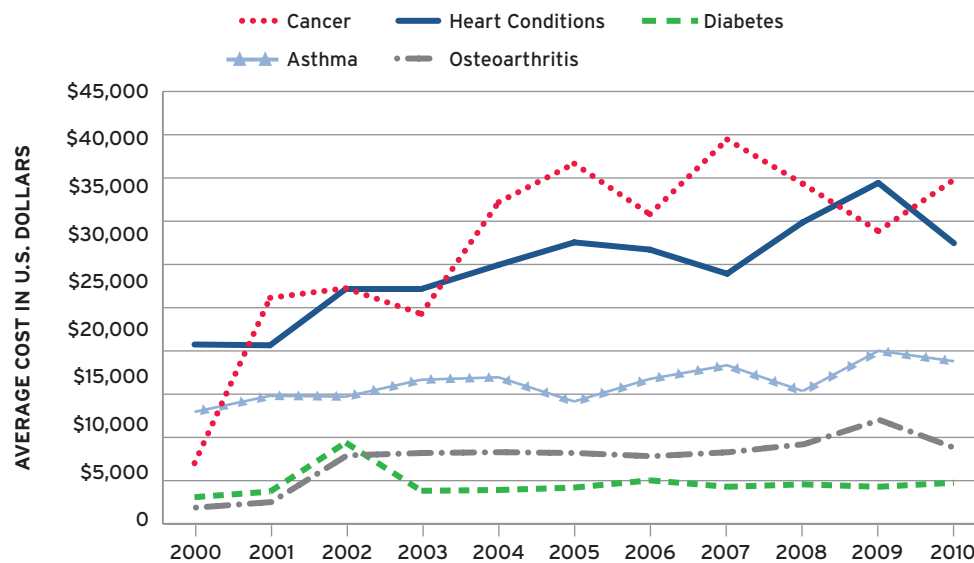
The cost of treating chronic illness varies by medical venue.³⁹ As shown in Table 7, treatment, as a hospital inpatient, is the most expensive kind of care at \$20,831 for heart conditions, compared to treatment through hospital outpatient service, emergency room visits, or prescribed medicines.

In the United States some chronic diseases are more expensive to treat than others.⁴⁰ In general, costs have increased for cancer treatment and heart conditions, while remaining stable for asthma, diabetes, and osteoarthritis (see Figure 17).

Table 7
Average Costs of Chronic Illnesses by Type of Medical Facility in the United States

Condition	Hospital Outpatient	Hospital Inpatient	Emergency Room Visits	Prescribed Medicines	Home Health	Any Service
Heart conditions	\$1,215	\$20,831	\$1,839	\$583	NA	\$4,648
Cancer	\$3,060	\$24,401	NA	\$1,544	NA	\$5,705
Diabetes mellitus	\$683	NA	NA	\$1,217	NA	\$2,334
COPD, asthma	\$531	\$13,570	\$866	\$612	NA	\$1,357
Osteoarthritis	\$926	NA	NA	\$480	\$4,751	\$1,684

Figure 17
Costs of Different Chronic Conditions in the United States, 2000-2010



Cardiovascular Disease

One of the biggest health challenges in both countries is cardiovascular disease. According to the Chinese Ministry of Health around 132 per 10 million people in China die from cardiovascular disease.⁴¹ Research from the Cardiovascular Disease Prevention Research Center of Ministry of Health, indicates that the prevalence of cardiovascular disease in China will grow rapidly as shown in Figure 18. The number of cardiovascular disease patients in China will increase by 0.5 times, or about 21.3 million in the next two decades.⁴²

Hypertension causes about half of the deaths associated with cardiovascular disease. The 2012 Beijing population health status report shows that among hypertension patients, a lack of awareness about high blood pressure accounts nearly 50 percent of deaths.⁴³ Thus, many of the deaths caused by cardiovascular disease are preventable. Due to lack of medical facilities in rural areas, cardiovascular disease kills more people in rural areas than in developed regions. Real-time monitoring can benefit those people who suffer from cardiovascular disease.

Figure 18
Cardiovascular Disease in China, 1980-2010

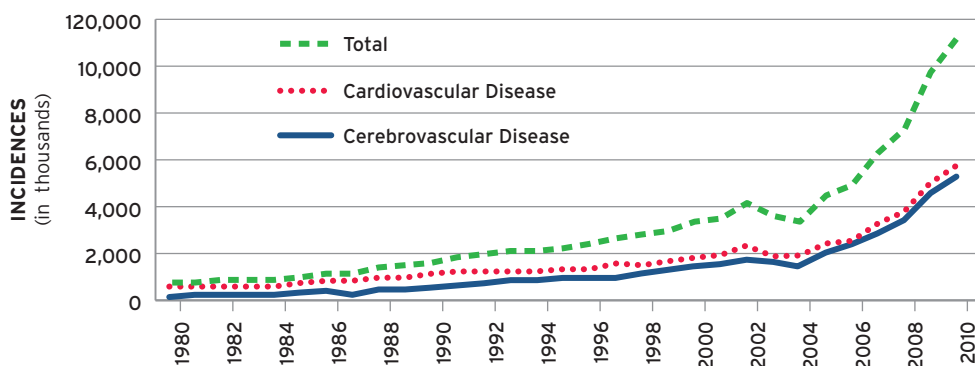
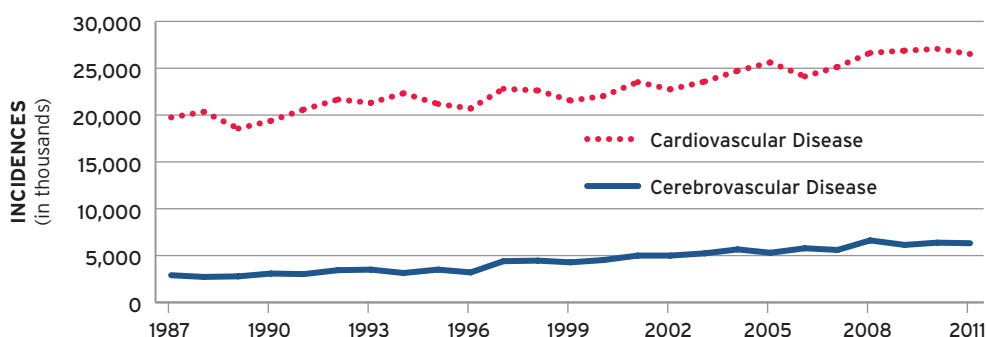


Figure 19
Cardiovascular Diseases in the United States⁴⁴



Cardiovascular diseases place a substantial economic burden upon the patients' family (see Figure 20). In China, acute myocardial infarctions cost the economy 4.287 billion RMB (US \$702 million), intracranial hemorrhages cost 12.35 billion RMB (US \$2.01 billion) and cerebral infarctions cost 22.75 billion RMB (US \$3.71 billion) in 2010 statistics in China.

Per capita acute myocardial infarctions cost 15,773.5 RMB (US \$2,586), intracranial hemorrhage cost 11,019.8 RMB (US \$1,801), and cerebral infarction cost 7143.3 RMB (US \$1,167). Since the prevalence of cardiovascular disease keeps growing, the costs related to these diseases will continue to rise.

Chinese people spend a great deal on the treatment of cardiovascular disease. The World Bank estimates that if incidence of cardiovascular disease were reduced by 1 percent over the next 30 years then China would save \$10.7 trillion.⁴⁵

In the United States, the annual deaths from cardiovascular disease have dropped from 725,000 in 1998 to just below 600,000 in 2010 (see Figure 21).⁴⁶ With the introduction of new pharmaceutical treatments and improved hospital procedures, heart disease is an area where we have seen significant progress in diagnosis and treatment.

The costs of treating heart disease have risen considerably over the past decade in the United States. In looking at the costs from 2000 to 2010, we see that the treatment for hospital inpatients on heart disease has risen from \$13,433 to \$20,831 over the past decade.⁴⁷ There have been similar increases for emergency room visits, prescribed medicines, and hospital outpatient treatment (see Table 8).

Figure 20
Hospitalization Costs of Cardiovascular Disease in China

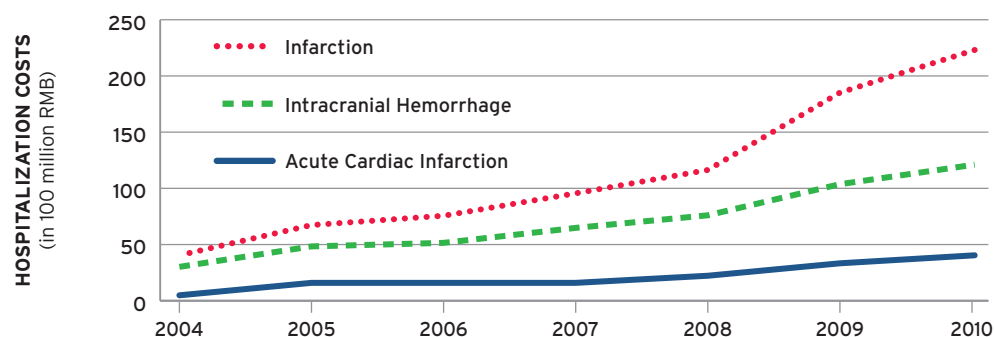


Figure 21
Drop in U.S. Cardiac Deaths, 1998-2010

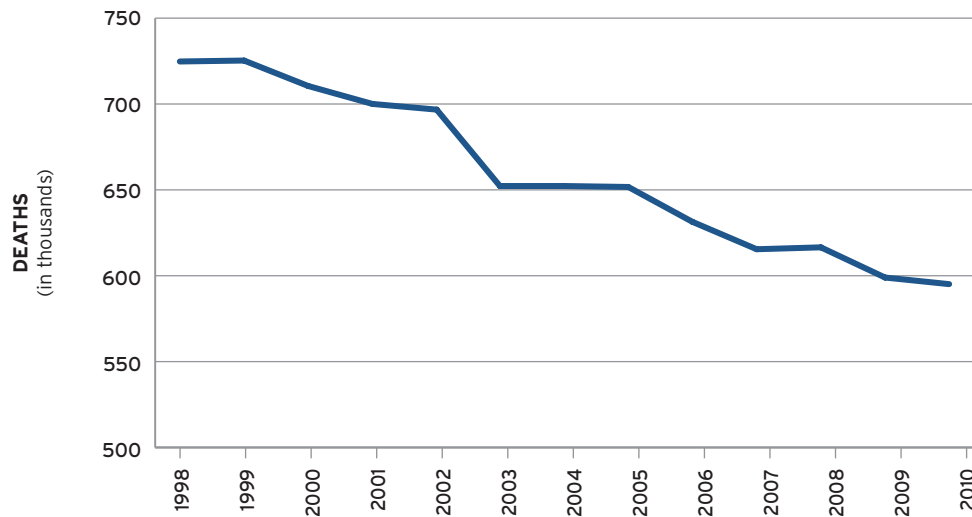


Table 8
The Costs of Heart Disease in the United States, 2000-2010

Year	Hospital Outpatient	Hospital Inpatient	Emergency Room Visits	Prescribed Medicines	Home Health	Any Service
2010	\$1,215	\$20,831	\$1,839	\$583	NA	\$4,648
2009	\$1,357	\$18,867	\$1,857	\$506	\$8,423	\$4,304
2008	\$1,036	\$17,298	\$2,519	\$566	\$5,729	\$4,114
2007	\$945	\$19,123	\$1,389	\$554	NA	\$3,949
2006	\$1,095	\$14,990	\$1,397	\$542	\$6,484	\$3,964
2005	\$930	\$18,081	\$1,039	\$577	\$4,535	\$3,988
2004	\$993	\$16,362	\$1,369	\$540	\$3,102	\$4,508
2003	\$864	\$14,227	\$1,025	\$505	\$4,297	\$3,391
2002	\$865	\$14,235	\$862	\$456	\$4,465	\$3,437
2001	\$879	\$12,970	\$898	\$443	NA	\$3,316
2000	\$737	\$13,433	\$685	\$435	NA	\$3,286

The Rise of Mobile Health

mHealth activities have grown in popularity around the world. A global survey of 114 nations undertaken by the World Health Organization found that many countries have established mHealth initiatives.⁴⁸ The most common activity was the creation of health call centers (38 percent), which respond to patient inquiries (see Figure 22). This was followed by using SMS for appointment reminders (25 percent), using telemedicine (18 percent), accessing patient records (18 percent), measuring treatment compliance (17 percent), raising health awareness (10 percent), monitoring patients (8 percent), and physician decision support (6 percent).

Not surprisingly, the differences between developed and developing nations were large. Africa had the lowest rate of mHealth adoption while North America, South America, and Southeast Asia showed the highest adoption levels. A number of countries have initiatives in the pilot stage or have informal activities that are underway.

Analysts predict that the size of the worldwide mobile health market will reach US \$23 billion by the year of 2017 (See Figure 23). They forecast that Europe and Asia-Pacific will have the largest markets followed by North America. Latin America and Africa will have the smallest markets (See Figure 24).⁴⁹

Researchers at GSMA built a model to predict the growth of mHealth. Within the Asian region, China and Japan will account for the largest percentage of the market with 37 percent and 21 percent respectively (See Figure 25).⁵⁰

Figure 22
Countries Reported Use of mHealth Initiatives

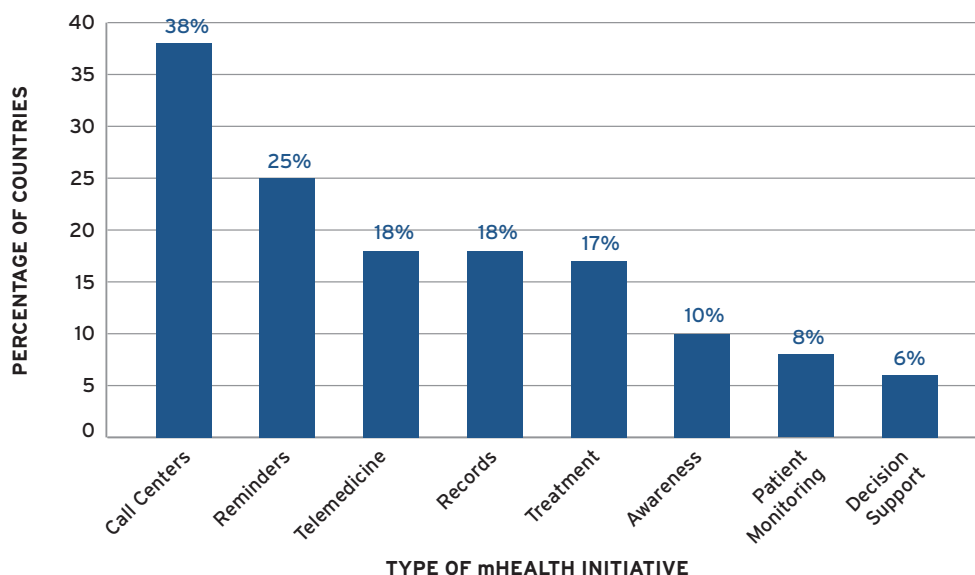


Figure 23
Global mHealth Market

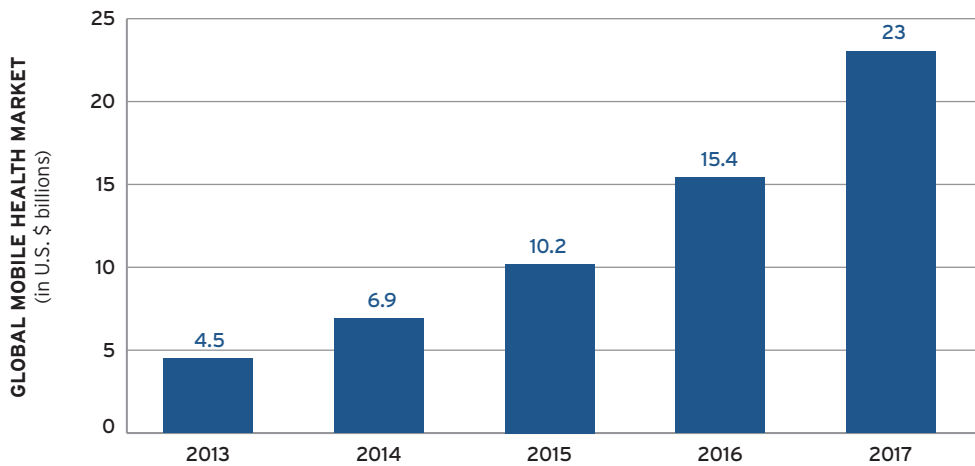
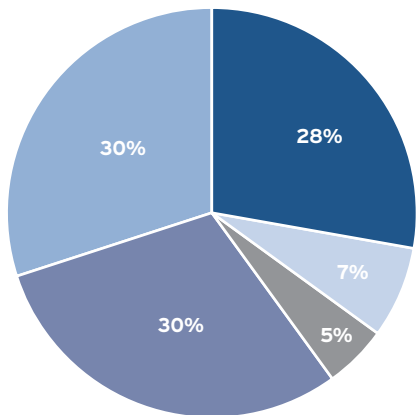
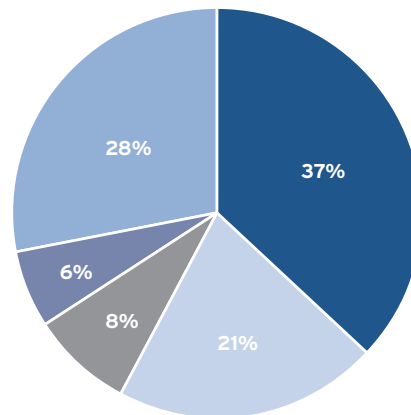


Figure 24
Global mHealth Market Shares



■ USA/Canada | \$6.5 billion | 28%
 ■ Latin America | \$1.6 billion | 7%
 ■ Africa | \$1.2 billion | 5%
 ■ Europe | \$6.9 billion | 30%
 ■ APAC | \$6.8 billion | 30%

Figure 25
mHealth Market Shares in APAC



■ China | \$2.5 billion | 37%
 ■ Japan | \$1.4 billion | 21%
 ■ India | \$0.6 billion | 8%
 ■ Australia | \$0.4 billion | 6%
 ■ Rest of Asia-Pacific | \$1.9 billion | 28%

GSMA estimates that in 2017 the countries with the largest mHealth markets will be the United States and China. They predict the market shared by these two countries will account for more than one-third of the worldwide market (see Figure 26).⁵¹

The research firm iiMedia found that the Chinese mobile medical applications market is growing rapidly. They estimate the size of the Chinese mHealth market is about 1.86 billion RMB, which is up to 17.7 percent over the last year. They also predict the mobile medical market in China will exceed 10 billion RMB by the end of 2017 (as shown in Figure 27).⁵²

They also predict rapid growth in the Chinese wearable medical devices market. iiMedia data shows that in 2012 the wearable medical equipment market in China reached 420 million RMB, and will exceed 5 billion RMB by 2017 (see Figure 28).⁵³

Figure 26

Top 10 Countries Based on mHealth Revenue (U.S. \$ billion), 2017

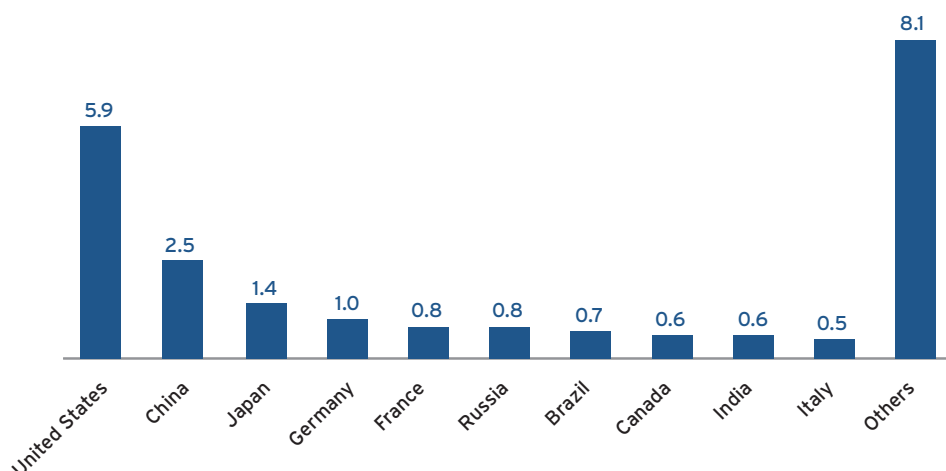
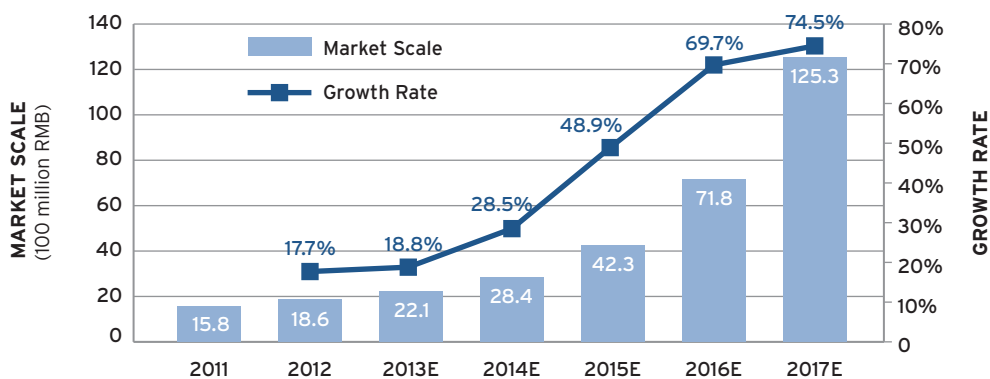


Figure 27

mHealth Market in China



Remote monitoring devices represent a fast-growing part of the mHealth sector. According to a report jointly authored by GSMA and PricewaterhouseCoopers (PwC), the Chinese medical monitoring services market will reach \$1.2 billion by 2017, with over 90 percent of the revenues coming from chronic disease management solutions.⁵⁴

They also predicts that monitoring services will dominate the worldwide mHealth market. They predict that by 2017 monitoring services will reach about 15 billion (US dollars). The next two largest market sub-sectors are diagnosis and treatment (see Figure 29).⁵⁵

Figure 28
Market Scale of Wearable Mobile Medical Equipment in China

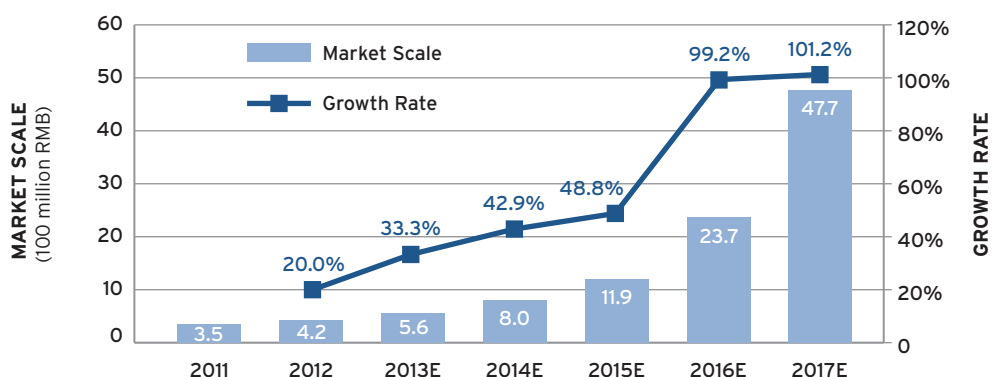
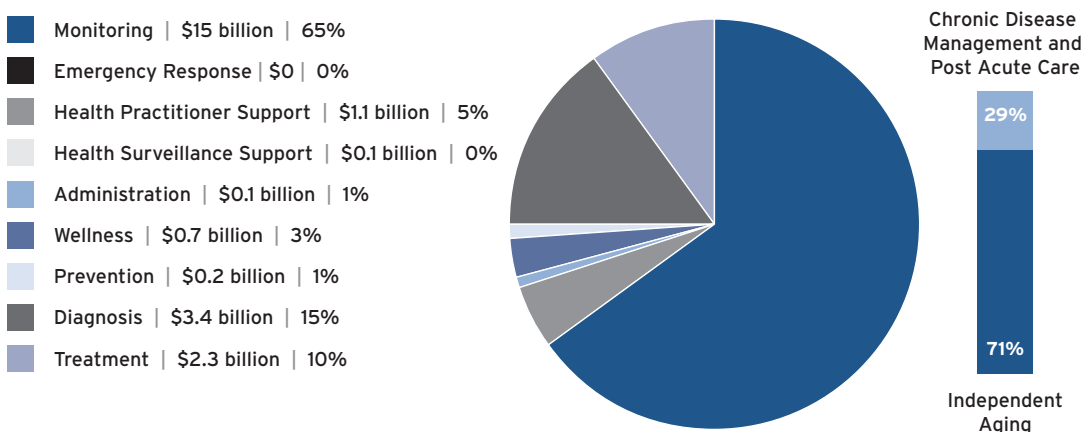


Figure 29
Global mHealth Market Opportunity by Service Categories, US\$ billion, 2017



Note: Total worldwide market size (2017E): US\$ 23 billion
Source: PwC analysis

An area where we are seeing growth is in the use of videoconferencing. Technologies such as Facetime, Skype, and the like offer a simple solution for health providers to confer with one another across wide geographic areas. Physicians could get advice from one another on medical treatment and diagnosis.⁵⁶

Videoconferencing systems help those who live in less developed or under-served areas gain access to low-cost, but high-quality medical services. This represents a way to overcome geographic disparities between urban and rural areas and bring quality health care to locales that may lack physicians or medical facilities. The video conferencing systems market in China grows each year. In 2010, the size of the video conferencing market was 6.63 billion RMB and grew 28.24 percent compared with last year.⁵⁷

mHealth usage is growing rapidly in the United States. A national survey undertaken by the Pew Internet and American Life Project found in 2012 that 31 percent of respondents reported using their cell phones to look up health or medical information online.⁵⁸ The poll also found more people used apps to track or manage their health in 2012 (37 percent) than in 2010 (17 percent).

Fifty-two percent gather health information on their phones, compared with 6 percent of non-smartphone owners. And 80 percent of cell phone owners say they send and receive text messages. Only 9 percent of cell phone owners say they receive any text updates or alerts about health or medical issues.

Video chat is a way to connect health providers for informal consultations. Yet few American doctors make use of this because it is difficult under current reimbursement rules for them to get paid. According to Medicare, physicians cannot receive reimbursement for video consults unless the beneficiary lives in a health professional shortage area and the consultation takes place at a distant site with real-time voice and video. A study undertaken by Manhattan Research Survey of 2,041 practicing physicians in the United States found that only 7 percent have used video chat to communicate with patients.⁵⁹

A mHealth Report undertaken by Ruder Finn in 2013 found that 16 percent of smart phone and tablet users access health or healthy living applications regularly or at least once a week.⁶⁰ Sixty-five percent of those aged 18-24 and 52 percent of 25-34 year olds report they are "fairly likely" or "very likely" to use mHealth technology in the next six months. The apps people report they would have the greatest interest in if they were available include calorie counter apps (44 percent) or healthy eating apps (37 percent).

The mHealth sector is expecting to grow rapidly in the future. Analysis by Vishwanath, Siddharth et al for PwC shows that annual mHealth revenues are expected to reach \$23 billion globally by 2017.⁶¹ Its estimate was based on current gaps in healthcare delivery and extrapolations of existing initiatives. Projected Mobile Health Revenues are expected to reach \$5.9 billion in the United States and \$2.5 billion in China.

The mobile health application market has the potential for huge growth. In China, there are about 2,000 mobile applications. A Cube Labs study finds that 30 percent of smartphone users are expected to use healthcare application by 2015. Mobile applications provide medical services for users through mobile terminal devices, which will shorten the distance between the health care provider and the user. It will help the users save time and allow doctors to treat their patients more efficiently. The Cube Labs study also finds that mobile applications can save medical workers about 39 minutes every day.⁶²

Although there are many mobile health applications, the user utilization rate is still not high. iiMedia Consulting data shows that only 2.9 percent of Chinese mobile phones have an installed mobile health application.

Case Study: Wireless Heart Health in China

Several mHealth companies offer a view into the future of the sector. One example is the Wireless Heart Health program operated by Life Care Networks, in collaboration with the Community Health Association of China and Qualcomm. This project aims to provide reliable medical monitoring for people living in remote areas.

The Wireless Heart Health program deploys a 3G-enabled cardiovascular screening and monitoring system, developed by Life Care Networks, to resource-scarce community health clinics in Shandong, Anhui, and Sichuan provinces, as well as the Chongqing municipality. The 3G enabled system includes smartphones with built-in electrocardiogram (ECG) sensors; web-based, electronic medical record software; and Internet ready workstations located within the clinics. Each workstation includes a computer terminal with Internet access, providing health care workers with instant access to electronic patient records, including ECG data. Smartphones automatically send patient data over China Telecom's 3G network for fast analysis to a cardiac specialist in the Beijing Life Care Networks Call Center. Doctors provide rapid feedback to patients and clinic staff via SMS or a phone call. The facility has over 60 physicians who record and analyze the ECG information and provide rapid feedback to the users.

Life Care Networks operates in cooperation with China Telecom, the third largest mobile operator in China. This telecom company runs the China remote ECG and blood pressure monitoring network system through the 3G mobile network, while Life Care Networks operates the remote cardiac monitoring center.

According to Life Care Networks, since the program was implemented in July 2011, 96 community doctors are using the system and 11,012 patients in four Community Health Clinics have benefitted from Wireless Heart Health. Out of all of the patient participants, 1,171 have been screened for serious cardiovascular conditions and referred to higher-level clinics for further evaluation and testing.

Case Study: Care beyond Walls and Wires in the United States

A U.S. pilot project is taking place at the Flagstaff Medical Center in Arizona (FMC) on heart failure management that has generated successful results. The program uses remote monitoring devices to treat patients suffering from congestive heart failure. Many of the individuals have low incomes and live a considerable distance from FMC. Wireless devices track patient weight, blood pressure, and activity level on a daily basis, and electronically transmit them to health providers. Doctors and nurses use this material to send routine advice on nutrition and medication.⁶³

According to William Bradel, president and CEO at FMC, “this project launches a model of care that transcends traditional medicine, using state-of-the-art technology to care for patients beyond the walls of the hospital. Working with these technology companies and national health agencies will extend FMC’s reach into outlying areas where healthcare is most needed.”⁶⁴

Rita Yazzi is the primary caregiver for her father, who has congestive heart failure. They live almost two hours away from the closest hospital, and have no electricity or running water. After joining the “Care beyond Walls and Wires” program, though, she has seen positive results. “My dad really likes [the program] it has improved his health. He used to be in and out of the hospital twice a month, and now he hasn’t been to the hospital in over two months and that’s what we’re looking for,” she said.⁶⁵

This was not an isolated result. The Medical Center tracked hospital readmissions, medical utilization, emergency room visits, and cost savings for 50 patients enrolled in this program and found that, compared to the six months prior to enrollment, these patients had fewer hospitalizations (1.82 vs. 3.26 mean per patient) and fewer days hospitalized (5.13 vs. 13.98 mean per patient) in the six months following enrollment. As a result, hospital charges per patient were a mean of \$92,317 less in the six months following enrollment (\$43,703) than in the six months prior to enrollment (\$136,020).

According to Bill Riley, chief of the Science of Research and Technology Branch at the National Cancer Institute who participated in the study while at the National Heart, Lung, and Blood Institute, “felt they were being cared for and the hospital was paying attention to them after hospitalization.” There was more contact between patients and care-givers, and those being treated “feel like someone is staying on top of things and caring about them,” according to Riley.

Gigi Sorenson was the registered nurse who ran the program at the facility. She noted the high satisfaction with the program results. The remote monitoring program helped caregivers “maintain close clinical care beyond discharge” and did a better job “building relationships” with patients. Those in the program reported that their depression was significantly lower and both physicians and patients indicated they were highly satisfied with the program.

Overall, patients indicated that they “felt in control of what was happening to them,” according to Sorenson and that the monitoring equipment “gave them a sense of ownership of their disease and the ability to manage what was going on.” There were significant reductions in hospital readmissions and emergency room visits. This helped reduce the cost of health care while still maintaining the quality of medical treatment.

Challenges for Mobile Health

Despite the opportunities for mobile health, there remain a number of different challenges for the field to advance. We need to address these issues in order to improve adoption levels among patients and providers.

The Market is Small and Mobile Services Are Not Widely Accepted

The mobile health market still is small and not widely accepted, both in China and the United States. mHealth is complex. Network operators, equipment manufacturers, users, service providers, and hospitals need to work on growing this market and taking advantage of new opportunities afforded by mobile devices.

In order to speed development, it is crucial to encourage cooperation among telecommunication operators, hospitals, clinics, and patients. Right now, the industry is in its infancy so business operations are not well-developed. But innovation is taking place at a rapid rate so change will accelerate in the very near future.

Policy and Legal Challenges

There are policy and legal challenges in both countries. Currently, the Chinese Ministry of Health only allows mobile health service providers to offer consulting services through mobile devices. They are not authorized to treat patients or offer prescriptions. This has slowed the development of mobile health and represents a major obstacle for mHealth growth.

In the United States, there also are challenges. One of the most important concerns reimbursement practices. Right now, most Americans doctors receive inadequate reimbursement for mobile health initiatives. In many cases, neither public nor private insurance covers the cost of mHealth consultations, diagnosis, or treatment. This has slowed the adoption of mHealth initiatives and made it difficult to reap the benefits of the mobile technology revolution.

Uncertainty about Regulation and Standards

Right now, in the United States, the majority of mHealth applications are not regulated because they make general health and wellness claims that are not considered medical in nature. Mobile applications that merely help a person track calories or activity levels may fall within this general health category and are most likely not subject to U.S. government regulation.⁶⁶ However, some applications may perform functions that are considered medical in nature, thereby those applications would meet the definition of a medical device as stipulated by U.S. law.

Those would include applications that diagnose, treat and attempt to cure or prevent specific disease and conditions. This would also apply to apps that are either intended to be used as an accessory to a regulated medical device, or an app that would transform a mobile device such as a general purpose smartphone into a medical device (e.g., an app which claims a smartphone camera can help analyze medical conditions on the skin). In either of the above examples, those apps would be medical devices and any developer of such apps would need to adhere to medical device laws.

In September 2013, the U.S. Food and Drug Administration recently put out a guidance document that described which applications are regulated including examples of those which are not and those which the agency would exercise its “enforcement discretion” and not actively regulate them. This was a step in the right direction.⁶⁷

In China, a research2guidance survey data indicate that 50 percent of respondents think the lack of hardware and software standards is an important reason impeding the development of the mobile medical market. The lack of standards creates uncertainty in the marketplace and makes it more difficult for companies to develop new products and services.

The Benefits of mHealth

There are a number of benefits that arise from the development and adoption of mHealth. First, mobile devices offer the potential to improve access and affordability of health care by lowering disparities based on geography and income. Wireless solutions help those who live in rural areas to draw on the expertise of health providers living in urban areas. Through video chats and conferences, those who reside a long distance from medical facilities can gain access to health care and receive early stage diagnosis and treatment that can ward off more expensive illnesses.

Second, they improve administrative efficiency by reducing errors and streamlining medical processes. One of the virtues of digital technology is by improving accuracy in prescriptions and medical treatment. If doctors electronically can prescribe medication, this saves money by cutting error rates. Mobile devices also can reduce duplicate medical tests by making it easier for patients to get a second opinion.

Third, mobile phones and mobile enabled devices aid the patient experience by providing a means to deliver medical reminders and diagnostic information to patients and physicians. Many patients do not take their medication at the prescribed time or dosage. Mobile devices can send text messages or voicemails that remind people when to take their medicine. This improves the efficacy of drug therapies and reduces the risk of more serious illnesses down the road.

Finally, mobile health helps policymakers by encouraging better health data collection and analysis. One of the biggest challenges in health care is having real-time data

for decision-makers. Too often, public officials make decisions based on incomplete data or inadequate information. Mobile devices help facilitate the development of data sharing networks and data analytics that improve the informational bases of health care decision-making. In the long run, better information will improve the manner in which we make major health care and budgetary decisions.

Polymakers could speed up the development of mHealth by taking several steps. They could reduce the uncertainty surrounding government regulation. It is difficult for device-makers and app-developers to innovate when they are not sure which rules apply and what standards they need to meet. Clarifying rules and regulations would improve the adoption of mHealth practices.

It also would be useful to clarify policies on adoption and reimbursement. Health officials should address rules that prohibit patient consultations through mobile devices and reimbursement practices that do not pay physicians who deal with patients through video chats or remote monitoring devices. Removing these barriers would encourage health professionals to make use of newly-emerging ways to diagnose and treat patients.

Encouraging greater cooperation among network operators, equipment manufacturers, and health care professionals would encourage the adoption of mHealth. By improving discussions across these groups, it would be easier to innovate and speed up the growth of the mHealth market.

Endnotes

1. A. T. Kearney Analysis, "GSMA The Mobile Economy," London: United Kingdom, 2013, p. 4.
2. A. T. Kearney Analysis, "GSMA The Mobile Economy," London: United Kingdom, 2013, p. 5.
3. The number of mobile devices is shown in <http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2013.pdf>.
4. ITU, <http://mobile.cctime.com/html/2013-7-9/201379958920.htm>.
5. GSMA Intelligence, "Study Predicts One Billion LTE Connections by 2017," January 14, 2014.
6. Cisco Visual Network Index. "VNI Forecast Widget" <http://ciscovni.com/forecast-widget/advanced.html>.
7. Atif, Syed, James Endres, and James Macdonald. "Broadband Infrastructure and Economic Growth: A Panel Data Analysis of OECD Countries." *Available at SSRN 2166167* (2012).
8. "Economic Impact of Broadband: An Empirical Study," LECG Ltd (2009), http://www.connectivityscorecard.org/images/uploads/media/Report_BroadbandStudy_LECG_March6.pdf.
9. The 32nd China Internet Development Statistics Report, CNNIC, June, http://www.cnnic.net.cn/hlwfzj/hlwzbg/hlwjbg/201307/t20130717_40664.htm.
10. Tirado, Miguel. "Role of mobile health in the care of culturally and linguistically diverse US populations." *Perspectives in health information management/AHIMA, American Health Information Management Association* 8.Winter (2011).
11. China Health Statistical Yearbook 2012.
12. Data from the Centers for Medicare and Medicaid Services "National Health Expenditures 2011–2021." *Centers for Medicare and Medicaid Services*. <http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/Proj2011PDF.pdf>.
13. Evan Applegate, "Growing Older, Faster," *Bloomberg Businessweek*, August 22, 2013, p. 20.
14. Vincent, Gayson, and Victoria Velkoff. "The Next Four Decades: The Older Population in the United States 2010 to 2050." *United States Census Bureau*. <http://www.census.gov/prod/2010pubs/p25-1138.pdf>.
15. "Aging of the population supporting medical needs—data analysis of the Chinese sixth census," MINSHENG SECURITIES Industry Research Report.
16. UNFPA, "Population ageing in China-facts and figures."
17. UNFPA, "Population ageing in China-facts and figures."
18. China Health Statistical Yearbook, 2012.
19. Claxton, Gary, et al. "Employer Health Benefits: 2012 Annual Survey." *Kaiser Family Foundation* (2012).
20. Young, Richard A., and Jennifer E. DeVoe. "Who will have health insurance in the future? An updated projection." *The Annals of Family Medicine* 10.2 (2012): 156–162.
21. "National Healthcare Disparities Report 2012." *Agency for Healthcare Research and Quality*. Chapter 9. 2012.
22. "National Healthcare Disparities Report 2012." *Agency for Healthcare Research and Quality*. Chapter 9. 2012.

23. Data from National Health Interview Survey (NHIS) by CDC. <http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=1#11>.
24. Gamm, L. D., et al. "Rural Healthy People 2010." See http://srph.tamhsc.edu/centers/rhp2010/Volume_3/Vol3rhp2010.pdf (2003).
25. United Health Group, Analysis of HRSA Area Resource File, see http://www.unitedhealthgroup.com/hrm/unh_workingpaper6.pdf.
26. See Analysis of HRSA Area Resource File at <http://bhpr.hrsa.gov/healthworkforce/reports/nursing-workforce/nursingworkforcefullreport.pdf>.
27. China Health Statistics Yearbook, 2012.
28. Health reform office of state council, "The report of national health reform summary in recent three years."
29. "Chinese Medical and Health Undertakings" White Paper.
30. China Health Statistics Yearbook, 2012.
31. John Walls, "Wireless Changing U.S. Healthcare," *Washington Post*, March 25, 2013.
32. Data from the National Health Interview Survey conducted by Centers for Disease Control and Prevention.
33. Chinese Journal of Preventive Medicine, 2012.
34. Fourth National Health Services Survey, 2008.
35. Chinese Chronic Disease Prevention Work Plan, 2012.
36. Chinese medical and health undertakings.
37. The second session of the European Society of Cardiology Forum for Asia.
38. National Health and Family Planning Commission of the PRC, "2012 Chinese health and family planning statistical bulletin."
39. Data from the National Health Interview Survey conducted by Centers for Disease Control and Prevention.
40. Administered by US Health and Human Services. http://meps.ahrq.gov/mepsweb/data_stats/quick_tables_search.jsp?component=1&subcomponent=0.
41. China Health Statistics Yearbook, 2012.
42. Cardiovascular Disease Prevention Research Center of Ministry of Health, "China Cardiovascular Disease Report 2011."
43. Beijing population health status report, 2012.
44. Based on Summary Health Statistics for U.S. Adults: National Health Interview Survey. <http://www.cdc.gov/nchs/products/series/series10.htm>.
45. World Bank, "Toward a Healthy and Harmonious Life in China: Stemming the Rising Tide of Non-Communicable Diseases."
46. Compiled from the National Vitality Statistics Reports 1997–2010.

47. Based on Table 3a from Medical Expenditure Panel Survey Administered by US Health and Human Services. http://meps.ahrq.gov/mepsweb/data_stats/quick_tables_search.jsp?component=1&subcomponent=0.
48. *World Health Organization*, "mHealth: New Horizons for Health Through Mobile Technologies," Global Observatory for eHealth Series, Volume 3, 2011.
49. GSMA, "Touching Lives Through Mobile Health Assessment of the Global Market Opportunity," 2012.
50. GSMA, "Touching Lives Through Mobile Health Assessment of the Global Market Opportunity," 2012.
51. GSMA, "Touching Lives Through Mobile Health Assessment of the Global Market Opportunity," 2012.
52. iiMedia Consulting, "2012–2013 Annual Report of China Mobile healthcare market."
53. iiMedia Consulting, "2012–2013 Annual Report of China Mobile healthcare market."
54. GSMA, "Touching Lives Through Mobile Health Assessment of the Global Market Opportunity," 2012.
55. GSMA, "Touching Lives Through Mobile Health Assessment of the Global Market Opportunity," 2012.
56. Armstrong, David G., et al. "FaceTime for Physicians: Using Real Time Mobile Phone-Based Videoconferencing to Augment Diagnosis and Care in Telemedicine." *Eplasty* 11 (2011).
57. "2013–2017 Chinese video conferencing systems development prospects and investment analysis report."
58. Fox, Susannah, and Maeve Duggan. "Mobile health 2012." *Pew Internet and American Life Project* 8 (2012). The results reported here come from a nationwide survey of 3,014 adults living in the United States. Telephone interviews were conducted by landline (1,808) and cell phone (1,206, including 624 without a landline phone). Princeton Survey Research Associates International conducted the survey.
59. Manhattan Research's "Taking the Pulse," U.S. v11.0 Study, press release.
60. "mHealth Report." Ruder Finn (2013). <http://www.ruderfinn.com/pdf/Ruder%20Finn%20US%20mHealth%20report%20FINAL.pdf>.
61. Vishwanath, Siddharth et al "Touching lives through mobile health: Assessment of the global market opportunity." Pricewaterhouse Coopers (2012).
62. [x]cube LABS. "mobility in healthcare prescription for success."
63. Qualcomm Wireless Reach, "Care Beyond Walls and Wires," 2012.
64. *PR Newswire*, "Flagstaff Medical Center to Use Smart Phones to Extend Care for Heart Patients," December 12, 2011.
65. <http://www.washingtonpost.com/sf/brand-connect/wp/2013/03/25/wireless-changing-u-s-healthcare/>.
66. Darrell West, "Improving Health Care Through Mobile Medical Devices and Sensors," Brookings Institution Policy Report, October 22, 2013.
67. The press release on the final MMA guidance document can be found at <http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm369431.htm>, while the final guidance itself is found here at <http://www.fda.gov/downloads/MedicalDevices/DeviceRegulationandGuidance/GuidanceDocuments/UCM263366.pdf>.



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